PROGRAM STRUCTURE AND SYLLABUS

(I to VIII Semesters)

COMPUTER SCIENCE & ENGINEERING

for

B. TECH. FOUR YEAR DEGREE PROGRAM

(Applicable for the batches admitted in 2023-24)

ADITYA ENGINEERING COLLEGE

An Autonomous Institution

Approved by AICTE, Permanently Affiliated to JNTUK & Accredited by NBA (Tier-1), NAAC with 'A++' Grade
Recognized by UGC under the sections 2(f) and 12(B) of UGC act 1956
Aditya Nagar, ADB Road, Surampalem - 533 437

VISION & MISSION OF THE INSTITUTE

VISION

To emerge as a premier institute for quality technical education and innovation.

MISSION

M1: Provide learner centric technical education towards academic excellence
M2: Train on technology through collaborations
M3: Promote innovative research & development
M4: Involve industry institute interaction for societal needs

VISION & MISSION OF THE DEPARTMENT

VISION

To emerge as a competent Centre of excellence in the field of Computer Science and Engineering for industry and societal needs.

MISSION

M1. Impart quality and value based education.
M2. Inculcate the inter personal skills and professional ethics
M3. Enable research through state-of-the-art infrastructure

M4. Collaborate with industries, government and professional societies

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the Program will

PEO 1	Adopt new technologies and provide innovative solutions.
PEO 2	Be employable, become an entrepreneur or researcher for a successful career.
PEO 3	Demonstrate interpersonal, multi-disciplinary skills and professional ethics to serve society.

PROGRAM OUTCOMES (POs)

After successful completion of the program, the graduates will be able to

PO1	**Engineering Knowledge:** Apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem Analysis:** Identify, formulate, research literature and analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
PO3	**Design/Development of Solutions:** Design solutions for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
PO4	**Conduct Investigations of Complex Problems:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions.
PO5	**Modern Tool Usage:**Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations.
PO6	**The Engineer and Society:**Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.
PO7	**Environment and Sustainability:**Understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for sustainable development.
PO8	**Ethics:**Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
PO9	**Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
PO10	**Communication:**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project Management and Finance:**Demonstrate knowledge and understanding of engineering management principles and apply these to one’s own work, as a member and leader in a team and to manage projects in multidisciplinary

	environments.
PO12	**Life-Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After successful completion of the program, the graduates will be able to

PSO1	Develop efficient solutions to real world problems using the domains of Algorithms, Networks, database management and latest programming tools and techniques.
PSO2	Provide data centric business solutions through emerging areas like IoT, AI , data analytics and Block Chain technologies.

Mission of the department – PEOs mapping

PEO's Statements		**M1**	**M2**	**M3**	**M4**
PEO 1:	Adopt new technologies and provide innovative solutions.	2	2	3	3
PEO 2:	Be employable, become an entrepreneur or researcher for a successful career.	2	3	2	2
PEO 3:	Demonstrate interpersonal, multi-disciplinary skills and professional ethics to serve society.	2	3	2	2

Note:.

Mapping / Correlation levels
1: Slight (Low)
2: Moderate (Medium)
3: Substantial (High)

INDUCTION PROGRAMME

S.No.	Course Name	L-T-P-C
1	Physical Activities -- Sports, Yoga and Meditation, Plantation	0-0-6-0
2	Career Counselling	2-0-2-0
3	Orientation to all branches -- career options, tools etc.	3-0-0-0
4	Orientation on admitted Branch -- corresponding labs, tools and platforms	2-0-3-0
5	Proficiency Modules & Productivity Tools	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	2-0-3-0
7	Remedial Training in Foundation Courses	2-1-2-0
8	Human Values & Professional Ethics	3-0-0-0
9	Communication Skills -- focus on Listening, Speaking, Reading, Writing skills	2-1-2-0
10	Concepts of Programming	2-0-2-0

PROGRAM STRUCTURE

I Semester

S. No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	231BS1T03	Chemistry	BSC	3	0	0	3
2	231BS1T02	Linear Algebra & Calculus	BSC	3	0	0	3
3	231ES1T03	Basic Electrical and Electronics Engineering	ESC	3	0	0	3
4	231ES1T04	Introduction to Programming	ESC	3	0	0	3
5	231HS1T01	Communicative English	HSMC	2	0	0	2
6	231ES1L03	Electrical and Electronics Engineering Lab	ESC	0	0	3	1.5
7	231ES1L04	Computer Programming Lab	ESC	0	0	3	1.5
8	231BS1L02	Chemistry Lab	BSC	0	0	2	1
9	231ES1L01	IT Workshop	ESC	0	0	2	1
10	231HS1L03	NSS/NCC/Scouts & Guides/Community Service	HSMC	0	0	1	0.5
11	231MC1T02	Constitution of India	MC	2	0	0	0
						TOTAL	**19.5**

II Semester

S. No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	231BS2T02	Engineering Physics	BSC	3	0	0	3
2	231BS2T03	Differential Equations & Vector Calculus	BSC	3	0	0	3
3	231ES2T03	Basic Civil and Mechanical Engineering	ESC	3	0	0	3
4	231ES2T04	Engineering Graphics	ESC	1	0	4	3
5	231CS2T01	Data Structures	PCC	3	0	0	3
6	231BS2L02	Engineering Physics Lab	BSC	0	0	2	1
7	231ES2L03	Engineering Workshop	ESC	0	0	3	1.5
8	231CS2L01	Data Structures Lab	PCC	0	0	3	1.5
9	231HS2L01	Communicative English Lab	HSMC	0	0	2	1
10	231HS2L02	Health and wellness, Yoga and sports	HSMC	0	0	1	0.5
11	231MC2T02	Environmental Science	MC	2	0	0	0
						TOTAL	**20.5**

III Semester

S. No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	**231BS3T05**	Discrete Mathematics & Graph Theory	BSC	3	0	0	3
2	**231HS3T01**	Universal Human values	HSMC	2	1	0	3
3	**231ES3T05**	Digital Logic &Computer Organization	ESC	3	0	0	3
4	**231CS3T01**	Advanced Data Structures & Algorithms Analysis	PCC	3	0	0	3
5	**231CS3T02**	Object Oriented Programming Through Java	PCC	3	0	0	3
6	**231CS3L01**	Advanced Data Structures & Algorithms Analysis Lab	PCC	0	0	3	1.5
7	**231CS3L02**	Object Oriented Programming Through Java Lab	PCC	0	0	3	1.5
8	**231CS3S01**	Python Programming	SC	0	1	2	2
9	**231MC3T01**	Essence of Indian Traditional Knowledge	MC	2	0	0	0
10	**231CS3P01**	Community Service project	MC	0	0	4	0
11	**231MC3T02**	Cognitive English For Engineers - I	MC	0	0	2	0
						TOTAL	**20**

IV Semester

S. No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	**231HS4T01**	Managerial Economics and Financial Analysis	HSMC	2	0	0	2
2	**231BS4T02**	Probability& Statistics	BSC	3	0	0	3
3	**231CS4T01**	Operating Systems	PCC	3	0	0	3
4	**231CS4T02**	Database Management Systems	PCC	3	0	0	3
5	**231CS4T03**	Software Engineering	PCC	3	0	0	3
6	**231CS4L01**	Operating Systems Lab	PCC	0	0	3	1.5
7	**231CS4L02**	Database Management Systems Lab	PCC	0	0	3	1.5
8	**231CS4S01**	Full Stack Development-1	SC	0	1	2	2
9	**231ES4T04**	Design Thinking & Innovation	ESC	1	0	2	2
10	**231MC4T03**	Cognitive English For Engineers - II	MC	0	0	2	0
						TOTAL	**21**

V Semester

S.No	Course Code	Course Title	Course Component	L	T	P	Credits
1	231CS5T01	Data Warehousing and Data Mining	PCC	3	0	0	3
2	231CS5T02	Computer Networks	PCC	3	0	0	3
3	231CS5T03	Formal Languages and Automata Theory	PCC	3	0	0	3
4		Professional Elective-I	PEC	3	0	0	3
5		Open Elective-I	OEC	3	0	0	3
6	231CS5L01	Data Mining Lab	PCC	0	0	3	1.5
7	231CS5L02	Computer Networks Lab	PCC	0	0	3	1.5
8	231CS5S01	Full Stack development-2	SEC	0	1	2	2
9	231CS5L03	Tinkering Lab: User Interface Design using Flutter	PCC	0	0	2	1
10	231MC5T01	Professional Ethics And Human Values	MC	2	0	0	0
11	231CS5P01	Summer Internship - I	-	-	-	-	2
		Total					**23**

VI Semester

S.No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	231CS6T02	Compiler Design	PCC	3	0	0	3
2	231CS6T01	Cloud Computing	PCC	3	0	0	3
3	231CS6T03	Cryptography & Network Security	PCC	3	0	0	3
4		Professional Elective-II	PEC	3	0	0	3
5		Professional Elective-III	PEC	3	0	0	3
6		Open Elective – II	OEC	3	0	0	3
7	231CS6L01	Cloud Computing Lab	PCC	0	0	3	1.5
8	231CS6L02	Cryptography & Network Security Lab	PCC	0	0	3	1.5
9	231CS6S01	Soft skills	SEC	0	1	2	2
10	231MC6T01	Technical Paper Writing &IPR	MC	2	0	0	0
						Total	**23**

VII Semester

S.No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	231CS7T01	Augmented Reality & Virtual Reality	PCC	2	1	0	3
2	231HS7T01	Human Resources & Project Management	HSMC	2	0	0	2
3		Professional Elective-IV	PEC	3	0	0	3
4		Professional Elective-V	PEC	3	0	0	3
5		Open Elective-III	OEC	3	0	0	3
6		Open Elective-IV	OEC	3	0	0	3
7	231CS7S01	Prompt Engineering/ SWAYAM Plus - Certificate program in Prompt Engineering and ChatGPT	SEC	0	1	2	2
8	231MC7T01	Research Methodology	MC	2	0	0	0
9	231CS7P01	Summer Internship- II	PROJ	0	0	0	2
						Total	**21**

VIII Semester

S.No.	Course Code	Course Title	Course Component	L	T	P	Credits
1	231CS8P01	Project(Full Semester Internship)	PROJ	0	0	24	12

Course Code and Definition:

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
PCC-CS	Professional Core Courses
PEC-CS	Professional Elective Courses
OEC-CS	Open Elective Courses
MC	Mandatory Courses

PROFESSIONAL ELECTIVES

Professional Electives I
(V Semester)

S.No	Course Code	Name of the Course
1.	231CS5E01	Object Oriented Analysis and Design
2.	231CS5E02	Artificial Intelligence
3.	231CS5E03	Microprocessors & Microcontrollers
4.	231CS5E04	Quantum Computing
5.		MOOCS-NPTEL/SWAYAM

Professional Electives II
(VI Semester)

S.No	Course Code	Name of the Course
1.	231CS6E08	Software Testing Methodologies
2.	231CS6E02	Cyber Security
3.	231CS6E03	DevOps
4.	231CS6E05	Machine Learning
5.		MOOCS-NPTEL/SWAYAM

Professional Electives III
(VI Semester)

S.No	Course Code	Name of the Course
1.	231CS6E09	Software Project Management
2.	231CS6E06	Mobile Adhoc Networks
3.	231CS6E07	Natural Language Processing
4.	231CS6E01	Big Data Analytics
5.	231CS6E04	Distributed Operating System
6.		MOOCS-NPTEL/SWAYAM

Professional Electives IV
(VII Semester)

S.No	Course Code	Name of the Course
1.	231CS7E08	Software Architecture & Design Patterns
2.	231CS7E03	Blockchain Technology
3.	231IT7E02	Deep Learning
4.	231CS7E06	Internet of Things
5.		MOOCS-NPTEL/SWAYAM

Professional Electives V
(VII Semester)

S.No	Course Code	Name of the Course
1.	231CS7E01	Agile Methodologies
2.	231CS7E07	Generative AI
3.	231CS7E05	Cyber Physical Systems
4.	31DS7E05	High Performance Computing
5.		MOOCS-NPTEL/SWAYAM

Note: Open Elective Course (OEC) must be selected from the list of Open Elective Courses offered by Other Department(s) only.

OPEN ELECTIVE - I (V Semester)			
S.No	**Course Code**	**Course Name**	**Offered By Department**
1.	231CE5O01	Waste Water Management	CE
2.	231CE5O02	Construction Technology & Management	CE
3.	231CE5O03	Green Buildings	CE
4.	231EE5O01	Renewable Energy Sources	EEE
5.	231EE5O02	Concepts of Energy Auditing & Management	EEE
6.	231ME5O01	Sustainable Energy Technologies	ME
7.	231ME5O02	Applied Operations Research	ME
8.	231ME5O03	Nano Technology	ME
9.	231ME5O04	Thermal Management of Electronic systems	ME
10.	231ME5O05	Entrepreneurship	ME
11.	231ME5O06	Entrepreneurship Development & Venture Creation	ME
12.	231EC5O01	Principles of Signals and Systems	ECE
13.	231EC5O02	Introduction to Internet of Things	ECE
14.	231EC5O03	Digital Electronics and Logic Design	ECE
15.	231CS5O01	Database Management Systems	CSE
16.	231DS5O01	Python Programming	DS
17.	231IT5O01	Computer Organization	IT
18.	231AM5O01	Object Oriented Programming Through Java	AIML
19.	231PT5O01	Introduction to Petroleum Engineering	PT
20.	231PT5O02	Introduction to Petroleum Geology	PT
21.	231PT5O03	Introduction to Well Logging	PT
22.	231MI5O01	Introduction to Underground Mining	Min.E
23.	231MI5O02	Introduction to Surface Mining	Min.E
24.	231MI5O03	Tunnelling and Underground Space Design	Min.E
25.	231MI5O04	Introduction to Mine Environment	Min.E
26.	231AG5O01	Basic Crop Production Practices	Ag.E
27.	231AG5O02	Groundwater, Wells and Pumps	Ag.E

OPEN ELECTIVE - II (VI Semester)			
S.No	**Course Code**	**Course Name**	**Offered By Department**
1.	231CE6O01	Basic Concrete Technology	CE
2.	231CE6O02	Basic of Surveying	CE
3.	231CE6O03	Repair and rehabilitation of structures	CE
4.	231CE6O04	Air Pollution Control	CE
5.	231CE6O05	Integrated Solid Waste Management for a Smart City	CE
6.	231EE6O01	Fundamentals of Electric Vehicles	EEE
7.	231EE6O02	Electrical Wiring Estimation and Costing	EEE
8.	231ME6O01	Introduction to Industrial Robotics	ME
9.	231ME6O02	Industrial Management	ME
10.	231ME6O03	Additive Manufacturing	ME
11.	231ME6O04	Vehicle Technology	ME
12.	231ME6O05	Industrial Safety	ME
13.	231EC6O01	Principles of Communications	ECE
14.	231EC6O02	Biomedical Engineering	ECE
15.	231EC6O03	ECAD Tools	ECE
16.	231EC6O04	Quantum Science	ECE
17.	231CS6O01	Web Technologies	CSE
18.	231DS6O01	Introduction to Data Science	DS
19.	231IT6O01	Operating Systems	IT
20.	231AM6O01	Computer Organization and Architecture	AIML
21.	231PT6O01	Introduction to Drilling Technology	PT
22.	231PT6O02	Introduction to Well Completions	PT
23.	231PT6O03	Introduction to Petroleum Production Engineering	PT
24.	231MI6O01	Mineral Economics	Min.E
25.	231MI6O02	Landslides & Slope Stability Engineering	Min.E
26.	231MI6O03	Remote Sensing and GIS	Min.E
27.	231MI6O04	Geostatistics	Min.E
28.	231AG6O01	Engineering Properties of Agricultural Produce	Ag.E
29.	231AG6O02	Plastic Applications In Agriculture	Ag.E

OPEN ELECTIVE - III (VII Semester)			
S.No	**Course Code**	**Course Name**	**Offered By Department**
1.	231CE7O01	Industrial Waste Water Management	CE
2.	231CE7O02	Basics of RS&GIS	CE
3.	231CE7O03	Safety Engineering	CE
4.	231EE7O01	Battery Management Systems and Charging Stations	EEE
5.	231EE7O02	Concepts of Smart Grid Technologies	EEE
6.	231ME7O01	Finite Element Methods	ME
7.	231ME7O02	Introduction to Mechatronics	ME
8.	231ME7O03	Product design and development	ME
9.	231ME7O04	Advanced Materials	ME
10.	231ME7O05	Smart Manufacturing	ME
11.	231EC7O01	Discrete Time Signal Processing	ECE
12.	231EC7O02	Linear and Digital IC Applications	ECE
13.	231EC7O03	Principles of Embedded Systems	ECE
14.	231CS7O01	Cyber Security	CSE
15.	231DS7O01	Bigdata Analytics	DS
16.	231IT7O01	Internet of things	IT
17.	231AM7O01	Computer Networks	AIML
18.	231PT7O01	Pipeline Engineering	PT
19.	231PT7O02	Introduction to Seismic methods	PT
20.	231PT7O03	Introduction to Artificial Lift Methods	PT
21.	231MI7O01	Mine Waste Management	Min.E
22.	231MI7O02	Sustainable Development in Mining Industry	Min.E
23.	231MI7O03	Mine Reclamation	Min.E
24.	231MI7O04	Impacts of Mining on Environment	Min.E
25.	231AG7O01	Water Harvesting and Soil Conservation Structures	Ag.E

OPEN ELECTIVE - IV (VII Semester)			
S.No	**Course Code**	**Course Name**	**Offered By Department**
1.	231CE7O04	Basics of Soil Mechanics	CE
2.	231CE7O05	Construction Materials and Equipments	CE
3.	231CE7O06	Natural Disaster Management and Mitigation	CE
4.	231EE7O03	Concepts of Power Quality	EEE
5.	231EE7O04	Quantum Science and Technology	EEE
6.	231ME7O06	Optimization Techniques	ME
7.	231ME7O07	Advanced Manufacturing Processes	ME
8.	231ME7O08	Total Quality Management	ME
9.	231ME7O09	Operations Management	ME
10.	231ME7O10	Energy Auditing	ME
11.	231EC7O04	Fundamentals of Image Processing	ECE
12.	231EC7O05	Electronic Measurement Techniques	ECE
13.	231EC7O06	Sensors and Actuators	ECE
14.	231CS7O02	Introduction to Machine Learning	CSE
15.	231DS7O02	Data Visualization	DS
16.	231IT7O02	Cloud Computing	IT
17.	231AM7O02	Software Engineering	AIML
18.	231PT7O04	Deepwater Technology	PT
19.	231PT7O05	Introduction to acidizing and hydro-fracturing	PT
20.	231PT7O06	Introduction to Reservoir Engineering	PT
21.	231MI7O02	Principles of Mineral Engineering	Min.E
22.	231MI7O06	Mining Instrumentation	Min.E
23.	231MI7O07	Mine Safety & Ergonomics	Min.E
24.	231MI7O08	Mineral Exploration	Min.E
25.	231AG7O02	Agricultural Structures and Protected Cultivation	Ag.E

Minor Degree in Computer Science and Engineering
Offered by Department of Computer Science and Engineering

S.No.	Course Code	Course Name	L	T	P	C	Semester
1	231CS5M01	Principles of Database Management Systems	3	0	0	3	V
2	231CS5M02	Principles of Database Management Systems Lab	0	0	1.5	1.5	V
3	231CS6M01	Advanced Data Structures & Algorithm Analysis	3	0	0	3	VI
4	231CS6M02	Advanced Data Structures & Algorithm Analysis Lab	0	0	1.5	1.5	VI
5	231CS6M03	Computer Networks	3	0	0	3	VI
6	231CS7M01	MOOCS-I Principles of Operating Systems (or)	3	0	0	3	VII
	231CS7M02	Computer Organization and Architecture					
7	231CS8M01	MOOCS-II Principles of Software Engineering (or)	3	0	0	3	VIII
	231CS8M02	Object Oriented Programming through Java					
Total			15	0	3	18	

Minor Degree in Quantum Technologies
Offered By Department of Electronics and Communication Engineering

S.No.	Course Code	Course Name	L	T	P	C	Semester
Mandatory Courses							
1	231EC5M01	Survey of Quantum technologies and Application	3	0	0	3	V
2	231EC5M02	Foundations of Quantum Technologies	3	0	0	3	V
3	231EC6M01	Basic Programming Lab (or)	0	0	2	2	VI
	231EC6M02	Basic Laboratory Course for Quantum Technologies					

Atleast one course form 4, 5, 6, 7 is Mandatory							
4	231EC6M03	Introduction to Quantum Computation	3	0	0	3	VI
5	231EC6M04	Introduction to Quantum Communication	3	0	0	3	VI
6	231EC7M01	Introduction to Quantum Sensing	3	0	0	3	VII
7	231EC7M02	Introduction to Quantum Materials	3	0	0	3	VII
Optional / Additional Courses							
8	231EC5M03	Engineering Foundations of Quantum Technologies	3	0	0	3	V
9	231EC5M04	Solid State Physics for Quantum Technologies	3	0	0	3	V
10	231EC6M05	Quantum Optics	3	0	0	3	VI
11	231EC6M06	Quantum Cybersecurity	3	0	0	3	VI
12	231EC7M03	Quantum Machine Learning	3	0	0	3	VII
Atleast one of the following MOOC Course(s)							
13		Quantum Algorithms and Cryptography	12 week 3 Credit - NPTEL MOOC			3	VIII
Total			18	0	0	18	

CHEMISTRY

(Common to CSE, IT, AI&ML, CSE (DS))

	L	T	P	C
I Semester	**L**	**T**	**P**	**C**
Course Code: 231BS1T03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, the students will be able to:

CO1 Summarize the fundamentals of bonding models.
CO2 Discuss the fundamentals and applications of polymers.
CO3 Outline the difference between primary and secondary cells.
CO4 Interpret the various modern engineering materials and their applications
CO5 Illustrate about Spectroscopic Methods and Chromatographic Techniques.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	2	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-

Unit-I:
Structure and Bonding Models

Valence bond theory, Hybridisation - Types of hybridizations - Molecular orbital theory – – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of H_2, B_2, N_2, O_2 and CO, NO. π-molecular orbitals of butadiene and benzene, calculation of bond order.

UNIT II:
Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and methods of polymerization (Suspension polymerization and Emulsion Polymerization)
Plastics: Thermoplastics and Thermosetting polymers, Preparation, properties, and applications of PVC, Teflon, Bakelite, Nylon-6,6.
Elastomers–Buna-S, Buna-N–preparation, properties, and applications.
Conducting polymers: polyacetylene, polyaniline, – mechanism of conduction and applications.
Bio-Degradable polymers - Poly Glycolic Acid (PGA), Poly L-Lactic Acid (PLA).

UNIT III:
Electrochemistry and Applications

Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations).

Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, Secondary cells –lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen fuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC).

Unit-IV:
Modern Engineering materials

Semiconductors, band diagram in solids, Semiconductor devices (p-n junction diode as rectifier and transistors)

Super conductors-Introduction, types, and applications.

Supercapacitors: Introduction, Basic Concept-Classification and applications.

Nano materials: Introduction, Preparation of nano materials by Sol-Gel method, Applications of Fullerenes, carbon nano tubes and Graphene nanoparticles.

Unit-V:
Instrumental Methods and Applications

Electromagnetic spectrum. Absorption of radiation: Beer-Lambert's law. UV-Visible Spectroscopy, electronic transition, Instrumentation, IR spectroscopies, fundamental modes and selection rules, Instrumentation. Chromatography-Basic Principle, Classification-HPLC: Principle, Instrumentation and Applications.

Text Books:

1. Prasanta Rath, S. Aruna Kumari Engineering Chemistry, CENGAGE Learning,
2. Shikha Agarwal, Engineering Chemistry Fundamentals and Applications, Cambridge 2nd Edition.

Reference Books:

1. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
2. Dr S.S.Dara,Dr S.S.Umare , A Textbook of Engineering Chemistry, S.Chand Publication, 2022 .

Web Links:

1. https://archive.nptel.ac.in/courses/104/106/104106096/
2. https://archive.nptel.ac.in/courses/104/105/104105124/
3. https://archive.nptel.ac.in/courses/104/106/104106137/
4. https://nptel.ac.in/courses/118102003
5. https://archive.nptel.ac.in/courses/104/106/104106075/

LINEAR ALGEBRA AND CALCULUS

(Common to all branches)

	L	T	P	C
I Semester	**L**	**T**	**P**	**C**
Course Code: 231BS1T02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1: Solve the system of Linear equations
CO2: Calculate Eigen values and Eigen vectors
CO3: Apply Mean value theorems for given functions
CO4: Calculate the Maximum value and Minimum value of a function of several variables
CO5: Compute areas and volumes using multiple integrals

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Unit-I:

Matrices:

Rank of a matrix by echelon form, normal form, Cauchy–Binet formulae (without proof). Inverse of Non- singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

Unit-II:

Eigen values, Eigen vectors and Orthogonal Transformation:

Eigen values, Eigen vectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

Unit-III:

Calculus:

Mean Value Theorems: Rolle’s Theorem, Lagrange’s mean value theorem with their geometrical interpretation, Cauchy’s mean value theorem, Taylor’s and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

Unit-IV:

Partial differentiation and Applications (Multi variable calculus):

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor’s and Maclaurin’s series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit-V:

Multiple Integrals (Multi variable Calculus):

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018,14th Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, Michael Greenberg, , Pearson publishers, 9th edition
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications,2014,Third Edition (Reprint 2021)

Web Links:

1. https://archive.nptel.ac.in/courses/111/104/111104137/
2. https://archive.nptel.ac.in/courses/111/107/111107108/

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
I Semester	**L**	**T**	**P**	**C**
Course Code: 231ES1T03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Analyze the concepts associated to AC and DC circuits.
CO2: Explain the operating principles of motors, generators and measuring instruments.
CO3: Analyze the Different Energy Resources and Equipment Safety Measures.
CO4: Explain the concept and the applications of semiconductor Diodes.
CO5: Analyze the Basic Electronic Circuits and Instrumentation.
CO6: Interpret numeric information in different code formats.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	1	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-
CO6	2	3	1	-	-	-	-	-	-	-	-	-

PART A: BASIC ELECTRICAL ENGINEERING

UNIT-1 DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, source transformation technique, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor series RLC circuit only (Simple Numerical problems).

UNIT-II Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of digital multi meter, Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge. Tong tester and megger.

UNIT-III Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy**.**

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Text Books:

1. Basic Electrical and Electronics Engineering, Ramana Pilla, Venkata Lalitha Narla, Gulivindala suresh, S. Chand Publications.
2. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
3. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
4. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Links:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

PART B: BASIC ELECTRONICS ENGINEERING

UNIT I SEMICONDUCTOR DEVICES

Introduction - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics.

UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator.

Electronic Instrumentation: Block diagram of an electronic instrumentation system.

UNIT III DIGITAL ELECTRONICS

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XORand XNOR. Simple combinational circuits–Half and Full Adders

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, . PearsonEducation, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education,2009.

Web Links:

1. https://www.electronics-tutorials.ws/diode/diode_2.html

2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11 by Dr. Chitralekha Mahanta, IIT Guwahati.

INTRODUCTION TO PROGRAMMING
(Common to CSE, IT, AIML & CSE (DS))

I semester	**L T P C**
Course Code: 231ES1T04	**3 0 0 3**

Course Outcomes: After completion of the course the student will be able to

CO1: Demonstrate basics of computer, algorithm and flow chart for problem solving.

CO2: Make use of an appropriate control structures to solve a given problem.

CO3: Solve complex problems using Arrays and Strings.

CO4: Develop modular programming using functions and dynamic memory allocation using pointers.

CO5: Utilize structure, union and file operations to handle heterogeneous data.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	-	-	-	-	-
CO2	1	1	2	-	-	-	-	-	-	-	-	-
CO3	1	1	3	-	-	-	-	-	-	-	-	-
CO4	1	1	3	-	-	-	-	-	-	-	-	-
CO5	1	1	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT I Introduction to Programming and Problem Solving

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and

Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.
Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

UNIT II Control Structures

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do-while) Break and Continue.

UNIT III Arrays and Strings

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings, string handling functions.

UNIT IV Functions & Pointers

Functions: Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, arrays as parameters, Scope and Lifetime of Variables, recursion.

Pointers: Introduction to Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, modifying parameters inside functions using pointers, Command line Arguments.

UNIT V User Defined Data types & File Handling

Structures, Unions, Bit Fields: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type – enum variables, Using Typedef keyword, Bit Fields.
Data Files: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Text Books:

1. Programming in C, Rema Theraja, Oxford, 3rd edition.
2. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
3. Let Us C YashwanthKanetkar, Eighth edition, BPB Publications.
4. Programming for problem solving using C Behrouz A.Forouzan. Richard F.Gilberg.
5. How to Solve it by Computer , R.G. Dromey, Pearson Education

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/

3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://onlinecourses.nptel.ac.in/noc22_cs40/preview
6. https://archive.nptel.ac.in/courses/106/104/106104128/

Note: The syllabus is designed with **C Language** as the fundamental language of implementation**.**

COMMUNICATIVE ENGLISH

(Common to all branches)

	L	T	P	C
I Semester	**L**	**T**	**P**	**C**
Course Code:231HS1T01	**2**	**0**	**0**	**2**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Understand the context, topic, and pieces of specific information from social or Transactional dialogues.
CO2:	Apply grammatical structures to formulate sentences and correct word forms.
CO3:	Analyze discourse markers to speak clearly on a specific topic in informal discussions.
CO4:	Evaluate reading/ listening texts and to write summaries based on global comprehension of these texts.
CO5:	Create a coherent paragraph, essay, and resume.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

UNIT I

Lesson: HUMAN VALUES: The Gift of The Magi by O. Henry **(Short Story)**

Listening:	Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking:	Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading:	Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing:	Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.
Grammar:	Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary:	Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening:	Answering a series of questions about main ideas and supporting ideas after listening to audio texts.
Speaking:	Discussion in pairs/small groups on specific topics followed by short structure

talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics)

Grammar: Cohesive devices - linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences -recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs - tenses; subject-verb agreement; Compound words, Collocations

Vocabulary: Compound words, Collocations

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters, Resumes

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Jargons

UNIT V

Lesson: MOTIVATION: The Power of Intrapersonal Communication - (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts.

Reading: Reading comprehension.

Writing: Writing structured essays on specific topics.

Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Technical Jargons

Text Books:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, OrientBlack Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

Reference Books:

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge,2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge UniversityPress, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building aSuperior Vocabulary. Anchor, 2014.

Web Links:

GRAMMAR:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

ELECTRICAL & ELECTRONICS ENGINEERING LAB
(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
I Semester **Course Code: 231ES1L03**	0	0	3	1.5

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Analyze the circuits by using KCL, KVL& Superposition theorem to electrical circuits.
CO2: Analyze the active and reactive power using one wattmeter method.
CO3: Determine the resistance using Wheat stone bridge and Megger.
CO4: Analyze the characteristics of diodes and BJT.
CO5: Analyze the characteristics of Rectifiers and amplifier.
CO6: Examine the operation of logic gates.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	2	-	-	-	-	1	1	-	1
CO2	2	3	1	2	-	-	-	-	1	1	-	1
CO3	2	3	1	1	-	-	-	-	1	1	-	1
CO4	2	3	1	2	-	-	-	-	1	1	-	1
CO5	2	3	1	2	-	-	-	-	1	1	-	1
CO6	2	3	1	2	-	-	-	-	1	1	-	1

PART A: ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Power and Power factor using Single-phase wattmeter
4. Measurement of Resistance using Wheat stone bridge
5. Measurement of Insulation Resistance using Megger.

List of Augmented Experiments:

(Any one of the following experiment can be performed)

6. Calculation of Electrical Energy for Domestic Premises.
7. Verification of KCL, KVL and ohm’s law using simulation.
8. Magnetization Characteristics of DC shunt Generator.

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Web Links:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

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PART B: ELECTRONICS ENGINEERING LAB

List of Experiments:

1. V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. V-I characteristics of Zener Diode and its application as voltage Regulator.
3. Input & Output characteristics of BJT in CE configuration.
4. Implementation of half wave and full wave rectifiers (ripple factor & waveform analysis)
5. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.

List of Augmented Experiments:

(Any one of the fallowing experiment can be performed)

6. Input & Output characteristics of BJT in CB configuration.
7. Design and verify Half Adder and Full Adder circuits.

Reference Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education.

Web Links:

1. https://www.electronics-tutorials.ws/diode/diode_2.html
2. http://fourier.eng.hmc.edu/e84/lectures/ch4/node3.html
3. http://nptel.ac.in/courses/117103063/11 by Dr. Chitralekha Mahanta, IIT Guwahati.

COMPUTER PROGRAMMING LAB

(Common to CSE, IT, AIML & CSE(DS))

I Semester **L T P C**

Course Code 231ES1L04 **0 0 3 1.5**

Course Outcomes: After completion of the course the student will be able to

CO1: Develop the basic C programs in different environments.

CO2: Utilize appropriate control structures, arrays and strings for problem solving.

CO3: Develop modular programming using functions.

CO4: Apply pointers for dynamic memory allocation and file operations for file handling.

CO5: Make use of structures and unions to handle heterogeneous data.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	3	-	1	-	-	-	2	2	-	-
CO2	1	1	3	-	1	-	-	-	2	2	-	-
CO3	1	1	2	-	1	-	-	-	2	2	-	-
CO4	1	1	2	-	1	-	-	-	2	2	-	-
CO5	1	1	2	-	1	-	-	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

List of Experiments:

Develop the following programs using 'C'

Week 1: Explore different platforms

a. Basic Linux environment and its editors like Vi, Vim & Emacs etc.
b. Exposure to Turbo C, gcc
c. Explore to Hacker Rank or any other Online coding platform and compiler environment.
d. “Hello World” in C
Objective: Learn about the syntax of reading from stdin and writing to stdout.

https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true

e Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.

Week 2: Basics and Operators

a. Sum and Difference of 2 numbers
Objective: Learn int and float data types.
https://www.hackerrank.com/challenges/sum-numbers-c/problem?isFullScreen=true

b. Playing with Characters
Objective: Learn how to take a character, a string and a sentence as input in C.
https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true

c. Bitwise Operators
Objective: Learn how to work with bits (0,1) and bitwise operators.
https://www.hackerrank.com/challenges/bitwise-operators-in-c/problem?isFullScreen=true

d. Conversion of Fahrenheit to Celsius and vice versa.

e. Distance travelled by an object.

f. Calculate Simple interest and compound interest.

Week 3: Operators and Expressions, Variables and Type conversions

a. Evaluate the following expressions
    i. a/b*c-b+a*d/3
    ii. j = (i++) + (++i)

b. Square root of a given number.

c. Find the area of circle, square, rectangle and triangle.

d. Find the maximum of three numbers using conditional operator.

e. Take marks of 5 subjects in integers, find the total in integer and average in float.

Week 4: Conditional Statements

a. Conditional statements in C.
Objective: Understand *if* and *else.*
https://www.hackerrank.com/challenges/conditional-statements-in-c/problem?isFullScreen=true

b. Roots of a Quadratic Equation.

c. Generate electricity bill.

d. Simulate a calculator using switch case.

e. Find the given year is a leap year or not.

Week 5: Loops

a. "for" Loop in C.
Objective: Learn the usage of the *for* loop.
https://www.hackerrank.com/challenges/for-loop-in-c/problem?isFullScreen=true

b. Sum of the digits of a 5-digit number.
Objective: Learn the usage of while loop and usage of operators - % and /.
https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true

c. Given number is a prime or not. (Also Prime numbers between a given range.)
d. Armstrong Number or not.
e. Palindrome or not.
f. Printing patterns using Loops.
   Objective: Print a pattern of numbers.
   https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true
g. Construct a Pyramid pattern.

Week 6: Arrays

a. 1D Arrays in C
   Objective: Print the sum and free the memory where the array is stored.
   https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true
b. Array reversal
   Objective: Working with indices in array
   https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true
c. Search an element in array (Linear Search)
d. Find min and max elements in array
e. Insert an element into array
f. Eliminate duplicate elements from array
g. Sorting of elements in an array using Bubble sort

Week 7: 2-D Arrays

a. Sum of two 2-D arrays
b. Multiplication of two 2-D arrays
c. Transpose of a Matrix
d. Trace of a Matrix
e. Lower Triangular Matrix

Week 8: Strings

a. Printing Tokens
   Objective: print each word of the sentence in a new line
   https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true
b. Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits
   Objective:
c. Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
   Objective:
d. Digit Frequency
   Objective: find the frequency of each digit in the given string.
   https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true
e. Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.

Week 9: Functions and Recursion

a. Functions in C
   Objective: Learn simple usage of functions.
   https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true

b. Fibonacci Numbers
   Objective: Complete the recursive function.
   https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem
c. Factorial

   Objective: N! (N factorial) using recursion.
   https://www.hackerrank.com/contests/ccc-veltech-practice-set-ende/challenges/factorial-using-recursion-1
d. Digit Sum
   Objective: find the *super digit* of the integer.
   https://www.hackerrank.com/challenges/recursive-digit-sum/problem
e. LCM
f. Calculate the Nth term
   Objective: Find the Nth term.
   https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true

Week 10: Pointers

a. Pointers in C
   Objective: learn to implement the basic functionalities of pointers in C.
   https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true
b. Students Marks Sum
   Objective: Learn using Pointers with Arrays and Functions
   https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true
c. Sorting Array of Strings
   Objective: sort a given array of strings into lexicographically increasing order or into an order in which the string with the lowest length appears first.
   https://www.hackerrank.com/challenges/sorting-array-of-strings/problem?isFullScreen=true
d. Find the sum of a 1D array using malloc()
e. Swap two numbers using functions and pointers - call by value and reference.
f. Dynamic Array in C
   Objective: Handling requests by a Librarian to place the books in the shelves.
   https://www.hackerrank.com/challenges/dynamic-array-in-c/problem?isFullScreen=true

Week 11: Structure, Union, typedef, bit-fields and enum

a. Write a C program to find the total, average of n students using structures
b. Boxes through a Tunnel
   Objective: Using a structure for transporting some boxes through a tunnel
   https://www.hackerrank.com/challenges/too-high-boxes/problem?isFullScreen=true
c. Post Transition
   Objective: Storing and transferring packages using pointers in structures.
   https://www.hackerrank.com/challenges/post-transition/problem?isFullScreen=true
d. Copy one structure variable to another structure of the same type.
e. Read student name and marks from the command line and display the student details along with the total.
f. Shift/rotate using bitfields.

Week 12: Files

a. Write text into and read text from a file
b. Write into text and read text from a binary file using fread() and fwrite()
Objective:
c. Copy the contents of one file to another file.
d. Merge two files into the third file using command-line arguments.
e. Find no. of lines, words and characters in a file

Week 13-17: Logic Building – Augmented Experiments (Complete any 2)

13. Variadic functions in C
Objective: Understanding variable number of arguments
https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true

14. Querying the Document
Objective: representing the words, sentences, paragraphs, and documents using pointers.
https://www.hackerrank.com/challenges/querying-the-document/problem?isFullScreen=true

15. Structuring the Document
Objective: Using structure with pointers
https://www.hackerrank.com/challenges/structuring-the-document/problem?isFullScreen=true

16. Small Triangles, Large Triangles
Objective: Print sorted by their areas
https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true

17. Permutations of Strings
Objective: print all strings permutations in strict lexicographical order
https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true

Reference Books:

1. The C Programming Language, Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988
2. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
3. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
4. Let Us C YashwanthKanetkar, Eighth edition, BPB Publications.
5. Programming in C A-Practial Approach Ajay Mittal. Pearson Education

Web Links:

1. https://www.hackerrank.com/
2. https://www.codechef.com/
3. https://www.topcoder.com/
4. https://code-cracker.github.io/
5. https://nptel.ac.in/courses/106105085/2

NOTE: The Students are expected to complete C Programming with five star badge in Hacker Rank Platform.

Practice Programs:

Write a C program to implement the following,

1.	Print the values, address and size of variables of different data types.
2.	Add, subtract, divide, multiply the given numbers.
3.	Convert Centigrade to Fahrenheit.
4.	Swap 2 numbers using 2 , 3 variables .
5.	Find the area of the circle.
6.	Find the simple interest and compound interest.
7.	Convert the distance kms into mts, cms, mms and vice versa
8.	Find the result of (ax+b)/(ax-b).
9.	Demonstrate arithmetic, assignment, increment/decrement relational ,logical Bitwise and conditional operators.
10.	Find the total distance travelled by vehicle in 't' seconds is given by distance = ut + ½ at^2 where 'u' and 'a' are the initial velocity (m/sec) and acceleration (m/sec^2). Write C program to find the distance travelled at regular intervals of time given the values of 'u' and 'a'. The program should provide the flexibility to the user to select his own time intervals and repeat the calculations for different values of 'u' and 'a'.
11.	Check the given number is even or odd.
12.	Find the largest and smallest of 2 numbers and 3 numbers.
13.	Find the student grade.
14.	Calculate the income tax.
15.	Print the given 3 numbers in ascending order.
16.	Check the given year is a leap year or not.
17.	Find roots of a Quadratic equation.
18.	Print the given number in words using Switch statement.
19.	Print the colour based on a given character.
20.	Print from first 'n' natural numbers (1 2 3 …. 10 & 10 9 8 …. 1).
21.	Find the sum of first 'n' natural numbers using do-while loop.
22.	Find the squares of N numbers using do - while loop.
23.	Find the sum of even and odd numbers & count number of even and odd numbers.
24.	Find the factors and factorial of a given number
25.	Find whether the given number is prime or not and within a given range.
26.	Calculate the sum of the digits of a given number (Eg: 123→1+2+3=6).
27.	Display a given number in reverse order (Eg: 123 → 321).
28.	Display a given number is a Palindrome or not.
29.	Find the given number is Armstrong or not.
30.	Find the given number is Perfect or not.
31.	Find the given number is Strong or not.
32.	Calculate the sum of the digits of a given number upto single digit (Lucky Number)
33.	Display the Fibonacci series [Hint: 0 1 1 2 3 5 …(sum of the consecutive numbers)].
34.	Display from 1 to 20 [Eg: 5 * 1 = 5 ….. 5 * 20 = 100].
35.	Display following format 1

	1 2 1 2 3 1 2 3 ⋯.. n
36.	Display following format (Floyd’ s Triangle) 1 2 3 4 5 6 ………………….....
37.	Display following format 1 1 2 1 2 3 ………………………………..n 3 2 1 2 1 1
38.	Generate pyramid structure format 0 1 0 1 2 1 0 1 2 3 2 1 0 1 2 3
39.	Generate Pascal triangle format 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1
40.	Find the value of ncr [Hint : n!/r!(n-r)!].
41.	Print the sum of the following series. $1 + x + x^2 + x^3 + \cdots\cdots\cdots + x^n$
42.	Print the sum of the following series. $1 + x + x^2/2 + x^3/3 + \cdots\cdots + x^n/n$
43.	Print the sum of the following series. $1 + x + x^2/2! + x^3/3! + \cdots.. + x^n/n!$
44.	Print the sum of the following series. $X + x^3/3! + \cdots\cdots\cdots + x^n/n!$
45.	Find LCM & GCD of given numbers.
46.	Convert decimal number to binary number and vice versa
47.	Convert Decimal number to Octal number and vice versa.
48.	Convert Decimal number to Hexa-Decimal number and vice versa.
49.	Read elements into array and display them.
50.	Accept ‘n’ cells into integer array i) copy into another array in reverse order. ii) accept a number to search and how many times that number is found and print the positions at which it is found. iii) accept the delete position and delete that position value from the array. iv) accept a value and a position to insert the accepted value into that position. v) accept delete value and delete that value from array. vi) and place the even numbers in one array and odd numbers in another array.

	vii) count number of even, odd values and display. viii) find the Maximum and Minimum number of the array. ix) sort the elements in Ascending order. x) display elements in a right angle triangle format.
51.	Read the order of a matrix and read elements into 2-D array and display in a Matrix format. Do the following Operations i) Addition ii) Multiplication iii) Transpose iv) Trace v) Display Upper & Lower triangular vi) Symmetric matrix or not vii) Norm of a Matrix
52.	Declare and initialize strings in different ways. [Hint : “hello” , { ‘h’ ,’ e’ ,’ l’ ,’ l’ ,’ o’ ,’ \0’ }, {{ ‘h’ },{’ e’ },{’ l’ },{’ l’ },{’ o’ },{’ \0’ }}]
53.	Read a string from keyboard in different ways.
54.	Accept a string and i) find its length and display. ii) copy that string into another and display both strings iii) copy that string into another in reverse order and display both strings. iv) concatenate second string at the end of the first string. v) count number of upper case, lower case, digits and special characters. vi) count number of vowels, consonants and special characters. vii) convert into upper case string.[eg: hello → HELLO] viii) convert into lower case.[eg: HELLO → hello] ix) convert into toggle case.[eg: hElLo→HeLlO : upper to lower & lower to upper] x) convert into proper case.[eg: i TeAch cDs → I teach cds] xi) count number of words in string. xii) until we press ctrl+z and count number of lines, words and characters. xiii) check whether that string is Palindrome or not. xiv) display in the format. h h a h a i h a h xv) insert second string into first string at a given position. xvi) find a substring in each string. xvii) perform sorting of strings and display them.
55.	5 string-handling functions
56.	Find one’ s and two’ s compliment.
57.	Perform arithmetic operations using functions.
58.	Demonstrate difference between local and global variables using functions.
59.	Demonstrate all function prototypes.
60.	Demonstrate “Call By Value” and “Call By Reference” in functions.
61.	Find Factorial , Fibonacci series , Tower of Hanoi and GCD of a given number using Recursion.
62.	Storage classes (auto, extern, static, register).
63.	User-Defined header files.
64.	Built-in or Standard library functions.

65.	Find sum of odd and even series using function with argument and with return value.
66.	Write a program to evaluate the equation s = sqr(m() + n()) using function.
67.	Generate Fibonacci series using “with argument and return type”.
68.	Find sum of given series by using function with argument and return value e = 2 + 3/1! - 6/2! + 9/3! - 12/4! .....
69.	Demonstrate the concept of pointers using i) &(address) operator. ii) malloc() i.e., dynamic allocation iii) printing array elements using arrays and pointers iv) Declare and read elements into array using dynamic pointers. v) pointer variable to access array elements. vi) a pointer to access 2-dimensional arrays. vii) Access 2-dimensional array using array name itself as pointer.
70.	Program to sort the string using array of pointers to functions.
71.	Command-Line Arguments
72.	Demonstrate the concept of Structures i) using arrays. ii) within structures using local and global scope. iii) functions and arrays. iv) pointers and arrays. v) pointers(dynamic memory allocation) as arrays. vi) functions and pointers. vii) arrays, functions and pointers. viii) self-referential structures ix) Unions x) union of structures xi) Unions within Structures. xii) Unions within Unions.
73.	Demonstrate the concept of “typedef to define datatypes” and “typedef to define structures”.
74.	Demonstrate the concept of Bit fields.
75.	Demonstrate the concept of enum (Enumerated datatypes).
76.	Demonstrate the concept of creating and storing information in a text file.
77.	Demonstrate the concept of reading information from a text file.
78.	Demonstrate the concept of appending information in a text file.
79.	Demonstrate the concept of copying a file to another file.
80.	Demonstrate the concept of Merginh two files and write them to another file.
81.	Demonstrate the concept of fseek(), ftell() and rewind().

82.	**Links for Practice Programs** 1. https://www.hackerrank.com/c-practice-programs-1-7 2. https://www.hackerrank.com/c-practice-programs-8-14 3. https://www.hackerrank.com/c-practice-programs-15-21 4. https://www.hackerrank.com/c-practice-programs-22-28 5. https://www.hackerrank.com/c-practice-programs-29-39 6. https://www.hackerrank.com/c-practice-programs-40-48 **7.** https://www.hackerrank.com/c-practice-programs-49-52

CHEMISTRY LAB

(Common to CSE, IT, AI&ML, CSE (DS))

I Semester	**L T P C**
Course Code: 231BS1L02	**0 0 2 1**

Course Outcomes: At the end of the course, the students will be able to:

- **CO1** Analyze and improve the experimental skills.
- **CO2** Summarize parameters of water
- **CO3** Analyze the strength of acids by instrumentation.
- **CO4** Preparation of polymer and nano particles
- **CO5** Analysing the samples by Spectroscopic and chromatographic techniques

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	1	-	2	-	-	-
CO2	3	-	-	-	-	-	1	-	2	-	-	-
CO3	2	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	-	-	-	-	-	-	2	-	-	-
CO5	2	-	-	-	-	-	-	-	2	-	-	-

List of Experiments (Any ten Experiments):

1. Determination of Hardness of a ground water sample
2. Determination of Chloride content in given water sample
3. Estimation of dissolved oxygen in given water sample
4. Estimation of Vitamin-C in ascorbic acid
5. Preparation of a polymer (Bakelite)
6. Conductometric titration of strong acid vs strong base
7. Potentiometry - determination of strong acid -strong base
8. Paper chromatography technique
9. Preparation of nano particles by Green synthesis
10. Determination of Strength of an acid in Pb-Acid battery

Augmented Experiments (Any One Experiment to be conducted):

11. Wavelength measurement of sample through UV-Visible Spectroscopy

12. Identification of simple organic compounds by IR

Reference Books:

"Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes, and B. Sivasankar

IT WORKSHOP

(Common to all branches)

I Semester	**L**	**T**	**P**	**C**
Course Code: 231ES1L01	**0**	**0**	**2**	**1**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Experiment with assembling, disassembling hardware components of a computer.
CO2:	Explain the process of safeguarding a computer system or network from virus/worm.
CO3:	Demonstrate virtual machine and software installation.
CO4:	Develop a Document, Spreadsheet and Presentation using MS-Office and AI Tools.
CO5:	Make use of GIT for version control and LaTeX for document preparation.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	2	-	-	-	2	2	-	-
CO2	2	1	1	-	2	-	-	-	2	2	-	-
CO3	2	1	-	-	2	-	-	-	2	2	-	-
CO4	1	1	3	-	2	-	-	-	2	2	-	-
CO5	1	1	3	-	2	-	-	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

List of Experiments:

Week 1: Identification of peripherals of a computer

a. Block diagram of the CPU along with the configuration of the each peripheral and its functions.

Week 2: System Assembling and Disassembling

a. Disassembling the components of a PC.
b. Assembling the components back to working condition.

Week 3: Virtual Machine setup

a. Setting up and configuring a new virtual machine.

Week 4: Installation of software

a. Every student should individually install LINUX on the personal computer.
b. Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.

Week 5: Networking and Internet

a. Networking commands.
b. Exploring Internet and World Wide Web.
c. Exploring Search Engines, Cyber hygiene.

Week 6: Text Editors

a. Demonstration and Practice on Text Editors like Notepad++, Sublime Text, Atom, Brackets, Visual code, etc

Week 7: Word

a. Demonstration and practice on Microsoft Word- Formatting, Page Borders, Reviewing, Equations, symbols.

Week 8: Excel

a. Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text
b. Calculating GPA - Features to be covered: Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function.

Week 9: Power Point

a. Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.
b. Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

Week 10: AI TOOLS – ChatGPT and Version Control - GITHUB

a. Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas · Ex: Prompt: In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality.
b. Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are. · Ex:Prompt: Translate the following English sentence to French: 'Hello, how are you doing today?'
c. GIT Commands and GITHUB: config, init, clone, status, add, commit, push,

branch, checkout, merge, pull, log

Week 11: LaTeX

a. Installation of LaTeX and related Software’s.
b. Basic formatting using LaTeX.
c. Handling the equations in LaTeX.
d. Inserting the Tables in LaTeX.

Week 12: Internet & World Wide Web (WWW)

a. Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.
b. Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active downloads to avoid viruses and/or worms.

Week 13-16: List of Augmented Experiments: (Complete any 2)

13. Prepare a power point presentation for college information (Include 10 slides).
14. List the common computer hardware problem and write down the solutions.

15. Prepare your resume using MS-Word and LaTeX.
16. Upload all your documents into GIT and work with access permissions.

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003.
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition.
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition.
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft).
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. Essential Computer and IT Fundamentals for Engineering and Science Students, Dr.N.B.Vekateswarlu, S.Chand.

Web Links:

1. https://assembleyourpc.net/
2. https://www.latex-tutorial.com/tutorials
3. http://www.teachmsoffice.com/
4. https://www.geeksforgeeks.org/top-12-most-used-git-commands-for-developers/

NSS/NCC/SCOUTS & GUIDES/COMMUNITY SERVICE
(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
I Semester	**L**	**T**	**P**	**C**
Course Code: 231HS1L03	**0**	**0**	**1**	**0.5**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Explain the importance of discipline, character and service motto.
CO2:	Solve some societal issues by applying acquired knowledge, facts, and techniques.
CO3:	Explore human relationships by analyzing social problems.
CO4:	Determine to extend their help for the fellow beings and downtrodden people.
CO5:	Develop leadership skills and civic responsibilities.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	2	-	1	-	1
CO2	-	-	-	-	-	2	1	1	1	-	-	-
CO3	-	-	-	-	-	2	-	-	2	2	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	1	1	-	3	3	-	-

UNIT I Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i) Conducting –ice breaking sessions-expectations from the course-knowing personaltalents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasingroad map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societalissues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT II Nature & Care

Activities:

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

UNIT III Community Service

Activities:

i) Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities-experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health,Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and PopulationEducation.
v) Any other programmes in collaboration with local charities, NGOs etc.

Reference Books:

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme* Vol;.I, Vidya Kutir Publication, 2021 (ISBN 978-81-952368-8-6)
2. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, DirectorateGeneral of NCC, Ministry of Defence, New Delhi
3. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering",McGraw Hill, New York 4/e 2008
4. Masters G. M., Joseph K. and Nagendran R. "Introduction to EnvironmentalEngineering and Science", Pearson Education, New Delhi. 2/e 2007
5. Ram Ahuja. *Social Problems in India*, Rawat Publications, New Delhi.

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

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CONSTITUTION OF INDIA

(Common to CSE, IT, AIML & CSE(DS))

I Semester	**L**	**T**	**P**	**C**
Course Code:231MC1T02	**2**	**0**	**0**	**0**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1	Explain historical background of the constitution making and its importance for building a democratic India
CO2	Compare the functioning of three wings of the government i.e.., executive, legislative and judiciary
CO3	Interpret the value of the fundamental rights and duties for becoming good citizen of India
CO4	Compare the decentralization of power between central, state and local self-government
CO5	Extend the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.
CO6	Understand the Electoral Process and Amendment procedure.

Mapping of course outcomes with program outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO1	-	-	-	-	-	3	-	1	2	-	-	-
CO2	-	-	-	-	-	2	-	1	3	-	-	-
CO3	-	-	-	-	-	3	-	2	3	-	-	-
CO4	-	-	-	-	-	3	-	2	1	-	-	-
CO5	-	-	-	-	-	2	-	1	3	-	-	-
CO6	-	-	-	-	-	3	-	1	2	-	-	-

UNIT-I

Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT-II

Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions.

UNIT-III

State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

UNIT-IV

Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy.

UNIT-V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissionerate State Election Commission, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd. NewDelhi.
2. Subash Kashyap, Indian Constitution, National BookTrust.

Reference Books:

1. J.A. Siwach, Dynamics of Indian Government & Politics.
2. D.C. Gupta, Indian Government andPolitics.
3. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication).
4. J.C. Johari, Indian Government and PoliticsHans.

Web Links:

1. nptel.ac.in/courses/109104074/8
2. nptel.ac.in/courses/109104045/
3. nptel.ac.in/courses/101104065/
4. www.hss.iitb.ac.in/en/lecture-details
5. www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

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ENGINEERING PHYSICS

(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
II Semester	**L**	**T**	**P**	**C**
Course Code: 231BS2T02	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1	Apply the principles of interference and diffraction to design and enhance the resolving power of grating.
CO2	Familiarize with the basics of crystals and their structures.
CO3	Explain the fundamental concepts of Quantum behaviour of matter.
CO4	Explain the basic concepts of Semiconductors and identify the type of semiconductors using Hall effect.
CO5	Summarize various types of polarizations of dielectrics and classify the magnetic materials.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-

Unit– I Wave Optics

Interference : Introduction Principle of Superposition-Interference of light- Conditions for sustained Interference**-** Interference in thin films (reflected geometry) – Colours in thin films – Newton's Rings (reflected geometry) – Determination of wavelength and refractive index.

Diffraction : Introduction – Fresnel and Fraunhofer Diffraction - Diffraction due to Single slit (quantitative), Double slit, N– Intensity distribution curves – Diffraction Grating formula – Grating spectrum– Rayleigh's criterion – Resolving powers of grating(qualitative), dispersive power of grating.

Unit– II Crystallography and X-ray diffraction

Crystal Structure: Basis and lattice – Crystal Systems – Bravais Lattice - Unit cell-packing fraction – coordination number- Miller indices – Separation between successive (h k l) planes.

X-ray Diffraction : Bragg's law-Bragg's x-ray spectrometer – crystal structure determination by Laue's and powder methods.

Unit–III Quantum Mechanics and Free electron Theory

Quantum Mechanics: Introduction – Matter waves – de Broglie's hypothesis – Heisenberg's Uncertainity Principle – interpretation of wave function – Schröedinger Time Independent and Time Dependent wave equations– Particle in a potential box.

Free Electron Theory: Introduction–Classical free electron theory(merits and demerits only)- Fermi energy state – Fermi Dirac distribution function –Temperature dependence of Fermi-Dirac distribution function- Quantum Free electron theory–electrical conductivity based on quantum free electron theory–Density of states.

Unit– IV Semiconductors

Semiconductor Physics : Formation of energy bands in crystalline solids – classification of crystalline solids - Intrinsic semi-conductors - density of charge carriers - Electrical conductivity – Fermi level – extrinsic semiconductors - p-type & n-type - Density of charge carriers -Dependence of Fermi energy on carrier concentration and temperature – Hall effect- Hall coefficient –Applications of Hall effect –Drift and Diffusion currents–Einstein's equation.

Unit– V Magnetic & Dielectric Materials

Magnetic materials : Introduction – Magnetic dipole moment – Magnetization – Magnetic susceptibility and permeability – Origin of permanent magnetic moment – Bohr magneton – Classification of magnetic materials :Dia, para & Ferro–Domain concept of Ferro magnetism Hysteresis–soft and hard magnetic materials–applications of Ferro magnetic material.

Dielectric Materials: Introduction - Dielectric polarization – Dielectric polarizability, Susceptibility, Dielectric constant - Relation between D,E& ϵ_0 -Types of polarizations- Electronic(Quantitative), Ionic(Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation –Ferro electric materials– Frequency dependence of polarization—complex dielectric constant- dielectric loss –Applications.

Text Books:

1. "A Textbook of Applied Physics"by P.K Palanisamy, Scitech Publishers
2. "Engineering Physics"by M.Arumugam,Anuradha publishers
3. "ATextbook of Engineering Physics"by M N Avadhanulu,P G Kshirsagar & T.V.S.ArunMurthy S Chand & Company Ltd, 11thedition

Reference Books:

1. "Engineering Physics"by M.R.Srinivasan, NewAge International publishers.
2. "Engineering Physics"by D.K.Bhattacharyaand PoonamTandon,Oxfordpress.
3. "Engineering Physics"by R.K Gaur.and S.LGupta.,-Dhanpat Rai publishers.

Web Links:

1. http://nptel.ac.in/courses/122107035/11
2. http://nptel.ac.in/courses/115102023/
3. https://phet.colorado.edu/en/simulations/category/physics
4. http://physicsgecg.blogspot.in/p/reading-materials.html
5. https://sites.google.com/site/physicsbysureshsaganti/home

DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to all branches)

	L	T	P	C
II Semester	**L**	**T**	**P**	**C**
Course Code:231BS2T03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1: Solve Linear differential equations of first order

CO2: Solve Linear differential equations of higher order

CO3: Identify methods of solution for various partial differential equations

CO4: Calculate the gradient, divergence and curl

CO5: Compute work done, flux using vector integration

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Unit-I:
Differential equations of first order and first degree :

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay, Electrical circuits.

Unit-II:
Linear differential equations of higher order :

Definitions, homogenous and non-homogenous equations, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

Unit-III:
Partial Differential Equations :

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

Unit-IV:

Vector differentiation :

Scalar and vector point functions, vector operator Del, Del applied to scalar point functions-Gradient and its applications, Directional derivative, del applied to vector point functions-Divergence and Curl, solenoidal and irrotational vectors, scalar potential, vector identities.

Unit-V:

Vector integration :

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

Text Books:

1. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones and Bartlett,2018.
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 2021 5th Edition (9th reprint).
5. Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

Web Links:

1. https://archive.nptel.ac.in/courses/111/106/111106100/
2. https://archive.nptel.ac.in/courses/111/105/111105122/

BASIC CIVIL AND MECHANICAL ENGINEERING

(Common to CSE, IT, AIML & CSE(DS))

II Semester **L T P C**

Course Code: **231ES2T03** **3 0 0 3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Explain various sub-divisions of Civil Engineering and basic characteristics of Civil Engineering Materials and attain knowledge on prefabricated technology.

CO2: Illustrate the concepts of surveying and to understand the measurement of distances, angles and levels through surveying.

CO3: Describe the significance and Engineering aspects of transportation, water storage and water conveyance structures.

CO4: Explain the role and applications of mechanical engineering and materials.

CO5: Explain the different manufacturing processes, mechanical power transmission systems and robotics.

CO6: Explain the working of IC Engines, Boilers and Power Plants.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	1	1	-	-	-	-	-
CO5	3	1	-	-	-	1	1	-	-	-	-	-
CO6	3	1	-	-	-	1	1	-	-	-	-	-

PART A: BASIC CIVIL ENGINEERING

UNIT I

Basics of Civil Engineering: Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering- Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate – Bricks - Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements-Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III

Transportation Engineering Importance of Transportation in Nation's economic development-Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

Text Books:

1. Basic Civil and Mechanical Engineering, Ommi Srikanth, M. Sreenivasa Reddy, S. Chand Publications.
2. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt. Ltd. Fourth Edition.
3. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers. 2022. First Edition.
4. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. Fifth Edition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, Khanna Publishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, Khanna Publishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ce42/preview
2. https://www.youtube.com/watch?v=chhuq_t40rY&list=PL20A0651466E8A776
3. https://www.youtube.com/results?search_query=Transportation+engineering+NPTEL
4. https://www.mcgill.ca/civil/undergrad/areas/water

PART B: BASIC MECHANICAL ENGINEERING

UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials: – Metals - Ferrous and Non-ferrous, Ceramics, Composites, Smart Materials.

UNIT II

Manufacturing Processes: Principles of Casting, Forming, Joining Processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their Applications.

Introduction to Robotics - Joints & Links, Configurations, and Applications of Robotics.

UNIT III

Thermal Engineering – **I.C Engine:** Heat Engine – Types of Heat Engine –Classification of I.C. Engine, Working principle of SI and CI Engines, Comparison of 2-Stroke and 4-Stroke engines, Components of Electric and Hybrid Vehicles.

Boilers: Classification of Boilers – Simple Vertical Boiler – Cochran Boiler –Babcock and Wilcox Boiler – Benson Boiler.

Power Plants – Working principle of Steam, Diesel, Hydro, and Nuclear power plants.

(**Note:** The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject).

Text Books:

1. Internal Combustion Engines by V. Ganesan, By Tata McGraw Hill publications (India) Pvt. Ltd.
2. A Text book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications, (India) Pvt. Ltd.
3. Introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I.
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak M Pandey, Springer publications.
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt. Ltd.
4. G. Shanmugam and M.S. Palanisamy, Basic Civil and the Mechanical Engineering, Tata McGraw Hill publications (India) Pvt. Ltd.

Web Links:

1. https://www.youtube.com/playlist?list=PL8tFFpsLHxMRZsJljPLGVGthqSEJV11DZ
2. https://sedyono.files.wordpress.com/2015/10/ch-02.pdf
3. https://www.cedengineering.com/userfiles/Mechanical%20Power%20Transmission%20Fundamentals-R1.pdf
4. https://ccsuniversity.ac.in/bridge-library/pdf/Lecture-3-Engine.pdf
5. https://www.sathyabama.ac.in/sites/default/files/course-material/2020-10/UNIT 5_14.pdf
6. https://www.youtube.com/watch?v=q79bl99rWFM

ENGINEERING GRAPHICS
(Common to CSE, IT, AIML & CSE(DS))

		L	T	P	C
II Semester					
Course Code:	**231ES2T04**	**1**	**0**	**4**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Apply the principles of engineering drawing, to construct engineering curves and orthographic projection of points.

CO 2: Construct projections of Lines and planes in various positions in first quadrant.

CO 3: Construct projections of solids in various positions in first quadrant.

CO 4: Develop surfaces of the regular solids.

CO 5: Construct isometric and orthographic views of simple solids.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	-	-	-	-	1	-	-
CO2	3	2	1	-	2	-	-	-	-	1	-	-
CO3	3	2	1	-	2	-	-	-	-	1	-	-
CO4	3	2	1	-	2	-	-	-	-	1	-	-
CO5	3	2	1	-	2	-	-	-	-	1	-	-

UNIT I

Introduction to Drawing: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general method, Cycloid, Involute, Normal and tangent to Curves.

UNIT II

Projections of Points: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes.

UNIT III

Projections of Planes: Regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

UNIT IV

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone simple cases.

UNIT V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views. Creating 2D & 3D drawings of objects (prism, cylinder, pyramid and cone)

Text Books:

1. T Jeyapoovan, M. Sreenivasa Reddy, Computer Aided Engineering Graphics, Vikas Publications.
2. N. D. Bhatt, Engineering Drawing, Charotar Publishing House.
3. Venugopal, Engineering Drawing and Graphics, 2nd edition, New Age Publications, New Delhi.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill.
2. Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill.
4. Computer Aided Engineering Graphics, T. Jeyapoovan, Vikas Publishing house, New Delhi, First Edition.

Web Links:

1. http://nptel.ac.in/courses/112103019
2. http://freevideolectures.com/Course/3420/Engineering-Drawing
3. http://engineeringdrawing.org
4. http://inoxwap.com/video/category/engineering-drawing-for-first yearengineering.html

DATA STRUCTURES
(Common to CSE, IT, AIML & CSE(DS))

II Semester **L T P C**
Course Code: 231CS2T01 **3 0 0 3**

Course Outcomes: At the end of the course, Student will be able to

CO1: Illustrate Time and Space complexities for different searching and sorting algorithms.

CO2: Demonstrate various operations on Linked Lists.

CO3: Explain different operations on Stack and its applications.

CO4: Illustrate different operations on queue and its applications.

CO5: Demonstrate the importance and various operation on non-linear data structures and hashing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-
CO4	1	1	2	1	-	-	-	-	-	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT I

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures. Searching Techniques: Linear & Binary Search, Sorting Techniques: Bubble sort, Selection sort, Insertion Sort

UNIT II

Linked Lists: Singly linked lists: representation and operations, doubly linked lists and circular linked lists, Comparing arrays and linked lists, Applications of linked lists.

UNIT III

Stacks: Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, Applications of stacks in expression evaluation, backtracking, reversing list etc.

UNIT IV

Queues: Introduction to queues: properties and operations, implementing queues using arrays and linked lists, Applications of queues in breadth-first search, scheduling, etc.

Deques: Introduction to deques (double-ended queues), Operations on deques and their applications.

UNIT V

Trees: Introduction to Trees, Binary Search Tree – Insertion, Deletion & Traversal

Graphs: Introduction, Graph Terminology, Representation of Graphs-Adjacency Matrix and using Linked list, Graph Traversals (BFT & DFT)

Hashing: Brief introduction to hashing and hash functions, Collision resolution techniques: chaining and open addressing.

Textbooks:

1. Data Structures Using C,Reema Thareja, Oxford University Press,2nd Edition.
2. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand.

Reference Books:

1. “The Algorithm Design Manual”, Steven S. Skiena, Second Edition, Springer Publication
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008
3. Data Structures and Algorithms by Maganti Venkatesh, Naresh Tangudu,A.Satish, K Sujatha, D. Ganesh, Indo-Continental Academic Publishers.
4. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
5. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://archive.nptel.ac.in/courses/106/105/106105225/
3. https://www.udemy.com/topic/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms
5. https://www.coursera.org/specializations/boulder-data-structures-algorithms?trk_location=query-summary-list-link

ENGINEERING PHYSICS LAB
(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
II Semester				
Course Code: 231BS2L02	**0**	**0**	**2**	**1**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Operate optical instruments like travelling microscope and spectrometer.
CO2: Study Temperature Resistance Characteristics of different materials.
CO3: Estimate magnetic field intensity, wave length and Frequency of electrical vibrator.
CO4: Estimate acceleration due to gravity and Elastic moduli by oscillatory methods.
CO5: Study voltage current characteristics of different semiconductors.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-

List of Experiments:

(Any **TEN** of the listed experiments are to be conducted)

1. Determination of radius of curvature of a given Plano-convex lens by Newton’s rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster’s law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck’s constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee’s Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum.

14. Determination of thickness of a thin wire by forming interference fringes.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or single cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

List of Augmented Experiments:

(Any **TWO** of the listed experiments are to be conducted)

19. Resolving power of grating.
20. Determination of V-I characteristics and Breakdown voltage of Zener Diode.
21. Determination of spring constant of springs using coupled oscillators.

Reference Books:

1. A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers.
2. Engineering Physics Lab Manual by Dr.C.V.Madhusudhana Rao, V.Vasanth Kumar,Scitech Publications
3. Laboratory Manual Cum Record for Engineering Physics I & II byDr.Y.Aparna, Dr.K.Venkateswara Rao, VGS Techno series.

Web Links:

1. www.vlab.co.in
2. https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

ENGINEERING WORKSHOP
(Common to CSE, IT, AIML & CSE(DS))

II Semester	**L**	**T**	**P**	**C**
Course Code: 231ES2L03	**0**	**0**	**3**	**1.5**

Course Outcomes:
At the end of the Course, Student will be able to:

CO 1: Prepare various wooden joints

CO 2: Develop various fitting joints

CO 3: Develop surfaces for making the various sheet metal models

CO 4: Develop basic knowledge for house wiring and plumbing practice

CO 5: Demonstrate and Practice on welding joints

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	-	-	-	2	1	-	1
CO2	1	1	-	-	-	-	-	-	2	1	-	1
CO3	2	1	-	-	-	-	-	-	2	1	-	1
CO4	1	-	-	-	-	-	-	-	2	1	-	1
CO5	2	-	-	-	-	-	-	-	2	1	-	1

Demonstration: Safety Practices and Precautions to be observed in workshop.

Carpentry:

1. To make a T-Lap joint from the wood of given size
2. To make a Dovetail joint from the wood of given size

Fitting:

1. To make a V- fitting from the given two M.S pieces
2. To make a Square- fitting from the given two M.S pieces

Sheet Metal Work:

1. To make a Taper tray using given sheet metal
2. To make a conical funnel using given sheet metal

House Wiring:

1. To give connection to three bulbs by Series
2. To give connection to three bulbs by Parallel

Welding:

1. To make a butt joint using given M.S pieces by Arc Welding
2. To make a Lap joint using given M.S pieces by Arc Welding

List of Augmented Experiments:
(Any two of the following experiments can be performed)

1. Demonstration and prepare an Elbow joint by using plumbing tools.
2. To make a Mortise and Tenon joint from the wood of given size.
3. To make a T-joint using given M.S pieces and by Arc Welding.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix.; Workshop Processes, Practices and materials; Routledge Publishers.
2. A course in Workshop Technology Vol I & Vol II, B.S. Raghuwanshi, Dhanpath Rai & Co.

Reference Books:

1. Workshop Practice by H.S.Bawa, Tata-McGraw Hill,2nd Edition.
2. Elements of Workshop Technology, VOL I by S.K. Hajra Choudhury & others 14th edition
3. Workshop Technology, Part 1, Fifth edition, W.A.J. Chapman.
4. Workshop Technology Manufacturing Processes by Dr. R. K. Singal, Vol II, Kat Books Publications.

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DATA STRUCTURES LAB
(Common to CSE, IT, AIML & CSE(DS))

II Semester **L T P C**
Course Code: 231CS2L01 **0 0 3 1.5**

Course Outcomes: At the end of the course, Student will be able to

CO1: Make use of iterative and recursive procedures for problem solving.

CO2: Utilize appropriate searching and sorting techniques to search and sort elements.

CO3: Implement various operations on linear data structures.

CO4: Implement various operations on non-linear data structures.

CO5: Apply appropriate data structure to solve different types of applications.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	1	-	-	-	2	2	-	-
CO2	1	2	3	1	1	-	-	-	2	2	-	-
CO3	1	1	3	-	1	-	-	-	2	2	-	-
CO4	1	1	3	-	1	-	-	-	2	2	-	-
CO5	1	1	3	1	1	-	-	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

List of Experiments: Implement the following experiments using ‘C’

Week 1: Array Manipulation and Searching Techniques

a. Arrays - DS

Objective: Reverse array elements

https://www.hackerrank.com/challenges/arrays-ds/problem?isFullScreen=true

b. Linear Search

Objective: Find the position of number K in the given list

https://www.hackerrank.com/contests/17cs1102/challenges/1-a-linear-search

Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.

c. Binary Search ‑ Basic

Objective: find index (0-based) of a given key in a sorted array

https://www.hackerrank.com/contests/launchpad-1-winter-challenge/challenges/binary-search-basic

d. Binary Search ‑ Iterative

Objective: Given queries found in array elements or not.

https://www.hackerrank.com/contests/17cs1102/challenges/1-b-binary-search-iterative

e. Binary Search ‑ Recursion

Objective: Given queries found in array elements or not.

https://www.hackerrank.com/contests/17cs1102/challenges/1-c-binary-search-recursion

Week 2: Sorting Techniques

a. Bubble Sort

Objective: Sort the array in ascending order

https://www.hackerrank.com/challenges/ctci-bubble-sort/problem

b. Insertion Sort

Objective: Implement insertion sort on array

https://www.hackerrank.com/contests/17cs1102/challenges/3-a-implement-insertion-sort

c. Selection Sort

Objective: Implement insertion sort on array.

https://www.hackerrank.com/contests/17cs1102/challenges/3c-implement-selection-sort

Week 3: Sorting Techniques – Divide and Conquer

a. Merge Sort

Objective: Implement merge sort on array.

https://www.hackerrank.com/contests/17cs1102/challenges/merge-sort-6

b. Quick Sort

Objective: Implement quick sort on array.

https://www.hackerrank.com/contests/17cs1102/challenges/4a-quick-sort

Week 4: Linked List

a. Single Linked List

Objective: Perform different operations in single linked list.

https://www.hackerrank.com/contests/17cs1102/challenges/5a-single-linked-list

b. Double Linked List

Objective: Perform different operations in double linked list.

https://www.hackerrank.com/contests/17cs1102/challenges/5b-doubly-linked-list

Week 5: Linked List Continued

a. Circular Linked List

Objective: Perform different operations in circular linked list.

https://www.hackerrank.com/contests/17cs1102/challenges/5c-circular-linked-list

b. Reverse a linked list

Objective: Reversing a single linked list

https://www.hackerrank.com/challenges/reverse-a-linked-list/problem?isFullScreen=true

c. Compare 2 linked list

Objective: Compare the data in the nodes of the linked lists to check if they are equal.

https://www.hackerrank.com/challenges/compare-two-linked-lists/problem?isFullScreen=true

Week 6: Linked List - Applications

a. Implement a linked list to represent polynomials and perform addition.

b. Delete duplicate-value nodes from a sorted linked list.

Objective: Delete nodes and return a sorted list with each distinct value in the original list.

https://www.hackerrank.com/challenges/delete-duplicate-value-nodes-from-a-sorted-linked-list/problem?isFullScreen=true

Week 7: Stack

a. Stack and its operations using arrays

b. Stack Using Linked List

Objective: Implement Stack using Linked List

https://www.hackerrank.com/contests/17cs1102/challenges/6a-stack-using-linked-list

c. Stack using two Queues

Objective: Implement Stack using two Queues

https://www.hackerrank.com/contests/17cs1102/challenges/6b-implement-stack-using-two-queues-

Week 8: Queue

a. Queue and its operations using arrays

b. Queue Using Linked List

Objective: Implement a queue using Linked List

https://www.hackerrank.com/contests/17cs1102/challenges/7b-implement-a-queue-using-linked-list

c. Queue using two Stacks

Objective: Implement Queue using two Stacks

https://www.hackerrank.com/contests/17cs1102/challenges/queue-using-two-stacks

d. Circular Queues

Objective: Implement Circular Queue using Arrays

https://www.hackerrank.com/contests/17cs1102/challenges/7a-circular-queue-using-arryas

Week 9: Stacks - Applications

a. Towers of Hanoi Using Stack

Objective: Implement Towers of Hanoi using Stack

https://www.hackerrank.com/contests/17cs1102/challenges/6c-towers-of-hanoi-using-stack

b. Balanced Brackets

Objective: Given strings of brackets, determine whether each sequence of brackets is balanced.

https://www.hackerrank.com/contests/17cs1102/challenges/balanced-brackets

Week 10: Stacks - Applications

a. Infix to Postfix

Objective: Convert an infix expression into postfix expression.

https://www.hackerrank.com/contests/17cs1102/challenges/8b-infix-to-postfix

b. Postfix Expression Evaluation

Objective: Implement a program to evaluate a postfix expression.

https://www.hackerrank.com/contests/17cs1102/challenges/8-c-postfix-expression-evaluation

Week 11: Tree

a. Binary search tree (BST)

Objective: Implement Binary search tree (BST).

https://www.hackerrank.com/contests/17cs1102/challenges/9a-implement-binary-search-tree

b. Binary search Tree (BST) Traversals

Objective: Implement Binary search Tree (BST) Traversals.

https://www.hackerrank.com/contests/17cs1102/challenges/9b-implement-binary-search-tree

Week 12: Graphs and Hashing – Collision Resolution

a. Breadth First Search (BFS)

Objective: Graph Traversal using BFS

https://www.hackerrank.com/contests/17cs1102/challenges/13-a-breadth-first-search

b. Depth First Search (DFS)

c. Open Hashing - Separate chaining

d. Closed Hashing - Open Addressing – Linear Probing

Week 13-16: List of Augmented Experiments (Complete any 2)

13. DeQueue Implementation

14. Fibonacci Search

15. Radix Sort

16. Quadratic Probing

Reference Books:

1. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, 2008
2. Algorithms and Data Structures: The Basic Toolbox by Kurt Mehlhorn and Peter Sanders
3. C Data Structures and Algorithms by Alfred V. Aho, Jeffrey D. Ullman, and John E. Hopcroft
4. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein.

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://archive.nptel.ac.in/courses/106/105/106105225/
3. https://www.udemy.com/topic/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms
5. https://www.coursera.org/specializations/boulder-data-structures-algorithms?trk_location=query-summary-list-link
6. Master Link: https://www.hackerrank.com/contests/17cs1102/challenges

NOTE: The Students are expected to complete Data Structure with five star badge in Hacker Rank Platform.

COMMUNICATIVE ENGLISH LAB

(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
II Semester **Course Code:231HS2L01**	**0**	**0**	**2**	**1**

Course Outcomes: At the end of the course, student will be able to:

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills.

CO2: Apply communication skills through various language learning activities

CO3: Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.

CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.

CO5: Develop the capacity to use various writing forms to achieve their professional needs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

List of Topics:

1. Communication Skills & JAM
2. Role Play - Conversational Practice
3. Phonetics -Vowels & Consonants
4. Neutralization/Accent Rules
5. Group Discussions-methods & practice
6. Debates - Methods & Practice
7. PPT Presentations/ Poster Presentation
8. Interview Skills
9. Resume Writing, Cover letter, SOP
10. E-mail Writing
11. Outstanding people – People you admire, Discuss a challenge, Write an article
12. Survival – Discuss dangerous situations, Write guidelines in a leaflet

Suggested Software:

- Walden Infotech
- Young India Films
- Cambridge Empower

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford University Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India,2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed),Kindle, 2013
5. Cambridge Empower – Second Edition B2 Level

Web Links:

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/EnglishClass101/featured
7. www.cambridgeone.org

Voice & Accent:

1. https://www.youtube.com/user/letstalkaccent/videos

2.https://www.youtube.com/c/EngLanguageClub/featured

3.https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc

4.www.cambridgeone.org

HEALTH AND WELLNESS, YOGA AND SPORTS

(Common to CSE, IT, AIML & CSE(DS))

II semester **L T P C**
Course Code: 231HS2L02 **0 0 1 0.5**

Course Outcomes: At the end of the course, Student will be able to

CO1: Explain the importance of yoga and sports for Physical fitness and sound health.

CO2: Demonstrate an understanding of health-related fitness components.

CO3: Compare and contrast various activities that help enhance their health.

CO4: Assess current personal fitness levels.

CO5: Develop Positive Personality

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	2	3	3	-	-
CO2	-	-	-	-	-	-	-	2	3	3	-	-
CO3	-	-	-	-	-	-	-	2	3	3	-	2
CO4	1	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	1	-	2	-	1

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index(BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc. Practicing general and specific warm up, aerobics

ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping andrunning.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to Surviving Anywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. --3rd ed. HumanKinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as manyas Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

ENVIRONMENTAL SCIENCE
(Common to CSE, IT, AIML & CSE(DS))

II Semester	**L**	**T**	**P**	**C**
Course Code: 231MC2T02	**2**	**0**	**0**	**0**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Outline the natural resources and their importance for the sustenance of the life
CO2: Explain about the biodiversity of India, threats and its conservation methods
CO3: Illustrate various attributes of the pollution, impacts and measures to control the pollution along with waste management practices
CO4: Describe social issues of both rural and urban environment to combat the challenges and the
legislations of India in environmental protection
CO5: Explain the population growth and its implications
CO6: Summarize the Role of IT on Environment and Human Health

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	-	-	-	-	1	2	-	-	-	-	-
CO2	1	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	2	3	-	-	-	-	1
CO4	-	-	-	-	-	1	3	1	-	-	-	1
CO5	-	-	-	-	-	-	3	-	-	-	-	-
CO6	-	-	-	-	-	1	3	-	-	-	-	1

Unit - I

Multidisciplinary Nature of Environmental Studies: Definition, Scope and Importance, Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems.

Unit – II

Ecosystem, Biodiversity and Its Conservation:

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers, and decomposers. Food chains, food webs and ecological pyramids.

Biodiversity And Its Conservation: Defi

Unit – III

Environmental Pollution and Solid Waste Management:

Environmental Pollution: Definition, Cause, effects, and control measures of:

a. Air Pollution.
b. Water Pollution
c. Soil Pollution
d. Marine Pollution
e. Noise Pollution

Solid Waste Management:Causes

Unit – IV

Social Issues and The Environment:Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to Energy &Water. Resettlement and rehabilitation of people, Environmental ethics, Climate change, global warming,

Unit – V

Human Population and The Environment: Population growth, variation among nations. Environment and human health, Human Rights, Value Education. Role of Information Technology in Environment and human health.

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Palaniswamy – Pearson education
3. Environmental Studies by Dr.S.Azeem Unnisa, Academic Publishing Company.

Reference Books:

1. Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.
2. Textbook of Environmental Sciences and Technology by M.Anji Reddy, B.S Publication.
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications
4. Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Prentice Hall of India Private limited.
5. A Textbook of Environmental Studies by G.R.Chatwal, Himalaya Publishing House

Web Links:

1. https://www.youtube.com/watch?v=mOwyPENHhbc
2. https://www.youtube.com/watch?v=_mgvsPnCYj4
3. https://www.youtube.com/watch?v=L5B-JMnBIyQ
4. https://www.youtube.com/watch?v=3RDGV5i82_Q

Discrete Mathematics & Graph Theory

(Common to AIML, CSE, CSE-DS & IT)

Semester: III	**L T P C**
Course Code: 231BS3T05	**3 0 0 3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Apply the principles of mathematical logic to statement calculus and predicate calculus.

CO2: Compute transitive closure, equivalence classes of binary relations.

CO3: Solve recurrence relations by various methods.

CO4: Apply the concepts of Graph theory to find Euler paths, Hamiltonian paths.

CO5: Demonstrate different traversal methods for trees.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I: Mathematical Logic:

Propositional Calculus: Statements and Notations, Connectives, Well Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus, Consistency of Premises, Indirect Method of Proof, Predicate Calculus: Predicates, Predicative Logic, Statement Functions, Variables and Quantifiers, Free and Bound Variables, Inference Theory for Predicate Calculus.

Unit – II: Set Theory:

Sets: Operations on Sets, Principle of Inclusion-Exclusion, Relations: Properties, Operations, Partition and Covering, Transitive Closure, Equivalence, Compatibility and Partial Ordering, Hasse Diagrams, Functions: Bijective, Composition, Inverse, Permutation, and Recursive Functions, Lattice and its Properties.

Unit – III: Combinatorics and Recurrence Relations:

Basis of Counting, Permutations, Permutations with Repetitions, Circular and Restricted Permutations, Combinations, Restricted Combinations, Binomial and Multinomial Coefficients and Theorems.

Recurrence Relations:

Generating Functions, Function of Sequences, Partial Fractions, Calculating Coefficient of Generating Functions, Recurrence Relations, Formulation as Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots, Solving Inhomogeneous Recurrence Relations.

Unit – IV: Graph Theory:

Basic Concepts, Graph Theory and its Applications, Subgraphs, Graph Representations: Adjacency and Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs.

Unit – V: Multi Graphs:

Multigraphs, Bipartite and Planar Graphs, Euler's Theorem, Graph Colouring and Covering, Chromatic Number, Spanning Trees, Prim's and Kruskal's Algorithms, BFS and DFS Spanning Trees.

Text Books:

1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and P. Manohar, Tata McGraw Hill.
2. Elements of Discrete Mathematics-A Computer Oriented Approach, C. L. Liu and D. P. Mohapatra, 3rd Edition, Tata McGraw Hill.
3. Mathematical Foundations of Computer Science, S. Santha and E. V. Prasad, Cengage Publishers.

Reference Books:

1. Discrete Mathematical Structures, Bernand Kolman, Robert C. Busby and Sharon Cutler Ross, PHI.
2. Discrete Mathematics for Computer Scientists and Mathematicians, J. L. Mott, A. Kandel and T. P. Baker, 2nd Edition, Prentice Hall of India.

Web links:

1. http://nptel.ac.in/courses/106106094/
2. http://mathworld.wolfram.com/classroom/classes/DiscreteMathematics.html
3. http://mathworld.wolfram.com/topics/GeneralLogic.html
4. https://ggc-discrete-math.github.io/

Universal Human Values

(Common to ALL Branches)

Semester: III	**L**	**T**	**P**	**C**
Course Code: 231HS3T01	**2**	**1**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Define the terms like Natural Acceptance, Happiness and Prosperity
CO2:	Identify one’ s self, and one’ s surroundings (family, society nature)
CO3:	Apply what they have learnt to their own self in different day today settings in real life
CO4:	Relate human values with human relationship and human society
CO5:	Justify the need for universal human values and harmonious existence

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	-	-	-	-	-	2	-	2	-	-	-	2
CO2:	-	-	-	-	-	2	-	2	-	-	-	2
CO3:	-	-	-	-	-	2	-	2	-	-	-	2
CO4:	-	-	-	-	-	2	-	2	-	-	-	2
CO5:	-	-	-	-	-	2	-	2	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Introduction to Value Education:

Lecture 1: Right Understanding, Relationship and Physical Facility

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: selfexploration as the Process for Value Education

Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

Practice Sessions:

PS1 Sharing about Oneself

PS2 Exploring Human Consciousness

PS3 Exploring Natural Acceptance

UNIT – II

Harmony in the Human Being :

Lecture 7: Understanding Human being as the Coexistence of the self and the body.

Lecture 8: Distinguishing between the Needs of the self and the body

Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.

Lecture 9: The body as an Instrument of the self Lecture 10: Understanding Harmony in the self

Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self Lecture 11:

Harmony of the self with the body

Lecture 12: Programme to ensure selfregulation and Health

Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

Practice Sessions:

PS4 Exploring the difference of Needs of self and body

PS5 Exploring Sources of Imagination in the self

PS6 Exploring Harmony of self with the body

UNIT ‐ III

Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)

Lecture 13: Harmony in the Family ‐ the Basic Unit of Human Interaction

Lecture 14: 'Trust' ‐ the Foundational Value in Relationship

Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust

Lecture 15: 'Respect' ‐ as the Right Evaluation

Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect

Lecture 16: Other Feelings, Justice in HumantoHuman Relationship

Lecture 17: Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order

Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

Practice Sessions:

PS7 Exploring the Feeling of Trust

PS8 Exploring the Feeling of Respect

PS9 Exploring Systems to fulfil Human Goal

UNIT - IV

Harmony in the Nature/Existence :

Lecture 19: Understanding Harmony in the Nature

Lecture 20: Interconnectedness, selfregulation and Mutual Fulfilment among the Four Orders of Nature

Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature

Lecture 21: Realizing Existence as Coexistence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 Exploring Coexistence in Existence.

Practice Sessions:

PS10 Exploring the Four Orders of Nature

PS11 Exploring Coexistence in Existence

UNIT - V

Implications of the Holistic Understanding - a Look at Professional Ethics

Lecture 23: Natural Acceptance of Human Values Lecture 24: Definitiveness of (Ethical) Human Conduct

Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct

Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal

Human Order.

Lecture 26: Competence in Professional Ethics

Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education

Lecture 27: Holistic Technologies, Production Systems and Management ModelsTypical Case Studies.

Lecture 28: Strategies for Transition towards Valuebased Life and Profession

Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal

Human Order

Practice Sessions:

PS12 Exploring Ethical Human Conduct

PS13 Exploring Humanistic Models in Education

PS14 Exploring Steps of Transition towards Universal Human Order.

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, ISBN 9789387034471`
2. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak,

Reference Books:

1. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi.
2. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

Web Links:

1. https://fdp-si.aicte-india.org/8dayUHV_download.php
2. https://journals.sagepub.com/home/JHV

Digital Logic and Computer Organization

(Common to CSE & IT)

	L	T	P	C
Semester: III				
Course Code: 23IES3T05	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Apply number systems, binary codes, signed numbers, design and simplify logic circuit
CO2:	Develop advanced digital logic circuits and the foundational structure of computers.
CO3:	Apply computer arithmetic operations and processor organization principles
CO4:	Explain the concepts of memory hierarchy comprehensively
CO5:	Explian the architecture and functionality of central processing unit

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	2	2	2	-	-	-	-	-	-	-	-	1
CO2:	3	2	2	-	-	-	-	-	-	-	-	1
CO3:	3	2	1	-	-	-	-	-	-	-	-	1
CO4:	2	2	1	-	-	-	-	-	-	-	-	1
CO5:	2	2	1	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	-	2
CO2:	-	1
CO3:	-	2

CO4:	**-**	2
CO5:	**-**	2

UNIT - I

Data Representation: Binary Numbers, Fixed Point Representation. Floating Point Representation. Number base conversions, Octal and Hexadecimal Numbers, components, Signed binary numbers, Binary codes

Digital Logic CircuitsI: Basic Logic Functions, Logic gates, universal logic gates, Minimization of Logic expressions. KMap Simplification, Combinational Circuits, Decoders, Multiplexers

UNIT - II

Digital Logic CircuitsII: Sequential Circuits, FlipFlops, Binary counters, Registers, Shift Registers, Ripple counters

Basic Structure of Computers: Computer Types, Functional units, Basic operational concepts, Bus structures, Software, Performance, multiprocessors and multi computers, Computer Generations, Von Neumann Architecture

UNIT - III

Computer Arithmetic : Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signedoperand Multiplication, Fast Multiplication, Integer Division, FloatingPoint Numbers and Operations

Processor Organization: Fundamental Concepts, Execution of a Complete Instruction, MultipleBus Organization, Hardwired Control and Multi programmed Control

UNIT - IV

The Memory Organization: Basic Concepts, Semiconductor RAM Memories, ReadOnly Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage

UNIT - V

Input/Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces

Text Books:

1. Computer Organization, Carl Hamacher, Zvonko Vranesic, SafwatZaky, 6th edition, McGraw Hill, 2023
2. Digital Logic and Computer Design, Morris Mano, Pearson Education 11thEdition.
3. Computer System Architecture,M.MorrisMano,PHI,3rdedition.

Reference Books:

1. Digital Logic and Computer Organization, Rajaraman, Radhakrishnan, PHI.
2. Computer Organization, Hamacher, Vranesic and Zaky, TMH, 5thedition.
3. Computer Organization & Architecture: Designing for Performance, William Stallings,PHI,7th edition.

Web Links:

1. http://nptel.ac.in/courses/106106092/
2. http://nptel.ac.in/courses/106103068/2
3. http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf
4. https://www.geeksforgeeks.org/computerarithmeticset1/
5. https://onlinecourses.nptel.ac.in/noc20_ee11/preview

Advanced Data Structures & Algorithm Analysis
(Common to AIML, CSE, CSE-DS & IT)

	L	T	P	C
Semester: III	**L**	**T**	**P**	**C**
Course Code: 231CS3T01	**3**	**0**	**0**	**3**

Course Outcomes:
At the end of the Course, Student will be able to:

CO1: Outline the analysis of algorithms.
CO2: Illustrate the concepts of search trees, priority queues and graphs.
CO3: Analyze the algorithms of Divide & Conquer, Greedy and Dynamic Programming.
CO4: Design the algorithms of Backtracking and Brach & Bound.
CO5: Summarize the problems of NP Hard and NP Complete.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	1	2	1	2	-	-	-	-	-	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-
CO5	2	1	-	2	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	2	-

Unit - I

Introduction to Algorithm Analysis, Space and Time Complexity analysis, AsymptoticNotations.

AVL Trees – Creation, Insertion, Deletion operations and Applications.

B-Trees – Creation, Insertion, Deletion operations and Applications

Unit - II

Heap Trees (Priority Queues) – Min and Max Heaps, Operations and Applications

Graphs – Terminology, Representations, Connected Components and Biconnected Components, applications.

Divide and Conquer: The General Method, Quick Sort, Merge Sort, Strassen's matrix multiplication, Convex Hull

Unit - III

Greedy Method: General Method, Job Sequencing with deadlines, Knapsack Problem, Minimum cost spanning trees, Single Source Shortest Paths

Dynamic Programming: General Method, All pairs shortest paths, Single Source Shortest Paths– General Weights (Bellman Ford Algorithm), Optimal Binary Search Trees, 0/1 Knapsack, String Editing, Travelling Salesperson problem

Unit - IV

Backtracking: General Method, 8-Queens Problem, Sum of Subsets problem, Graph Coloring, 0/1 Knapsack Problem.

Branch and Bound: The General Method, 0/1 Knapsack Problem, Travelling Salesperson problem.

Unit - V

NP Hard and NP Complete Problems: Basic Concepts, Cook's theorem

NP Hard Graph Problems: Clique Decision Problem (CDP), Chromatic Number DecisionProblem (CNDP), Traveling Salesperson Decision Problem (TSP)

NP Hard Scheduling Problems: Scheduling Identical Processors, Job Shop Scheduling

Text Books:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta,Dinesh, 2nd Edition Universities Press.
2. Computer Algorithms in C++, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran,2nd Edition University Press.

Reference Books:

1. Data Structures and program design in C, Robert Kruse, 2nd Edition Pearson Education Asia.
2. An introduction to Data Structures with applications, Trembley& Sorenson, McGrawHill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth,Addison-Wesley.
4. Data Structures using C & C++: Langsam, Augenstein &Tanenbaum, Pearson.

Web Links:

1. https://archive.nptel.ac.in/courses/106/102/106102064/
2. https://archive.nptel.ac.in/courses/106/106/106106131/
3. http://peterindia.net/Algorithms.html

Object Oriented Programming Through Java

(Common to AIML, CSE, CSE-DS & IT)

	L	T	P	C
Semester: III	**L**	**T**	**P**	**C**
Course Code: 231CS3T02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Create Well-Structured Java Programs Using Object-Oriented Programming Principles.
CO2:	Create and implement Java classes, objects, and methods.
CO3:	Analyze and utilize arrays and inheritance in Java programs.
CO4:	Integrate packages, libraries, and exception handling in Java applications.
CO5:	Design and construct advanced Java applications with strings, multithreading, JDBC, and Java FX.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
2	1	1	-	1	-	-	-	-	-	-	-	-
2	1	3	-	1	-	-	-	-	-	-	-	-
2	3	2	-	1	-	-	-	-	-	-	-	-
2	2	2	-	1	-	-	-	-	-	-	-	-
2	2	3	-	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	1	-
CO2:	1	-
CO3:	1	-

CO4:	2	**-**
CO5:	3	**-**

UNIT - I

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators : Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator, Basic Arithmetic Operators, Increment and Decrement Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if-else Expressions, Ternary Operator, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement**.**

UNIT - II

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static

UNIT - III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Twodimensional Arrays, Arrays of Varying Lengths, Three dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super ClassObject Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT - IV

Packages and Java Library:

Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto boxing and Autounboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

UNIT - V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multicore Processor, Thread Class, Main ThreadCreation of New Threads, Thread States, Thread PrioritySynchronization, Deadlock and Race Situations, Interthread Communication Suspending, Resuming, and Stopping of Threads.

Java Database Connectivity:Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface

Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, Debasis Samanta, Monalisa Sarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Web Links:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

Advanced Data Structures & Algorithm Analysis Lab

(Common to AIML, CSE & IT)

	L	T	P	C
Semester: III	**L**	**T**	**P**	**C**
Course Code: 231CS3L01	**0**	**0**	**3**	**1.5**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Apply the concepts of search trees, priority queues and graphs in software design.
CO2: Develop algorithms of Divide & Conquer and Greedy methods
CO3: Analyze algorithms of Dynamic Programming.
CO4: Design algorithms of Backtracking.
CO5: Analyze algorithms of Brach & Bound.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	-	2	-	-	-	1	2	-	1
CO2	2	1	3	-	2	-	-	-	1	2	-	1
CO3	2	2	2	2	3	-	-	-	1	2	-	1
CO4	1	2	3	-	2	-	-	-	1	2	-	1
CO5	2	2	2	2	2	-	-	-	1	2	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	2	-

List of Experiments:

Week - 1

Write a C Program to implement an AVL tree for a given set of elements which are stored in a file and perform insert and delete operations on the constructed tree. Write contents of tree into a new file using in-order.

Week - 2

Write a C Program to implement a B-Tree an order of 5 with a set of 100 random elements stored in array and perform searching and display operations

Week - 3

Write a C Program to construct Min and Max Heap using arrays, delete any element and display the content of the Heap.

Week - 4

Implement BFT and DFT for given graph using C language, when graph is represented by

a) Adjacency Matrix b) Adjacency Lists

Week - 5

Write a C program for finding the biconnected components in a given graph.

Week - 6

Implement Quick sort and Merge sort using C language and observe the execution time for various input sizes (Average, Worst and Best cases).

Week - 7

Compare the performance of Single Source Shortest Paths using Greedy method when the graph is represented by adjacency matrix and adjacency lists using C language.

Week - 8

Write a C program to implement Job Sequencing with deadlines using Greedy method.

Week - 9

Write a C program to solve 0/1 Knapsack problem Using Dynamic Programming.

Week - 10

Write a C program to implement N-Queens Problem using Backtracking strategy

Week - 11

Write a C program to implement 0/1 Knapsack problem using Backtracking strategy

Week - 12

Write a C program to implement Travelling Salesperson problem using Branch and Bound approach.

List of Augmented Experiments (Any of two):

13) Bheem promised all his friends that if he won the tournament so he will give ladoos. But he knew that he can afford only one ladoo per day. If he is unable to give ladoo to any of his friend he will loose his friendship with them (if more than one his friend demanded for ladoo on same day). As he has won the tournament now he has to give ladoos to his friends. Now your task is to tell how many friends he will be able to save. INPUT: The first line consists of number of friends of Bheem. The second line consists of an array A, which represents the which friend asked for ladoo on which day. Example: 5 3 3 1 2 4 OUTPUT:4

14) Suppose a student wants to go from home to school in the shortest possible way. She knows some roads are heavily congested and difficult to use, this means the edge has a large weight--the shortest path tree found by the algorithm will try to avoid edges with larger weights. Find the shortest path from home to school in the given graph.

15) Write a C program to count number of occurrences of a word in a given text

Reference Books:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta,Dinesh, 2ndEdition Universities Press.
2. Computer Algorithms in C++, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran,2nd Edition University Press, 2019.
3. Data Structures and program design in C, Robert Kruse, 2nd Edition Pearson Education Asia.
4. An introduction to Data Structures with applications, Trembley& Sorenson, McGrawHill

Web Links:

1. http://cse01-iiith.vlabs.ac.in/
2. http://peterindia.net/Algorithms.html

Object Oriented Programming through Java Lab

(Common to AIML, CSE, CSE-DS & IT)

	L	T	P	C
Semester: III				
Course Code: 231CS3L02	**0**	**0**	**3**	**1.5**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Apply class, inheritance, and interface for problem solving.
CO2: Develop error free programs using exception handling.
CO3: Develop a solution for ITC using multithreading.
CO4: Build applications using packages to group liked classes.
CO5: Apply event handling for interactive applications and Develop JDBC applications using MySQL.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	1	-	-	-	1	2	-	2
CO2	2	3	3	-	1	-	-	-	1	2	-	2
CO3	2	2	3	-	1	-	-	-	1	2	-	2
CO4	2	2	2	-	1	-	-	-	1	2	-	2
CO5	2	2	3	-	1	-	-	-	1	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	2	-

List of Experiments:

Week – 1

a) Write a JAVA program to display default value of all primitive data type of JAVA
b) Write a java program that display the roots of a quadratic equation $ax^2+bx=0$. Calculate the discriminate D and basing on value of D, describe the nature of root.

Week - 2

a) Write a JAVA program to search for an element in a given list of elements using binary search mechanism.
b) Write a JAVA program to sort for an element in a given list of elements using bubble sort
c) Write a JAVA program using String Buffer to delete, remove character.

Week - 3

a) Write a JAVA program to implement class mechanism. Create a class, methods and invoke them inside main method.
b) Write a JAVA program implement method overloading.
c) Write a JAVA program to implement constructor.
d) Write a JAVA program to implement constructor overloading.

Week - 4

a) Write a program to check if a given string is a pangram (contains every letter of the alphabet at least once).
b) Write a program to find the most frequently occurring character in a string.
c) Write a program to find all permutations of a given string.
d) Write a program to check if a given string is a anagram (Ex: CAT and ACT).

Week - 5

a) Write a JAVA program to implement Single Inheritance
b) Write a JAVA program to implement multi level Inheritance
c) Write a JAVA program for abstract class to find areas of different shapes

Week - 6

a) Write a JAVA program give example for "super" keyword.
b) Write a JAVA program to implement Interface. What kind of Inheritance can be achieved?
c) Write a JAVA program that implements Runtime polymorphism

Week - 7

a) Write a JAVA program that describes exception handling mechanism
b) Write a JAVA program Illustrating Multiple catch clauses
c) Write a JAVA program for creation of Java Built-in Exceptions
d) Write a JAVA program for creation of User Defined Exception

Week - 8

a) Write a JAVA program that creates threads by extending Thread class.First thread display "Good Morning "every 1 sec, the second thread displays "Hello "every 2 seconds and the third display "Welcome" every 3 seconds,(Repeat the same by implementing Runnable)
b) Write a program illustrating is Alive and join ()

Week - 9

a) Write a Program illustrating Daemon Threads.
b) Write a JAVA program Producer Consumer Problem

Week – 10

a) Write a JAVA program that import and use the user defined packages

Week - 11

b) Without writing any code, build a GUI that display text in label and image in an ImageView (use JavaFX)
c) Build a Tip Calculator app using several JavaFX components and learn how to respond to user interactions with the GUI

Week – 12

a) Write a java program that connects to a database using JDBC
b) Write a java program to connect to a database using JDBC and insert values into it.
c) Write a java program to connect to a database using JDBC

Augmented Experiments (Any of two)

13.Demonstrates how to validate user login credentials against the database.
14.Student management

15.Book management

References Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Web Links:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

Python Programming

(Common to AIML, CSE, CSE-DS & IT)

	L	T	P	C
Semester: III				
Course Code: 231CS3S01	**0**	**1**	**2**	**2**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Develop programs using Python fundamentals, including control statements

CO2: Design and implement Python programs using functions, strings, and lists

CO3: Develop programs using dictionaries, sets and tuples

CO4: Apply OOPs concepts and files for developing programs

CO5: Apply data science techniques using Python for data manipulation, analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	2	2	2	-	1	-	-	-	1	2	-	2
CO2:	2	3	3	-	1	-	-	-	1	2	-	2
CO3:	2	2	3	-	1	-	-	-	1	2	-	2
CO4:	2	2	2	-	1	-	-	-	1	2	-	2
CO5:	2	2	3	-	1	-	-	-	1	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	1	-
CO2:	1	-
CO3:	1	-
CO4:	1	-
CO5:	2	-

List of Experiments:

WEEK 1:

1. Write a program to find the largest element among three Numbers.

2. Write a Program to display all prime numbers within an interval

3. Write a program to swap two numbers without using a temporary variable.

WEEK 2:

1. Demonstrate the following Operators in Python with suitable examples.

i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators

2. Write a program to add and multiply complex numbers

WEEK 3:

3. Write a program to print multiplication table of a given number.

WEEK 4:

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.

WEEK 5:
1. Write a program to check if the substring is present in a given string or not.
2. Write a program to perform the given operations on a list:
i. addition ii. Insertion iii. slicing
3. Write a program to perform any 5 built-in functions by taking any list.

WEEK 6:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.

2. Write a program to count the number of vowels in a string (No control flow allowed).

3. Write a program to check if a given key exists in a dictionary or not.

WEEK7:

4. Write a program to add a new key-value pair to an existing dictionary.

5.Write a program to sum all the items in a given dictionary

WEEK8:

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.

2. Python program to print each line of a file in reverse order.

3. Python program to compute the number of characters, words and lines in a file.

WEEK9:

1. Write a program to create, display, append, insert and reverse the order of the items in the array.

2. Write a program to add, transpose and multiply two matrices.

3. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

WEEK 10:

1. Python program to check whether a JSON string contains complex object or not.

2. Python Program to demonstrate NumPy arrays creation using array () function.

3. Python program to demonstrate use of ndim, shape, size, dtype.

WEEK 11:

1. Python program to demonstrate basic slicing, integer and Boolean indexing.

2. Python program to find min, max, sum, cumulative sum of array

3. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:

a) Apply head () function to the pandas data frame

b) Perform various data selection operations on Data Frame

Augmented Experiments(Any of Two)

12) Write a program to find the greatest number that can be formed by using given set of numbers.

13) Write a program to find sum of digits of a number until you get single digit sum.

14) Write a program to count how many times each word present in a file.

Text Books:

1. Python for Everybody Exploring Data in Python 3, Charles Russell Severance, SueBlumenberg.
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Reference Books:

1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2ndEdition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson

Web Links:

1. https://www.coursera.org/learn/pythonforapplieddatascienceai
2. https://ocw.mit.edu/courses/6-189-a-gentle-introduction-to-programming-using-python-january-iap-2011/
3. https://www.coursera.org/learn/python?specialization=python#syllabus

Essence of Indian Traditional Knowledge
(Common to All branches)

	L	T	P	C
Semester: III	**L**	**T**	**P**	**C**
Course Code: 231MC3T01	**2**	**0**	**0**	**0**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Identify the concept of Traditional knowledge and its importance.
CO2: Explain the need and importance of protecting traditional knowledge.
CO3: Illustrate the various enactments related to the protection of traditional knowledge
CO4: Interpret the concepts of Intellectual property to protect the traditional knowledge.
CO5: Explain the importance of Traditional knowledge in Agriculture and Medicine.
CO6: Explain the Importance of conservation and sustainable development of environment.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	3	1	1	-	-	-	-
CO2	-	-	-	-	-	3	1	1	-	-	-	-
CO3	-	-	-	-	-	3	1	1	-	-	-	-
CO4	-	-	-	-	-	3	1	1	-	-	-	-
CO5	-	-	-	-	-	3	1	1	-	-	-	-
CO6	-	-	-	-	-	3	1	1	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit - I

Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge.

Unit - II

Protection of traditional knowledge: The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

Unit - III

Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.

Unit - IV

Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.

Unit - V

Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

Text Books:

1. Traditional Knowledge System in India, by Amit Jha.

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers.
2. Knowledge Traditions and Practices of India

Web Links:

1. https://www.youtube.com/watch?v=LZP1StpYEPM
2. http://nptel.ac.in/courses/121106003/

COGNITIVE ENGLISH FOR ENGINEERS - I

(Common to CSE, IT, AIML & CSE (DS))

	L	T	P	C
Semester: III	**L**	**T**	**P**	**C**
Course Code: 231MC3T02	**0**	**0**	**2**	**0**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2:	Apply communication skills through various language learning activities
CO3:	Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
CO4:	Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5:	Develop the capacity to use various writing forms to achieve their professional needs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

List of Topics:

Talent – Discuss ability and achievement, Sports activities and issues, suggestions, write a description of data

Life Lessons – Discuss events that changed your life, describe rules, photos, write an email to apply for work.

Chance – Discuss possible future events, Prepare for a job interview, write an argument for and against an idea.

Around the Globe – Discuss choices, Changes, Introduce request and say you are grateful, Write a travel blog.

Suggested Software:

- Cambridge Empower
- Young India Films
- Walden Infotech

Text Books:

1. Cambridge Empower – Second Edition B2 Level

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford University Press.
2. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India.
3. Hewing's, Martin. Cambridge Academic English (B2). CUP.
4. J. Sethi & P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed), Kindle.

Web Links:

Spoken English:

1. www.cambridgeone.org
2. www.englishinteractive.net
3. https://www.britishcouncil.in/english/online
4. http://www.letstalkpodcast.com/
5. https://www.youtube.com/c/EnglishClass101/featured

Voice & Accent:

1. www.cambridgeone.org
2. https://www.youtube.com/user/letstalkaccent/videos
3. https://www.youtube.com/c/EngLanguageClub/featured
4. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc

Managerial Economics And Financial Analysis

Semester: IV	**L**	**T**	**P**	**C**
Course Code: 231HS4T01	**2**	**0**	**0**	**2**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the Managerial Economic concepts and Illustrate the law of demand forecasting methods..

CO2: Identify the production , cost behavior for managerial decision making and Break Even Point (BEP) of an enterprise.

CO3: Differentiate types of market structures, business organizations along with basic knowledge on business cycle.

CO4: Utilize various techniques on investment project proposals with the help of capital budgeting techniques for decision making.

CO5: Make use of the process & principles of accounting for the preparation of basic accounts.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	1	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	-	-	-	-	-	-	1	1	-	-
CO5	1	-	-	-	-	-	-	-	3	1	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-

CO4	-	-
CO5	-	-

Unit - I

Managerial Economics:

Introduction - Nature, meaning, significance, functions, and advantages. Demand-Concept, Function, Law of Demand - Demand Elasticity- Types - Measurement. Demand Forecasting- Factors governing Forecasting, Methods. Managerial Economics and Financial Accounting and Management

Unit - II

Production and Cost Analysis:

Introduction Nature, meaning, significance, functions and advantages. Production Function- Least-cost combination- Short run and long run Production Function- Isoquants and Is costs, Cost & Break-Even Analysis - Cost concepts and Cost behaviour- Break-Even Analysis (BEA) - Determination of Break-Even Point (Simple Problems).

Unit - III

Business Organizations and Markets:

Introduction - Forms of Business Organizations- Sole Proprietary Partnership - Joint Stock Companies - Public Sector Enterprises. Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly- Monopolistic Competition-Oligopoly-Price-Output Determination - Pricing Methods and Strategies

Unit - IV

Capital Budgeting:

Introduction Nature, meaning, significance. Types of Working Capital, Components, Sources of Short-term and Long-term Capital, Estimating Working capital requirements. Capital Budgeting- Features, Proposals, Methods and Evaluation. Projects - Pay Back Method, Accounting Rate of (IRR) Method (sample problems) Return (ARR) Net Present Value (NPV) Internal Rate Return

Unit ‑ V

Financial Accounting and Analysis:

Introduction-Concepts and Conventions- Double-Entry Bookkeeping, Journal, Ledger, Trial Balance- Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments). Introduction to Financial Analysis - Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability

Text Books:

1. Dr. A. R. Aryasri ‑ Managerial Economics and Financial Analysis, TMH 2011
2. Dr. N. Appa Rao, Dr. P. Vijay Kumar: ‘Managerial Economics and Financial Analysis’, Cengage Publications, New Delhi.

Reference Books:

1. V. Maheswari : Managerial Economics, Sultan Chand
2. Suma Damodaran : Managerial Economics, Oxford.

Web Links:

1. https://www.coursera.org/specializations/accounting-fundamentals
2. https://archive.nptel.ac.in/courses/110/101/110101149/

Probability and statistics

(Common to CSE, IT, AIML &DS)

	L	T	P	C
Semester: IV	**L**	**T**	**P**	**C**
Course Code: 231BS4T02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1:	Compute mean, median, mode, standard deviation and variance.
CO 2:	Apply various Probability distributions for both discrete and continuous random variables.
CO 3:	Compute mean and variance of sample means with replacement and without replacement and estimating maximum errors.
CO 4:	Compute mean and variance of sampling distributions and estimating maximum errors.
CO 5:	Apply the concepts of correlation and regression to the given statistical data.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT I

Descriptive statistics and methods for data science:

Data science – Statistics Introduction – Population vsSample – Collection of data – primary and secondary data – Type of variable: dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency – Measures of Variability (spread or variance) – Skewness– Kurtosis

UNIT- II

Probability and Distributions:

Probability – Conditional probability and Baye's theorem – Random variables – Discrete and Continuous random variables – Distribution function – Probability mass function, Probability density function and Cumulative distribution functions–Mathematical Expectation and Variance – Binomial, Poisson, Uniform and Normal distributions.

UNIT III

Sampling Theory:

Introduction – Population and samples – Sampling distribution of Means and Variance – Point and Interval estimations – Maximum error of estimate– Central limit theorem (without proof)-

UNIT IV

Tests of Hypothesis:

Introduction – Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – Test of significance for large samples and small samples: Single and difference means – Single and two proportions –F-test, $\square^2$ -test.

UNIT-V

Correlation and Regression:

Correlation – Correlation coefficient – Rank correlation. Linear Regression: Straight line – Multiple Linear Regression - Regression coefficients and properties – Curvilinear Regression: Parabola – Exponential – Power curves.

Text Books:

1. Probability and Statistics for Engineers,Miller and Freund's, 7/e, Pearson,
2. Fundamentals of Mathematical Statistics, S. C. Gupta and V.K. Kapoor. 11/e,Sultan Chand & Sons Publications.
3. Probability, Statistics and Random Processes, Murugesan, Anuradha Publishers, Chennai

Reference Books:

1. Probability, Statistics and Random processes, T.B.Veerarajan, TMH.
2. Probability and statistics by T.K.V.Iyengar, S.Chand publishers.

3. Higher engineering mathematics by John Bird, 5th edition Elsevier Limited.

4. Sheldon M. Ross, Introduction to probability and statistics Engineers and the Scientists, 4th Edition, Academic Foundation.

Web Links:

1. https://archive.nptel.ac.in/content/syllabus_pdf/111105041.pdf
2. http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html
3. https://www.math.net/probability-and-statistics
4. http://nptel.ac.in/courses/111105041/1
5. https://www.khanacademy.org/math/statistics-probability

Operating Systems

(Common to CSE & IT)

	L	T	P	C
Semester: IV				
Course Code: 231CS4T01	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Describe various concepts of operating systems and system calls.
CO2:	Describe the concept of program, process and thread and analyze various CPUScheduling Algorithms and compare their performance.
CO3:	Solve Inter Process Communication problems by various methods.
CO4:	Compare various Memory Management Schemes especially paging and Segmentation in Operating System and apply various Page Replacement Techniques.
CO5:	Outline File Systems in Operating System like UNIX/Linux and Windows.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	2	-	-	-	-	-	-	-	-	-	-	-
CO2:	1	3	-	-	-	-	-	-	-	-	-	-
CO3:	1	2	-	-	-	-	-	-	-	-	-	-
CO4:	1	3	-	-	-	-	-	-	-	-	-	-
CO5:	2	2	-	-	-	-	-	-	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	1	-
CO2:	2	-
CO3:	1	-

CO4:	2	**-**
CO5:	1	**-**

UNIT - I

Operating Systems Overview: Operating system functions, Operating system structure, Operating systems operations, Computing environments, OpenSource Operating Systems.
System Structures: Operating System Services, User and OperatingSystem Interface, systems calls, Types of System Calls, system programs, operating system structure, operating system debugging, System Boot.

UNIT - II

Process Concept: Process scheduling, Operations on processes, Interprocess communication, Communication in client server systems.

Multithreaded Programming: Multithreading models, Thread libraries, Threading issues.

Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling.

Interprocess Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Barriers, Classical IPC Problems Dining philosophers problem, Readers and writers problem.

UNIT - III

MemoryManagement Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

Virtual Memory Management: Introduction, Demand paging, Copy onwrite, Page

replacement, Frame allocation, Thrashing, Memorymapped files, Kernel memory allocation

UNIT - IV

Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock

detection and recovery, Deadlock avoidance, Deadlock prevention.

File Systems: Files, Directories, File system implementation, management and optimization.

SecondaryStorage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation

UNIT - V

System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.

System Security: Introduction, Program threats, System and network threats, Cryptography

for security, User authentication, Implementing security defenses, Firewalling to protect systems and networks, Computer security classification.

Text Books:

1. Silberschatz A, Galvin P B, and Gagne G, Operating System Concepts, 9th edition, Wiley.
2. Tanenbaum A S, Modern Operating Systems, 3rd edition, Pearson Education. (for Interprocess Communication and File systems.)

Reference Books:

1. Dhamdhere D M, Operating Systems A Concept Based Approach, 3rd edition, Tata McGrawHill.
2. Stallings W, Operating Systems Internals and Design Principles, 6th edition, Pearson Education.
3. Nutt G, Operating Systems, 3rd edition, Pearson Education.

Web Links:

1. https://nptel.ac.in/courses/106/105/106105214/

Database Management Systems

(Common to CSE, IT, AIML &DS)

	L	T	P	C
Semester: IV				
Course Code: 231CS4T02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Summarize the database characteristics and architectures
CO2:	Design Entity - relationship diagrams for given scenarios
CO3:	Implement relational database using SQL.
CO4:	Apply normalization techniques for efficient database design.
CO5:	Analyze the mechanisms of transaction management, storage management and indexing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	2	1	-	-	-	-	-	-	-	-	-	-
CO2:	2	2	2	-	-	-	-	-	-	-	-	1
CO3:	2	2	1	1	1	-	-	-	-	-	-	1
CO4:	2	2	3	-	-	-	-	-	-	-	-	1
CO5:	2	2	-	1	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	1	-

CO2:	2	-
CO3:	3	-
CO4:	2	-
CO5:	2	-

UNIT - I

Introduction: Database system, Characteristics (Database Vs File System), Database Users, Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture

for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

UNIT - II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance, Relational Algebra, Relational Calculus. BASIC SQL:Simple Database schema,

data types, table definitions (create, alter), different DML operations (insert, delete, update).

UNIT - III

SQL: Basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and nonupdatable), relational set operations

UNIT - IV

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependencyLossless join and dependency preserving decomposition, (1NF, 2NF and 3 NF), concept of surrogate key, BoyceCodd normal form(BCNF), MVD, Fourth normal form(4NF), Fifth Normal Form (5NF).

UNIT - V

Transaction Concept: Transaction State, ACID properties, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, lock based, time stamp based, optimistic, concurrency protocols, Deadlocks, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Introduction to Indexing Techniques: B+ Trees, operations on B+Trees, Hash Based Indexin

Text Books:

1: Database Management Systems, 3rd edition, Raghurama Krishnan, Johannes Gehrke, TMH (For Chapters 2, 3, 4)
2: Database System Concepts,5th edition, Silberschatz, Korth, Sudarsan,TMH (For Chapter 1 and Chapter 5)

Reference Books:

1. Introduction to Database Systems, 8thedition, C J Date, Pearson.
2. Database Management System, 6th edition, RamezElmasri, Shamkant B. Navathe, Pearson
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Web Links:

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview

Software Engineering

(Common to CSE, IT)

	L	T	P	C
Semester: IV				
Course Code: 231CS4T03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Explain the evolution of software development and analyse life cycle models like Waterfall, RAD, Agile, and Spiral.
CO2:	Apply estimation techniques and risk management for effective project management and develop SRS.
CO3:	Design software using good design principles, structured analysis, and user interface methodologies.
CO4:	Conduct blackbox, whitebox, and integration testing to ensure software reliability and quality.
CO5:	Use CASE tools for software maintenance, reverse engineering, cost estimation, and reuse strategies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1:	3	2	-	-	-	-	-	-	-	-	-	1
CO2:	2	1	3	2		-	-	-	-	-	2	
CO3:	2	2	3		3	-	-	-	-	-	-	-
CO4:	2	2	-	3	2	1	-	-	-	-	-	-
CO5:	2	2	-	-	3	-	-	-	1	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	-	2

CO2:	-	1
CO3:	-	2
CO4:	-	1
CO5:	-	2

UNIT - I

Introduction: Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.

Software Life Cycle Models: Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model, Spiral model.

Requirements Analysis And Specification: Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

UNIT - III

Software Design: Overview of the design process, How to characterize a good software design? Layered arrangement of modules, Cohesion and Coupling.approaches to software design.

Agility: Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, Tool Set for the Agile Process (Text Book 2)

FunctionOriented Software Design: Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review.

User Interface Design: Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of componentbased GUI development, and user interface design methodology.

UNIT - IV

Coding And Testing: Coding, Code review, Software documentation, Testing, Blackbox testing, WhiteBox testing, Debugging, Program analysis tools, Integration testing, Testing objectoriented programs, Smoke testing, and Some general issues associated with testing.

Software Reliability And Quality Management: Software reliability. Statistical testing, Software quality, Software quality management system, ISO 9000.SEI Capability maturity model. Few other important quality standards, and Six Sigma.

UNIT - V

ComputerAided Software Engineering (Case): CASE and its scope, CASE environment, CASE support in the software life cycle, other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

Software Maintenance: Characteristics of software maintenance, Software reverse engineering, and Software maintenance process models and Estimation of maintenance cost.

Software Reuse: reuse definition, introduction, reason behind no reuse so far, Basic issues in any reuse program, A reuse approach, and Reuse at organization level.

Text Books:

1. Fundamentals of Software Engineering, Rajib Mall, 5th Edition, PHI.
2. Software Engineering A practitioner's Approach, Roger S. Pressman, 9th Edition, Mc Graw Hill International Edition

Reference Books:

1. Software Engineering, Ian Sommerville,10th Edition, Pearson.
2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

Web Links:

1. https://nptel.ac.in/courses/106/105/106105182/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01260589506387148827_shared/overview
3. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview

Operating Systems Lab

(Common to CSE & IT)

Semester: IV	**L**	**T**	**P**	**C**
Course Code: 231CS4L01	**0**	**0**	**3**	**1.5**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Illustrate various process scheduling algorithms.
CO2: Experiment with various system calls and deadlock algorithm.
CO3: Develop algorithms for memory management.
CO4: Explain Page replacement algorithms and file allocation strategies.
CO5: Make use of Pthread library for thread concurrent execution.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	1	-	-	-	-	-	-	-
CO2	2	1	-	1	2	-	-	-	-	-	-	-
CO3	2	1	1	-	1	-	-	-	-	-	-	-
CO4	2	2	-	-	1	-	-	-	-	-	-	-
CO5	2	1	2	-	1	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

List of Experiments:

WEEK 1:

Write C programs to simulate the following CPU Scheduling algorithms

a)FCFS b) SJF

WEEK 2:

Write C programs to simulate the following CPU Scheduling algorithms

a)Round Robin b) Priority.

WEEK 3:

Write programs using the I/O system calls of UNIX/LINUX operating system (open, read, write, close, fcntl, seek, stat, opendir, readdir).

WEEK 4:

Write a C program to simulate Bankers Algorithm for Deadlock Avoidance and Prevention.

WEEK 5:

Write a C program to implement the Producer – Consumer problem using semaphores using UNIX/LINUX system calls.

WEEK 6:

Write a C program to implement the Read-Writers problem using semaphores using UNIX/LINUX system calls.

WEEK 7:

Write C programs to illustrate the following IPC mechanisms a) Pipes b) FIFOs c) Message Queues d) Shared Memory

WEEK 8:

Write C programs to simulate the following memory management techniques a) Paging b) Segmentation

WEEK 9:

Write C programs to simulate Page replacement policies a) FCFS b) LRU c) Optimal

WEEK 10:

Write C programs to illustrate two process communication using shared memory

WEEK 11:

Write C program to create a thread using pthreads library and let it run its function.

WEEK 12:

Write a C program to illustrate concurrent execution of threads using pthreads library

Augmented Experiments(Any of two):

13.Simulate Bankers Algorithm for Dead Lock Prevention.
14.Simulate Best-Fit contiguous memory allocation technique.
15.Simulate FCFS Disk Scheduling algorithm.
16.Write a C program to simulate producer and consumer problem using semaphores

TEXT BOOKS:

1. Operating System Principles- Abraham Silberchatz, Peter B. Galvin, Greg Gagne 7th Edition, John Wiley

2. Advanced programming in the Unix environment, W.R.Stevens, Pearson education.

REFERENCE BOOKS:

1. Operating Systems – Internals and Design Principles, William Stallings, Fifth Edition–Pearson Education/PHI

2. Operating System - A Design Approach-Crowley, TMH.

3. Modern Operating Systems, Andrew S Tanenbaum, 2nd edition, Pearson/PHI

4. UNIX Programming Environment, Kernighan and Pike, PHI/Pearson Education

5. UNIX Internals: The New Frontiers, U. Vahalia, Pearson Education

WEB LINKS:

1. http://nptel.ac.in/downloads/106108101/
2. https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems
3. https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923

Database Management Systems Lab

(Common to CSE, IT, AIML &DS)

Semester: IV	**L**	**T**	**P**	**C**
Course Code: 231CS4L02	**0**	**0**	**3**	**1.5**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Construct a database schema for a given problemdomain.

CO2: Apply database language commands to create simple database.

CO3: Apply integrity constraints on a database using RDBMS

CO4: Analyze the database using queries to retrieve records

CO5: Develop PL/SQL stored procedures, stored functions, cursors and packages.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1:	2	1	1	1	1	-	-	-	1	2	-	-
CO2:	2	1	1	1	1	-	-	-	1	2	-	-
CO3:	2	2	1	1	3	-	-	-	1	2	-	-
CO4:	2	2	1	1	3	-	-	-	1	2	-	-
CO5:	2	2	1	1	3	-	-	-	1	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1:	1	-
CO2:	1	-
CO3:	1	-

CO4:	2	-
CO5:	2	-

List of Experiments:

WEEK 1:

Creation, altering and droping of tables and inserting rows into a table (use constraints while creating tables) examples using SELECT command

WEEK 2:

Queries (along with sub Queries) using ANY, ALL, IN, EXISTS, NOTEXISTS, UNION, INTERSET, Constraints. Example: Select the roll number and name of the student who secured fourth rank in the class.

WEEK 3:

Queries using Aggregate functions (COUNT, SUM, AVG, MAX and MIN), GROUP BY, HAVING and Creation and dropping of Views.

WEEK 4:

Queries using Conversion functions (to_char, to_number and to_date), string functions (Concatenation, lpad, rpad, ltrim, rtrim, lower, upper, initcap, length, substr and instr), date functions (Sysdate, next_day, add_months, last_day, months_between, leas

WEEK 5:

i. Create a simple PL/SQL program which includes declaration section, executable section and exception –Handling section (Ex. Student marks can be selected from the table and printed for those who secured first class and an exception can be raised if no records were found)

ii. Insert data into student table and use COMMIT, ROLLBACK and SAVEPOINT in PL/SQL block.

WEEK 6:

Develop a program that includes the features NESTED IF, CASE and CASE expression. The program can be extended using the NULLIF and COALESCE functions.

WEEK 7:

Program development using WHILE LOOPS, numeric FOR LOOPS, nested loops using ERROR Handling, BUILT –IN Exceptions, USE defined Exceptions, RAISEAPPLICATION ERROR.

WEEK 8:

Programs development using creation of procedures, passing parameters IN and OUT of PROCEDURES.

WEEK 9:

Program development using creation of stored functions, invoke functions in SQL Statements and write complex functions

WEEK 10:

Develop programs using features parameters in a CURSOR, FOR UPDATE CURSOR, WHERE CURRENT of clause and CURSOR variables.

WEEK 11:

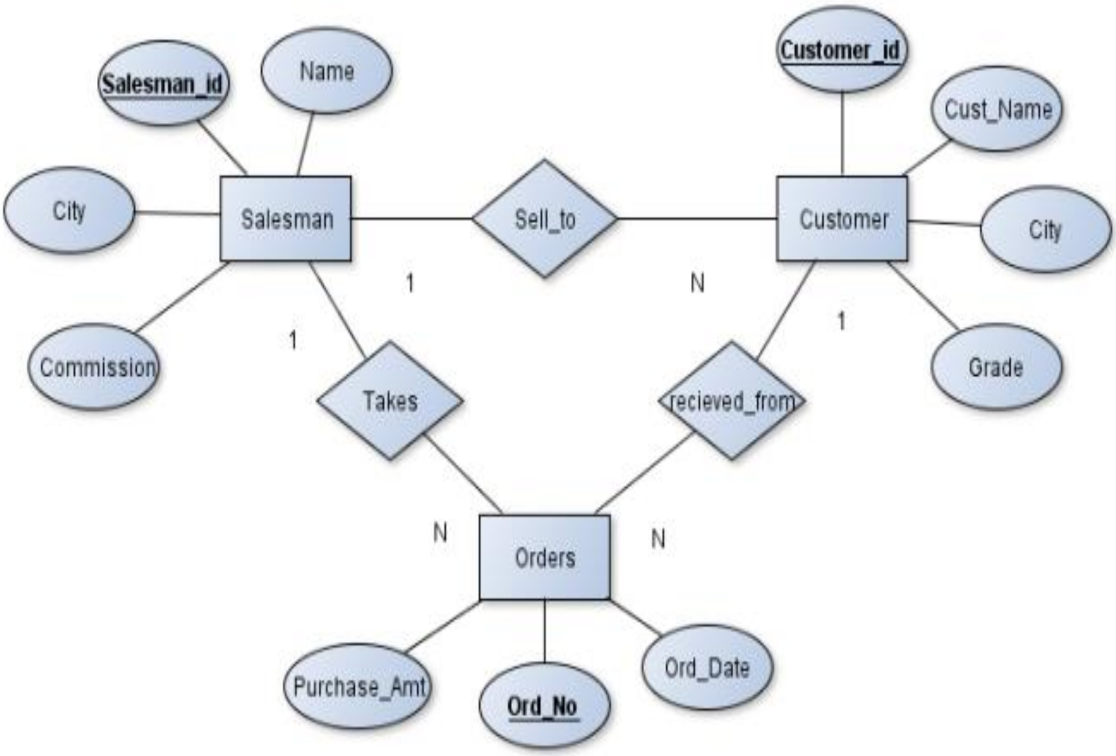
Develop Programs using BEFORE and AFTER Triggers, Row and Statement Triggers and INSTEAD OF Triggers

WEEK 12:

Create a table and perform the search operation on table using indexing and nonindexing Techniques

List of Augmented Experiments(Any of Two)

13) For a Sales Order Database System, based on the given E-R diagram.



a)Design a schema by applying functional dependencies.
b)Apply constraints and verify them.

14) Based on the following schema for a Library Database:
BOOK (Book_id, Title, Publisher_Name, Pub_Year)
BOOK_AUTHORS (Book_id, Author_Name) PUBLISHER (Name, Address, Phone)
BOOK_COPIES (Book_id, Branch_id, No-of_Copies)
BOOK_LENDING (Book_id, Branch_id, Card_No, Date_Out, Due_Date)
LIBRARY_BRANCH (Branch_id, Branch_Name, Address)

a. Draw the E-R diagram and show the necessary multiplicity and associations among them.
b. Draw the Schema diagram and show the necessary associations among them.

15) For a Faculty Database
EMPLOYEE (EMPID, FName, LName,Address, Sex, Salary,DeptNo)
DEPARTMENT (DeptNo, DName, HOD_EMPID)
PROJECT (ProjNo, PName, DeptNo)
WORKS_ON (EMPID, ProjNo, Hours)

EMPLOYEE DATA

EMPID	FName	LName	Address	Sex	Salary	DeptNo
1201	Adarsh	Kumar	Kakinada	F	150000	1
1240	Mahi	John	Rajahmundry	F	95000	1
1245	Ramu	Murty	Rajahmundry	M	90000	2
1234	Aditya	Surya	Bangalore	M	80000	1
1247	Jack	Paul	Bangalore	M	75000	2
1235	Pradeep	Chitra	Rajahmundry	M	78000	1
1211	Srinivas	Kumar	Hyderabad	M	59000	1
1492	Gopala	Rao	Kakinada	M	65000	2
1250	Eswari	Nirupama	Kakinada	F	65000	2

DEPARTMENT DATA

DeptNo	DName	HOD_EMPID
1	CSE	1240
2	IT	1245

WORKS_ON DATA

EMPID	ProjNo	Hours
1245	104	16
1240	101	22
1201	100	31
1250	102	25
1492	103	25
1235	105	29

PROJECT DATA

ProjNo	PName	DeptNo
100	IoT	1
101	CLOUD	1
102	BIGDATA	2
103	NETWORKS	2
104	IoT	2
105	NETWORKS	1

Text Books/Suggested Reading:

1.Oracle: The Complete Reference by Oracle Press
2. Nilesh Shah, "Database Systems Using Oracle”, PHI.
3. Rick F Vander Lans, “Introduction to SQL”, Fourth Edition, Pearson Education.

Reference Books:

1. SQL, PL/SQL The programming language of ORACLE, Ivan Bayross, Fourth edition, BPB Publication.
2. SQL/PLSQL for ORACLE 9i, P.S.Deshpande, Dreamtech Press..
3.Teach yourself PL/SQL in 21 days, Tom Luers, Timothy Atwood and Jonatham Gennick, First Edition, Techmedia.

Web Links:

1. http://nptel.ac.in/courses/106106093/6
2. http://www.tutorialspoint.com/plsql/
3. https://www.plsql.co/
4. https://www.w3schools.com/sql/
5. http://www.oracle.com/technetwork/database/features/plsql/index.html

Full Stack Development - 1
(Common to AIML & CSE)

Semester: IV
Course Code:201CS4S01

L	T	P	C
0	1	2	2

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Make use of HTML tags, elements and their attributes for designing static web pages
CO2: Apply form elements for developing Registration and Login web pages.
CO3: Build a web page by applying appropriate CSS styles to HTML elements.
CO4: Develop a real time web site using the core concepts of HTML5 and JavaScript concepts.
CO5: Develop a real time web site using the core concepts of HTML5 and advanced JavaScript along with media.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	2	-	-	-	-	-	-	2
CO2	2	2	2	-	2	-	-	-	-	-	-	2
CO3	2	3	3	-	3	-	-	-	-	-	-	3
CO4	2	3	3	-	3	-	-	-	-	-	-	2
CO5	2	3	3	-	3	-	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

List of Experiments:

WEEK 1:

Lists, Links and Images :

a. Write a HTML program, to explain the working of lists.
Note: It should have an ordered list, unordered list, nested lists and ordered list in an unordered list and definition lists.

b. Write a HTML program, to explain the working of hyperlinks using <a> tag and href, target Attributes.

c. Create a HTML document that has your image and your friend’ s image with a specific height and width. Also when clicked on the images it should navigate to their respective profiles.

d. Write a HTML program, in such a way that, rather than placing large images on a page, the preferred technique is to use thumbnails by setting the height and width parameters to something like to 100*100 pixels. Each thumbnail image is also a link to a full sized version of the image. Create an image gallery using this technique

WEEK 2:

HTML Tables, Forms and Frames :

a.Write a HTML program, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)

b. Write a HTML program, to explain the working of tables by preparing a timetable. (Note: Use <caption> tag to set the caption to the table & also use cell spacing, cell padding, border, rowspan, colspan etc.).

c. Write a HTML program, to explain the working of forms by designing Registration form. (Note: Include text field, password field, number field, date of birth field, checkboxes, radio buttons, list boxes using <select>&<option> tags, <text area> and two buttons ie: submit and reset. Use tables to provide a better view).

WEEK 3:

HTML 5 :

a. Write a HTML program, to explain the working of frames, such that page is to be divided into 3 parts on either direction. (Note: first frame image, second frame paragraph, third frame hyperlink. And also make sure of using "no frame" attribute such that frames to be fixed).

b. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, <span> tags.

c. Write a HTML program, to embed audio and video into HTML web page.

WEEK 4:

Cascading Style Sheets, Types of CSS and Selector forms :

a. Write a program to apply different types (or levels of styles or style specification formats) - inline, internal, external styles to HTML elements. (identify selector, property and value).

b. Write a program to apply different types of selector forms

i. Simple selector (element, id, class, group, universal)

ii. Combinator selector (descendant, child, adjacent sibling, general sibling)

iii. Pseudo-class selector

iv. Pseudo-element selector

v. Attribute selector

c. Selector forms

i. Write a program to apply different types of selector forms

ii. Simple selector (element, id, class, group, universal)

iii. Combinator selector (descendant, child, adjacent sibling, general sibling)

iv. Pseudo-class selector

v. Pseudo-element selector

vi Attribute selector

d. Write a program to apply different types of selector forms

i. Simple selector (element, id, class, group, universal)

ii. Combinator selector (descendant, child, adjacent sibling, general sibling)

iii. Pseudo-class selector

iv. Pseudo-element selector

v. Attribute selector

WEEK 5:

CSS with Color, Background, Font, Text and CSS Box Model :

a. Write a program to demonstrate the various ways you can reference a color in CSS.

b. Write a CSS rule that places a background image halfway down the page, tilting it horizontally. The image should remain in place when the user scrolls up or down.

c. Write a program using the following terms related to CSS font and text:
i. font-size ii. font-weight iii. font-style
iv. text-decoration v. text-transformation vi. text-alignment

d. Write a program, to explain the importance of CSS Box model using
i. Content ii. Border iii. Margin iv. Padding

WEEK 6:

Applying JavaScript - internal and external, I/O, Type Conversion :

a. Write a program to embed internal and external JavaScript in a web page.

b. Write a program to explain the different ways for displaying output.

WEEK 7:

a. Write a program to explain the different ways for taking input.

b. Create a webpage which uses prompt dialogue box to ask a voter for his name and age.Display the information in table format along with either the voter can vote or not

JavaScript Pre-defined and User-defined Objects :

a. Write a program using document object properties and methods.

b. Write a program using window object properties and methods.

c. Write a program using array object properties and methods.

WEEK 8:

JavaScript Pre-defined and User-defined Objects :

d. Write a program using math object properties and methods.

e. Write a program using string object properties and methods.

f. Write a program using regex object properties and methods.

g. Write a program using date object properties and methods.

h. Write a program to explain user-defined object by using properties, methods, accessors, constructors and display.

WEEK 9:

JavaScript Conditional Statements and Loops :

a. Write a program which asks the user to enter three integers, obtains the numbers from the user and outputs HTML text that displays the larger number followed by the words “LARGER NUMBER” in an information message dialog. If the numbers are equal, output HTML text as “EQUAL NUMBERS”.

b. Write a program to display week days using switch case.

c. Write a program to print 1 to 10 numbers using for, while and do-while loops.

WEEK 10:

JavaScript Conditional Statements and Loops :

d. Write aprogram to print data in object using for-in, for-each and for-of loops

e. Develop a program to determine whether a given number is an ‘ARMSTRONG NUMBER’ or not. [Eg: 153 is an Armstrong number, since sum of the cube of the digits is equal to the number i.e.,13 + 53+ 33 = 153]

f. Write a program to display the denomination of the amount deposited in the bank in terms of 100’s, 50’s, 20’s, 10’s, 5’s, 2’s & 1’s. (Eg: If deposited amount is Rs.163, the output should be 1-100’s, 1-50’s, 1- 10’s, 1-2’s & 1-1’s)

WEEK 11:

Javascript Functions and Events

a. Design a appropriate function should be called to display

b. Factorial of that number

c. Fibonacci series up to that number

d. Prime numbers up to that number

e. Is it palindrome or not

WEEK 12:

a. Design a HTML having a text box and four buttons named Factorial, Fibonacci, Prime, and Palindrome. When a button is pressed an appropriate function should be called to display

1. Factorial of that number
2. Fibonacci series up to that number
3. Prime numbers up to that number
4. Is it palindrome or not

b. Write a program to validate the following fields in a registration page

- i. Name (start with alphabet and followed by alphanumeric and the length should not be less than 6 characters)
- ii. Mobile (only numbers and length 10 digits)
- iii. E-mail (should contain format like xxxxxxx@xxxxxx.xxx)

List of Augmented Experiments: **(Any of two)**

13. Design a web page with all the features of HTML elements.

14. Design a web page with new features of HTML5.

15. Design a web page with all the features of HTML elements and apply CSS styles.

16. Design a web page with new features of HTML5 and CSS3.

Text Books:

1 Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson.

2 Web Programming with HTML5, CSS and JavaScript, John Dean, Jones & Bartlett Learning, 2019 (Chapters 1-11).

3 Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O’ Reilly.

Web Links:

1 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0135015558437027848287/overview

2 https://www.w3schools.com/css

3 https://www.w3schools.com/js/

4 https://www.w3schools.com/nodejs

5 https://www.w3schools.com/html

6 https://www.w3schools.com/typescript

Design Thinking & Innovation
(Common all Branches)

Semester: IV	**L**	**T**	**P**	**C**
Course Code: 231ES4T04	**1**	**0**	**2**	**2**

Course Outcomes: At the end of the course, student will be able to:

CO1: Appreciate various design process procedure

CO2: Generate and develop design ideas through different technique

CO3: Identify the significance of reverse Engineering to understand products

CO4: Draw technical drawing for design ideas

CO5: Illustrate design teams to create feasible and user-focused solutions to complex problems in design.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	-	-	2	2	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	1	1	2	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

UNIT – I

Process of Design Understanding Design thinking: Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping.

UNIT – II

Tools for Design Thinking: Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

UNIT – III

Design Thinking in IT: Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenario based Prototyping

UNIT – IV

DT For strategic innovations: Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design.

UNIT – V

Design thinking workshop: Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test.

Text Books:

1. Engineering Design, John.R.Karsnitz, Stephen O’ Brien and John P. Hutchinson, Cengage learning (International edition) 2nd Edition, ISBN 9788131530740
2. The Design of Business: Why Design Thinking is the Next Competitive Advantage, Roger Martin, Harvard Business Press, ISBN 9781422177808

Reference Books:

1. Engineering Design Process, Yousef Haik and Tamer M.Shahin, Cengage Learning, 2nd Edition, ISBN 9788131529041
2. Solving Problems with Design Thinking - Ten Stories of What Works, Jeanne Liedtka, Andrew King & Kevin Bennett (Columbia Business School Publishing) Hardcover, ISBN 978-0231163569

Web Links:

1. www.tutor2u.net/business/presentations/. /Product lifecycle/default.html
2. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf

Note: The performance of the student is evaluated through Continuous Internal Evaluation (CIE) and Semester End Examinations (SEE) with a maximum of 100 marks.

Evaluation procedure:

Project-Based Assessment (PBA): CIE (30 Marks): Continuous assessment of a design thinking project throughout the semester can be done by each stage of Design Thinking (5 Stages)

- Empathize stage: 5 Marks
- Define & Problem Identification: 5 Marks
- Ideate stage: 5 Marks
- Prototype Development:10 marks
- Testing & Feedback:5 Marks

Final Project Demo : SEE (70 Marks): Team of students present their final demo and solution to a panel, followed by Q&A.
Presentation of idea and solution through: 50 Marks
Viva Voce: 20 Marks

COGNITIVE ENGLISH FOR ENGINEERS - II
(Common to CSE, IT, AIML & CSE (DS))

	L	T	P	C
Semester: IV	**L**	**T**	**P**	**C**
Course Code: 231MC4T03	**0**	**0**	**2**	**0**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Understand the different aspects of the English language proficiency with emphasis on LSRW skills.
CO2:	Apply communication skills through various language learning activities
CO3:	Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.
CO4:	Evaluate and exhibit professionalism in participating in debates and group discussions.
CO5:	Develop the capacity to use various writing forms to achieve their professional needs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

List of Topics:

1. City Living – Discuss living in cities, Changes to a home, write an email to complaint.
2. Dilemmas – Discuss personal finance, Moral dilemmas and crime, Be encouraging, Write a review.
3. Discoveries – Discuss new inventions, People's lives and achievements, Express

uncertainty, Write an essay expressing a point of view.

4. Possibilities – Speculate about the past, Discuss life achievements, How you felt, Write a narrative.

Suggested Software:

- Cambridge Empower
- Young India Films
- Walden Infotech

Text Books:

1. Cambridge Empower – Second Edition B2 Level

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford University Press.
2. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India,
3. Hewing's, Martin. Cambridge Academic English (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed), Kindle.

Web Links:

Spoken English:

1. www.cambridgeone.org
2. www.englishinteractive.net
3. https://www.britishcouncil.in/english/online
4. http://www.letstalkpodcast.com/
5. https://www.youtube.com/c/EnglishClass101/featured

Voice & Accent:

1. www.cambridgeone.org
2. https://www.youtube.com/user/letstalkaccent/videos
3. https://www.youtube.com/c/EngLanguageClub/featured
4. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc

Data Warehousing and Data Mining

V Semester	**L**	**T**	**P**	**C**
Course Code: 231CS5T01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Illustrate data warehousing architectures and mining concepts for knowledge discovery.

CO2: Explain pre-processing techniques to prepare data for mining algorithms.

CO3: Build classification model using Decision tree induction.

CO4: Analyze association rule generation using Apriori and FP growth algorithms

CO5: Apply Clustering algorithms on given data to find similarity between classes.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	1	-	-	-	-	-	-	-
CO2	2	2	-	-	2	-	-	-	-	-	-	-
CO3	2	2	3	-	1	-	-	-	-	-	-	-
CO4	2	2	3	-	1	-	-	-	-	-	-	-
CO5	2	2	3	-	1	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT–I

Data Warehousing and Online Analytical Processing: Basic concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Cloud Data Warehouse, Data Mining and Patten Mining, Technologies, Applications, Major issues, Data Objects & Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. (Text Book- 1)

UNIT – II

Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization. (Text Book- 1)

UNIT – III

Classification: Basic Concepts, General Approach to solving a classification problem, Decision Tree Induction: Attribute Selection Measures, Tree Pruning, Scalability and Decision Tree Induction, Visual Mining for Decision Tree Induction, Bayesian Classification Methods: Bayes Theorem, Naïve Bayes Classification, Rule-Based Classification, Model Evaluation and Selection. (Text Book- 2)

UNIT – IV

Association Analysis: Problem Definition, Frequent Itemset Generation, Rule Generation: Confident Based Pruning, Rule Generation in Apriori Algorithm, Compact Representation of frequent item sets, FP-Growth Algorithm. (Text Book- 2)

UNIT – V

Cluster Analysis: Overview, Basics and Importance of Cluster Analysis, Clustering techniques, Different Types of Clusters; K-means: The Basic K-means Algorithm, K-means Additional Issues, Bi-secting K Means, Agglomerative Hierarchical Clustering: Basic Agglomerative Hierarchical Clustering Algorithm DBSCAN: Traditional Density Center-Based Approach, DBSCAN Algorithm, Strengths and Weaknesses. (Text Book- 2)

Text Books:

1. Data Mining concepts and Techniques, 3rd edition, Jiawei Han, Michel Kamber, Elsevier, ISBN-10: 0123814790.
2. Introduction to Data Mining: Pang-Ning Tan & Michael Steinbach, Vipin Kumar, Pearson, ISBN-10. 9332571406,.

Reference Books:

1. Data Mining: VikramPudi and P. Radha Krishna, Oxford Publisher, ISBN-10 : 0195686284.
2. Data Mining Techniques, Arun K Pujari, 3rd edition, Universities Press, ISBN, 8173713804.

Web Links:

1. http://onlinecourses.nptel.ac.in/noc17_mg24/preview
2. http://www.saedsayad.com/data_mining_map.htm

Computer Networks

(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
V Semester				
Course Code: 231CS5T02	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the fundamentals of computer networks through OSI and TCP/IP reference models.

CO2: Identify physical and data link layer technologies including error control and multiple access protocols.

CO3: Analyze network layer design, IP addressing schemes, and routing algorithms including IPv4 and IPv6.

CO4: Explain the functionalities and protocols of the transport layer including TCP, UDP, and SCTP.

CO5: Describe application layer services and protocols such as HTTP, DNS, email, and file transfer.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	1	-	-	-	-	1	-	2
CO2	2	-	2	-	1	-	-	-	-	-	-	1
CO3	3	2	3	-	1	-	-	-	-	-	-	2
CO4	2	2	3	-	1	-	-	-	-	-	-	1
CO5	2	2	2	2	2	-	-	-	1	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	1
CO2	2	1
CO3	3	1
CO4	3	1
CO5	2	1

UNIT - I: Introduction

Types of Computer Networks, Reference Models- The OSI Reference Model, The TCP/IP Reference Model, A Critique of the OSI Model and Protocols, A Critique of the TCP/IP Reference Model. History of Internet.

UNIT -II: The Data Link Layer

Physical Layer- Introduction to Guided Media- Twisted-pair cable, Coaxial cable and Fiber optic cable and introduction about unguided media.

Data Link Layer- Design Issues, Services Provided to the Network Layer, Error detecting and Error Correcting codes, Elementary Data Link Protocols, Sliding Window Protocols, HDLC, PPP. Multiple Access Protocols Wired Lans: Ethernet, Fast Ethernet, Gigabit Ethernet.

UNIT - III: The Network Layer

Network Layer Design Issues, Routing Algorithms, Congestion, Congestion control algorithms. The Network Layer in the Internet, The IP Version 4 Protocol, IP Addresses-Classful, CIDR, NAT, IP Version 6 Protocol, Transition from IPV4 to IPV6.

UNIT -IV: The Transport Layer

The Transport Layer Services, Transport Layer Protocols: UDP, TCP and SCTP.

UNIT -V: The Application Layer

The World Wide Web, HTTP, Domain Name Space, Remote Loging, Electronic Mail and File Transfer

Text Books:

1. "Computer Networks", Andrew S Tanenbaum, David J Wetherall, 5th Edition, Pearson, ISBN-13:978-0132126953
2. "Data Communications and Networking", Behrouz A Forouzan, 4th Edition, Tata McGraw Hill Education,ISBN-13:978-0070634145

Reference Books:

1. "Data and Computer Communication", William Stallings, Pearson Education India,ISBN-13:978-9332518865
2. "TCP/IP Protocol Suite", Behrouz Forouzan, 4th edition, McGraw Hill, ISBN-13:978-0073376042.

Web Links:

1. https://nptel.ac.in/courses/106105081
2. https://www.coursera.org/learn/fundamentals-network-communications
3. https://nptel.ac.in/courses/106/106/106106091/
4. https://www.udemy.com/course/mta-networking-fundamentals

Formal Languages and Automata Theory

	L	T	P	C
V Semester **Course Code: 231CS5T03**	3	0	0	3

Course Outcomes: At the end of the course, student will be able to:

CO1: Explain the properties of languages and automata to solve a given problem.
CO2: Construct an automata for a given language.
CO3: Design grammars for a given language.
CO4: Apply interconversion on automata, grammar and regular expressions.
CO5: Analyze decidability and undecidability problems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	-	-	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-	-	-
CO3	1	2	1	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	2	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Finite Automata: Need of Automata theory, Central Concepts of Automata Theory, Automation, Finite Automation, Transition Systems, Acceptance of a String, DFA, Design of DFAs, NFA, Design of NFA, Equivalence of DFA and NFA, Conversion of NFA into DFA, Finite Automata with Є-Transitions, Minimization of Finite Automata, Finite Automata with output-Mealy and Moore Machines, Applications and Limitation of Finite Automata.

UNIT – II

Regular Expressions, Regular Sets, Identity Rules, Equivalence of two RE, Manipulations of REs, Finite Automata and Regular Expressions, Inter Conversion, Equivalence between FA and RE, Pumping Lemma of Regular Sets, Closure Properties of Regular Sets, Grammars, Classification of Grammars, Chomsky Hierarchy Theorem, Right and Left Linear Regular Grammars, Equivalence between RG and FA, Inter Conversion.

UNIT - III

Formal Languages, Context Free Grammar, Leftmost and Rightmost Derivations, Parse Trees, Ambiguous Grammars, Simplification of Context Free Grammars-Elimination of Useless Symbols, ϵ-Productions and Unit Productions, Normal Forms-Chomsky Normal form and Greibach Normal Form, Pumping Lemma, Closure Properties, Applications of Context Free Grammars.

UNIT - IV

Pushdown Automata, Definition, Model, Graphical Notation, Instantaneous Description, Language Acceptance of Pushdown Automata, Design of Pushdown Automata, Deterministic and Non - Deterministic Pushdown Automata, Equivalence of Pushdown Automata and Context Free Grammars, Conversion, Two Stack Pushdown Automata, Application of Pushdown Automata.

UNIT - V

Turing Machine: Definition, Model, Representation of TMs-Instantaneous Descriptions, Transition Tables and Transition Diagrams, Language of a TM, Design of TMs, Types of TMs, Church's Thesis, Universal and Restricted TM, Decidable and Un-decidable Problems, Halting Problem of TMs, Post's Correspondence Problem, Modified PCP, Classes of P and NP, NP-Hard and NP-Complete Problems.

Text Books:

1. Introduction to Automata Theory, Languages and Computation, J. E. Hopcroft, R. Motwani and J. D. Ullman, 3rd Edition, Pearson, 2008 ISBN: 978-8131720479
2. Theory of Computer Science-Automata, Languages and Computation, K. L. P. Mishra and N. Chandrasekharan, 3rd Edition, PHI, 2007 ISBN: 978-8120329683

Reference Books:

1. Elements of Theory of Computation, Lewis H.P. & Papadimitriou C.H., Pearson /PHI ISBN: 978-0132624787
2. Theory of Automata, Languages and Computation, Rajendra Kumar, McGraw Hill, 2014 ISBN: 978-0070702042

Web Links:

1. http://nptel.ac.in/courses/111103016
2. https://archive.nptel.ac.in/courses/106/104/106104148/
3. https://www.iitg.ac.in/dgoswami/Flat-Notes.pdf
4. https://www.ics.uci.edu/~goodrich/teach/cs162/notes/
5. https://www.geeksforgeeks.org/introduction-of-finite-automata/

Object Oriented Analysis and Design

(Professional Elective-I)

(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231CS5E01	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Describe the characteristics and challenges of designing complex software systems.
CO2: Explain the importance and principles of object-oriented modeling using UML.
CO3: Create class and object diagrams to model system structure.
CO4: Develop behavioral diagrams like use case, sequence, and activity diagrams.
CO5: Design architectural diagrams to represent software deployment and components.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	3	-	2	-	-	-	-	-	-	-
CO2	2	2	2	-	3	-	-	-	-	-	-	-
CO3	2	2	3	-	1	-	-	-	-	-	-	-
CO4	-	2	1	2	3	-	-	-	-	-	-	-
CO5	2	2	3	-	2	-	-	-	-	-	-	-

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	2	-

UNIT - I

Introduction: The Structure of Complex systems, The Inherent Complexity of Software, Attributes of Complex System, Organized and Disorganized Complexity, Designing Complex Systems.

UNIT - II

Introduction to UML: Importance of modeling, principles of modeling, object-oriented modeling, conceptual model of the UML, Architecture, and Software Development Life Cycle. Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams.

UNIT - III

Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams.
Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages.

UNIT - IV

Basic Behavioral Modeling: Interactions, Interaction diagrams, Use cases, Use case Diagrams, Activity Diagrams.

UNIT-V

Advanced Behavioral Modeling: Events and signals, state machines, processes and Threads, time and space, state chart diagrams.
Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams.

Text Books:

1. Grady BOOCH, Robert A. Maksimchuk, Michael W. ENGLE, Bobbi J. Young, Jim Conallen, Kellia Houston, “Object- Oriented Analysis and Design with Applications”, 3rd edition,PEARSON. ISBN: 978-0201895513

2. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education. ISBN: 978-0321267979

Reference Books:

1. Meilir Page-Jones: Fundamentals of Object-Oriented Design in UML, Pearson Education. ISBN: 978-0201699463.
2. Pascal Roques: Modeling Software Systems Using UML2, WILEY- Dream tech India Pvt. Ltd. ISBN: 978-8126505050**.**
3. Atul Kahate: Object Oriented Analysis &Design, The McGraw-Hill Companies. ISBN978-: 0070583764

Web Links:

1. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013501564040249344834 8/overview
2. https://onlinecourses.nptel.ac.in/noc25_cs52/preview
3. https://www.geeksforgeeks.org/object-oriented-analysis-and-design/
4. https://www.lucidchart.com/pages/tutorial/uml

Artificial Intelligence

(Professional Elective I)

(Common to CSE & IT)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231CS5E02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe the evolution of Artificial Intelligence

CO2: Apply searching techniques for problem solving.

CO3: Analyze Knowledge Representation Techniques.

CO4: Explain the logical concepts to solve logical problems.

CO5: Demonstrate Expert Systems and probability theory.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	2	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT - I

Introduction: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT - II

Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A* ,AO* Algorithms, Problem reduction, Game Playing-Adversial search, Games, mini-max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha-Beta pruning, Evaluation functions.

UNIT - III

Representation of Knowledge: Knowledge representation issues, predicate logic- logic programming, semantic nets- frames and inheritance, constraint propagation, representing knowledge using rules, rules based deduction systems. Reasoning under uncertainty, review of probability, Bayes' probabilistic interferences and dempster shafer theory.

UNIT - IV

Logic concepts: First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, Learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

UNIT - V

Expert Systems: Architecture of expert systems, Roles of expert systems – Knowledge Acquisition Meta knowledge Heuristics. Typical expert systems – MYCIN, DART, XCON: Expert systems shells.

Text Books:

1. S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Third Edition Pearson Education. 2010. ISBN 978-0-13-604259-4.
2. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Third Edition, Mc Graw Hill. 2017. ISBN 9780070087705.

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence: A Logical Approach", First Edition, Oxford University Press. 1998. ISBN 0195102703.
2. G. Luger, "Artificial Intelligence:Structures and Strategies for complex problem solving" Sixth Edition, Pearson Education. 2021. ISBN 978-9354493782.
3. J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers. 1998. ISBN : 978-1558604674
4. Artificial Intelligence, Saroj Kaushik, Second Edition, CENGAGE Learning. 2022 ISBN: 978-9355730428.

Web Links:

1. https://ai.google/
2. https://nptel.ac.in/courses/106102220
3. https://onlinecourses.nptel.ac.in/noc22_cs56/preview

MICROPROCESSORS & MICROCONTROLLERS
(Professional Elective-I)

	L	T	P	C
Semester: VI	**L**	**T**	**P**	**C**
Course Code: 231CS5E03	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Interpret the architecture of microcomputer systems
CO2: Develop assembly language program for 8086.
CO3: Demonstrate the interfacing of peripherals to microprocessor.
CO4: Interpret the architecture of 8051 microcontroller.
CO5: Demonstrate the interfacing of peripherals to 8051 microcontroller.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	1
CO5	3	1	-	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Introduction: Basic Microprocessor architecture, Harvard and Von Neumann architectures with examples, Microprocessor Unit versus Microcontroller Unit, History and classifications of Microprocessor and Microcontroller.

8086 Architecture: Register organization, internal architecture of 8086, pin description of 8086, minimum mode and maximum mode of 8086 operation and timing diagrams.

Unit – II

8086 Programming: Instruction set, addressing modes, assembler directives, programming with an assembler, writing simple programs with an assembler, stack and stack structure, interrupts and interrupt service routines 8086 system.

Unit - III

8086 Interfacing: Semiconductor memories interfacing (RAM, ROM), Intel 8255 programmable peripheral interface, Interfacing switches and LEDS, Interfacing seven segment displays, Interfacing stepper motor, A/D and D/A converters, Intel 8251 USART architecture and interfacing, Intel 8237a DMA controller, Need for 8259 programmable interrupt controllers.

Unit - IV

Intel 8051 Microcontroller: Architecture, Hardware concepts, Input/output ports and circuits, external memory, counters/timers, serial data input/output, interrupts. Assembly language programming: Instructions, addressing modes, simple programs.

Unit - V

8051 Interfacing: Interfacing to 8051: A/D and D/A Convertors, Stepper motor interface, keyboard, LCD Interfacing, Traffic light control.

Text Books:

1. Microprocessors & Interfacing, Douglas V Hall, McGraw Hill, 2ndEdition, 2005.
2. The 8051 Micro Controller Architecture, Programming and Applications, Kenneth J Ayala, Thomson Publishers, 3rdEdition, 2004.

Reference Books:

1. Advanced Microprocessors and Interfacing, K.M. Bhurchandi, A.K. Ray, Tata McGraw Hill, 3rd Edition, 2012.
2. The 8051 Microcontrollers and Embedded systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay; Pearson 2ndEdition, 2011
3. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Saravanan, S. Jeevananthan, Oxford University Press, 2ndEdition, 2016.

Web Links:

1. https://nptel.ac.in/courses/108/105/108105102/ Prof. Santanu Chattopadhyay
2. https://edutechlearners.com/download/MP/8255%20&%20IO%20Interfacing.pdf
3. https://www.keil.com/dd/docs/datashts/atmel/at89c51_ds.pdf

Quantum Computing

(Professional Elective-I)

V Semester	**L T P C**
Course Code: 231CS5E04	**3 0 0 3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Describe the evolution of quantum computing and distinguish between classical and quantum computation principles.
CO2: Apply foundational concepts from mathematics, physics, and biology relevant to quantum computing.
CO3: Analyze qubit representations and design basic quantum circuits using quantum gates.
CO4: Evaluate quantum algorithms and compare their efficiency with classical algorithms.
CO5: Explain quantum error correction methods and the principles of quantum cryptography and teleportation.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	1	1	-	-	-	-	2
CO2	3	3	-	-	-	-	-	-	-	-	-	2
CO3	3	2	2	1	3	-	-	-	-	-	-	2
CO4	3	3	2	2	2	-	-	-	-	-	-	2
CO5	3	2	-	2	2	1	-	2	-	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	3	3
CO4	3	3
CO5	3	3

UNIT - I

History of Quantum Computing: Importance of Mathematics, Physics and Biology. Introduction to Quantum Computing: Bits Vs Qubits, Classical Vs Quantum logical operations

UNIT - II

Background Mathematics: Basics of Linear Algebra, Hilbert space, Probabilities and measurements.

Background Physics: Paul's exclusion Principle, Superposition, Entanglement and super-symmetry, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis. Background Biology: Basic concepts of Genomics and Proteomics (Central Dogma)

UNIT - III

Qubit: Physical implementations of Qubit. Qubit as a quantum unit of information. The Bloch sphere Quantum Circuits: single qubit gates, multiple qubit gates, designing the quantum circuits. Bell states.

UNIT - IV

Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor's factorization algorithm, Grover's search algorithm.

UNIT - V

Noise and error correction: Graph states and codes, Quantum error correction, fault-tolerant computation. Quantum Information and Cryptography: Comparison between classical and quantum information theory. Quantum Cryptography, Quantum teleportation

Text Books:

1. Quantum Computation and Quantum Information, Nielsen M. A., Cambridge, ISBN-978-1107002173.

Reference Books:

1. Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci, Cambridge University Press, ISBN 978-0521879965.

2. Principles of Quantum Computation and Information, Benenti G., Casati G. and Strini G., Vol.I: Basic Concepts, Vol II, World Scientific Publishing Company ISBN-978-981-256-345-3.

3. An Introduction to Quantum Computing Algorithms, Basic Tools and Special Topics, World Scientific. Pittenger A. O., ISBN-978-0817641276.

Web Links:

1. https://www.geeksforgeeks.org/blogs/introduction-quantum-computing/
2. https://learning.quantum.ibm.com/course/basics-of-quantum-information

WASTE WATER MANAGEMENT
(Open Elective-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231CE5O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Summarize the importance of sanitation and wastewater management.
CO2: Estimation of sewage flow and storm water drainage.
CO3: Identify the various characteristics of sewage and plan the treatment system.
CO4: Examination of waste water characteristics
CO5: Outline various waste water treatment technologies and effluent disposal methods

Mapping of Course Outcomes with Program Outcomes:

CO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-	2	-	-	-	-	-	-
CO2	1	1	1	-	-	1	-	-	-	-	-	-
CO3	3	2	1	-	-	1	-	-	-	-	-	-
CO4	2	1	-	2	-	2	-	-	-	-	-	-
CO5	2	1	-	-	-	2	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO 2
CO1	-	-
CO2	2	-
CO3	3	-
CO4	-	2
CO5	-	-

Unit - I
Introduction:

Introduction to sanitation–systems of sanitation–relative merits and demerits –need for waste water management–basic terminology in waste water–generation of waste water– types – collection and conveyance of waste water– classification of sewerage systems.

Unit – II
Sewage Flow and Pumping:

Estimation of sewage flow and storm water drainage–fluctuations. Types of sewers– hydraulics of sewers– appurtenances in sewerage. Pumping of waste water:pumping stations–location–components– typesofpumpsand their suitability with regards to waste waters.

Unit – III

Sewage Analysis and Treatment Sewage characteristics-sampling and analysis of waste water–physical, chemical ,and biological examination– measurement of BOD, COD. Preliminaryandprimarytreatment–screens–gritchambers–greasetraps–floatation– sedimentation.

Unit – IV

Secondary Treatment:

Aerobic and anaerobic treatment process-comparison.
Aerobic units:
Activated sludge process, principles, modifications of activated sludge processes Oxidation ponds– Trickling filters–Rotating biological contactors.
Anaerobic units: UASB Reactor, principle and working.

Unit – V

Tertiary Treatment and Disposal:

Removal of Nutrients–Nitrification and Denitrification–Ion exchange–membrane processes – MF, UF, NF, RO. Disposal of sewage–Methods of disposal–Effluent Standards. Need, Scope and demand for waste water recycling

Text Books:

1. Wastewater Engineering: Treatment and Resource Recovery, Metcalf & Eddy, 5th Edition, McGraw-Hill, New York, 2014.
2. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill edition, 2018.

Reference Books:

1. Environmental Engineering-II: Sewage disposaland Air pollution Engineering, Garg & S.K., Khanna Publications.
2. Environmental Engineering by D. Srinivasan, PHI Learning private Limited, New Delhi, 2011

Web Links:

1. https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf
2. http://www.civil.iitm.ac.in/dwwm/sites/default/files/presentations

Construction Technology and Management

(Open Elective-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231CE5O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course the student will be able to:

CO1: Demonstrate understanding of project planning, scheduling, and monitoring techniques using tools like bar charts, milestone charts, and CPM.

CO2: Analyze and optimize project timelines and resources using PERT, crashing methods, and project management software like Primavera.

CO3: Evaluate the working, capacity, and productivity of earthwork and hoisting equipment such as dump trucks, cranes, bulldozers, and rollers.

CO4: Understand the usage and operation of concreting equipment including batching plants, mixers, and techniques for placing and finishing concrete.

CO5: Apply modern construction techniques involving formwork, piling, fabrication, quality control, safety practices, and integrate BIM in project planning.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	-	-	1	1	-	-	-
CO2	2	1	2	1	-	-	-	1	1	-	-	-
CO3	2	1	2	1	-	-	-	1	1	-	-	-
CO4	2	1	2	-	-	-	-	1	1	-	-	-
CO5	2	1	2	1	-	-	-	1	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2
CO 1	1	-
CO 2	1	-
CO 3	1	-
CO 4	1	-
CO 5	1	-

UNIT – I

Construction project management and its relevance – qualities of a project manager – project planning – coordination –scheduling - monitoring – bar charts – milestone charts – critical path method

UNIT – II

Project evaluation and review technique–cost analysis-updating–crashing for optimum cost crashing for optimum resources–allocation of resources introduction to software's for construction management, project management using PRIMAVERA (or) equivalent.

UNIT – III

Construction equipment – economical considerations – earthwork equipment – Trucks and handling equipment – rear dump trucks – capacities of trucks and handling equipment – calculation of truck production – compaction equipment – types of compaction rollers Hoisting and earth work equipment–hoists–cranes–tractors-bull dozers–graders–scrapers draglines clam shell buck

UNIT-IV

Concreting equipment— concrete mixers–Batching plants, mobile using plants like "Ajax" etc. mixing and placing of concrete – consolidating and finishing.

UNIT-V

Construction methods – earthwork – piling – placing of concrete – form work – fabrication and erection – quality control and safety engineering. BIM for Civil Engineers (Building Information Modelling)

Textbooks:

1. Construction Planning, Equipment and Methods' by Peurifoy and Schexnayder, Shapira, Tata McGraw hill.
2. Construction Project Management Theory and Practice' by Kumar NeerajJha (2011), Pearson.

Reference Books:

1. Construction Project Management-An Integrated Approach 'by Peter Fewings, Taylor and Francis
2. Construction Management Emerging Trends and Technologies' by Trefor Williams , Cengage learning

Web Links:

1. NPTEL :: Civil Engineering - NOC:Principles of Construction Management
2. NPTEL :: Civil Engineering - Construction Planning and Management

GREEN BUILDINGS

(Open Elective-I)

V Semester **L T P C**
Course Code: 231CE5O03 **3 0 0 3**

Course Outcomes: At the end of the course the student will be able to

CO1: Understand the fundamental concepts, benefits, and sustainable features of green buildings.

CO2: Describe and analyze green building rating systems and sustainability practices in construction.

CO3: Apply principles of energy-efficient green design and evaluate renewable energy integration.

CO4: Assess HVAC design strategies and energy modeling used in green building projects.

CO5: Evaluate indoor air quality measures, sustainable material use, and occupant well-being strategies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	2	-	2	-	-	-	-	-	-
CO2	3	1	-	2	-	2	-	-	-	-	-	-
CO3	3	2	2	3	-	-	-	-	-	-	1	-
CO4	3	3	2	2	-	2	-	-	-	-	1	-
CO5	3	2	2	2	-	2	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes

CO/PSO	PSO 1	PSO 2
CO 1	-	-
CO 2	-	-
CO 3	-	-
CO 4	-	-
CO 5	-	-

UNIT – I

Introduction What is Green Building, Why to go for Green Building, Benefits of Green Buildings, Green Building Materials and Equipment in India, What are key Requisites for Constructing a Green Building, Important Sustainable features for Green Building

UNIT – II

Green Building Concepts And Practices Indian Green Building Council, Green Building Moment in India, Benefits Experienced in Green Buildings, Launch of Green Building Rating

Systems, Residential Sector, Market Transformation; Green Building Opportunities And Benefits: Opportunities of Green Building, Green Building Features, Material and Resources, Water Efficiency, Optimum Energy Efficiency, Typical Energy Saving Approach in Buildings, LEED India Rating System and Energy Efficiency,

UNIT-III

Green Building Design Introduction, Reduction in Energy Demand, Onsite Sources and Sinks, Maximise System Efficiency, Steps to Reduce Energy Demand and Use Onsite Sources and Sinks, Use of Renewable Energy Sources. Eco friendly captive power generation for factory, Building requirement,

UNIT- IV

Air Conditioning Introduction, CII Godrej Green business centre, Design philosophy, Design interventions, Energy modeling, HVAC System design, Chiller selection, pump selection, Selection of cooling towers, Selection of air handing units, Precooling of fresh air, Interior lighting system, Key feature of the building. Eco-friendly captive power generation for factory, Building requirement.

UNIT -V

Material Conservation Handling of non process waste, waste reduction during construction, materials with recycled content, local materials, material reuse, certified wood, Rapidly renewable building materials and furniture; Indoor Environment Quality And Occupational Health: Air conditioning, Indore air quality, Sick building syndrome, Tobacco smoke control, Minimum fresh air requirements avoid use of asbestos in the building, improved fresh air ventilation, Measure of IAQ, Reasons for poor IAQ, Measures to achieve Acceptable IAQ levels,

Text Books:

1. Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.
2. Green Building Hand Book by Tom woolley and Samkimings, 2009. Recommended

Reference Books:

1. Complete Guide to Green Buildings by Trish Riley, The Lyons Press, 2009.
2. Standard for the Design of High-Performance Green Buildings by Kent Peterson, ASHRAE, 2009.

Web Links:

1. https://nptel.ac.in/courses/105107213
2. https://nptel.ac.in/courses/105107212

RENEWABLE ENERGY SOURCES
(OPEN ELECTIVE-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231EE5O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1: Analyze solar radiation data, extra-terrestrial radiation, radiation on earth's surface and solar Energy Storage.

CO2: Illustrate the components of wind energy systems.

CO3: Illustrate the working of biomass, hydel plants and Geothermal plants.

CO4: Demonstrate the principle of Energy production from OTEC, Tidal and Waves.

CO5: Evaluate the concept and working of Fuel cells & MHD power generation.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	1	-	-	-	1	1	-	-
CO2	3	2	2	-	-	-	-	-	1	1	-	-
CO3	3	2	2	-	-	-	-	-	1	1	-	-
CO4	3	2	2	-	-	-	-	-	1	1	-	-
CO5	3	2	2	-	-	-	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

UNIT – I

Solar Energy

Introduction - Renewable Sources - prospects, solar radiation at the Earth Surface - Equivalent circuit of a Photovoltaic (PV) Cell - I-V & P-V Characteristics - Solar Energy Collectors: Flat plate Collectors, concentrating collectors - Solar Energy storage systems and Applications: Solar Pond - Solar water heating - Solar Green house.

UNIT - II

Wind Energy

Introduction - basic Principles of Wind Energy Conversion, the nature of Wind - the power in the wind - Wind Energy Conversion - Site selection considerations - basic components of Wind Energy Conversion Systems (WECS) - Classification - Applications.

UNIT - III

Biomass, Hydel and Geothermal Energy

Biomass: Introduction - Biomass conversion technologies- Photosynthesis. Factors affecting Bio digestion.

Hydro plants: Basic working principle – Classification of hydro systems**:** Large, small, micro hydel plants.

Geothermal Energy: Introduction, Geothermal Sources – Applications - operational and Environmental problems.

UNIT - IV

Energy From oceans, Waves & Tides:

Oceans: Introduction - Ocean Thermal Electric Conversion (OTEC) – methods - prospects of OTEC in India.

Waves: Introduction - Energy and Power from the waves - Wave Energy conversion devices.

Tides: Basic principle of Tide Energy -Components of Tidal Energy.

UNIT - V

Chemical Energy Sources:

Fuel Cells: Introduction - Fuel Cell Equivalent Circuit - operation of Fuel cell - types of Fuel Cells - Applications.

Hydrogen Energy: Introduction - Methods of Hydrogen production - Storage and Applications

Magneto Hydro Dynamic (MHD) Power generation: Principle of Operation - Types.

Text Books:

1. G.D.Rai, Non-Conventional Energy Sources, Khanna Publications, 2011.
2. John Twidell& Tony Weir, Renewable Energy Sources, Taylor & Francis, 2013.

Reference Books:

1. S.P.Sukhatme&J.K.Nayak, Solar Energy-Principles of Thermal Collection and Storage, TMH, 2011.
2. John Andrews & Nick Jelly, Energy Science- principles, Technologies and Impacts, Oxford, 2nd edition, 2013.
3. ShobaNath Singh, Non- Conventional Energy Resources, Pearson Publications, 2015.

Web Links:

1. https://archive.nptel.ac.in/courses/103/103/103103206
2. https://archive.nptel.ac.in/courses/103/107/103107157

CONCEPTS OF ENERGY AUDITING & MANAGEMENT

(OPEN ELECTIVE-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231EE5O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1: Understand the principles of energy audit along with various Energy related terminologies.

CO2: Asses the role of Energy Manager and Energy Management program.

CO3: Design a energy efficient motors and good lighting system.

CO4: Analyse the methods to improve the power factor and identify the energy instruments for various real time applications.

CO5: Evaluate the computational techniques with regard to economic aspects.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	2	2	-	1		-	-	1	1	-	-
CO2	3	2	2	-	-	-	-	-	1	1	-	-
CO3	3	2	2	-	-	-	-	-	1	1	-	-
CO4	3	2	2	-	-	-	-	-	1	1	-	-
CO5	3	2	2	-	-	-	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

UNIT – I

Basic Principles of Energy Audit

Energy audit- definitions - concept - types of Energy audit - energy index - cost index - pie charts - Sankey diagrams and load profiles - Energy conservation schemes- Energy audit of industries- energy saving potential - energy audit of process industry, thermal power station - building energy audit - Conservation of Energy Building Codes (ECBC-2017)

UNIT - II

Energy Management

Principles of energy management - organizing energy management program - initiating - planning - controlling - promoting - monitoring - reporting. Energy manager - qualities and functions - language - Questionnaire – check list for top management.

UNIT - III

Energy Efficient Motors and Lighting

Energy efficient motors - factors affecting efficiency - loss distribution - constructional details - characteristics – variable speed - RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design and practice - lighting control - lighting energy audit.

UNIT - IV

Power Factor Improvement and Energy Instruments

Power factor – methods of improvement - location of capacitors - Power factor with non-linear loads - effect of harmonics on power factor - power factor motor controllers – Energy Instruments- watt meter - data loggers - thermocouples - pyrometers - lux meters - tongue testers.

UNIT - V

Economic Aspects and their Computation

Economics Analysis depreciation Methods - time value of money - rate of return - present worth method - replacement analysis - lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value method- Power factor correction - lighting – Applications of life cycle costing analysis - return on investment.

Text Books:

1. Energy management by W.R.Murphy & G.Mckay Butter worth - Heinemann publications - 1982.
2. Energy management hand book by W.CTurner - John wiley and sons - 1982.

Reference Books:

1. Energy efficient electric motors by John.C.Andreas - Marcel Dekker Inc Ltd-2nd edition - 1995.
2. Energy management by Paul o' Callaghan - Mc-graw Hill Book company-1st edition - 1998.
3. Energy management and good lighting practice : fuel efficiency- booklet12-EEO.

Web Links:

1. https://nptel.ac.in/courses/108106022
2. https://archive.nptel.ac.in/courses/108/106/108106022

SUSTAINABLE ENERGY TECHNOLOGIES

(Open Elective-I)

V Semester	**L**	**T**	**P**	**C**
Course Code: 231ME5O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1	Explain the importance of Sustainable energy Sources and Solar radiation.
CO2	Explain working of Solar Energy collection and Storage.
CO3	Discuss the Working of Solar PV module and Solar PV systems.
CO4	Describe process of energy extraction from Wind and Biomass.
CO5	Discuss process of energy extraction from Geothermal, Ocean and fuel cells.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	3	-	-	-	-	-	-
CO2	2	-	-	-	-	3	-	-	-	-	-	-
CO3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	2	-	-	-	-	3	-	-	-	-	-	-
CO5	2	-	-	-	-	3	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Sustainable Energy Sources

Types of Sustainable Energy sources, Importance, and limitations of Sustainable sources of energy, Sustainable Design and development, Present Indian and international energy scenario of conventional and non-conventional energy sources.

Solar Radiation: Role and potential of new and renewable sources, fundamentals of solar radiation, sun-earth relationships, coordinate systems and coordinates of the sun, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

Unit – II

Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation.

Solar Energy Storage and Applications: Different methods, sensible, latent heat and stratified storage, solar ponds, solar applications- solar heating/cooling technique, solar distillation and drying, solar cookers, central power tower concept and solar chimney.

Unit – III

Solar PV Modules and PV Systems:

PV Module Circuit Design, Module Structure, Electrical and Mechanical Insulation, Lifetime of PV Modules, Degradation and Failure, PV Module Parameters, Efficiency of PV Module, Solar PV Systems-Design of Off Grid Solar Power Plant. Installation and Maintenance.

Storage in PV Systems:
Battery Operation, Types of Batteries, Battery Parameters, Application and Selection of Batteries for Solar PV System.

Unit – IV

Wind Energy: Sources and potentials, types of winds, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

Bio-Mass: Principles of bio-conversion, anaerobic/aerobic digestion, types of bio-gas digesters, gas yield, utilization for cooking, bio fuels.

Unit – V

Geothermal Energy: Origin, Applications, Types of Geothermal Resources, Relative Merits

Ocean Energy: Ocean Thermal Energy; Open Cycle & Closed Cycle OTEC Plants, Environmental Impacts, Challenges
Fuel Cells: Introduction, Applications, Classification, Different Types of Fuel Cells Such as Phosphoric Acid Fuel Cell, Alkaline Fuel Cell, PEM Fuel Cell, MC Fuel Cell.

Text Books:

1. Non-conventional energy source, B.H. Khan, McGraw Hill Education India Private Limited, 3rd edition, 2017
2. Renewable Energy Sources and Emerging Technologies, D.P. Kothari, K.C Singal, Rakesh Ranjan PHI Learning Pvt.Ltd, New Delhi, 3rd edition, 2021.

Reference Books:

1. Sustainable Energy, Richard A. Dunlap, Cengage Learning India Private Limited, Delhi, 2015

2. Renewable energy, Godfrey Boyle, Open University, Oxford University Press in association with the Open University, 2004
3. Solar Photovoltaics: Fundamentals, Technologies and Applications, Chetan Singh Solanki , PHI Learning Private Limited, New Delhi, 2011
4. Photovoltaic Systems: Analysis and Design, A.K. Mukerjee and Nivedita Thakur, PHI Learning Private Limited, New Delhi, 2011

Web Links:

1. https://nptel.ac.in/courses/112105051
2. https://www.eia.gov/energyexplained/renewable-sources/

APPLIED OPERATIONS RESEARCH

(Open Elective-I)

V Semester	**L**	**T**	**P**	**C**
Course Code: 231ME5O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Formulate and solve real industrial problems using Graphical and Simplex methods

CO2: Interpret Transportation and sequencing problems

CO3: Solve replacement problems and analyze queuing models

CO4: Solve game theory and deterministic inventory problems

CO5: Interpret dynamic programming and simulation.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	-	-	2	-	-	-	-	1	-
CO2	1	1	1	-	-	1	-	-	-	-	1	-
CO3	3	2	1	-	-	1	-	-	-	-	1	-
CO4	2	1	1	-	-	2	-	-	-	-	1	-
CO5	2	1	1	-	-	2	-	-	-	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

Unit – I

INTRODUCTION - definition– characteristics and phases–types of operation research models – applications.

Linear programming: Problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.

Unit – II

TRANSPORTATION PROBLEM: Formulation–optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- travelling salesman problem.

SEQUENCING – Introduction – flow –shop sequencing – n jobs through two machines – n jobs through three machines – job shop sequencing – two jobs through 'm' machines.

Unit – III

REPLACEMENT THEORY: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

GAME THEORY: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

Unit – IV

WAITING LINES: Introduction – single channel – poison arrivals – exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel.

PROJECT MANAGEMENT: Basics for construction of network diagram,Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) – PERT Vs. CPM, determination of floats- Project crashing and its procedure.

Unit – V

DYNAMIC PROGRAMMING: Introduction – Bellman's principle of optimality - applications of dynamic programming-shortest path problem – linear programming problem.

SIMULATION: Definition – types of simulation models – phases of simulation– applications of simulation – inventory and queuing problems – advantages and disadvantages

Text Books:

1. Operations Research-An Introduction/Hamdy A Taha/Pearson publishers
2. Operations Research - Theory & publications / S.D.Sharma Kedarnath/McMillan publishers India Ltd

Reference Books:

1. Introduction to O.R/Hiller & Libermann/TMH
2. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi /Pearson Education.

Web links:

1. https://ocw.mit.edu/courses/find-by-topic/#cat=engineering&subcat=operationsresearch
2. https://nptel.ac.in/courses/112/107/112107209/

NANO TECHNOLOGY

(Open Elective-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231ME5O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the classification of Nano structured Materials

CO2: Explain the unique properties of Nano materials.

CO3: Explain the Synthesis Routes - Bottom up and Top down approaches

CO4: Analyse the tools to characterize Nano materials

CO5: Understand the applications of Nano materials

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	2	-	2	-	-	-	-	-	-	-
CO5	3	-	-	-	-	1	1	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	3	-

UNIT – I

INTRODUCTION: History and Scope, Classification of Nano structured Materials, Fascinating Nanostructures, and applications of nano-materials, challenges and future prospects.

UNIT – II

UNIQUE PROPERTIES OF NANO MATERIALS: Microstructure and Defects in Nano crystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations. Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

UNIT – III

SYNTHESIS ROUTES: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method, Self-assembly. Top down approaches: Mechanical alloying, Nano-lithography. Consolidation of Nano powders: Shock wave consolidation, Hot iso-static pressing and Cold iso-static pressing, Spark plasma sintering.

UNIT – IV

TOOLS TO CHARACTERIZE NANOMATERIALS: X-Ray Diffraction (XRD), Small Angle X-ray scattering, Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation.

UNIT – V

APPLICATIONS OF NANO MATERIALS: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS),Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology

Text Books:

1. Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens.Wiley India Pvt. Ltd.
2. Nano Materials- A.K.Bandyopadhyay/ New Age Publishers.
3. Nano Essentials- T.Pradeep/TMH

Reference Books:

1. Solid State physics by Pillai, Wiley Eastern Ltd.
2. Introduction to solid state physics 7th edition by Kittel. John Wiley & sons (Asia) Pvt Ltd

THERMAL MANAGEMENT OF ELECTRONIC SYSTEMS

(Open Elective-I)

V Semester	**L**	**T**	**P**	**C**
Course Code: 231ME5O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: To understand the basics of heat transfer and analyze heat transfer through fins

CO2: To acquire the knowledge on Free and forced convective systems

CO3: To understand the air cooling and single phase liquid cooling systems with case studies.

CO4: To demonstrate the concepts of two phase cooling and heat pipes.

CO5: To understand thermoelectric coolers, mini and micro channels.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	3	2	3	2	2	3	1	1
CO2	3	2	3	3	2	1	2	3	1	2	2	1
CO3	3	2	2	2	1	3	1	2	2	2	3	1
CO4	3	2	2	2	1	2	1	1	3	1	1	1
CO5	3	2	1	2	1	1	1	1	2	2	1	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	2	3
CO4	2	3
CO5	3	3

Unit - I

Introduction of Heat Transfer: Modes – Conduction, Convection and Radiation – Basic Laws – Applications of Heat Transfer.

Basics of Conduction –Conduction equation – Thermal analogy – Lumped heat capacity analysis - Heat conduction with phase change - Thermal Resistance – Extended Surfaces – Uniform cross section fins – Fin efficiency – Selection and design of fins

Unit -II

Forced and Free Convection – Heat transfer coefficient - Parameters effecting heat transfer – Thermal Properties of fluids - Combined Modes.

Radiation – Stefan- Boltzmann Law – Kirchoff's law and Emissivity – Radiation between Black Isothermal Surfaces – Radiation between Grey Isothermal Surfaces – Extreme Climatic conditions - Radiation at normal ambient Temperature measurement and its Instrumentation.

Unit - III

Printed Circuit boards – Chip packaging – thermal Resistance – Board Cooling methods – Board thermal Analysis – Equivalent thermal Conductivity.

Air Cooling – Fans – Heat transfer Enhancement – Air handling systems - Blowers

Single Phase Cooling – Coolant Selection – Natural Convection – Forced Convection - Air Cooling - Convective cooling in Small systems – Forced cooling in medium and large systems – Liquid cooling in high power modules – Case Studies.

Unit - IV

Two Phase Cooling – Direct Immersion Cooling – Basics of Pool Boiling – Enhancement of Pool Boiling – Flow Boiling.

Heat Pipes – Operation Principles – Useful Characteristics – Operating Limits and Temperatures – Operation Methods – Applications – Micro Heat Pipes.

Unit – V

Thermoelectric coolers: Basics theories – Thermoelectric effect – Operation Principles.

Phase change materials, Thermal Interface materials, Heat Spreaders and Heat Sinks – Working Principles Mini and Micro Channels. Use of nano fluids in electronic cooling.

Text Books:

1. Thermal Analysis and Control of Electronic Equipment – Allan D. Kraus and Avram BarCohen, McGraw Hill, New York, NY, 1983.
2. Fundamentals of Microelectronics Packaging – Ed: Rao Tummala, McGraw Hill, New York, NY, 2001.1.
3. Packaging of Electronic Systems – James W. Dally, McGraw Hill, New York, NY, 1990

Reference Books:

1. Fundamentals of Microelectronics Packaging – Edited by Rao Tummala, McGraw Hill, New York, NY, 2001.
2. Heat Transfer: Thermal Management of Electronics – Younes Shabany, CRC Press, 2009
3. HoSung Lee, Thermal Design: Heat Sinks, Thermoelectrics, Heat Pipes, Compact Heat Exchangers, and Solar Cells, 2011 John Wiley & Sons, Inc.

Web Links:

1. https://nptel.ac.in/courses/108108110 -
2. https://ocw.mit.edu/courses/6-622-power-electronics-spring
   2023/resources/mit6_622s23_lecture_01_mp4/
3. https://www.coursera.org/courses?query=electronics

ENTREPRENEURSHIP
(Open Elective-I)

	L	T	P	C
V Semester				
Course Code: 231ME5O05	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Identify the core characteristics, knowledge, and skills of successful entrepreneurs.

CO2: Explain the influence of family and societal structures on entrepreneurial initiatives.

CO3: Explain the fundamentals of international business, including schemes and policies.

CO4: Develop a comprehensive business model using the Business Model Canvas framework.

CO5: Develop a comprehensive small business plan.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	1	-	-	1	-	2	-
CO2	2	-	-	-	-	1	2	-	1	-	-	-
CO3	2	-	-	-	-	1	-	-	1	-	1	-
CO4	2	-	-	-	-	1	-	-	1	-	1	-
CO5	2	-	-	-	-	1	-	-	1	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	**1**	**-**
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

Unit - I
ENTREPRENEURAL COMPETENCE :

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur. - Features - Types - Functions - Entrepreneurship - Characteristics - Role of entrepreneurship in economic development.

Unit -II

ENTREPRENEURAL ENVIRONMENT

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services

Unit - III

INDUSTRIAL POLICIES

Central and State Government Industrial Policies and Regulations -Schemes- International Business.

Unit - IV

BUSINESS PLAN PREPARATION

Sources of Product for Business -Business model canvas-Business model generation-Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

Unit – V

LAUNCHING OF SMALL BUSINESS

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups. Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

Text Books:

1. Robert D Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2013.
2. Dr. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001

Reference Books:

1. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996..
2. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra ,2nd Edition ,2005
3. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.
4. Arya Kumar. Entrepreneurship. Pearson. 2012

Web Links:

1. https://www. nptel.ac.in/courses/127105007
2. https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s

Entrepreneurship Development & Venture Creation
(Open Elective – I)

Semester: V	**L**	**T**	**P**	**C**
Course Code: 231ME5O06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Develop an entrepreneurial mindset and appreciate the concepts of entrepreneurship, cultivate essential attributes to become an entrepreneur or Intrapreneur and demonstrate skills such as problem solving, team building, creativity and leadership

CO2: Comprehend the process of problem-opportunity identification through design thinking, identify market potential and customers while developing a compelling value proposition solution

CO3: Analyse and refine business models to ensure sustainability and profitability

CO4: Build Prototype for Proof of Concept and validate MVP of their practice venture idea

CO5: Create business plan, conduct financial analysis and feasibility analysis to assess the financial viability of a venture

CO6: Prepare and deliver an investible pitch deck of their practice venture to attract stakeholders

Mapping of Course Outcomes with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
CO1:												
CO2:												
CO3:												
CO4:												
CO5:												

Unit I: Entrepreneurship Fundamentals & Context
Meaning and concept, attributes and mindset of entrepreneurial and intrapreneurial leadership, role models in each and their role in economic development. An understanding of how to build entrepreneurial mindset, skillsets, attributes and networks while on campus.
Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity

Unit II: Problem & Customer Identification
Understanding and analysing the macro-Problem and Industry perspective, technological, socio economic and urbanization trends and their implication on new opportunities. Identifying passion, identifying and defining problem using Design thinking principles. Analysing problem and validating with the potential customer. Iterating problem-customer fit. Understanding customer segmentation, creating and validating customer personas. Competition and Industry trends mapping and assessing initial opportunity.
Core Teaching Tool: Several types of activities including Class, game, Gen AI, ‘Get out of the Building’ and Venture Activity.

Unit III: Solution design, Prototyping & Opportunity Assessment and Sizing

Understanding Customer Jobs-to-be-done and crafting innovative solution design to map to customer's needs and create a strong value proposition. Developing Problem-solution fit in an iterative manner. Understanding prototyping and MVP. Developing a feasibility prototype with differentiating value, features and benefits. Initial testing for proof-of-concept and iterate on the prototype. Assess relative market position via competition analysis, sizing the market and assess scope and potential scale of the opportunity. Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity

Unit IV: Business & Financial Model, Go-to-Market Plan

Introduction to Business model and types, Lean approach, 9 block lean canvas model, riskiest assumptions to Business models. Importance of Build - Measure – Lean approach.

Business planning: components of Business plan- Sales plan, People plan and financial plan. Financial Planning: Types of costs, preparing a financial plan for profitability using financial template, understanding basics of Unit economics and analysing financial performance.
Introduction to Marketing and Sales, Selecting the Right Channel, creating digital presence, building customer acquisition strategy.
Choosing a form of business organization specific to your venture, identifying sources of funds: Debt & Equity, Map the Start-up Lifecycle to Funding Options.
Core Teaching Tool: Founder Case Studies – Sama and SecurelyShare; Class activity and discussions; Venture Activities.

Unit V: Scale Outlook and Venture Pitch readiness

Understand and identify potential and aspiration for scale vis a vis your venture idea. Persuasive Storytelling and its key components. Build an Investor ready pitch deck. Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

Text Books:

1. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
2. Ries, E. (2011). The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Business

Reference Books:

1. Osterwalder, A., & Pigneur, Y. (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley & Sons.
2. Simon Sinek (2011) Start with Why, Penguin Books limited
3. Brown Tim (2019) Change by Design Revised & Updated: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Business
4. Namita Thapar (2022) The Dolphin and the Shark: Stories on Entrepreneurship, Penguin Books Limited
5. Saras D. Sarasvathy, (2008) Effectuation: Elements of Entrepreneurial Expertise, Elgar Publishing Ltd

Web Resources

- Learning resource- Ignite 5.0 Course Wadhwani platform (Includes 200+ components of custom created modular content + 500+ components of the most relevant curated content)

PRINCIPLES OF SIGNALS & SYSTEMS
(Open Elective-I)

	L	T	P	C
V SEMESTER				
Course Code: 231EC5O01	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Outline the signal representation using fourier series.

CO2: Interpret the signals in frequency domain using fourier transform.

CO3: Infer LTI system characteristics.

CO4: Compare sampling methods

CO5: Apply Z-transform techniques for the analysis of discrete-time signals and Systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I
Signals: Classification of Signals, Different deterministic signals: impulse, step, ramp, gate, signum, sinc, sinusoidal, exponential, complex exponential, operations on signals. Fourier Series: Representation of Fourier series for continuous time periodic signals, Trigonometric Fourier series and Exponential Fourier series.

Unit – II
Fourier Transform: Deriving Fourier Transform (FT) from Fourier series, Fourier transform of arbitrary signal, Fourier transform of standard signals, Fourier transform of periodic signals, properties of Fourier transforms, Fourier transforms involving impulse function and Signum function, Applications of Fourier Transforms

Unit – III
Signal Transmission Through LTI Systems: Classification of Systems, Impulse response and step response of LTI systems, Transfer function of a LTI system. Filter characteristics of LTI systems. Distortion less transmission through a system, Ideal LPF, HPF and BPF characteristics, Causality and Paley-Wiener criterion for physical realization, Signal bandwidth, system bandwidth.

Unit – IV

Sampling: Sampling, Sampling theorem – Graphical and analytical proof for Band Limited Signals, Nyquist rate, Nyquist duration, Impulse sampling, Natural sampling and Flat top Sampling, Reconstruction of signal from its samples, Effect of under sampling – Aliasing,

Unit – V

Z–Transforms: Z-Transform of a discrete time signal, Distinction between Laplace, Fourier and Z-transforms, Region of convergence in Z-Transform, constraints on ROC for various classes of discrete signals, Properties of Z-transforms, Inverse Z-transform.

Text Books:

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky, and S.H. Nawab, PHI, 2nd Edition, 2016.
2. Signals, Systems & Communications - B.P. Lathi, BS Publications, 2003.
3. Signals and Systems – A. Anand Kumar, PHI, 4th Edition, 2017.

Reference Books:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition

Web Links:

1. https://freevideolectures.com/course/3540/signals-and-systems-i(Signals and Systems Iby Prof. K.S.Venktesh IIT Kanpur)
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/
3. https://nptel.ac.in/courses/108104100(Principles of Signals and Systems, Video course, Coordinator by Prof. Aditya, K. Jagannatham, IIT Kanpur)

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INTRODUCTION TO INTERNET OF THINGS
(Open Elective-I)

	L	T	P	C
V Semester				
Course Code: 231EC5O02	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Interpret the evolution of different internet technologies and need for IOT.

CO 2: Identify different networking components in IOT with respect to OSI.

CO 3: Infer the need of sensors and actuators used in IOT.b

CO 4: Outline the terminologies and technologies associated with IOT connectivity.

CO 5: Summarize IOT applications for societal needs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	1	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Introduction to IOT: Introduction, Evolution of IOT, IOT and M2M, IOT -CPS, IOT-WoT, Various enablers of IOT and Complex interdependence technologies, Networking components of IOT.

Unit – II

Networking Components in IOT: Introduction, Network types, Network reachability, OSI model, Internet Protocol suite, Data link layer addressing, Network layer addressing, TCP/IP transport layer.

Unit – III

IOT sensors and actuators: Introduction, Sensors and its characteristics, types of sensing, sensing considerations, Actuators, characteristics of actuators, types of actuators.

Unit – IV

IOT software and Protocols: Introduction, data protocols, MQTT, MQTT-SN, CoAP, XMPP, HTTP, Web Socket, Identification protocols, EPC, u Code.

Unit – V

Connectivity Technologies in IOT: Introduction, IEEE 802 15 4, Zigbee, Communication topologies in Zigbee, Wireless HART network architecture, RFID, Lora, WI-Fi, Bluetooth. IOT Applications: IOT in agriculture, Smart irrigation Management system, IOT in health care systems.

Text Books:

1. Internet of Things- A Hands-on Approach, Arshdeep Bahgaand Vijay Madisetti, Universities Press, 2015, ISBN:9788173719547
2. Getting Started with RaspberryPi, Matt Richardson & Shawn Wallace, O'ReiIIy(SPD), 2014, ISBN:9789350239759.
3. Misra,S.,Mukherjee,A.,&Roy,A.(2021).Introduction to IoT. Cambridge:Cambridge University Press. doi:10.1017/9781108913560.

Reference Books:

1. Adrian McEwen, Hakim Cassimally “Designing the Internet of Things”, John Wiley & Sons, 2014.
2. Peter Friess,’ lnternet of Things—From Research and Innovation to Market Deployment’, River Publishers, 2014

Web Links:

1. https://onlinecourses.nptel.ac.in/noc2lee85/course
2. https://onlinecourses.nptel.ac.in/noc2lcs17/preview
3. https://nptel.ac.in/courses/106/105/106105166/

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DIGITAL ELECTRONICS AND LOGIC DESIGN
(Open Elective-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231EC5O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Interpret number representation in different code formats.

CO2: Illustrate the functionality of logic gates

CO3: Realize logic minimization using suitable techniques.

CO4: Construct combinational logic circuits for desired functionality.

CO5: Realize Boolean functions using PLDs.

CO6: Interpret the functionality of flip flops.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-
CO4	2	3	2	-	-	-	-	-	-	-	-	-
CO5	2	3	2	-	-	-	-	-	-	-	-	-
CO6	2	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit - I

Number Systems: Representation of numbers of different radix, conversion from one radix to another radix, r-1'scompliments and r's compliments of signed numbers, problem solving.

Binary Codes:4 bit codes, BCD, Excess-3, 2421, 84-2-1 9's compliment code etc. Error detection & correction codes, Gray code, error detection, error correction codes.

Logic Gates: Basic logic operations: NOT,OR, AND, Universal building blocks, EXOR, EX-NOR Gates.

Unit – II

Boolean Algebra &Minimization Techniques: Boolean theorems, principle of complementation & duality, De-Morgan theorems, minimization of logic functions using Boolean theorems, minimization of switching functions using K-Map up to 4 variables, tabular minimization.

Unit – III

Combinational Logic Circuits: Design of Half adder, full adder, half sub-tractor, full sub-tractor, applications of full adders, 4-bit binary adder-sub-tractor circuit, BCD adder circuit, look-a-head adder circuit, Design of decoder, de-multiplexer, 7 segment decoder, higher order de-multiplexing, encoder, multiplexer, higher order multiplexing, realization of Boolean functions using decoders & multiplexers.

Unit – IV

Programmable Logic Devices: Introduction to PLD's: PROM, PAL, PLA-Basics structures, realization of Boolean function with PLDs, programming tables of PLDs, merits & demerits of PROM, PAL, PLA comparison, realization of Boolean functions using PROM, PAL, PLA, programming tables of PROM, PAL, PLA.

Unit – V

Sequential Circuits: Classification of sequential circuits (synchronous and asynchronous) basic flip-flops, truth tables and excitation tables (NAND RS latch, NOR RS latch, RS flip-flop, JK flip-flop, T-flip-flop, D- flip-flop with reset and clear terminals). Conversion from one flip-flop to another flip-flop.

Text Books:

1. Digital Design, Morris Mano, Pearson, 3rd Edition, 2002.
2. Fundamentals of Logic Design, Charles H. Roth Jr., Jaico Publishers, 2004.
3. Switching Theory and Logic Design, A. Anand Kumar, Pearson, 3rdEdition, 2013.

Reference Books:

1. Modern Digital Electronics, RP Jain, Tata Mc Graw Hill, 4th Edition, 2010.
2. Introduction to Switching Theory and Logic Design, Fredriac J. Hill, Gerald R. Peterson, 3rd Edition, John Wiley & Sons Inc., 1982.
3. Switching and Finite Automata Theory, ZviKohavi&NirajK.Jha, 3rdEdition 2010.

Web Links:

1. http://nptel.ac.in/courses/117/106/117106086/ (By Prof. Goutam Saha, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur).
2. https://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html(By Prof. Santanu Chattopadhyay, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur).
3. https://www.smartzworld.com/notes/switching-theory-and-logic-design-stld/.

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DATA BASE MANAGEMENT SYSTEMS

(Open Elective-I)

V Semester	L	T	P	C
Course Code: 231CS5O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Summarize the database characteristics and identify various database architectures.

CO2: Interpret relational database using SQL

CO3: Examine issues in data storage and query processing for appropriate

CO4: Make use of normalization techniques for database design

CO5: Illustrate the mechanisms of transaction management.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	-	-	-	-	-	-	-	-	1
CO2	1	2	3	-	-	-	-	-	-	-	-	2
CO3	2	3	1	-	-	-	-	-	-	-	-	1
CO4	2	2	3	-	-	-	-	-	-	-	-	2
CO5	3	1	2	-	-	-	-	-	-	-	-	2

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Introduction: Database system, Characteristics (Database Vs File System), Database Users(Actors on Scene, Workers behind the scene), Advantages of Database systems, Database applications. Brief introduction of different Data Models; Concepts of Schema, Instance and data independence; Three tier schema architecture for data independence; Database system structure, environment, Centralized and Client Server architecture for the database.

Unit – II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance

Unit – III

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.

Unit – IV

Schema Refinement (Normalization): Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).

Unit – V

Transaction Concept: Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, Failure Classification, Storage, Recovery and Atomicity, Recovery algorithm.

Text Books:

1. Database Management Systems, 3/e, Raghurama Krishnan, Johannes Gehrke, TMH
2. Database System Concepts,5/e, Silberschatz, Korth, TMH

Reference Books:

1. Introduction to Database Systems, 8/e C J Date, PEA.
2. Database Management System, 6/e Ramez Elmasri, Shamkant B. Navathe, PEA
3. Database Principles Fundamentals of Design Implementation and Management, Corlos Coronel, Steven Morris, Peter Robb, Cengage Learning.

Web Links:

1. https://nptel.ac.in/courses/106/105/106105175/
2. https://www.geeksforgeeks.org/introduction-to-nosql/
3. https://www.youtube.com/watch?v=wkOD6mbXc2M
4. https://beginnersbook.com/2015/05/normalization-in-dbms/

PYTHON PROGRAMMING
(Open Elective-I)

V Semester L T P C
Course Code: 231DS5O01 3 0 0 3

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Develop programs using fundamentals of python

CO2: Make use of control statements and strings for developing applications

CO3: Develop applications using data structures and functions

CO4: Apply OOPs concepts and files for developing programs

CO5: Illustrate Exception Handling to handle runtime errors.

CO6: Build applications using GUI.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	-	1	-	-	-	-	-	-	2
CO2	2	2	3	-	1	-	-	-	-	-	-	2
CO3	2	2	2	-	1	-	-	-	-	-	-	2
CO4	2	2	2	-	1	-	-	-	-	-	-	2
CO5	2	1	2	-	1	-	-	-	-	-	-	2
CO6	2	1	3	-	1	-	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	2	-
CO6	1	-

Unit - I

Programming: Introduction to Programming Concepts with Scratch Introduction: Introduction to Python, Program Development Cycle, Input, Processing, and Output, Displaying Output with the Print Function, Comments, Variables, Reading Input from the Keyboard, Performing Calculations, Operators. Type conversions, Expressions, More about Data Output. Data Types Expression: Strings Assignment, and Comment, Numeric Data Types and Character Sets, Using functions and Modules. Decision Structures and Boolean Logic: if, if-else, if-elif-else Statements, Nested Decision Structures, Comparing Strings, Logical Operators, Boolean Variables. Repetition Structures: Introduction, while loop, for loop, Calculating a Running Total, Input Validation Loops, Nested

Loops

Unit – II

Control Statement: Definite iteration for Loop Formatting Text for output, Selection if and if else Statement Conditional Iteration The While Loop Strings and Text Files: Accessing Character and Substring in Strings, Data Encryption, Strings and Number Systems, String Methods Text Files

Unit – III

List and Dictionaries: Lists, Defining Simple Functions, Dictionaries Design with Function: Functions as Abstraction Mechanisms, Problem Solving with Top Down Design, Design with Recursive Functions, Case Study Gathering Information from a File System, Managing a Program's Namespace, Higher Order Function. Modules: Modules, Standard Modules, Packages

Unit – IV

Object Oriented Programming: Concept of class, object and instances, Constructor, class attributes and destructors, Real time use of class in live projects, Inheritance , overlapping and overloading operators, Adding and retrieving dynamic attributes of classes, Programming using Oops support Design with Classes: Objects and Classes, Data modeling Examples, Case Study An ATM, Structuring Classes with Inheritance and Polymorphism File Operations: Reading config files in python, Writing log files in python, Understanding read functions, read(), readline() and readlines(), Understanding write functions, write() and writelines(), Manipulating file pointer using seek, Programming using file operations

Unit – V

Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, User- defined Exceptions, Defining Clean-up Actions, Redefined Clean up Actions. Graphical User Interfaces: The Behavior of Terminal Based Programs and GUI - Based, Programs, Coding Simple GUI-Based Programs, Other Useful GUI Resources.

Text Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2018
2. Beginning Python: from Novice to Professional, Lie Hetland, Magnus, 2nd Edition, 2005

Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 2017.
3. Think Python, Allen Downey, Green Tea Press,2012 .
4. Python for Everybody Exploring Data in Python 3, Charles Russell Severance, Sue Blumenberg.

Web Links:

1. https://www.python.org/
2. https://www.coursera.org/courses?query=Python%20programming
3. https://www.learnpython.org/
4. https://www.tutorialspoint.com/python3/python_tutorial.pdf

COMPUTER ORGANIZATION
(Open Elective-I)

V Semester **L T P C**
Course Code: 231IT5O01 **3 0 0 3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Describe the basic structure of a computer system, various number systems and arithmetic operations.
CO2: Explain the Operation of CPUs including RTL, ALU, Instruction Cycle and Buses
CO3: Demonstrate the architecture and functionality of central processing unit
CO4: Illustrate the I/O and memory organization in an efficient way.
CO5: Make use of multi processors and pipelining to improve the efficiency of computer system.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	1	-	-	-	-	-	-	-	-
CO2	3	1	1	2	-	-	-	-	-	-	-	-
CO3	2	2	2	3	-	-	-	-	-	-	-	-
CO4	2	1	3	2	-	-	-	-	-	-	-	-
CO5	2	3	1	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I
Basic Structure of Computers: Basic Organization of Computers, Historical Perspective, Bus Structures. Data Representation: Data types, Complements, Fixed Point Representation. Floating – Point Representation. Other Binary Codes, Error Detection Codes. Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms.

Unit – II
Register Transfer Language and Microoperations: Register Transfer language. Register Transfer Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit.Basic Computer Organization and Design: Instruction Codes, Computer Register, Computer Instructions, Instruction Cycle, Memory – Reference Instructions. Input – Output and Interrupt, Complete Computer Description,

UNIT-III
Central Processing Unit: General Register Organization, STACK Organization. Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.
Microprogrammed Control: Control Memory, Address Sequencing, Micro Program example, Design of Control Unit.

Unit – IV
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct Memory Access.

Unit – V

Multi Processors: Introduction, Characteristics of Multiprocessors, Interconnection Structures, Inter Processor Arbitration.
Pipeline: Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor.

Text Books:

1. Computer System Architecture, M. Morris Mano, Third Edition, Pearson, 2008.
2. Computer Organization, Carl Hamacher, ZvonkoVranesic, SafwatZaky, 5/e, McGraw Hill, 2002.

Reference Books:

1. Computer Organization and Architecture, William Stallings, 6/e, Pearson, 2006.
2. Structured Computer Organization, Andrew S. Tanenbaum, 4/e, Pearson, 2005.
3. Fundamentals of Computer Organization and Design, Sivarama P. Dandamudi, Springer, 2006

Web Links:

1. https://nptel.ac.in/courses/106/105/106105163/
2. https://nptel.ac.in/courses/106/106/106106092/
3. https://www.udemy.com/course/computer-architecture-computer-organization-course/
4. http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pd

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Object Oriented Programming Through Java
(Open Elective-I)

	L	T	P	C
V Semester:	**L**	**T**	**P**	**C**
Course Code: 231AM5O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Create Well-Structured Java Programs Using Object-Oriented Programming Principles

CO2: Create and implement Java classes, objects, and methods.

CO3: Analyze and utilize arrays and inheritance in Java programs.

CO4: Integrate packages, libraries, and exception handling in Java applications.

CO5: Design and construct advanced Java applications with strings, multithreading, JDBC, and Java FX.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	3	-	-	-	-	-	-	-
CO2	3	-	3	-	3	-	-	-	-	-	-	-
CO3	2	3	2	-	3	-	-	-	-	-	-	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-
CO5	3	3	3	-	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	1
CO4	-	2
CO5	-	3

UNIT - I

Object Oriented Programming: Basic concepts, Principles, Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

Data Types, Variables, and Operators : Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, Introduction to Operators, Precedence and Associativity of Operators, Assignment Operator, Basic Arithmetic Operators, Increment and Decrement Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

Control Statements: Introduction, if Expression, Nested if Expressions, if-else Expressions, Ternary Operator, Switch Statement, Iteration Statements, while Expression, do-while Loop, for Loop, Nested for Loop, For-Each for Loop, Break Statement, Continue Statement.

UNIT - II

Classes and Objects: Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, Keyword this.

Methods: Introduction, Defining Methods, Overloaded Methods, Overloaded Constructor Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods, Overriding Methods, Attributes Final and Static

UNIT - III

Arrays: Introduction, Declaration and Initialization of Arrays, Storage of Array in Computer Memory, Accessing Elements of Arrays, Operations on Array Elements, Assigning Array to Another Array, Dynamic Change of Array Size, Sorting of Arrays, Search for Values in Arrays, Class Arrays, Twodimensional Arrays, Arrays of Varying Lengths, Three dimensional Arrays, Arrays as Vectors.

Inheritance: Introduction, Process of Inheritance, Types of Inheritances, Universal Super ClassObject Class, Inhibiting Inheritance of Class Using Final, Access Control and Inheritance, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes, Interfaces and Inheritance.

Interfaces: Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

UNIT - IV

Packages and Java Library:

Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto boxing and Autounboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class, Temporal Adjusters Class.

Exception Handling: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

Java I/O and File: Java I/O API, standard I/O streams, types, Byte streams, Character streams, Scanner class, Files in Java(Text Book 2)

UNIT - V

String Handling in Java: Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer.

Multithreaded Programming: Introduction, Need for Multiple Threads Multithreaded Programming for Multicore Processor, Thread Class, Main ThreadCreation of New Threads, Thread States, Thread PrioritySynchronization, Deadlock and Race Situations, Interthread Communication Suspending, Resuming, and Stopping of Threads.

Java Database Connectivity: Introduction, JDBC Architecture, Installing MySQL and MySQL Connector/J, JDBC Environment Setup, Establishing JDBC Database Connections, ResultSet Interface

Java FX GUI: Java FX Scene Builder, Java FX App Window Structure, displaying text and image, event handling, laying out nodes in scene graph, mouse events (Text Book 3)

Text Books:

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.
3. JAVA 9 for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

Reference Books:

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson

Web Links:

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

INTRODUCTION TO PETROLEUM ENGINEERING

(OPEN ELECTIVE-I)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231PT5O01	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1:	Differentiate between Upstream, Mid-stream and Downstream processes
CO2:	Explain the concept of Hydrocarbon Phase diagrams and Reservoir Drives
CO3:	Demonstrate the production system and subsea wells
CO4:	Explain about production separators and transportation process.
CO5:	Discuss about refinery products and safety in refinery operations.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Introduction: What is Petroleum Engineering and its Significance? Introduction to Petroleum Industry- Upstream Sector – Midstream Processing-Downstream Processing- Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II

Upstream Sector-1: Exploration & Production – Indian and World Scenario of Petroleum and Natural Gas Resources.

The Reservoir –Reservoir fluids- Hydrocarbon Phase diagrams- Onshore and Offshore Reservoirs – Reservoir Drives.

UNIT III

Upstream Sector-2: Drilling Rigs- Rig Components-Drill and drill bits- Drilling Fluids-Well Completions.

Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.

Subsea Wells: Drilling & Completion and Production.

Artificial Lift: Principles and operation of Rod Pumps –Gas Lift –Electrical submersible pumps.

Well Workover and Intervention- Well Stimulation: Basic concepts in Matrix Acidizing and Hydro-fracturing.

UNIT IV

Gathering of Oil & Gas and Storage:

Well Tubing- Separation of Reservoir Fluids- Manifolds and Gathering – Production Separators – Gas Treatment and Compression - Oil & Gas Storage, Metering and Export.

Midstream processing: Transportation of Crude Oil & its Products and Natural Gas - World and Indian pipeline scenario- Design of Oil and Gas pipelines - Safety aspects of pipelines- Environmental issues.

UNIT V

Downstream Processing:

Crude Oil Refining: Classification and Composition – Constituents - Products and their specifications– Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Text Books:

1. Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, Havard Devold, ABB ATPA Oil and Gas, 2006.
2. Introduction to Petroleum Engineering, John R. Fanchi and Christiansen, R.L., John Wiley & Sons, 2017.

Reference Books:

1. Petroleum engineering handbook: Howard.B. Bradley,SPE,1987
2. Petroleum engineering hand book: Larry .W.lake, SPE, volume II, 2006.
3. Petroleum engineering handbook: Production operations engineering, volume IV, Joe Dunn Clegg, 2009.

Web Links:

1. http://182.72.188.194:8080/jspui/bitstream/123456789/1493/1/Introduction%20to%20Petroleum%20Engineering%20by%20John%20R.%20Fanchi.pdf
2. https://guides.loc.gov/oil-and-gas-industry/upstream
3. https://www.slideshare.net/slideshow/fundamentals-of-petroleum-engineering-module-4/68976696
4. https://www.slideshare.net/slideshow/an-introduction-to-oil-and-gas-production/92982115
5. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCH1308.pdf

INTRODUCTION TO PETROLEUM GEOLOGY

(OPEN ELECTIVE-I)

V Semester	L	T	P	C
Course Code: 231PT5O02	3	0	0	3

Course Outcomes:At the end of the Course, Student will be able to:

CO 1: Apply the concepts of igneous, sedimentary, metamorphic rocks to evaluate drilling operations

CO 2: Identify different source rocks from which hydrocarbons are generated.

CO 3: Classify the sources of reservoir rocks, pore space, porosity and permeability

CO 4: Classify and evaluate the sedimentary basins in India.

CO 5: Gain knowledge of fluid hydrocarbons migration

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Dimensions of earth, structure, composition and origin of earth-envelops of the Earth- crust, mantle, core. Internal dynamic process- Plate tectonics- continental drift, Earthquake and volcanoes. External dynamic process- weathering, erosion and deposition.

Origin of igneous, sedimentary and metamorphic rocks. Sedimentary structures-petrographic character of conglomerate, sandstone, shale, limestone.

UNIT-II

Source rocks- Definition of source rocks, organic source rocks, nature and types of source rocks.

The process of diagenesis, catagenesis and metagenesis in the formation of source rocks, Kerogen- types, thermal maturation, sub-surface pressure temperature conditions for the generation of oil and gas from the source sediments – oil window.

UNIT-III

Characteristics of Reservoir rocks: Classification and nomenclature: Clastic Reservoir Rocks, Carbonate Reservoir Rocks, Unconventional, Fractured and Miscellaneous reservoir rocks, Marine and non-marine reservoir rocks.

UNIT-IV

Reservoir Properties and Cap Rocks: Reservoir pore space, porosity- primary and secondary porosity, effective porosity, fracture porosity – permeability, saturation- effective and relative permeability relationship between porosity, permeability. Cap rocks: Definition and characteristics of cap rocks.

Introduction to sedimentary basins and deltaic systems. Topographic maps, thematic maps, Topographic and thematic profiles.

UNIT-V

Hydrocarbon migration: Geological framework of migration and accumulation, the concept of hydrocarbon migration from source beds to the carrier beds, carrier beds to the reservoir.

Classification and types of traps, Structural, stratigraphic and combination type of traps, Traps associated with salt domes.

Sedimentary Basins: Introduction to sedimentary basins.

Tectonic classification, stratigraphic evolution and hydrocarbon accumulations of the following basins: Krishna-Godavari basin, Assam Arakan basin, Cambay basin and Mumbai off-shore.

Text Books:

1. Bell, F.G., Engineering Geology, 2ndEdition,ButterworthHeimann,2007.
2. Mukharje, P.K., Text book of Geology, P.K The World Press PvtLtd., 2005.

Reference Books:

1. Gribble, C. D., Rutley's Elements of Mineralogy, 27th Edition. CBS Publishers, 2005.
2. David Duff, Homes' Principles of Physical Geology, Nelson Thornes Ltd; 4th Revised edition, 1992.
3. Mahapatra, G.B., Text Book of Physical Geology, CBS Publishers, 2002.
4. Bangar, K.M., Principles of Engineering Geology, 2nd Edition, Standard Publishers, 2009.

Web Links:

1. https://www.intechopen.com/chapters/68134
2. https://www.slideshare.net/SohailNawab2/source-rock-225744009
3. https://www.slideshare.net/Thomaschinnappan/reservoir-rock-in-fuel-geology
4. https://www.slideshare.net/slideshow/properties-of-reservoir-rocks/15829800
5. https://www.slideshare.net/slideshow/hydrocarbon-generation-migration/38904584

INTRODUCTION TO WELL LOGGING

(OPEN ELECTIVE-I)

	L	T	P	C
V Semester				
Course Code: 231PT5O03	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1	Discuss about Classification of well logging methods.
CO2	Identify different types of logging methods.
CO3	Different ion between cased hole logging and production logging.
CO4	List out the various advances in well logging.
CO5	Estimate the hydrocarbon reserves with the help of well logging tools.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Direct Methods: Mud logging- coring – conventional and sidewall coring - Core analysis.

Concepts of well logging: What is well logging? - Logging Terminology-Borehole environment Borehole temperature and pressure-Log header and depth scale-Major components of well Logging unit and logging setup- Classification of well logging methods- Log presentation- Log quality control.

UNIT-II

Open hole logging: SP Logging- Origin of SP, uses of SP log-Calculation of salinity of formation water- Shaliness-Factors influence SP log.

Resistivity log: Single point resistance log (SPR)- Conventional resistivity logs- Response of potential and gradient logs over thin and thick conductive and resistive formations-Limitations

of conventional resistivity tools, Focused resistivity log- Advantages of focused resistivity tools over conventional resistivity tools.
Micro resistivity log: Conventional and focused micro resistivity logs and their application.
Induction log: Principle of induction tool and the advantages. Criteria for selection of induction and lateral logging tool. Determination of true resistivity (Rt) of the formation-Resistivity index Archie's equation.

UNIT III

Cased hole logging: Gamma ray spectral log-Neutron decay time log-Determination of fluid saturation behind casing-Cement bond log- Casing collar log-Depth control- Perforation technique- Free point locater and Plug setting-Casing inspection logs.
Production logging: Solving production problems with the help of Fluid Density log Temperature log and Flow meter logs.

UNIT IV

Advances in Well logging: Dip meter log-Formation tester-Cased hole resistivity logs –Nuclear magnetic resonance log & Scanner logs (Sonic scanner, MR scanner Rt scanner).Study on confirmation of log interpretation, and also recording resistivity in cased holes.

UNIT V

Interpretation: Quick look interpretation- Cross plots. Neutron- Density, Sonic- Density, SonicNeutron cross plots-Hingle plot-Mid plot –Correlation- Hydrocarbon reserve estimate.

Text Books:

1. Formation evaluation, Edward J. Lynch, Harper & Row, 1962.
2. Well logging and formation evaluation, Toby Darling, Elsevier, New York, 2005.
3. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip, 2007.

Reference Books:

1. Hydrocarbon well logging recommended practice, Society of professional well log analysts.
2. Open – Hole log analysis and formation evaluation, Richard M. Batemons, International Human Resources Development Corporation, Bostan, 1985.
3. Well Logging for Earth Scientists, Darwin V. Ellis, Julian M. Singer, Springer, 2007.
4. Fundamentals of Well Log Interpretation: The Acquisition of Data, Oberto Serra,Elsevier, 1984.
5. Well Logging Handbook, Oberto Serra, Editions Technip, 2008.

Web Links:

1. https://www.slideshare.net/slideshow/well-log-the-bore-hole-image/86438073
2. https://homepages.see.leeds.ac.uk/~earpwjg/PG_EN/CD%20Contents/GGL-66565%20Petrophysics%20English/Chapter%2018.PDF
3. https://www.academia.edu/10349436/Cased_Hole_Wireline_Services_4_1_Cased_Hole_Wireline_Services_Cased_Hole_Wireline_Services_Formation_Evaluation_TMD_L_Thermal_Multigate_Decay_Lithology_Logging_Tool
4. https://www.academia.edu/332061/Well_Logging
5. https://esd.halliburton.com/support/LSM/GGT/PetroWorks/PetroWorks/5000/5000_0/Help/CrossPlot.interface.pdf?searchid=1405196362286

INTRODUCTION TO UNDERGROUND MINING
(OPEN ELECTIVE – I)

V Semester	**L T P C**
Course Code: 231MI5O01	**3 0 0 3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Outline coal mining industry trends and modes of mine entry.

CO2: Describe bord and pillar mining operations with safety measures.

CO3: Explain longwall mining methods and their applicability.

CO4: Analyze thick and deep seam mining methods and challenges.

CO5: Summarize modern underground mining techniques and innovations.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Introduction: Present situation and future growth of coal mining industry in India and world, different coal mining industries in India, factors effecting selection of mode of entry and different types of mode entry: incline, shaft, inclined shaft, coal mine development and its scenario, different terminology used in coal mine development, different coal mining methods, factors influencing choice of coal mining methods. Software application in coal mines for development and depillaring operations.

UNIT-II

Bord and Pillar Mining: applicability, limitations, advantages and disadvantages of Bord and pillar mining method, development and depillaring sequence operations in Bord and Pillar mining, and its related calculations, local fall, main fall, airblast. Dangers associated with B& Pmethod and precautions. Case study with layout.

UNIT–III

Longwall Mining: Applicability, limitations, merits and demerits, different long wall mining methods, factors influencing selection of long wall method, method of development and depillaring and its related calculations. Thin seam and thick seam mining with long wall mining method, Case study with layout.

UNIT-IV

Thick Seam and deep seam Mining: Problems associated with thick and deep seam Mining, selection of mining method, caving and stowing methods, limitations and applicability: different slicing methods- (inclined Slicing, Horizontal Slicing, Diagonal Slicing, Transversely Inclined Slicing),and Caving methods (Sublevel Caving) Working Steep and Moderately Thick Seams: Blasting Gallery Method, room and pillar method,

UNIT– V

Modern coal mining methods: applicability, limitations, merits and demerits of Inseam Mining and Horizon Mining, Hydraulic Mining, plough methods, working underneath surface features, extraction of multi seams, problems and issues:

Future Innovations: blind long hole pre-shattering methods, scientific mining approach, application of mining software for mine development and extraction and production planning and design of workings, Size and grade control by CSP and CWP, case study.

Text Books:

1. Principles and Practices of Modern Coal Mining–R.D. Singh, New Age International,1997.
2. Modern Coal Mining Technology–S.K.Das, 2^nd^edition, Lovely PrakashanPublishers,1994.

Reference Books:

1. Under ground Coal Mining Methods–J.G.Singh, BrajKalpa Publishers, Varnasi,2000.
2. Coal Mining – I.C.F. Statham, Vol. I, II, III and Vol. III. The Caxton Publishing CompanyLtd.Inc.1958.
3. Elements of Minning technology-D.JDeshmukhVol.1
4. Modern Coal mining Technology: SamirkumarDas
5. Under ground winning of coal:T.NSingh

Web Links:

1. https://arlweb.msha.gov/Fatals/AccidentClassifications.asp
2. http://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement and_
3. http://www.sciencedirect.com/topics/earth-and-planetary-sciences/rock-mechanics

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INTRODUCTION TO SURFACE MINING
(OPEN ELECTIVE – I)

V Semester	**L T P C**
Course Code: 231MI5O02	**3 0 0 3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Describe the applicability and limitations of opencast mining.

CO 2: Design open pit layouts considering bench parameters and slope stability.

CO 3: Explain drilling and blasting techniques with design considerations.

CO 4: Differentiate between surface mining methods and excavation equipment.

CO 5: Select appropriate transportation systems and equipment for surface mines.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Introduction: General consideration for the applicability of open cast mining, limits of opencast mining and its advantages and disadvantages. Method of opening box cut, selection of site for boxcut.

UNIT-II

Open Pit Layout and Design: Planning the layout and open pit mine with special reference to large mechanized mines. Optimum dimensions of open pit mines. Removal of over burden and disposal, open cast bench-number, height, width and slope angle of the bench. Factors affecting the stability of the slope. Various types of slope failures, problems on slope failures. Ground water control.

UNIT-III

Drilling and Blasting: Drill ability, mechanics of drilling, major types of drilling machines, basics of mechanics of blasting, principles of fragmentation.

Design of blasting: with special reference to heavy blasting, air blasting, ground vibrations, fly rocks novel methods of drilling, smooth blasting and pre-splitting.

UNIT-IV

Surface Mining Methods: Casting, strip, quarrying and Placer Mining, and Modern Methods Excavation and loading: Shovels, Dragline, Front-end loader, Stackers, Graders. Non-Cyclic Surface Mining: Bucket Wheel Excavators and Continuous surfaceminers.

UNIT-V

Transport Equipment: Dumpers, Aerial ropeways-monocable and bicable types and their constructional details. Shovel – dumper combination, high angle conveyor and in-pit crusher. Selection of equipment.

Text Books:

1. Surface Mining Technology by S.K.Das, Lovely Prakashan, Dhanbad,1994.
2. Surface Mining by G.B. Mishra, Dhanbad Publishers,1978.

Reference Books:

1. Elements of Mining Technology, Vol.–I, D.J.Deshmukh, 6thEdition, Central Techno Publications,Nagpur,1998.
2. Opencast Mining–R.T.Deshmukh, M.Publications, Nagpur,1996.
3. Latest Development of Heavy Earth Moving Machinery Amithosh De, Annapurna Publishers, Dhanbad,1995.
4. Rock Slope Engineering, Hoek and Bray, theInstitutionofMiningandMetallurgy,1981.
5. Introductory Mining Engineering, Hartman, John Wiley and Sons,1987.

Web Links:

1. https://arlweb.msha.gov/Fatals/AccidentClassifications.asp
2. http://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_
3. http://www.sciencedirect.com/topics/earth-and-planetary-sciences/rock-mechanics

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TUNNELLING AND UNDERGROUND SPACE DESIGN
(OPEN ELECTIVE – I)

V Semester	**L T P C**
Course Code: 231MI5O03	**3 0 0 3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the role of underground space in urban infrastructure and evaluate parameters influencing tunnel location and design.

CO2: Compare different tunnelling methods for soft and hard ground conditions with supporting techniques.

CO3: Analyze tunnel excavation through drilling and blasting, including blast design and equipment selection.

CO4: Evaluate mechanized tunnelling methods including TBMs, road headers, and impact hammers.

CO5: Design tunnels using field data, numerical modelling, and monitoring systems for stability assessment.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT I

INTRODUCTION: Congestion in cities and its impact on development of social infrastructure for transport, water and power supply, separation of pedestrian and motorized vehicles and its movements, storage of materials, defense facilities including civil shelters. Parameters influencing location, shape and size; geological aspects; planning and site investigations. Tunnels for various purposes like road, rail, hydropower tunnels and caverns, Underground storage applications.

UNIT II

TUNNELLING METHODS: Types and purpose of tunnels; factors affecting choice of excavation techniques; soil and rock sampling and testing, Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

UNIT III

TUNNELLING BY DRILLING AND BLASTING: Unit operations in conventional tunneling; Drilling - drilling principles, drilling equipment, drilling tools, drill selection, specific drilling, rock drillability factors; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts - fan, wedge and others; 21 blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

UNIT IV

MECHANIZED TUNNELLING: Cutting principles, method of excavation, selection, performance, limitations and problems. Boring principles, method of excavation, selection, performance, limitations and problems; Road headers, Impact Hammers, Tunnel Boring Machines and applications.

UNIT V

TUNNEL DESIGN: Planning and design, Assessment of behavior of tunneling media, deformation modulus and rock pressure assessment; determination of appropriate size and shape; Design of openings in rocks with the help of field data; Instrumentation and monitoring; Numerical modeling to assess the stability.

Text Books:

1. Hudson, J.A., Rock Engineering Systems Theory and Practice, Ellis Horwood, England.
2. Clark G.B., (1987), Principles of Rock Fragmentation, John Wiley and Sons, New York.

Reference Books:

1. Lohanson, John and Mathiesen, C.F., Modern trends in Tunnelling and Blast Design, AA Balkima, 154 P, 2000.
2. Bickel J.O., Kuesel T.R. and King E.H., Tunnel Engineering Hand Book, Chapmen & Hill Inc., New York and CBS Publishers, New Delhi 2nd addition.

Web Links:

1. https://arlweb.msha.gov/Fatals/AccidentClassifications.asp
2. http://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_
3. http://www.sciencedirect.com/topics/earth-and-planetary-sciences/rock-mechanics

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INTRODUCTION TO MINE ENVIRONMENT

(OPEN ELECTIVE – I)

		L	T	P	C
V Semester					
Course Code:	**231MI5O04**	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1:	Explain the causes and control measures of spontaneous heating in underground and surface coal mines.
CO 2:	Analyze fire hazards in mines and outline methods for fire prevention, control, and firefighting in different mining environments.
CO 3:	Evaluate causes and preventive strategies for firedamp and coal dust explosions, including explosion investigations.
CO 4:	Design preventive and recovery systems for mine inundation and plan approaches to old workings.
CO 5:	Describe rescue and recovery operations in mine emergencies and the role of rescue equipment and stations.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-

UNIT - I

SPONTANEOUS HEATING Causes, detection and preventive measures in underground and surface coal mines, control of spontaneous heating in stacks and dumps..

UNIT-II

MINE FIRES Mine fires, control of fires and fires extinguishers, study of atmosphere behind sealed off areas, fire stopping and sealing off an area, pressure balancing, conditions and procedure of reopening a sealed off area, firefighting organization. Fires in opencast mines and surface storage systems, emergency organization in mines.

UNIT-III

EXPLOSION Fire damp and coal dust explosions, their causes and prevention, stone dust and water barriers, investigations of explosion.

UNIT-IV

MINE INNUNDATION Causes and precautionary measures, bulk head doors, barriers, dams, their design, precautions to be taken while approaching old workings, burnside drilling apparatus, recovery of flooded mines and de watering of old workings.

UNIT-V

RESCUE AND RECOVERY Types of rescue equipment and their use, features of rescue stations and rescue rooms, first aid appliances, training of personnel, and organization of rescue and recovery work during mine fires, explosion, inundation.

Text Books:

1. Mine Environment By G.B. Mishra
2. Elements of Mining Tech. Vol.2 by D. J. Deshmukh
3. Subsurface Mine Ventilation. by Mcpherson

Reference Books:

1. Mine fires by Dr. Ramlu
2. Underground Mine Environment, M. Mcpherson
3. Subsurface Mine Ventilation, H.L. Hartman

Web Links:

1. https://arlweb.msha.gov/Fatals/AccidentClassifications.asp
2. http://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_
3. http://www.sciencedirect.com/topics/earth-and-planetary-sciences/rock-mechanics

BASIC CROP PRODUCTION PRACTICES

(Open Elective-I)

V Semester	**L**	**T**	**P**	**C**
Course Code: 231AG5O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Explain factors affecting on crop growth and production.

CO 2: Explain crop selection and establishment of an adequate crop stand and ground cover.

CO 3: Explain crop water management using integrated water management methods.

CO 4: Apply agriculture crops production practices in field.

CO 5: Apply the horticulture crops production practices in field.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO 1	1	1	-	-	1	-	-	-	-	-	-	2
CO 2	1	-	-	-	2	-	-	-	-	-	-	-
CO 3	1	1	-	-	2	-	-	-	-	-	-	-
CO 4	1	-	1	1	3	-	-	-	-	-	-	-
CO 5	1	-	1	1	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	2	-
CO2	2	-
CO3	3	-
CO4	2	-
CO5	2	-

UNIT - I

Agriculture and Crop Production: Introduction to agriculture and its crop production sub-sectors– field crop production and horticulture; Factors affecting crop growth and production: genetic (internal) and environmental (external) factors; Crop management through environmental modification and adaptation of crops to the existing environment through crop cultural practices.

UNIT – II

Crop Selection and Establishment: Regional and seasonal selection of crops; Systems of crop production; Competition among crop plants; Spacing and arrangement of crop plants; Field preparation for crops including systems of tillage; Establishment of an adequate crop stand and ground cover, including selection and treatment of seed, and nursery growing

UNIT – III

Crop Management: Crop water Management; a Crop nutrition management – need for supplementation to soil supplied nutrients, sources, generalized recommendations, methods and timing of application of supplemental nutrients including fertigation scheduling; Crop protection including management of weeds, pests and pathogens; Integrated methods of managing water, nutrients and plant protection; Types and methods of harvest.

UNIT – IV

Production Practices of Agricultural Crops: Generalized management and cultivation practices for important groups of field crops in Andhra Pradesh: cereal crops, grain legumes, oil seed crops, sugarcane, and fiber crops, and special purpose crops such as those grown for green manure and fodder.

UNIT – V

Production Practices of Horticultural Crops: Important basic groups of horticultural crops in A.P such as vegetable crops, fruit crops, flower crops; Cultivation practices of major fruits, major vegetables and major flowers of each group; Special features of production of horticultural crops – greenhouse cultivation, Organic farming, Zero budget farming, Vertical gardening and Kitchen farming.

Text Books:

1. Rajendra Prasad, Text Book of Field Crop Production. Directorate of Information and Publication, Krishi Anusandhan Bhavan, Pusa, New Delhi, 2015.
2. Reddy T. Sankara G.H. Yellamanda Reddi, Principles of Agronomy, Kalyani Publishers, New Delhi, 2005.
3. Handbook of Agriculture. ICAR Publications, New Delhi, 2011.

Reference Books:

1. Bose T. K. and L.P.Yadav. Commercial Flowers, Naya Prakash, Calcutta.1989.
2. Crop Production Guide, Tamil Nadu Agricultural University Publication, Coimbatore. 2005.
3. Kumar, N., Abdul Khader, M. Rangaswami, P. and Irulappan, I. Introduction to spices, plantation crops, medicinal and aromatic plants. Rajalakshmi Publications, Nagercoil. 1993.
4. Kumar, N., ”Introduction to Horticulture”, Rajalakshmi Publications. Nagercoil, 7th edition, 2015.
5. Shanmugavel, K.G. Production Technology of Vegetable Crops. Oxford India Publications, New Delhi. 1989.

Web Links:

1. https://www.careerlauncher.com/cbse-ncert/class-8/Science/CBSE-CropProduction and Management- Notes.html#:~:text=%E2%80%A2%20Basic%20Practices%20 of%20Crop,is%20called%20ploughing%20or%20tilling.
2. https://www.edubeans.com/Class_VIII_Science_Crop-Production-and-Management.php
3. https://byjus.com/biology/basic-practices-of-crop-production/
4. http://www.apagrisnet.gov.in/pdf/farmerbook.pdf

GROUNDWATER, WELLS AND PUMPS

(Open Elective-I)

V Semester	L	T	P	C
Course Code: 231AG5O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Explain scenario, types and properties of various water bearing formations.
CO 2: Select appropriate method for exploration and replenishment of groundwater.
CO 3: Explain design, development and construction of wells.
CO 4: Determine the aquifer properties under unsteady state and steady state subsurface flow conditions.
CO 5: Explain the types, working principles with components and diagram of various water lifting devices and pumps.
CO 6: Select the pump for irrigation by considering performance characteristics, installation and troubleshooting.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	3	-	1	-	-	-	-	-
CO3	-	-	3	2	-	-	-	-	-	-	-	-
CO4	1	-	2	-	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-	-
CO6	-	3	1	-	3	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	2	-
CO2	3	-
CO3	2	-
CO4	2	-
CO5	2	-
CO6	2	-

Unit - I

Occurrence and movement of ground water; aquifer and its types & properties; classification of wells, fully penetrating tube wells and open wells, familiarization of various types of bore wells.

Unit – II

Groundwater exploration techniques; methods of drilling of wells: percussion, rotary, reverse rotary; design of open wells; design of tube well and gravel pack, installation of well screen, completion and development of well.

Unit – III

Groundwater hydraulics- determination of aquifer parameters by different method such as Theis, Jacob and Chow's, Theis recovery method; well interference, multiple well systems, estimation of ground water potential, quality of ground water; artificial groundwater recharge techniques.

Unit – IV

Pumping systems: water lifting devices; different types of pumps, classification of pumps, component parts of centrifugal pumps, priming, pump selection, installation and troubleshooting, performance curves, effect of speed on capacity, head and power, effect of change of impeller dimensions on performance characteristics.

Unit – V

Propeller pumps; Mixed flow pumps and their performance characteristics; Vertical turbine pump- construction, installation, operation, maintenance and troubleshooting; and submersible pump- construction, installation, operation, maintenance and troubleshooting; hydraulic ram-principal of operation; Economics of pumping.

Text Books:

1. Water Well and Pumps, Michael AM, Khepar SD. and SK Sondhi, 2nd Edition,Tata Mc-Graw Hill, 2008.
2. Irrigation-Theory and Practice, Michael AM., 2nd Edition. Vikas Publishing House Pvt. Ltd, 2018.
3. Principles of Agricultural Engineering Vol-II, Michael A.M. and Ojha T.P. 5th Edition. Jain Brothers Publication, New Delhi, 2014.

Reference Books:

1. Land and Water Management Engineering, Murthy, V.V.N and Jha, M.K. Sixth Edition, Kalyani Publishers, Ludhiana, 2011.
2. Ground Water, Third Edition, New Age International, Raghunath, H.M. Publishers, New Delhi, 2007.
3. Groundwater Development and Management, Sarma, P.B.S., Allied Publishers Pvt. Ltd., New Delhi, 2009.
4. Ground Water Hydrology, Todd, D.K. John Wiley & Sons, New York, 2004.

Web Links:

1. http://ecoursesonline.iasri.res.in/course/view.php?id=513
2. https://nptel.ac.in/courses/105/105/105105042/

Data Mining Lab

V Semester	**L**	**T**	**P**	**C**
Course Code: 231CS5L01	**0**	**0**	**3**	**1.5**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Design a data mart or data warehouse for any organization
CO2: Interpret characteristics of data Sets using WEKA Tool
CO3: Experiment different pre-processing techniques in Data Mining
CO4: Demonstrate the working of algorithms for data mining tasks such as association rule mining, classification for realistic data
CO5: Apply the suitable visualization techniques to output analytical results CO6: Identify appropriate data mining algorithm for solving practical problems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	2	2	-	-	-	1	2	-	2
CO2	2	1	-	3	2	-	-	-	1	2	-	-
CO3	2	3	-	2	2	-	-	-	1	2	-	1
CO4	2	3	2	2	2	-	-	-	1	2	-	2
CO5	2	2	2	2	2	-	-	-	1	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	2
CO4	-	2
CO5	-	2

List of Experiments:

1. Creation of a Data Warehouse.

- Build Data Warehouse/Data Mart (using open source tools like Pentaho Data Integration Tool, Pentaho Business Analytics; or other data warehouse tools like Microsoft-SSIS, Informatica, Business Objects,etc.,)
- Design multi-dimensional data models namely Star, Snowflake and Fact Constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, manufacturing, Automobiles, sales etc).
- Write ETL scripts and implement using data warehouse tools.
- Perform Various OLAP operations such slice, dice, roll up, drill up and pivot

2. Explore machine learning tool “WEKA”

- Explore WEKA Data Mining/Machine Learning Toolkit.
- Downloading and/or installation of WEKA data mining toolkit.
- Understand the features of WEKA toolkit such as Explorer, Knowledge Flow interface, Experimenter, command-line interface.

- Navigate the options available in the WEKA (ex. Select attributes panel, Preprocess panel, Classify panel, Cluster panel, Associate panel and Visualize panel)
- Study the arff file format Explore the available data sets in WEKA. Load a data set (ex. Weather dataset, Iris dataset, etc.)
- Load each dataset and observe the following:

1. List the attribute names and they types
2. Number of records in each dataset
3. Identify the class attribute (if any)
4. Plot Histogram
5. Determine the number of records for each class.
6. Visualize the data in various dimensions

3. Perform data preprocessing tasks and Demonstrate performing association rule mining on data sets

- Explore various options available in Weka for preprocessing data and apply Unsupervised filters like Discretization, Resample filter, etc. on each dataset
- Load weather. nominal, Iris, Glass datasets into Weka and run Apriori Algorithm with different support and confidence values.
- Study the rules generated. Apply different discretization filters on numerical attributes and run the Apriori association rule algorithm. Study the rules generated.
- Derive interesting insights and observe the effect of discretization in the rule generation process.

4. Demonstrate performing classification on data sets Weka/R

- Load each dataset and run 1d3, J48 classification algorithm. Study the classifier output. Compute entropy values, Kappa statistic.
- Extract if-then rules from the decision tree generated by the classifier, Observe the confusion matrix.
- Load each dataset into Weka/R and perform Naïve-bayes classification and k-Nearest Neighbour classification. Interpret the results obtained.
- Plot RoC Curves
- Compare classification results of ID3, J48, Naïve-Bayes and k-NN classifiers for each dataset, and deduce which classifier is performing best and poor for each dataset and justify.

5. Demonstrate performing clustering of data sets

- Load each dataset into Weka/R and run simple k-means clustering algorithm with different values of k (number of desired clusters).
- Study the clusters formed. Observe the sum of squared errors and centroids, and derive insights.
- Explore other clustering techniques available in Weka/R.
- Explore visualization features of Weka/R to visualize the clusters. Derive interesting insights and explain.

6. Demonstrate knowledge flow application on data sets into Weka/R

- Develop a knowledge flow layout for finding strong association rules by using Apriori, FP Growth algorithms
- Set up the knowledge flow to load an ARFF (batch mode) and perform a cross validation using J48 algorithm

- Demonstrate plotting multiple ROC curves in the same plot window by using j48 and Random forest tree.

7. Demonstrate ZeroR technique on Iris dataset (by using necessary preprocessing technique(s)) and share your observations.
8. Write a java program to prepare a simulated data set with unique instances.
9. Write a Python program to generate frequent item sets / association rules using Apriori algorithm.
10. Write a program to calculate chi-square value using Python/R. Report your observation.
11. Write a program of Naive Bayesian classification using Python/R programming language.
12. Implement a Java/R program to perform Apriori algorithm.
13. Write a R program to cluster your choice of data using simple k-means algorithm using JDK.
14. Write a program of cluster analysis using simple k-means algorithm Python/R programming language.
15. Write a program to compute/display dissimilarity matrix (for your own dataset containing at least four instances with two attributes) using Python.
16. Visualize the datasets using matplotlib in python/R.(Histogram, Box plot, Bar chart, Pie chart etc.,)

Reference Books:

1. Learning Data Mining with Python , Second Edition, Robert Layton, Packt Publishers, ISBN-13: 978-1787126787
2. Java Data Mining: Strategy, Standard, and Practice: A Practical Guide for Architecture, Design, and Implementation,Mark F. Hornick , Erik Marcadé, Sunil Venkayala,Kindle Publishers, ISBN-10. 0123704529

Web Links:

1.https://nptel.ac.in/courses/106107220
2.https://dzone.com/refcardz/data-mining-discovering-and
3.https://www.springboard.com/blog/data-science/data-mining-python-tutorial/
4.https://www.cs.waikato.ac.nz/ml/weka/book.html
5.http://facweb.cs.depaul.edu/mobasher/classes/ect584/weka/index.html

Computer Networks Lab
(Common to CSE, IT & CSE(DS))

V Semester	**L**	**T**	**P**	**C**
Course Code: 231CS5L02	**0**	**0**	**3**	**1.5**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Analyze network devices and framing methods.

CO2: Explain the working of error detection and correction techniques.

CO3: Make use of various routing algorithms for effective data transmission

CO4: Discuss various sliding window Protocols and congestion control algorithm for traffic shaping.

CO5: Demonstrate the working of packet transfer with and without network management tools.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	1	-	-	-	1	2	-	1
CO2	2	2	2	-	1	-	-	-	1	2	-	1
CO3	2	2	2	2	1	-	-	-	1	2	-	1
CO4	1	1	1	1	1	-	-	-	1	2	-	1
CO5	2	2	2	1	1	-	-	-	1	2	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	POS1	POS2
CO1	1	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

List of Experiments:

1. Study of Network devices in detail and connect the computers in Local Area Network.
2. Write a Program to implement the data link layer framing methods such as

i) Character stuffing ii) bit stuffing.

3. Write a Program to implement data link layer framing method checksum.
4. Write a program for Hamming Code generation for error detection and correction.
5. Write a Program to implement on a data set of characters the three CRC polynomials – CRC 12, CRC 16 and CRC CCIP.
6. Write a Program to implement Sliding window protocol for Goback N.
7. Write a Program to implement Sliding window protocol for Selective repeat.
8. Write a Program to implement Stop and Wait Protocol.
9. Write a program for congestion control using leaky bucket algorithm

10. Write a Program to implement Dijkstra ‘s algorithm to compute the Shortest path through a graph.

11. Write a Program to implement Distance vector routing algorithm by obtaining routing table at each node (Take an example subnet graph with weights indicating delay between nodes).

12. Write a Program to implement Broadcast tree by taking subnet of hosts.

13. Wire shark

i. Packet Capture Using Wire shark

ii. Starting Wire shark

iii. Viewing Captured Traffic

iv. Analysis and Statistics & Filters.

List of Augmented Experiments:

14. How to run Nmap scan

15. Operating System Detection using Nmap

16. Do the following using NS2 Simulator

i. NS2 Simulator-Introduction

ii. Simulate to Find the Number of Packets Dropped

iii. Simulate to Find the Number of Packets Dropped by TCP/UDP

Reference Books:

1. Data Communications and Networking – Behrouz A.Forouzan, 5th Edition, McGraw Hill Education, 2012. ISBN-13 : 978-1259064753
2. Computer Networks–Asystem’s approach, Larry L Peterson, Bruce S Davie, 5th Edition, Elsevier,2011. ISBN-13 : 978-0123850591
3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 6th Edition, Pearson Education, 2013. ISBN-13 : 978-9332585492

Web Links:

1. https://www.coursera.org/learn/fundamentals-network-communications.
2. http://www.scribd.com/doc/58478622/Computer-Networks-Forouzan.
3. https://www.udacity.com/course/computer-networking

Full Stack Development – 2
(Common to CSE & AIML)

	L	T	P	C
V Semester **Course Code: 231CS5S01**	**0**	**1**	**2**	**2**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Create a web server using Express.js
CO2:	Make use of router, template engine and authentication using sessions to develop application in ExpressJS.
CO3:	Build a single page application using RESTful APIs in ExpressJS.
CO4:	Apply router and hooksin designing ReactJS application.
CO5:	Utilize MongoDB queries to handle Create, Read, Update, and Delete actions on a document database.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	2	-	-	-	-	-	-	2
CO2	2	2	2	-	2	-	-	-	-	-	-	2
CO3	2	2	2	-	2	-	-	-	-	-	-	2
CO4	2	3	3	-	3	-	-	-	-	-	-	3
CO5	2	3	3	-	3	-	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

List of Experiments

WEEK 1:

ExpressJS – Routing, HTTP Methods, Middleware.

a.Write a program to define a route, Handling Routes, Route Parameters, Query Parameters and URL building.

b.Write a program to accept data, retrieve data and delete a specified resource using http methods.

c.Write a program to show the working of middleware.

WEEK 2:

ExpressJS – Templating, Form Data

a.Write a program using templating engine.

b.Write a program to work with form data.

WEEK 3:
ExpressJS – Cookies, Sessions, Authentication
a.Write a program for session management using cookies and sessions.
b.Write a program for user authentication.

WEEK 4:
ExpressJS – Database, RESTful APIs
a.Write a program to connect MongoDB database using Mangoose and perform CRUD operations.
b.Write a program to develop a single page application using RESTful APIs.

WEEK 5:
ReactJS – Render HTML, JSX, Components – function & Class
a.Write a program to render HTML to a web page.
b.Write a program for writing markup with JSX.
c.Write a program for creating and nesting components (function and class).

WEEK 6:
ReactJS – Props and States, Styles, Respond to Events
a.Write a program to work with props and states.
b.Write a program to add styles (CSS & Sass Styling) and display data.
c.Write a program for responding to events.

WEEK 7:
ReactJS – Conditional Rendering, Rendering Lists, React Forms
a.Write a program for conditional rendering.
b.Write a program for rendering lists.
c.Write a program for working with different form fields using react forms.

WEEK 8:
ReactJS – React Router, Updating the Screen
a.Write a program for routing to different pages using react router.
b.Write a program for updating the screen.

WEEK 9:
ReactJS – Hooks, Sharing data between Components
a.Write a program to understand the importance of using hooks.
b.Write a program for sharing data between components.

WEEK 10:
a. MongoDB – Installation, Configuration, CRUD operations
Install MongoDB and configure ATLAS
b.Write MongoDB queries to perform CRUD operations on document using insert(), find(), update(), remove()

WEEK 11:
MongoDB – Databases, Collections and Records
a.Write MongoDB queries to Create and drop databases and collections.
b.Write MongoDB queries to work with records using find(), limit(), sort(), createIndex(), aggregate().

List of Augmented Experiments: **(Any of two)**

12. Development of a Full Stack Web Application Using React.js for Frontend and Express.js for Backend".

13.Design a to-do list application using NodeJS and ExpressJS.

14.Design a Quiz app using ReactJS.

15..Complete the MongoDB certification from MongoDB University website.

Text Books:

1.Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, 2nd edition, APress, O'Reilly.2025 ISBN-13: 978-1484243909

2. Mastering Express.js: A Comprehensive Guide to Node.js Web Development Rupes Kumar Tipu, 1st edition, Lap Lamber Academic ,2024 ,ISBN-13**:** 978-620-7-80809-0

3. React Quickly, AzatMardan, 2nd edition, Manning Publications, 2023,
ISBN-13 978-1633439290

Web Links:

1.ExpressJS - https://www.tutorialspoint.com/expressjs

2.ReactJS-https://www.w3schools.com/REACT

3.MongoDB - https://learn.mongodb.com/learning-paths/introduction-to-mongodb

Tinkering Lab: User Interface Design using Flutter

(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
V Semester				
Course Code: 231ES5L03	**0**	**0**	**2**	**1**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Set up the Flutter environment and construct basic Dart programs to demonstrate fundamental programming concepts.

CO2: Build user interfaces using various Flutter widgets and layouts, and design responsive UIs for multiple screen sizes.

CO3: Implement navigation between screens and demonstrate state management using Flutter's widget lifecycle and Provider.

CO4: Develop custom widgets, apply consistent theming, and validate form inputs using Flutter's form handling features.

CO5: Demonstrate REST APIs, add animations to enhance UX, and test and debug applications using Flutter tools and techniques.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	1	-	-	-	-	-	-	-
CO2	2	2	1	1	2	-	-	-	-	-	-	-
CO3	2	3	2	-	2	-	-	-	-	-	-	-
CO4	2	3	2	2	2	-	-	-	-	-	-	-
CO5	2	3	3	2	2	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	1
CO2	2	-
CO3	2	-
CO4	2	-
CO5	3	2

List of Experiments:

Experiment 1: Dart Basics and Setup

a) Install Flutter and Dart SDK.

b) Write a simple Dart program to understand the language fundamentals.

Experiment 2: Exploring Flutter Widgets and Layouts

a) Explore various Flutter widgets (Text, Image, Container, etc.).

b) Implement different layout structures using Row, Column, and Stack widgets.

Experiment 3: Responsive UI Design

a) Design a responsive UI that adapts to different screen sizes.

b) Implement media queries and breakpoints for responsiveness.

Experiment 4: Navigation Between Screens

a) Set up navigation between different screens using Navigator.

b) Implement navigation with named routes.

Experiment 5: Widget Lifecycle and State Management

a) Learn about stateful and stateless widgets.

b) Implement state management using set State and Provider.

Experiment 6: Custom Widgets and Theming

a) Create custom widgets for specific UI elements.

b) Apply styling using themes and custom styles.

Experiment 7: Forms and Validation

a) Design a form with various input fields.

b) Implement input validation and error messages using Form and validator.

Experiment 8: UI Animations

a) Add animations to UI elements using Flutter's animation framework.

b) Experiment with different types of animations (fade, slide, etc.).

Experiment 9: REST API Integration

a) Fetch data from a REST API.

b) Display the fetched data in a meaningful way in the UI.

Experiment 10: Testing and Debugging

a) Write unit tests for UI components.

b) Use Flutter's debugging tools to identify and fix issues.

Augmented Experiments (Any of two):

11. Real-Time Weather App Using External REST API
Consume an external weather API to display dynamic weather data based on user input.
Tasks:
Fetch weather data using an open API (like OpenWeatherMap).
Take city name input from the user.
Display temperature, weather condition, humidity, etc., with icons.
Add loading animation during the API call.

12. Counter App with Reset Button

Create a simple counter app that increases the count and includes a reset button.

Tasks:

Use a StatefulWidget.

Add a FloatingActionButton to increment the counter.

Add a Reset button to set the counter to zero.

13. Simple Calculator

Build a basic calculator that can perform the arithmetic operations

Tasks:

Use two TextFields for number input.

Add buttons for performing the arithmetic operations

Show the result in a Text widget.

Text Books:

1. Beginning Flutter: A Hands-On Guide to App Development, Marco L. Napoli, Wiley, 1st Edition, 2020, ISBN: 978-1119550853.
2. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, Rap Payne, 1stEdition 2022, ISBN: 978-1484277133

Reference Books:

1. Flutter for Beginners, Alessandro Biessek, Packt Publishing, 2nd Edition, 2020, ISBN: 978-1788996082
2. Programming Flutter: Native, Cross-Platform Apps the Easy Way, Carmine Zaccagnino, The Pragmatic Bookshelf, 1st Edition, 2020, ISBN: 978-1680506952
3. Flutter Complete Reference, Alberto Miola, Independently Published, 1st Edition, 2021, 979-8691939952

Web Links:

1. https://www.coursera.org/learn/flutter-and-dart-developing-ios-android-mobile-apps
2. https://www.udemy.com/course/learn-flutter-dart-to-build-ios-android-apps/
3. https://www.tutorialspoint.com/flutter/index.htm
4. https://docs.flutter.dev/get-started/learn-flutter

PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all branches)

	L	T	P	C
V Semester	**L**	**T**	**P**	**C**
Course Code: 231MC5T01	**2**	**0**	**0**	**0**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Make use of values, morals and ethics in their day to day life.

CO2: Identify what is right and wrong through moral ethics.

CO3: Analyze experimental learning while developing the society with ethics.

CO4: Apply ethical principles to resolve the problems that arise in work place.

CO5: Apply adequate knowledge on global code of conduct.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	3	-	2	-	1
CO2	-	-	-	-	-	-	-	3	2	-	-	1
CO3	-	-	-	-	-	-	-	3	-	2	-	1
CO4	-	-	-	-	-	-	-	3	-	2	-	1
CO5	-	-	-	-	-	-	-	3	2	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Human Values: Morals, Values and Ethics – Integrity –Trustworthiness - Work Ethics – Service Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self confidence – Spirituality- Character

Unit – II

Principles for Harmony: Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties - Aspirations and Harmony (I, We & Nature) – Gender Bias - Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

Unit – III

Engineering Ethics and Social Experimentation: History of Ethics - Need of Engineering Ethics - Senses of Engineering Ethics- Profession and Professionalism –– Self Interest - Moral Autonomy – Utilitarianism – Virtue Theory - Uses of Ethical Theories - Deontology- Types of Inquiry –Kohlberg's Theory - Gilligan's Argument – Heinz's Dilemma - Comparison with Standard Experiments –– Learning from the Past – Engineers as Managers – Consultants and Leaders – Balanced Outlook on Law - Role of Codes – Codes and Experimental Nature of Engineering

Unit – IV

Engineers' Responsibilities towards Safety and Risk: Concept of Safety - Safety and Risk – Types of Risks – Voluntary v/s Involuntary Risk – Consequences - Risk Assessment – Accountability – Liability - Reversible Effects - Threshold Levels of Risk - Delayed v/s Immediate Risk - Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis Accidents.

Unit – V

Engineers' Duties and Rights: Concept of Duty - Professional Duties – Collegiality - Techniques for Achieving Collegiality – Senses of Loyalty - Consensus and Controversy - Professional and Individual Rights – Confidential and Proprietary Information - Conflict of Interest-Ethical egoism - Collective Bargaining – Confidentiality - Gifts and Bribes - Problem solving-Occupational Crimes- Industrial Espionage- Price Fixing-Whistle Blowing Globalization and MNCs –Cross Culture Issues.

Text Books:

1. A Text Book On Professional Ethics And Human – R.S.Naagarazan.
2. Professional Ethics And Human Values By – M.P.Raghavan's – Scitech Publications (Indian Pvt., 2013).

Reference Books:

1. Engineering Ethics & Human Values By M.Govindarajan, S.Natarajan And V.S.Senthil Kumar-PHI Learning Pvt. Ltd – 2009.
2. Human Values And Professional Ethics By Jayshree Suresh And B. S. Raghavan, S.Chand Publications
3. Professional Ethics And Human Values By Prof.D.R.Kiran-Tata Mcgraw-Hill – 2014
4. Engineering Ethics By Harris, Pritchard And Rabins, Cengage Learning, New Delhi.

Web Links:

1. https://nptel.ac.in/courses/109104068
2. https://www.reelnreel.com/roles-and-responsibilities-of-a-typical-video-engineer/
3. http://nptel.ac.in/courses/109104068/30
4. http://nptel.ac.in/courses/122106031/Pdfs/2_1.pdf

Summary Internship - I

V Semester	L	T	P	C
Course Code: 231CS5P01	0	0	0	2

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Apply Technical Knowledge in a Real-World Setting – Students will utilize discipline-specific skills and academic learning to solve practical problems in an industrial or corporate environment.
CO2: Develop Professional Competencies – Students will demonstrate workplace skills such as punctuality, teamwork, communication, and adherence to industry standards and ethics.
CO3: Gain Industry Exposure and Best Practices – Students will observe and analyze operational workflows, technologies, and management strategies used in the industry**.**
CO4: Enhance Problem-Solving and Critical Thinking – Students will identify challenges in the workplace, propose solutions, and document their learning through reports or presentations.
CO5: Build Career Readiness and Networking Skills – Students will engage with professionals, understand organizational culture, and reflect on career aspirations based on internship experiences.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	3	-	-	-	-	-	-	-	1	-	1
CO2	3	-	-	-	-	1	1	-	-	-	-	1
CO3	3	-	-	-	-	-	-	-	-	1	1	1
CO4	1	1	3	2	-	-	-	-	-	-	-	-
CO6	-	-	-	-	3	-	-	2	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	1	1
CO3	1	2
CO4	1	1
CO5	1	2

Guidelines:

1. The Internship is a team activity of 3 to 4 students.
2. The students can undergo Industrial Training / Internship at Govt. Organizations, software MNCs or do Research projects in National Laboratories/Academic Institutions like IITs, NITs etc. during summer breaks after completion of IV Semester.
3. An industrial related Project is an alternative to the Summer Internship, whenever there is an exigency and students cannot pursue their Summer Internship. A group of students or even a single student can take up the Community Service Project during summer breaks. However, a student can opt for this only once. The students must identify social problems existing in any geographical area/village and try to solve them technically or suggest people the necessary solutions for solving these problems.
4. Prior letter and approval from the Head of the Department must be taken before applying to any organization for the course.

5. Every student should put in a minimum of 180 hours for the industry related Project during the summer vacation.
6. Each class/section should be assigned with a Project Coordinator.
7. The students are motivated to do projects based on societal needs using emerging technologies like IoT, Machine Learning, Deep Learning, Cyber security, cloud computing etc.,
8. After successful completion, students shall submit a summer internship technical report to the department concerned.
9. The student shall appear for the oral presentation before the Project Review Committee (PRC)* and an External Examiner.

Compiler Design

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6T02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Analyze the phases in compilation process.
CO2:	Make use of different parsing algorithms to develop parsers for a given grammar.
CO3:	Construct various forms of intermediate code.
CO4:	Apply techniques to generate optimized and target code.
CO5:	Compare the storage allocation strategies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	1	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	1	-

UNIT I:

Lexical Analysis: Language Processors, Structure of a Compiler, Lexical Analysis, The Role of the Lexical Analyzer, Specification of Tokens, Recognition of Tokens, Lexical Analyzer Generator-LEX, Finite Automata, Regular Expressions and Finite Automata, Design of a Lexical Analyzer Generator.

Syntax Analysis: The Role of the Parser, Context-Free Grammars, Derivations, Parse Trees, Ambiguity, Left Recursion, Left Factoring,

UNIT II:

Top Down Parsing: Pre Processing Steps of Top Down Parsing, Backtracking, Recursive Descent Parsing, LL (1) Grammars, Non-recursive Predictive Parsing, Error Recovery in Predictive Parsing.

Bottom Up Parsing: Introduction, Difference between LR and LL Parsers, Types of LR Parsers, Shift Reduce Parsing, SLR Parsers, Construction of SLR Parsing Tables, More Powerful LR Parses, Construction of CLR (1) and LALR Parsing Tables.

UNIT III:

Syntax Directed Translation: Syntax-Directed Definitions, Evaluation Orders for SDD’s, Applications of Syntax Directed Translation, Syntax-Directed Translation Schemes, Implementing L-Attributed SDD’s.

Intermediate Code Generation: Variants of Syntax Trees, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow.

UNIT IV:

Code Optimization: The Principle Sources of Optimization, Basic Blocks, Optimization of Basic Blocks, Structure Preserving Transformations, Flow Graphs, Loop Optimization, Data-Flow Analysis, Peephole Optimization.

UNIT V:

Run Time Environments: Storage Organization, Run Time Storage Allocation, Activation Records, Procedure Calls, Displays

Code Generation: Issues in the Design of a Code Generator, Object Code Forms, Code Generation Algorithm, Register Allocation and Assignment.

Text Books:

1. Compilers: Principles, Techniques and Tools, Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffry D. Ullman, Second Edition, Pearson.

Reference Books:

1. Compiler Construction-Principles and Practice, Kenneth C Louden, Cengage Learning, ISBN: 978-0534939724.
2. Modern compiler implementation in C, Andrew W Appel, Revised edition, Cambridge University Press, ISBN:978-0521607650.
3. Principles of Compiler Design, Nandhini Prasad, K.S, 3rd Edition, CENGAGE, ISBN: 978-8131534069 .

Web Links:

1. https://nptel.ac.in/courses/106/104/106104072/
2. http://www.cse.iitd.ernet.in/~sak/courses/cdp/slides.pdf
3. https://in.udacity.com/course/compilers-theory-and-practice--ud168
4. http://www.cse.iitd.ernet.in/~sak/courses/cdp/slides.pdf

Cloud Computing

(Common to CSE & IT)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6T01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Explain cloud computing concepts, service models (IaaS, PaaS, SaaS), and deployment models (public, private, hybrid).
CO2:	Analyze cloud-enabling technologies including distributed computing, virtualization, and SOA.
CO3:	Evaluate virtualization technologies and container platforms such as Docker and Kubernetes.
CO4:	Assess the major challenges in cloud computing, including security, interoperability, and fault tolerance.
CO5:	Describe advanced cloud topics like serverless computing, IoT integration, and DevOps practices.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2
CO3	2	2	3	2	2	-	-	-	-	-	-	-
CO4	2	3	-	3	2	1	1	-	-	-	-	2
CO5	3	2	2	2	2	-	-	-	-	1	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	3	2
CO4	3	1
CO5	2	3

UNIT -I: Introduction to Cloud Computing Fundamentals: Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google AppEngine).

UNIT-II: Cloud Enabling Technologies: Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

UNIT-III: Virtualization and Containers: Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

UNIT-IV: Cloud computing challenges: Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

UNIT -V: Advanced concepts in cloud computing: Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

Text Books:

1. Mastering Cloud Computing-Rajkumar Buyya,Christian Vecchiola,Thamarai Selvi,Shivananda Poojara,Satish N.Srirama 2nd Edition, McGraw Hill, 2024. ISBN: 978-9355329509.

2. Distributed and Cloud Computing -Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra 1st Edition, Elsevier ISBN-13: 978 9381269237.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier **ISBN-13:** 978 0128128107.
2. Essentials of cloud Computing, K. Chandrasekhran, 1st Edition,CRC press **ISBN-13:** 978-1482205435.

Web Links:

1. https://docs.aws.amazon.com
2. https://learn.microsoft.com/en-us/azure/
3. https://cloud.google.com/docs
4. https://nptel.ac.in/courses/106106129
5. https://nptel.ac.in/courses/106105167

Cryptography & Network Security

(Common to CSE & IT)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6T03	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the course, Student will be able to

CO1: Demonstrate the fundamentals of network security and cryptography mathematics.

CO2: Classify the symmetric key encryption and decryption algorithms.

CO3: Apply public key cryptographic techniques for data security.

CO4: Make use of cryptographic hash functions and digital signature to ensure data integrity

CO5: Describe the security protocols in network,transport and application layers.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT I

Basic Principles: Security Goals, Cryptographic Attacks, Services and Mechanisms, Mathematics of Cryptography- integer arithmetic, modular arithmetic, matrices, linear conguence.

UNIT II:

Symmetric Encryption: Mathematics of Symmetric Key Cryptography-algebraic structures, GF(2^n) Fields, Introduction to Modern Symmetric Key Ciphers-modern block ciphers, modern stream ciphers, Data Encryption Standard- DES structure, DES analysis, Security of DES, Multiple DES, Advanced Encryption Standard-transformations, key expansions, AES ciphers, Analysis of AES.

UNIT III:

Asymmetric Encryption: Mathematics of Asymmetric Key Cryptography-primes, primality testing, factorization, CRT, Asymmetric Key Cryptography- RSA crypto system, Rabin cryptosystem, Elgamal Crypto system, ECC

UNIT IV:

Data Integrity, Digital Signature Schemes & Key Management : Message Integrity and Message Authentication-message integrity, Random Oracle model, Message authentication, Cryptographic Hash Functions-whirlpool, SHA-512, Digital Signature- process, services, attacks, schemes, applications, Key Management-symmetric key distribution, Kerberos.

UNIT V:

Network Security-I: Security at application layer: PGP and S/MIME, Security at the Transport Layer: SSL and TLS, **Network Security-II :** Security at the Network Layer: IPSec-two modes, two security protocols, security association, IKE, ISAKMP, System Security-users, trust, trusted systems, buffer overflow, malicious software, worms, viruses, IDS, Firewalls.

Text Books:

1. Cryptography and Network Security, 3rd Edition Behrouz A Forouzan, Deb deep Mukhopadhyay, McGraw Hill, ISBN: 978-9339220945.
2. Cryptography and Network Security,4th Edition, William Stallings, (6e) Pearson, ISBN: 978-0132023221.
3. Everyday Cryptography, 1st Edition, Keith M.Martin, Oxford,ISBN: 978-0191625886.

Reference Books:

1. Network Security and Cryptography, 1st Edition, Bernard Meneges, Cengage Learning, ISBN: 978-9386858948.

Web Links:

1. https://nptel.ac.in/courses/106105031
2. https://nptel.ac.in/courses/106105162
3. https://users.cs.northwestern.edu/~ychen/classes/cs395-w05/lectures.html
4. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01329983769862144O392/overview

Software Testing Methodologies
(Professional Elective-II)
(Common to CSE & IT)

VI Semester

Course Code: 231CS6E08

L	T	P	C
3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain basic testing concepts and apply path testing using flow graphs.

CO2: Apply transaction, data flow, and domain testing techniques.

CO3: Make use of regular expressions and logic-based testing for test design.

CO4: Design test cases using state graphs and transition testing.

CO5: Analyze software using graph matrices and apply testing tools.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		-	-	-	-	-	-	-	-	1
CO2	3	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	2	3	2	-	-	-	-	-	-	-	-	1
CO5	2	2	-	2	3	-	-	-	-	-	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	3

UNIT - I

Introduction: Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs Flow graphs and Path testing: Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

UNIT - II

Transaction Flow Testing: transaction flows, transaction flow testing techniques.

Data Flow testing: Basics of data flow testing, strategies in data flow testing, application of data flow testing.

Domain Testing: domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability, non-functional software testing parameters.

UNIT - III

Paths, Path products and Regular expressions: path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.
Logic Based Testing: overview, decision tables, path expressions, kv charts, specifications.

UNIT - IV

State, State Graphs and Transition testing: state graphs, good & bad state graphs, state testing, Testability tips.

UNIT - V

Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like Jmeter/selenium/soapUI/Catalon).

Text Books:

1. Software Testing techniques - Baris Beizer, Dreamtech, second edition, 2002, ISBN:978-8177222609
2. Software Testing Tools – Dr. K. V. K. K. Prasad, Dreamtech. first edition, 2004, ISBN:978-8177225327

Reference Books:

1. The craft of software testing - Brian Marick, Pearson Education, first edition, 2007, ISBN:978-8131715710
2. Software Testing in the Real World – Edward Kit, Pearson, first edition, 1995, ISBN: 978-0201877564
3. Effective methods of Software Testing, Perry, John Wiley, third edition, 2006, ISBN: 9780470084679
4. Art of Software Testing – Meyers, John Wiley, third edition, 2011, ISBN: 978-1118031964

Web Links:

1. https://www.geeksforgeeks.org/software-testing-tutorial/
2. https://artoftesting.com/software-testing-tutorial

Cyber Security

(Professional Elective-II)

VI Semester	L	T	P	C
Course Code: 231CS6E02	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the fundamentals of cybercrime, its classifications, and the challenges posed by emerging technologies and mobile devices

CO2: Analyze various tools, methods, and techniques used by cybercriminals including phishing, malware, spoofing, social engineering, and network attacks.

CO3: Apply appropriate tools and techniques for cybercrime investigation, digital evidence collection, and forensic analysis of email and network activity

CO4: Demonstrate the role of computer forensics, forensic tools, and procedures for analyzing data from different operating systems and digital devices.

CO5: Summarize the legal aspects of cybercrime, including the Indian IT Act, amendments, cyber laws, and the global legal landscape related to digital offenses.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	2	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	-
CO3	3	3	-	3	3	-	-	-	-	-	-	-
CO4	3	2	-	3	3	-	-	-	-	-	-	-
CO5	2	2	-	-	1	-	-	3	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	1

UNIT I: Introduction to Cybercrime: Introduction, Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Cybercriminals, Classifications of Cybercrime, Cyberstalking, Cybercafe and Cybercrimes, Botnets. Attack Vector, Proliferation of Mobile and Wireless Devices, Security Challenges Posed by Mobile Devices, Attacks on Mobile/Cell Phones, Network and Computer Attacks.

UNIT II: Tools and Methods : Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horses and Backdoors, Steganography, Sniffers, Spoofing, Session Hijacking Buffer over flow, DoS and DDoS Attacks, SQL Injection, Buffer Overflow, Attacks on Wireless Networks, Identity Theft (ID Theft), Foot Printing and Social Engineering, Port Scanning, Enumeration.

UNIT III: Cyber Crime Investigation: Introduction, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Hands on Case Studies. Encryption and Decryption Methods, Search and Seizure of Computers, Recovering Deleted Evidences, Password Cracking.

UNIT IV: Computer Forensics and Investigations: Understanding Computer Forensics, Preparing for Computer Investigations. Current Computer Forensics Tools: Evaluating Computer Forensics Tools, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating andTesting Forensics Software, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Graphics and Network Forensics, E-mail Investigations, Cell Phone and Mobile Device Forensics.

UNIT V: Cyber Crime Legal Perspectives: Introduction, Cybercrime and the Legal Landscape around the World, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Amendments to the Indian IT Act, Cybercrime andPunishment, Cyberlaw, Technology and Students: Indian Scenario.

Text Books:

1. Sunit Belapure Nina Godbole “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, WILEY.
2. Nelson Phillips and Enfinger Steuart, “Computer Forensics and Investigations”, Cengage Learning, New Delhi.ss

Reference Books:

1. “Hands on Ethical Hacking and Network Defence” Michael T. Simpson, Kent Backman and James E. Corley, Cengage.
2. Computer Forensics, Computer Crime Investigation by John R. Vacca, Firewall Media, New Delhi.
3. Cyber Security and Cyber Laws” Alfred Basta, Nadine Basta, Mary Brown and Ravinder Kumar “, Cengage.

Web Links:

1. http://www.cert-in.org.in/
2. https://www.coursera.org/learn/introduction-cybersecurity-cyber-attacks
3. https://computersecurity.stanford.edu/free-online-videos
4. https://ocw.mit.edu/courses/6-858-computer-systems-security-fall-2014/

DevOps

(Professional Elective-II)

(Common to CSE & AIML)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6E03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Explain basic concepts of SDLC, Agile, and DevOps.
CO2:	Apply Git for version control and check code quality with testing tools.
CO3:	Demonstrate CI pipelines using Jenkins.
CO4:	Implement containerization using Docker and automate software delivery processes.
CO5:	Use Ansible and Kubernetes for configuration management and container orchestration.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	2	-	-	-	-	-	-	2
CO2	1	-	-	-	3	-	-	-	-	-	-	2
CO3	1	-	-	-	3	-	-	-	-	-	2	2
CO4	1	-	-	-	3	-	-	-	-	-	2	2
CO5	1	-	-	-	3	-	-	-	-	-	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	-
CO4	2	-
CO5	2	-

UNIT-I

Introduction to DevOps: Introduction to SDLC, Agile Model, DevOps Features, DevOps Architecture, DevOps Lifecycle, Understanding Workflow and principles, Introduction to DevOps tools, Build Automation, Delivery Automation, Understanding Code Quality, Automation of CI/ CD. Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples.

UNIT-II

Source Code Management (GIT): The need for source code control, The history of source code management, Roles and code, source code management system and migrations. What is Version Control and GIT, GIT Installation, GIT features, GIT workflow, working with remote repository, GIT commands, GIT branching, GIT staging and collaboration. UNIT TESTING - CODE COVERAGE: Junit, nUnit & Code Coverage with Sonar Qube, SonarQube - Code Quality Analysis.

UNIT-III

Build Automation - Continuous Integration (CI): Build Automation, What is CI Why Cl is Required, CI tools, Introduction to Jenkins (With Architecture), jenkins workflow, jenkins master slave architecture, Jenkins Pipelines, PIPELINE BASICS - Jenkins Master, Node, Agent, and Executor Freestyle Projects & Pipelines, Jenkins for Continuous Integration, Create and Manage Builds, User Management in Jenkins Schedule Builds, Launch Builds on Slave Nodes.

UNIT-IV

Continuous Delivery (CD): Importance of Continuous Delivery, CONTINUOUS DEPLOYMENT CD Flow, Containerization with Docker: Introduction to Docker, Docker installation, Docker commands, Images & Containers, DockerFile, Running containers, Working with containers and publish to Docker Hub.

Testing Tools: Introduction to Selenium and its features, JavaScript testing.

UNIT ‒ V

Configuration Management - ANSIBLE: Introduction to Ansible, Ansible tasks, Roles, Jinja templating, Vaults, Deployments using Ansible.

CONTAINERIZATION USING KUBERNETES(OPENSHIFT): Introduction to Kubernetes Namespace & Resources, CI/CD - On OCP, BC, DC & ConfigMaps, Deploying Apps on Openshift Container Pods. Introduction to Puppet master and Chef.

Text Books:

1. DevOps for Beginners: DevOps Software Development Method Guide for Software Developers and It Professionals, Joyner, Joseph.,1st Edition Mihails Konoplows, ISBN-13: 978-1682122105.
2. Hands-on DevOps with Linux, Alisson Machado de Menezes,BPB Publications, 1st Edition,India, 2021, ISBN-13: 978-9389423488.

Reference Books:

1. Liming Zhu. DevOps: A Software Architect's Perspective, LenBass, IngoWeber,. Addison Wesley; ISBN-10.
2. The DevOps Handbook, Gene Kim Je Humble, Patrick Debois, John Willis. 1st Edition, IT Revolution Press.
3. Joakim Practical DevOps, Verona, 1st Edition, Packt Publishing.
4. Practical Devops, Joakim Verona, Ingram shorttitle; 2ndedition. ISBN10: 1788392574
5. DevOps Tools from Practitioner's View point, Deepak Gaikwad, Viral Thakkar., Wiley publications. ISBN: 9788126579952

Web Links:

1. https://www.atlassian.com/devops
2. https://git-scm.com/doc
3. https://www.jenkins.io/doc/

Machine Learning
(Professional Elective-II)

VI Semester
Course Code: 231CS6E05

L	T	P	C
3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Outline the Fundamentals of Machine Learning
CO2: Build a Nearest Neighbor-based models
CO3: Apply Models based on decision trees and Bayes rule
CO4: Analyze the usage of Linear discriminants for machine Learning
CO5: Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	-	-	-	-	-	-	-	-	-	2
CO2	2	2	3	-	1	-	-	-	-	-	-	1
CO3	2	2	3	-	1	-	-	-	-	-	-	1
CO4	3	2	3	-	1	-	-	-	-	-	-	1
CO5	2	2	2	-	2	-	-	-	-	-	-	2

Mapping of course outcomes with program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT-I: Introduction to Machine Learning:
Evolution of Machine Learning, Paradigms for ML, Learning by Rote, Learning by Induction, Reinforcement Learning, Types of Data, Matching, Stages in Machine Learning, Data Acquisition, Feature Engineering, Data Representation, Model Selection, Model Learning, Model Evaluation, Model Prediction, Search and Learning, Data Sets.

UNIT-II: Nearest Neighbor-Based Models:
Introduction to Proximity Measures, Distance Measures, Non-Metric Similarity Functions, Proximity Between Binary Patterns, Different Classification Algorithms Based on the Distance Measures, K-Nearest Neighbor Classifier, Radius Distance Nearest Neighbor Algorithm, KNN Regression, Performance of Classifiers, Performance of Regression Algorithms.

UNIT-III: Models Based on Decision Trees:

Decision Trees for Classification, Impurity Measures, Properties, Regression Based on Decision Trees, Bias – Variance Trade-off, Random Forests for Classification and Regression.

The Bayes Classifier: Introduction to the Bayes Classifier, Bayes' Rule and Inference, The Bayes Classifier and its Optimality, Multi-Class Classification | Class Conditional Independence and Naive Bayes Classifier (NBC)

UNIT-IV: Linear Discriminants for Machine Learning:

Introduction to Linear Discriminants, Linear Discriminants for Classification, Perceptron Classifier, Perceptron Learning Algorithm, Support Vector Machines, Linearly Non-Separable Case, Non-linear SVM, Kernel Trick, Logistic Regression, Linear Regression, Multi-Layer Perceptrons (MLPs), Backpropagation for Training an MLP.

UNIT-V: Clustering:

Introduction to Clustering, Partitioning of Data, Matrix Factorization | Clustering of Patterns, Divisive Clustering, Agglomerative Clustering, Partitional Clustering, K-Means Clustering, Soft Partitioning, Soft Clustering, Fuzzy C-Means Clustering, Rough Clustering, Rough K-Means Clustering Algorithm, Expectation Maximization-Based Clustering, Spectral Clustering.

Text Books:

1. "Machine Learning Theory and Practice", M N Murthy, V S Ananthanarayana, Universities Press (India), 2024

Reference Books:

1. "Machine Learning", Tom M. Mitchell, McGraw-Hill Publication, 2017
2. "Machine Learning in Action", Peter Harrington, Dream Tech
3. "Introduction to Data Mining", Pang-Ning Tan, Michel Stenbach, Vipin Kumar, 7th Edition, Pearson,2019.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc23_cs18/preview.
2. https://www.coursera.org/browse/data-science/machine-learning.
3. https://www.tutorialspoint.com/machine_learning/index.htm.
4. https://www.udemy.com/course/machinelearning/?couponCode=CP130525.
5. https://online.stanford.edu/courses/cs229-machine-learning.

Software Project Management
(Professional Elective-III)
(Common to CSE, IT & CSE(DS))

VI Semester **L T P C**
Course Code: 231CS6E09 **3 0 0 3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain Software Project Management fundamentals and Planning activities
CO2: Compare SDLC models in project framework.
CO3: Demonstrate various Processes and Architectures of Software.
CO4: Elaborate the concepts of Project Organization Responsibilities, Automation and instrumentation.
CO5: Discuss Agile Methodology and DevOps eco system.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	2	-	1	-	-	-	-	-	-	-
CO2	2	3	1	-	2	-	-	-	-	-	-	-
CO3	1	1	3	-	1	-	-	-	-	-	-	-
CO4	1	-	3	-		-	-	-	-	-	-	-
CO5	1	2	1	-	2	-	-	-	-	-	-	-

Mapping of course outcomes with program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	-	1
CO3	2	-
CO4	2	-
CO5	-	2

UNIT-I

Conventional Software Management: The waterfall model, conventional software Management performance.
Evolution of Software Economics: Software Economics, pragmatic software cost estimation.
Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness, improving automation, Achieving required quality, peer inspections.
The old way and the new: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

UNIT-II

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.

Artifacts of the process: The artifact sets, Management artifacts, Engineering artifacts, programmatic artifacts.

UNIT-III

Model based software architectures: A Management perspective and technical perspective.

Work Flows of the process: Software process workflows, Iteration workflows.

Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments.

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process, Pragmatic planning.

UNIT-IV

Project Organizations and Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.

Process Automation: Automation Building blocks, The Project Environment.

Project Control and Process instrumentation: The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation.

UNIT-V

Agile Methodology: ADAP Ting to Scrum, Patterns for Adopting Scrum, Iterating towards Agility.

Fundamentals of DevOps: Architecture, Deployments, Orchestration, Need, Instance of applications, DevOps delivery pipeline, DevOps eco system. DevOps adoption in projects: Technology aspects, Agiling capabilities, Tool stack implementation, People aspect, processes

Text Books:

1. Software Project Management, Walker Royce, Sixth edition , Pearson, ISBN: 0-201-30958-0.
2. Succeeding with Agile: Software Development Using Scrum, Mike Cohn, Addison Wesley,Pearson, ISBN: 978-0-321-57936-2.
3. The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations, Gene Kim, John Willis, Patrick Debois, Jez Humb,1st Edition, O' Reilly publications, ISBN: 978-1950508402,2021.

Reference Books:

1. Software Project Management, Bob Hughes, Mike Cotterell, Fifth Edition ,TM, ISBN: 978-0077122799
2. Software Project Management, Joel Henry, Pearson, ISBN: 978-0201758658
3. Software Project Management in practice, Pankaj Jalote, Addison-Wesley, First edition, ISBN: 978-0201737219.
4. Effective Software Project Management, Robert K.Wysocki, John Wiley & Sons Inc; First edition, ISBN: 978-0764596360.
5. Project Management in IT, Kathy Schwalbe, Ninth Edition, Cengage, ISBN: 9789355736130,2023.
6. Agile Software Development Ecosystems-:Jim Highsmith, Addison Wisley, ISBN: 978-

0201760439.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc19_cs70/preview.
2. https://www.coursera.org/specializations/product-management
3. https://www.tutorialspoint.com/software_engineering/software_project_management.htm.
4. https://www.scribd.com/doc/7102316/Software-Project-Management.
5. https://www.udacity.com/course/agile-software-development-nanodegree--nd144.

Mobile Adhoc Networks
(Professional Elective - III)
(Common to CSE & IT)

VI Semester **L T P C**
Course Code: 231CS6E06 **3 0 0 3**

Course Outcomes:At the end of the course, Student will be able to

CO1: Describe cellular and Ad Hoc networks, focusing on MANETs and MAC protocols.
CO2: Explain routing and transport protocols in Ad Hoc networks, including classifications, issues, and solutions.
CO3: Analyze security challenges, key management, secure routing, and intrusion detection in Ad Hoc wireless networks.
CO4: Illustrate wireless sensor networks, design challenges, protocols, and applications in dynamic environments.
CO5: Apply security, key management, and simulation in Wireless Sensor Networks.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	1	1	2	1	-	-	-	-	-	-	-	-
CO4	1	1	2	1	-	-	-	-	-	-	-	-
CO5	1	1	2	2	-	-	-	-	-	-	-	-

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT I

Introduction to Ad Hoc Wireless Networks- Cellular and Ad Hoc Wireless Networks, Characteristics of MANETs, Applications of MANETs, Issues and Challenges of MANETs, Ad Hoc Wireless Internet, MAC protocols for Ad hoc Wireless Networks-Issues, Design Goals and Classifications of the MAC Protocols.

UNIT II

Routing Protocols for Ad Hoc Wireless Networks- Issues in Designing a Routing Protocol, Classifications of Routing Protocols, Topology-based versus Position-based Approaches, Issues and design goals of a Transport layer protocol, Classification of Transport layer solutions, TCP over Ad hoc Wireless Networks, Solutions for TCP over Ad Hoc Wireless Networks, Other Transport layer protocols.

UNIT III

Security protocols for Ad hoc Wireless Networks- Security in Ad hoc Wireless Networks, Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management, Secure Routing in Ad hoc Wireless Networks, Cooperation in MANETs, Intrusion Detection Systems.

UNIT IV

Basics of Wireless Sensors and Applications- The Mica Mote, Sensing and Communication Range, Design Issues, Energy Consumption, Clustering of Sensors, Applications, Data Retrieval in Sensor Networks-Classification of WSNs, MAC layer, Routing layer, Transport layer, High-level application layer support, Adapting to the inherent dynamic nature of WSNs.

UNIT V

Security in WSNs- Security in WSNs, Key Management in WSNs, Secure Data Aggregation in WSNs, Sensor Network Hardware-Components of Sensor Mote, Sensor Network Operating Systems–TinyOS, LA-TinyOS, SOS, RETOS, Imperative Language-nesC, **Dataflow Style Language-**TinyGALS, Node-Level Simulators, NS-2 and its sensor network extension, TOSSIM.

Text Books:

1. Ad Hoc Wireless Networks – Architectures and Protocols, 1st edition, C. Siva Ram Murthy, B. S. Murthy, Pearson Education, 2004, ISBN: 978-8126547869.
2. Ad Hoc and Sensor Networks – Theory and Applications, 2nd edition *Carlos Corderio Dharma P.Aggarwal,* World Scientific Publications / Cambridge University Press, March 2006, ISBN: 978-9812566829.

Reference Books:

1. Wireless Sensor Networks: An Information Processing Approach, 1st edition*, Feng Zhao, Leonidas Guibas*, Elsevier Science imprint, Morgan Kauffman Publishers, 2005, rp2009, ISBN: 978-1558609143.
2. Wireless Ad hoc Mobile Wireless Networks – Principles, Protocols and Applications, 1st edition*,* Subir Kumar Sarkar, et al., Auerbach Publications, Taylor & Francis Group, 2008, ISBN: 978-1420062212.
3. Ad hoc Networking, 1st edition*,Charles E.Perkins*, Pearson Education, 2001, ISBN: 978-8131720967.
4. Wireless Ad hoc Networking, 1st edition*, Shih-Lin Wu, Yu-Chee Tseng,* Auerbach Publications, Taylor & Francis Group, 2007, ISBN: 978-0367389314.
5. Wireless Sensor Networks – Principles and Practice, 1st edition, Fei Hu, Xiaojun Cao, An Auerbach book, CRC Press, Taylor & Francis Group, 2010, ISBN: 978-1420092158.

Web Links:

1. https://www.coursera.org/browse/computer-science
2. https://sgar91.files.wordpress.com/2011/10/mobile_communications_schiller_2e.pdf

Natural Language Processing

(Professional Elective-III)
(Common to CSE & IT)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6E07	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Use basic concepts of Natural Language Processing such as language models, regular expressions, morphology, tokenization, and spelling correction in practical scenarios.
CO2:	Describe the functioning of N-gram models and tagging approaches including rule-based and statistical methods in word-level processing.
CO3:	Differentiate among various syntactic parsing techniques used for analyzing sentence structure.
CO4:	Apply suitable techniques to resolve confusion in meaning based on sentence context.
CO5:	Analyze how different parts of a text are connected and how language tools help in resolving references

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	2	-	-	-	-	1	-	-
CO2	3	3	-	-	-	-	-	-	-	1	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-
CO4	3	2	-	2	2	-	-	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	POS1	POS2
CO1	-	2
CO2	-	1
CO3	-	2
CO4	-	1
CO5	-	2

UNIT-I

INTRODUCTION: Origins and challenges of NLP – Language Modelling: Grammar-based LM, Statistical LM – Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance.

UNIT-II

WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part- of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT-III

SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs – Feature structures, Unification of feature structures

UNIT-IV

SEMANTICS AND PRAGMATICS: Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT – V

DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Text Books:

1 Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech, Daniel Jurafsky, James H. Martin -Pearson, 2ndEdition, ISBN-13: 978-0131873216.

2 Natural Language Processing with Python, Steven Bird, Ewan Klein and Edward Loper, First Edition ,OReilly Media, ISBN-13: 978-0596516499.

Reference Books:

1 Language Processing with Java and Ling Pipe Cookbook, Breck Baldwin, Atlantic Publisher, 1stEdition, ISBN-13: 978-1783284672.

2 Natural Language Processing with Java, , Richard M Reese, OReilly Media,2015, ISBN-13: 978-1784391799.

3 Handbook of Natural Language Processing, Second, Nitin Indurkhya and Fred J. Damerau, Chapman and 2ndEdition, Hall/CRC Press, ISBN-13: 978-1420085921.

4 Natural Language Processing and Information Retrieval, Tanveer Siddiqui, U.S. Tiwary, 3rdEdition, Oxford University Press, ISBN-13: 978-0195692327.

Web Links:

1 https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2 https://nptel.ac.in/courses/106105158

Big Data Analytics

(Professional Elective III)

VI Semester **L T P C**
Course Code: 231CS6E01 **3 0 0 3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Demonstrate the use of Java data structures and generics to build efficient and reusable code.

CO2: Configure and manage Hadoop ecosystem components and cluster modes for big data storage and processing.

CO3: Develop and execute MapReduce programs using Hadoop API for large-scale data processing tasks.

CO4: Apply stream processing concepts and perform operations using Apache Spark and its RDD model.

CO5: Design and execute big data queries using Pig Latin and Hive for structured data analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	3	-	-	-	-	-	-	2
CO2	3	2	2	2	3	-	-	-	-	-	1	2
CO3	3	3	3	3	3	-	-	-	-	-	1	2
CO4	2	2	2	2	3	-	-	-	-	-	-	2
CO5	2	3	2	2	3	-	-	-	-	1	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	3	-
CO4	2	-
CO5	3	-

UNIT-I

Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters, Implementing Generic Types, Generic Methods, Wrapper Classes, Concept of Serialization

UNIT-II

Working with Big Data: Google File System, Hadoop Distributed File System (HDFS) Building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, Job Tracker, Task Tracker), Introducing and Configuring Hadoop cluster (Local, Pseudo-distributed mode, Fully Distributed mode), Configuring XML files.

UNIT-III

Writing Map Reduce Programs: A Weather Dataset, Understanding Hadoop API for Map Reduce Framework (Old and New), Basic programs of Hadoop Map Reduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Practitioner

UNIT-IV

Stream Memory and Spark: Introduction to Streams Concepts– Stream Data Modeland Architecture , Stream computing, Sampling Data in a Stream , Filtering Streams ,Counting Distinct Elements in a Stream , Introduction to Spark Concept , Spark Architecture and components , Spark installation , Spark RDD(Resilient Distributed Dataset) – Spark RDD operations.

UNIT – V

Pig: Hadoop Programming Made EasierAdmiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

Applying Structure to Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analysing data

Text Books:

1. Wiley & Big Java 4th Edition, Cay Horstmann, Wiley John Sons, INC
2. Hadoop: The Definitive Guide by Tom White, 3rd. Edition, O’reilly

Reference Books:

1. Hadoop in Action by Chuck Lam, MANNING Publ
2. Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss
3. Hadoop in Practice by Alex Holmes, MANNING Publ.
4. Big Data Analytics by Dr. A.Krishna Mohan and Dr.E.Laxmi Lydia
5. Hadoop Map Reduce Cookbook, SrinathPerera, ThilinaGunarathne

Web Links:

1. Hadoop:http://hadoop.apache.org/
2. Hive: https://cwiki.apache.org/confluence/display/Hive/Home
3. Piglatin: http://pig.apache.org/docs/r0.7.0/tutorial.html

Distributed Operating System
(Professional Elective-III)

(Common to CSE & IT)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6E04	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Illustrate the fundamentals and architecture of distributed computing systems and identify key issues in designing distributed operating systems.

CO2: Analyze message-passing mechanisms and construct inter-process communication using synchronization and buffering techniques.

CO3: Demonstrate the working of Remote Procedure Calls (RPC) and assess their performance in distributed environments.

CO4: Describe the structure and design of Distributed Shared Memory (DSM) systems and apply synchronization techniques for process coordination.

CO5: Evaluate resource management, process migration, and load balancing strategies, and examine the design and fault tolerance features of distributed file systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	-	-	-	-	-	-	2
CO2	3	3	2	-	2	-	-	-	-	-	-	2
CO3	3	2	2	-	2	-	-	-	-	-	-	2
CO4	3	3	2	-	2	-	-	-	-	-	-	2
CO5	3	3	2	-	2	-	-	-	1	1	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT I

Fundamentals:

What is Distributed Computing Systems? Evolution of Distributed Computing System; Distributed Computing System Models; What is Distributed Operating System? Issues in Designing a Distributed Operating System; Introduction to Distributed Computing Environment (DCE).

Message Passing:

Introduction, Desirable features of a Good Message Passing System, Issues in PC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Encoding and Decoding of Message Data, Process Addressing, Failure Handling, Group Communication, Case Study: 4.3 BSD UNIX IPC Mechanism.

UNIT II

Remote Procedure Calls:

Introduction, The RPC Model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC Messages, Marshaling Arguments and Results, Server Management, Parameter-Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client-Server Binding, Exception Handling, Security, Some Special Types of RPCs, RPC in Heterogeneous Environments, Lightweight RPC, Optimization for Better Performance, Case Studies: Sun RPC

UNIT III

Distributed Shared Memory:

Introduction, General Architecture of DSM systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other approaches to DSM, Heterogeneous DSM, Advantages of DSM. Synchronization: Introduction, Clock Synchronization, Event Ordering, Mutual Exclusion, Dead Lock, Election Algorithms

UNIT IV

Resource Management:

Introduction, Desirable Features of a Good Global Scheduling Algorithm, Task Assignment Approach, Load – Balancing Approach, Load – Sharing Approach Process Management: Introduction, Process Migration, Threads.

UNIT V

Distributed File Systems:

Introduction, Desirable Features of a Good Distributed File System, File models, File– Accessing Models, File – Sharing Semantics, File – Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions and Design Principles.

Text books:

1. “Distributed Operating Systems: Concepts and Design”, Pradeep K. Sinha, 1st Edition, PHI, ISBN-13: 978-8120313804.

Reference Books:

1.“Distributed Operating Systems”, Andrew S. Tanenbaum, 1st Edition, Pearson Education, ISBN-13: 978-8177581799
2.“Distributed Computing: Principles, Algorithms and Systems”, Ajay D. Kshemkalyani & Mukesh Singhal, Reissue Edition, Cambridge University Press, ISBN-13: 978-0521189842
3.“Distributed Computing”, Sunita Mahajan & Seema Shan, Oxford University Press, SBN-13: 978-8126565580

Web Links:

1. https://www.geeksforgeeks.org/evolution-of-distributed-computing-systems/

2. https://www.tutorialspoint.com/transparency-of-rpc-in-distributed-networks

3. https://en.wikipedia.org/wiki/Remote_procedure_call

4. https://www.cs.unc.edu/~prins/Classes/790-033/Readings/MemoryConsistencyModelsTutorial.pdf

5. https://wgropp.cs.illinois.edu/courses/cs598-s16/lectures/lecture24.pdf.

6. https://www.weka.io/learn/guide/distributed-file-systems/distributed-file-system/

BASIC CONCRETE TECHNOLOGY
(Open Elective-II)

	L	T	P	C
VI SEMESTER	**L**	**T**	**P**	**C**
Course Code: 231CE6O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Demonstrate the basic concepts of concrete.
CO2: Illustrate the importance of fresh concrete
CO3: Discuss the basic ingredient’ s role in the production of concrete.
CO4: Classify the fresh and the hardened concrete properties.
CO5: Design the concrete mix by BIS method.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-		-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-
CO5	3	1	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

UNIT - I

Ingredients of Concrete cements & Admixtures

Portland cement – Chemical composition –Hydration, Setting of cement, Fineness of cement Structure of hydrate cement – Test for physical properties – Different grades of cements – Admixtures – Mineral and chemical admixtures – accelerators, retarders, air entrainers, plasticizers, super plasticizers, fly ash and silica fume.

Aggregates Classification of aggregate – Particle shape & texture – Bond, strength & other mechanical properties of aggregates – Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate – Bulking of sand –Deleterious substance in aggregate – Soundness of aggregate – Alkali aggregate reaction – Thermal properties – Sieve analysis – Fineness modulus – Grading curves – Grading of fine & coarse Aggregates – Gap graded and well graded aggregate as per relevant IS code – Maximum aggregate size. Quality of mixing water.

UNIT-II

Fresh Concrete

Steps in Manufacture of Concrete–proportion, mixing, placing, compaction, finishing, curing – including various types in each stage. Properties of fresh concrete-Workability – Factors affecting workability – Measurement of workability by different tests, Setting times of concrete, Effect of time and temperature on workability-segregation & bleeding-Mixing and vibration of concrete, Ready mixed concrete, Concrete.

UNIT – III

Hardened Concrete

Water / Cement ratio – Abram's Law – Gel space ratio –Nature of strength of concrete – Maturity concept – Strength in tension & compression – Factors affecting strength – Relation between compression & tensile strength – Curing, Testing of Hardened Concrete: Compression tests – Tension tests – Factors affecting strength – Flexure tests – Splitting tests – Non-destructive testing methods – codal provisions for NDT. Anti washout concrete.

UNIT – IV

Elasticity, Creep & Shrinkage

Modulus of elasticity, Dynamic modulus of elasticity, Poisson's ratio, Creep of concrete, Factors influencing creep, Relation between creep & time, Nature of creep, Effects of creep – Shrinkage –types of shrinkage.

Mix Design Factors in the choice of mix proportions – Durability of concrete –Quality Control of concrete – Statistical methods – Acceptance criteria – Concepts Proportioning of concrete mixes by various methods – BIS method of mix design

UNIT – V

Special Concretes

Ready mixed concrete, Shotcrete, Light weight aggregate concrete, Cellular concrete, No-fines concrete, High density concrete, Fiber reinforced concrete, Different types of fibers, Factors affecting properties of F.R.C, Polymer concrete, Types of Polymer concrete, Properties of polymer concrete, High performance concrete – Self consolidating concrete, SIFCON, self-healing concrete, Recycled concrete

Text Books:

1. Concrete Technology: Theory and Practice, M.L. Gambhir, McGraw Hill, 5th Edition, 2017.
2. Concrete Technology, M.S.Shetty, Chand Publication, 2006

Reference Books:

1. Concrete Technology, A.M. Neville and J.J. Brooks, Pearson,2019.
2. Concrete Technology, A.R. Santhakumar, Oxford,2018.

Web Links:

1. https://nptel.ac.in/courses/105102012
2. www.brighthubengineering.com › Concrete Technology

BASIC OF SURVEYING

(Open Elective-II)

	L	T	P	C
VI SEMESTER				
Course Code: 231CE6O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the various fundamental principles Geodetics

CO2: Explain the Measurement of Horizontal Distances.

CO3: Describe the Measurement of Directions and Angles horizontal and vertical plane.

CO4: Explain Plane Table Surveying

CO5: Describe the compute areas and volumes and represent 3D data on plane figures as contours.

Mapping of Course Outcomes with Program Outcomes:

CO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	2	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	2	-	-	-	-	-	-
CO5	2	2	-	-	-	2	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT - I

Introduction:

Definition of surveying, Objectives and importance of surveying. Classification of surveys. Principles of surveying. Units of measurements, Surveying measurements and errors, types of errors, precision and accuracy. Classification of maps, map scale, conventional symbols, topographic maps, map layout, Survey of India Map numbering systems.

Measurement of Horizontal Distances:

Measuring tape and types. Measurement using tapes, Taping on level ground and sloping ground. Errors and corrections in tape measurements, ranging of lines, direct and indirect methods of ranging, Electronic distance measurement, basic principle. Booking of tape survey work, Field book, entries, Conventional symbols, Obstacles in tape survey, Numerical problems.

UNIT - II

Measurement of Directions and Angles:

Compass survey: Basic definitions; meridians, bearings, magnetic and True bearings. Prismatic and surveyor’s compasses, temporary adjustments, declination. Quadrantal bearings, whole circle bearings, local attraction and related problems

Traversing:

Traverse Survey and Computations: Latitudes and departures, rectangular coordinates, Traverse adjustments, Bowditch rule and transit rule, Numerical Problems.

UNIT - III

Leveling:

Basic terms and definitions, Methods of leveling, Dumpy level, auto level, digital and laser levels. Curvature and refraction corrections. Booking and reduction of levels. Differential leveling, profile leveling, fly leveling, check leveling, reciprocal leveling.

UNIT - IV

Plane Table Surveying:

Plane table and accessories, Advantages and limitations of plane table survey, Orientation and methods of orientation, Methods of plotting - Radiation, Intersection, Traversing, Resection method, Two point and three point problems, Solution to two point problem by graphical method, Solution to three point problem Bessel’s graphical method, Errors in plane table survey.

UNIT - V

Areas and Volumes:

Measurement of area by dividing the area into geometrical figures, area from offsets, mid ordinate rule, trapezoidal and Simpson’s one third rule, area from co-ordinates, introduction to planimeter, digital planimeter. Measurement of volumes- trapezoidal and prismoidal formula.

Contouring:Contours, Methods of contouring, Interpolation of contours, contour gradient, characteristics of contours and uses.

Text Books:

1. B.C. Punmia, “Surveying Vol.1”, Laxmi Publications pvt. Ltd., New Delhi -2017.
2. Kanetkar T P and S V Kulkarni , Surveying and Leveling Part I, Pune VidyarthiGrihaPrakashan,2015

Reference Books:

1. S.K. Duggal, "Surveying Vol.1", Tata McGraw Hill Publishing Co. Ltd. New Delhi.2019.
2. K.R. Arora, "Surveying Vol. 1" Standard Book House, New Delhi. -2017

Web Links:

1. nptel.iitm.ac.in
2. https://nptel.ac.in/courses/105/105/105105176/

REPAIR AND REHABILITATION OF STRUCTURES

(Open Elective-II)

VI SEMESTER	**L**	**T**	**P**	**C**
Course Code: 231CE6O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

- **CO1**: Recognize the mechanisms of degradation of concrete structures and to design durable Concrete structures.
- **CO2**: Conduct field monitoring and non-destructive evaluation of concrete structures
- **CO3**: Design and suggest repair strategies for deteriorated concrete structures, including the use of composites for repair.
- **CO4**: Understand the strengthening methods for concrete structures.
- **CO5**: Assessment of the serviceability and residual life span of concrete structures by visual inspection and in situ tests.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	1	-	1	-	2	3	-	1	-	-	-
CO2	2	1	-	2	-	2	2	-	2	-	-	-
CO3	2	2	3	2	-	2	2	-	2	-	-	-
CO4	2	2	-	2	-	2	2	-	2	-	-	-
CO5	2	2	-	2	-	2	2	-	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT: I

Materials for repair and rehabilitation- Admixtures- Types of admixtures- Purposes of using admixtures, chemical composition, Natural admixtures and Carbon fiber wraps, Steel Plates, Nondestructive evaluation: Importance-Concrete behavior under corrosion, disintegrated mechanisms- moisture effects and thermal effects – Visual investigation- Acoustical emission methods-Corrosion activity measurement- chloride content – Depth of carbonation-Impact echo methods-Ultra sound pulse velocity methods- pull out tests.

UNIT:II

Strengthening and stabilisation- Techniques- design considerations shear capacity strengthening- Shear Transfer strengthening-stress reduction techniques-Column strengthening-flexural strengthening-Connection stabilization and strengthening, Crack stabilization.

UNIT: III

Bonded installation techniques-Externally bonded FRP-Wetlay upsheet, bolted plate, near surface mounted FRP, fundamental debonding mechanisms-intermediate crack debonding-CDC debonding-plate end de bonding-strengthening of floor of structures post grout tests. Introduction to Liquefaction & its effects & applications.

UNIT: IV

Fiber reinforced concrete-Properties of constituent materials-Mix proportions, mixing and casting methods-Mechanical properties of fiber reinforced concrete-applications of fiber reinforced concretes-Lightweight concrete-properties of light weight concrete-No fines concrete-design of light weight concrete-Fly ash concrete-Introduction-classification of fly ash-properties and reaction mechanism of fly ash-Properties of fly ash concrete in fresh state and hardened state-Durability of fly ash concretes.

UNIT:V

High performance concretes-Introduction-Development of high performance concretes-Materials of high performance concretes-Properties of high performance concretes-Self Consolidating concrete-properties-qualifications.

Text Books:

1. Maintenance Repair Rehabilitation & Minor works of Buildings -P.C.Varghese, PHI Publications
2. Repair and Rehabilitation of Concrete Structures–P.I.Modi,C.N.Patel,PHI Publications

Reference Books:

1. Concrete Technology Theory and Practice-M.S.Shetty,SChandand Company
2. Concrete Repair and Maintenance illustrated-PeterHEmmons

Web Links:

1. https://www.academia.edu/30633495/Repair_and_Rehabilitatio n_of_Structures
2. https://www.vidyarthiplus.com/vp/Thread-CE2071-Repair-and- Rehabilitation-of-Structures-Lecture-Notes

Air Pollution Control

(Open Elective – II)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CE6O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Interpret the various ambient air quality parameters.
CO 2: Examine the plume behavior in prevailing atmospheric conditions.
CO 3: Explain the various methods related to sampling and analysis.
CO 4: Choose the appropriate air pollution control devices.
CO 5: Apply suitable particulate and gaseous control measures for an industry.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO 1	2	1	-	-	-	-	3	-	-	-	-	2
CO 2	3	2	-	-	-	-	2	-	-	-	-	3
CO 3	1	1	-	-	-	-	2	-	-	-	-	2
CO 4	1	2	-	-	-	-	1	-	-	-	-	3
CO 5	-	2	-	-	-	-	1	-	-	-	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO / PSO	PSO 1	PSO 2
CO 1	-	1
CO 2	-	2
CO 3	-	1
CO 4	-	2
CO 5	-	2

UNIT I

Air Pollution:

Definition – Sources and classification of Air Pollutants –indoor air quality – Effects of air pollution on health of Human & Animals, vegetation & materials, Global effects of air pollution - Carbon Credits and Carbon Trade.

UNIT II

Meteorology and Air Pollution:

Factors influencing air pollution – Temperature lapse rate and atmospheric stability – wind rose –Plume behaviour – Mixing depths – Plume rise and dispersion – prediction of air quality – box model – Gaussian model – Dispersion coefficient – Application of tall chimney for pollutant dispersion.

UNIT III

Control of Particulate Pollutants:

Sampling and analysis of air pollutants– Properties of particulate pollution – particle size distribution – control mechanism –Dust removal equipment – Design and operation of settling chambers, cyclones, wet dust scrubbers, fabric filters and ESP.

UNIT IV

Control of Gaseous Pollutants*:*

Process and equipment for the removal of gaseous pollutants by chemical methods – Design and operation of absorption and adsorption equipment- combustion and condensation equipment.

UNIT V

Control of Air and Noise Pollution:

Noise pollution and control – Definition – significance in general – sources, measurement - effects and control measures. Air pollution control: Environmental friendly fuels – In plant control measures, process changes, methods of removal and recycling – Air Pollution legislation – Automobile pollution, odour pollution, flares and control – Emission standards.

Text books:

1. Air Pollution**,** M.N.Rao and H.V.N.Rao, Tata McGraw Hill Comapany.
2. Air pollution and Control,Prof.K.V.S.G. Muralikrishna, Kaushal Publications-Kakinada.
3. Fundamentals of air pollution engineering,Richard C Flagan and John H Seinfeld, Prentice hall Inc,

Reference books:

1. An introduction to Air pollution,R.K.Trivedy and P.K. Goel, B.S. Publications, 2003.
2. Air Pollution control–A design approach, C DavidCooperand F.C. Alley, 4th Edition

Web Links:

1. https://nptel.ac.in/courses/103107084
2. http://www.moef.nic.in/report/0203
3. http://home.iitk.ac.in/~anubha/APC

INTEGRATED SOLID WASTE MANAGEMENT FOR A SMART CITY

(Open Elective – II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CE6O05	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe generation rates, composition, and issues of Solid waste
CO2: Explain the issues, collection, recovery, reuse, processing of Municipal solid waste
CO3: Illustrate the rules regarding MSW and current issues in Solid waste management
CO4: Interpret Construction and demolition waste management
CO5: Assess the issues related to E-waste generation and current management practices
CO6: Illustrate hazardous waste and current management practices

Mapping of Course Outcomes with Program Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	-	-	-	-	-	3	2	-	-	-	-
CO2	1	-	-	-	-	-	3	2	-	-	-	-
CO3	1	-	-	-	-	-	3	2	-	-	-	-
CO4	1	-	-	-	-	-	3	2	-	-	-	-
CO5	1	-	-	-	-	-	3	2	-	-	-	-
CO6	1	-	-	-	-	-	3	2	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Introduction:
Solid Waste Management- Definition, Concept of 4Rs (reduce, reuse, recycle and recover) of waste management, Elements of a waste management system, Issues in Solid Waste Management, Integrated Waste Management Hierarchy: Source reduction, Recycling, Waste-to-Energy and Landfilling, Review of waste management under Swachh Bharat Mission and Smart Cities Program.

Unit – II

Municipal Solid Waste:
Waste Composition and Quantities, Collection, Transportation, Segregation, and Processing.

Unit – III

Disposal of Municipal Solid Waste:
Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste, Municipal Solid Waste (MSW) Rules 2016, Current Issues in Solid Waste Management and Review of MSW Management

Unit – IV

Construction and Demolition (C&D) Waste Management:
Overview, Components; C&D Waste Management Rules 2016, Beneficial Reuse of C & D Waste Materials.

Unit – V

Electronic Waste (E-Waste) Management
Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.

Hazardous Wastes: Definition, Classification, Risk assessment, Transportation of hazardous waste, Current Management Practices: Environmental audit, Containment, Remedial alternatives.

Textbooks:

1. "Solid Waste Engineering", William A Worrell and P. AarneVeslind, 2nd Edition (SI Edition) Cengage Learning, 2012
2. "Integrated Solid Waste management", George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Tata McGraw Hill, 1993

Reference Books:

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India, 2016
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website
3. Construction and Demolition Waste Management Rules, 2016, MoEF&CC
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.

Web Links:

1. https://nptel.ac.in/courses/105/105/105105160/
2. http://swachhbharatmission.gov.in/sbmcms/index.htm
3. http://swachhbharaturban.gov.in/

FUNDAMENTALS OF ELECTRIC VEHICLES
(OPEN ELECTIVE-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231EE6O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1	Illustrate the use and advantages of different types of electric vehicles
CO2	Use suitable power converters for EV application.
CO3	Select suitable electric motor for EV power train
CO4	Design HEV configuration for a specific application.
CO5	Analyse various storage systems and battery management system for EVs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	1	-	-	-	1	1	-	-
CO2	3	2	2	-	-	-	-	-	1	1	-	-
CO3	3	2	2	-	-	-	-	-	1	1	-	-
CO4	3	2	2	-	-	-	-	-	1	1	-	-
CO5	3	2	2	-	-	-	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

UNIT – I
Introduction

Fundamentals of vehicles – Vehicle model – Calculation road load and tractive force – Components of conventional vehicles – Drawbacks of conventional vehicles – Need for electric vehicles– Advantages and applications of Electric Vehicles – History of Electric Vehicles – EV Market in India and outside India –Types of Electric Vehicles.

UNIT ‐ II

Components of Electric Vehicles

Main components of Electric Vehicles ‐ Electric Traction MotorandController ‐ Power Converters ‐ Rectifiers used in EVs ‐ Bidirectional DC‐DC Converters ‐ Voltage Source Inverters ‐ PWM inverters used in EVs.

UNIT ‐ III

Motors for Electric Vehicles

Characteristics of traction drive ‐ requirements of electric machines for EVs ‐ Comparison of Different motors for Electric and Hybrid Vehicles ‐ Induction Motors ‐ Synchronous Motors ‐ Permanent Magnetic Synchronous Motors ‐ Brushless DC Motors ‐ Switched Reluctance Motors (Construction details and working only).

UNIT ‐ IV

Hybrid Electric Vehicles

Evolution of Hybrid Electric Vehicles ‐ Advantages and Applications of Hybrid Electric Vehicles ‐ Architecture of HEVs ‐ Series and Parallel HEVs ‐ Complex HEVs ‐ Range extended HEVs ‐ Examples ‐ Merits and Demerits.

UNIT ‐ V

Energy Sources for Electric Vehicles

Batteries ‐ Types of Batteries ‐ Lithium-ion ‐ Nickel-metal hydride ‐ Lead-acid ‐ Comparison of Batteries ‐ Battery Charging ‐ Fast Charging ‐Battery Management System ‐ Ultra capacitors ‐ Flywheels ‐ Compressed air energy storage (CAES)‐ Fuel Cell ‐ it’s working.

Text Books:

1 Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.
2 Tom Denton, Hayley Pells - Electric and hybrid vehicles, Third Edition, 2024

Reference Books:

1 Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.
2 Chau - Kwok Tong. Electric vehicle machines and drives: design - analysis and application. John Wiley & Sons - 2015.
3 Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge university press - 2015.

Web Links:

1 MOOC at https://www.edx.org/learn/electric-cars
2 https://archive.nptel.ac.in/courses/108/106/108106170

ELECTRICAL WIRING ESTIMATION AND COSTING

(OPEN ELECTIVE-II)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231EE6O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1	Demonstrate the various electrical apparatus and their interconnections
CO2	Examine various components of electrical installations.
CO3	Estimate the cost for installation of wiring for different types of building and small industries.
CO4	Illustrate the components of electrical substations
CO5	Design suitable control circuit for starting of three phase induction motor and synchronous motor..

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
CO1	3	1	1	-	-	1	-	-	-	-	-	1
CO2	2	3	1	-	-	1	-	-	-	-	-	1
CO3	2	2	3	-	-	1	-	-	-	-	-	1
CO4	3	1	1	-	-	1	-	-	-	-	-	1
CO5	2	2	3	-	-	1	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Electrical Symbols and Simple Electrical Circuits

Identification of electrical symbols - Electrical wiring Diagrams - Methods of representation of wiring diagrams - introduction to simple light and fan circuits - system of connection of appliances and accessories.

UNIT – II

Design Considerations of Electrical Installations

Electric supply system - Three-phase four wire distribution system - protection of electric installation against overload - short circuit and earth fault - earthing - neutral and earth wire - types of loads - systems of wiring - permissible of voltage drops and sizes of wires - estimating and costing of electrical installations.

UNIT – III

Electrical Installation for Different Types of Buildings and Small Industries

Electrical installations for electrical buildings - estimating and costing of material - simple examples on electrical installation for residential buildings - electrical installations for commercial buildings - electrical installation for small industries-case study.

UNIT – IV

Substations

Introduction - types of substations - outdoor substations-pole mounted type - indoor substations-floor mounted type - simple examples on quantity estimation-case study.

UNIT – V

Motor control circuits

Introduction to AC motors - starting of three phase squirrel cage induction motors - starting of wound rotor motors - starting of synchronous motors - contractor control circuit components - basic control circuits - motor protection – Schematic and wiring diagrams for motor control circuits.

Text Books:

1. Electrical Design and Estimation Costing - K. B. Raina and S.K.Bhattacharya – New Age International Publishers - 2007

Reference Books:

1. Electrical wiring estimating and costing – S.L.Uppal and G.C.Garg – Khanna publishers - 6th edition – 1987.
2. A course in electrical installation estimating and costing – J.B.Gupta – Kataria SK & Sons - 2013.

Web Links:

1. https://onlinecourses.swayam2.ac.in/nou25_ec07/preview

INTRODUCTION TO INDUSTRIAL ROBOTICS
(OPEN ELECTIVE-II)

VI Semester	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1	Understand the fundamental components, types, and configurations of industrial robots.
CO2	Develop and analyze forward and inverse kinematic models of robotic manipulators.
CO3	Analyze the dynamics of robotic systems using Lagrangian and Newton-Euler methods.
CO4	Plan robot trajectories and motions, including path and slew motion planning.
CO5	Select and evaluate appropriate actuators, sensors, and end effectors for robotic tasks.
CO6	Apply robot programming methods for industrial tasks such as material handling a welding.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	2	-	-	-	-	-	-	-
CO2	3	3	3	2	3	-	-	-	-	--	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-
CO4	2	2	3	2	3	-	-	-	-	-	-	-
CO5	2	2	3	-	3	-	-	-	-	-	-	-
CO6	2	2	3	-	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	2
CO3	3	3
CO4	3	3
CO5	2	3
CO6	3	3

UNIT – I

Introduction: Automation and Robotics – An over view of Robotics – present and future applications.Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors,Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

UNIT – III

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems. Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

UNIT - IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools.

UNIT V

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading Processing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

Text Books:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

Reference Books:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science
3. Robotics – Fu et al / TMH Publications

Web Links:

1. https://onlinecourses.nptel.ac.in/noc23_me143/preview
2. https://www.youtube.com/playlist?list=PLXDsvE7qtfNf_N99hJZbdTEM001mOii6_

INDUSTRIAL MANAGEMENT
(OPEN ELECTIVE-II)

VI Semester	L	T	P	C
Course Code: 231ME6O02	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the theories of management and techniques of plant layout

CO2: Develop an efficient work system using method study and time study

CO3: Analyze the characteristics of quality control using control charts.

CO4: Explain the scope and nature of financial management

CO5: Discuss human resource management and value engineering

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	1	-	2	1	-	-	2
CO2	2	1	-	-	-	-	-	-	2	-	-	2
CO3	3	-	-	-	-	1	-	-	-	-	-	2
CO4	-	-	-	-	-	1	-	2	-	-	-	2
CO5	-	1	-	-	-	1	-	2	2	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	1	-
CO4	1	-
CO5	1	-

Unit - I

Introduction: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, differences between production management and industrial engineering, quantitative tools of IE and productivity measurement. concepts of management, importance, functions of management, scientific management, Taylor’s principles, theory X and theory Y, Fayol’s principles of management.

Plant Layout: Factors governing plant location, types of production layouts, advantages and disadvantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts, plant maintenance, preventive and break down maintenance.

Unit -II

Work Study: Importance, types of production, applications, work study, method study and time study, work sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

Unit - III

Statistical Quality Control: Quality control Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts - X and R -charts X and S charts and their applications, numerical examples.

Total Quality Management: Zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma-definition, basic concepts

Unit - IV

Financial Management: Scope and nature of financial management, Sources of finance, Ratio analysis, Management of working capital, estimation of working capital requirements, stock management, Cost accounting and control, budget and budgetary control, Capital budgeting – Nature of Investment Decisions – Investment Evaluation criteria- NPV, IRR, PI, Payback Period, and ARR, numerical problems.

Unit – V

Human Resource Management: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job- evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

Value Analysis: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

Text Books:

1. Industrial Engineering and Production Management, Mart and Telsang, S. Chand & Company Ltd. New Delhi.
2. Industrial Engineering and Management, O.P Khanna, Dhanpat Rai Publications (P) Ltd, 2018.

Reference Books:

1. Industrial Engineering and Management Science, T. R. Banga, S. C. Sharma, N. K.Agarwal, Khanna Publishers, 12th Edition
2. Operations Management, J.G Monks, McGraw Hill Publishers, 3rd edition.
3. Principles of Management, Koontz O’ Donnell, McGraw Hill Publishers, 4edition.
4. Industrial Management, Bhattacharya DK, S. Chand, publishers.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg43/preview
2. https://onlinecourses.nptel.ac.in/noc24_me15/preview
3. https://onlinecourses.nptel.ac.in/noc20_me43/preview

ADDITIVE MANUFACTURING
(OPEN ELECTIVE-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231ME6O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Demonstrate appropriate level of understanding on principles of additive manufacturing processes.

CO2: Identify the materials for solid based AM process.

CO3: Apply powder-based RP systems.

CO4: Analyze and apply various rapid tooling techniques.

CO5: Represent a 3D model in STL format and other RP data formats to store and retrieve the geometric data of the object.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	1	2	-	-	-	-	-	-	-
CO2	3	1	-	1	2	-	-	-	-	-	-	-
CO3	3	1	-	1	2	-	-	-	-	-	-	-
CO4	3	1	-	1	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	3	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

INTRODUCTION TO ADDITIVE MANUFACTURING: Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Advantages and Limitations of AM and Types of materials for AM.

LIQUID-BASED ADDITIVE MANUFACTURING PROCESS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT – II

SOLID-BASED ADDITIVE MANUFACTURING PROCESS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modelling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

UNIT – III

POWDER BASED ADDITIVE MANUFACTURING PROCESS: Selective laser sintering (SLS): Models and specifications, process, working principle, applications, advantages and disadvantages, Case studies. Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, applications, advantages and disadvantages, Case studies.

UNIT – IV

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting process. Direct rapid tooling: Direct AIM, LOM Tools, and Direct Metal Tooling using 3DP.

UNIT – V

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, and Newly Proposed Formats.
AM APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, RP medical and bioengineering applications: customized implants and prosthesis, forensic sciences.

Text Books:

1. “Rapid prototyping: Principles and applications”, Chua, C.K., Leong K.F. and Lim C.S., Third edition, World Scientific Publishers, 2010.
2. “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Gibson, I., Rosen, D.W. and Stucker, BSpringer, 2015.

Reference Books:

1. Additive Manufacturing: A Tool for Industrial Revolution 4.0, M. Manjaiah, K.

Raghavendra, N. Balashanmugam, J. Paulo Davim, Woodhead Publishing, Elsevier, 2021

2. “Additive Manufacturing: Principles, Technologies and Applications , C.P Paul, A.N Junoop, Second Edition, McGrawHill, 2021.
3. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & Francis Group, 2020.
4. Rapid Tooling: Technologies and Industrial Applications, Hilton, P.D. and Jacobs, P.F., CRC Press, 2000

Web Links:

1. https://www.nist.gov/additive-manufacturing
2. https://archive.nptel.ac.in/courses/112/103/112103306/
3. https://www.open.edu/openlearn/science-maths-technology/additive-manufacturing/content-section-0?active-tab=description-tab

VEHICLE TECHNOLOGY
(OPEN ELECTIVE-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231ME6O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Discuss the latest trends in engine technology

CO2: Discuss the need of advanced combustion technologies and its impact on reducing carbon foot-print on the environment.

CO3: Analyzing the basic characteristics of low carbon fuels, its impact over conventional fuels and in achieving sustainable development goals.

CO4: Discuss the working and energy flow in various hybrid and electric configurations.

CO5: Analyzing the need for fuel cell technology in automotive applications.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	3
CO3	-	3
CO4	-	2
CO5	-	3

Unit - I
Advanced Engine Technology:

Gasoline Direct Injection, Common Rail Direct Injection, Variable Compression Ratio Turbocharged Engines, Electric Turbochargers, VVT, Intelligent Cylinder De-activation, After Treatment Technologies, Electric EGR, Current EMS architecture.

Unit -II
Combustion Technology:

Spark Ignition combustion, Compression Ignition Combustion, Conventional Dual Fuel Combustion, Low Temperature Combustion Concepts– Controlled Auto Ignition, Homogeneous Charge Compression Ignition, Premixed Charge Compression Ignition, Partially Premixed Compression Ignition, Reactivity Controlled Compression Ignition, Gasoline Direct Injection Compression Ignition.

Unit - III

Low Carbon Fuel Technology:

Alcohol Fuels, Ammonia Fuel and Combustion, Methane Technology, Dimethyl Ether, Hydrogen Fuel Technology, Challenges, and way forward

Unit – IV

Hybrid and Electric Vehicle (Battery Powered)

Conventional Hybrids (Conventional ICE + Battery), Modern Hybrids (RCCI/GDCI Engine + Battery), Pure Electric Vehicle Technology – Challenges and Way forward

Unit – V

Fuel Cell Technology

Fuel cells for automotive applications - Technology advances in fuel cell vehicle systems - Onboard hydrogen storage - Liquid hydrogen and compressed hydrogen - Metal hydrides, Fuel cell control system - Alkaline fuel cell - Road map to market.

Text Books:

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
2. Rakesh Kumar Maurya, Characteristics and Control of Low Temperature Combustion Engines. ISBN 978-3-319-68507-6 , SPRINGER

Reference Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3. Rand D.A.J, Woods, R & Dell RM Batteries for Electric vehicles, John Wiley & Sons, 1998
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_ee18/preview
2. https://nptel.ac.in/courses/108106170

INDUSTRIAL SAFETY
(OPEN ELECTIVE-II)

		L	T	P	C
Semester: VI					
Course Code: 231ME6O05		3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the concepts of industrial safety and management

CO2: Describe about the smart machines and smart sensors

CO3: Apply IoT to Industry 4.0 and they are able to make a system tailor-made as per requirement of the industry

CO4: Explain about fire prevention and protection systems.

CO5: Understand and apply the fire safety principles in buildings

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	1	3	1	1	2	1	-	
CO2	2	-	-	-	1	1	2	1	2	2	-	
CO3	2	-	-	-	3	3	2	1	2	3	-	1
CO4	2	-	-	-	2	2	2	1	2	1	-	
CO5	2	-	-	-	2	2	2	1	2	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	2
CO4	-	1
CO5	-	1

Unit-I

Introduction to the Development of Industrial Safety and Management:
History and development of Industrial safety: Implementation of factories act, Safety and productivity, Safety organizations. Safety committees and structure, role of management and role of Govt. in industrial safety.

Unit-II

Accident Preventions and Protective Equipment:
Personal protective equipment, Survey the plant for locations, Part of body to be protected, Education and training in safety, Prevention causes and cost of accident, Housekeeping, First aid, Accident reporting, Investigations. Industrial psychology in accident prevention, Safety trials, Safety related to operations.

Unit - III

Safety Acts:
Features of Factory Act, Introduction of Explosive Act, Boiler Act, ESI Act, Workman's compensation Act, Industrial hygiene, Occupational safety, Diseases prevention, Ergonomics, Occupational diseases, stress, fatigue, health, safety and the physical environment, Engineering methods of controlling chemical hazards, safety and the physical environment, Control of industrial noise and protection against it, Code and regulations for worker safety and health, codes for safety of systems.

Unit - IV

Fire Prevention and Protection:
Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E-Fire extinguishing agents- Water, Foam, Dry chemical powder, Carbon-dioxide Halon alternatives Halocarbon compounds-Inert gases, dry powders – types of fire extinguishers – fire stoppers –hydrant pipes – hoses – monitors – fire watchers – layout of stand pipes – fire station-fire alarms and sirens – maintenance of fire trucks – foam generators – escape from fire rescue operations – fire drills –first aid for burns.

Unit–V

Building Fire Safety: Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exit– width calculations –fire certificates – fire safety requirements for high-rise buildings.

Text Books:

1. Industrial Maintenance Management Srivastava, S.K.-S. Chandand Co.
2. Occupational Safety Management and Engineering Willie Hammer-Prentice Hall
3. PurandareD.D & Abhay D.Purandare, "Hand book on Industrial Fire Safety" P &A pub lications, NewDelhi, 2006
4. McElroy,FrankE., "Accident Prevention Manual for Industrial Operations", NSC, Chicago,1988
5. Green, A.E., "High Risk Safety Technology", John Wiley and Sons, 1984.

Reference Books:

1. Installation, Servicing and Maintenance Bhattacharya, S.N.-S.ChandandCo.
2. JainVK“FireSafetyinBuilding”NewAgeInternational1996.
3. Reliability, Maintenance and Safety Engineering by Dr.A. K.Guptha
4. A Text book of Reliability and Maintenance Engineering by Alakesh Manna

Web Links:

1. https://nptel.ac.in/courses/110105094
2. https://onlinecourses.swayam2.ac.in/nou23_ge81/preview
3. https://www.youtube.com/watch?v=jFDWlKayrTc

PRINCIPLES OF COMMUNICATIONS
(Open Elective-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231EC6O01	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Summarize the functional blocks of a communication system.
CO2: Illustrate the working principle of amplitude modulation and demodulation.
CO3: Compare types of amplitude modulation.
CO4: Analyse the generation and detection of FM and PM signals.
CO5: Classify the radio transmitter and receivers.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	2	3	-	-	-	-	-	-	-	-	-	1
CO4	2	3	-	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Introduction: Definition of Signal, Types of signals, Fourier Transform (FT), Inverse Fourier Transform (IFT) and their properties, Introduction to Communication system, Elements of Communication system, Modulation, Need for Modulation, Electromagnetic Spectrum, Frequency Division Multiplexing (FDM), Amplitude Modulation: Introduction to Amplitude Modulation (AM), Double Sideband Suppressed Carrier ((DSB-SC) Modulation, Introduction to Single Sideband (SSB) Modulation and VSB modulation.

Unit – II

Angle modulation: Introduction, Phase Modulation, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Direct Method of FM generation, Phase locked loop, Comparison of FM and AM.

Unit – III

Pulse Modulation: Need for Digitizing Analog information, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Time Division Multiplexing, Introduction to Pulse Code Modulation and Delta Modulation.

Unit – IV

Pulse Digital Modulation: Elements of digital communication systems, advantages of digital communication systems, Elements of PCM: Sampling, Quantization and coding, Quantization error, companding in PCM systems. Differential PCM Systems (DPCM).

Delta Modulation: Delta Modulation, its drawbacks, adaptive delta modulation, comparison of PCM and delta and adaptive delta modulation, noise in PCM and DM systems.

Unit – V

Digital Modulation Techniques: Introduction, BPSK, DPSK, DEPSK, QPSK, M-ary PSK, ASK, QASK, BFSK, M-ary FSK, MSK, Duobinary Encoding, Comparison of digital modulation techniques, Partial response signalling.

Text Books:

1. Principles of Communication Systems, H Taub, D L Schilling, Gautam Sahe, TMH, 4th Edition, 2017.
2. Communication Systems – B. P. Lathi, BS Publication, 2006

Reference Books:

1. Principles of Communication Systems - Simon Haykin, John Wiley, 2nd Edition.
2. Electronics & Communication System – George Kennedy and Bernard Davis, TMH 2004.
3. Analog and Digital Communications: Theory and Lab Work- Abhay Gandhi, Cengage, 2015.

Web Links:

1. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ee08/,Principles of Communication Systems-I, Prof.Aditya K.Jagannatham, IIT Kanpur.
2. https://onlinecourses.nptel.ac.in/noc21_ee74/preview,AnalogCommunication,Prof.GoutamDas, IITKharagpur.
3. https://www.scribd.com/document/266137872/sanjay-sharma-pdf.
4. http://bayanbox.ir/view/914409083519889086/Book-Modern-Digital-And-AnalogCommunicationSystems-4th-edition-by-Lathi.pdf.
5. https://soaneemrana.org/onewebmedia/ELECTRONICS%20COMMUNICATION%20SYSTEM%20BY% 20GEORGE%20KENNEDY.pdf

Biomedical Engineering
(Open Elective-II)

	L	T	P	C
VI Semester **Course Code: 231EC6O02**	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1	Understand the principles of biomedical instrumentation, bioelectric potentials, transducers, biosensors, and electrical safety.
CO2	Measure and analyze biopotential signals such as ECG, EEG, EMG, ERG, EOG, and EGG
CO3	Perform non-electrical physiological measurements related to cardiovascular and respiratory systems.
CO4	Explain the working of critical care and therapeutic equipment used in clinical applications.
CO5	Apply diagnostic techniques and biotelemetry systems in telemedicine and healthcare monitoring.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	2	3	-	2	-	2	-	1
CO2	3	3	3	2	3	-	-	-	-	2	-	1
CO3	3	3	3	2	3	3	-	-	-	2	-	1
CO4	3	2	3	2	3	3	-	-	-	2	-	1
CO5	3	3	3	2	3	3	-	-	-	3	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Introduction: Age of Biomedical Engineering, Development of Biomedical Instrumentation, Man Instrumentation System, Components of the Man-Instrument System, Physiological System of the Body. Bioelectric Potential Electrodes- Examples, Physiological signals, Bio-Amplifiers, transducers- Piezo-electric and ultrasonic, Bio Sensors – Principles – Piezo-electric, Thermal, Optical. Safety issues from electrical Hazards

Unit – II

Biopotential Measurements: Bio signals characteristics – frequency and amplitude ranges. ECG – Einthovens triangle, standard lead system, Measurement of Heart sound, Recording methods. EEG – 10-20 electrode system, unipolar, bipolar and average mode, Recording methods. EMG- unipolar and bipolar mode, Recording methods. Recording of ERG, EOG and EGG

Unit – III

Non-Electrical Measurements:Heart and Cardiovascular System, Electro Cardiograph, Blood Pressure Measurement, Measurement of Blood Flow and Cardiac Output, Angiogram. Body

Plethysmography- Blood Gas analysers, pH of blood. Respiratory System: The Physiology of the Respiratory System, Tests and Instrumentation for the Mechanics of Breathing, Respiratory Therapy Equipment.

Unit – IV

Critical Care and Therapeutic Equipment: Elements of intensive-care monitoring – Clinical laboratory instruments – Biomaterials – Ventilators: Types, classification, and positive pressure ventilators – Cardiac defibrillators: Types and applications – Cardiac pacemakers: External and implantable – Audiometers and hearing aids – Myoelectric arm – Physiotherapy equipment: Diathermy (short wave, microwave, ultrasonic) – Electrotherapy equipment: Nerve muscle stimulator, Functional electrical stimulator.

Unit – V

Diagnostic Techniques and Biotelemetry: Ultrasonic measurement and imaging – Applications of ultrasound in diagnosis and therapy – X-Ray instrumentation – CAT scan – Emission computerized tomography – MRI – Introduction to telemedicine and cyber medicine – Applications of telemedicine – Biotelemetry: Components and physiological parameters – Implantable telemetry units – Telemetry for ECG and emergency monitoring – Wireless wearable health care technology.

Text Books:

1. Bio-Medical Instrumentation Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd edition, PHI, 2011
2. Introduction to Bio-Medical Equipment Technology - Joseph J. Carr, John M. Brown, 4th edition, Pearson Publications, 2012.
3. Medical Instrumentation Application and design, John G.Webster, Wiley India Edition, 2009.
4. Handbook of Biomedical Instrumentation, Khandpur R.S, Tata McGraw-Hill, New Delhi, 2nd edition, 2003

Reference Books:

1. Handbook of Bio-Medical Instrumentation, Khandapur, R.S., McGrawHill, 2nd edition, 2003
2. Biomedical Instrumentation, Arumugam, M., Anuradha Publications, 2006.
3. Health Care Systems, Technology and Techniques, Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Springer, 1st Edition, 2011.
4. Standard Handbook of Biomedical Engineering and Design, Myer Kutz, McGraw Hill Publisher, 2003.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_ee17/preview, IIT Kharagpur, By Prof. Sudipta Mukhopadhyay
2. https://www.class-central.com/course/nptel-medical-image-analysis-7934, IIT Kharagpur, By Prof. Debdoot Sheet
3. https://www. https://www.electrical4u.com/introduction-to-biomedical-instrumentation/

ECAD TOOLS
(Open Elective-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231EC6O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Summarize the basic concepts on ECAD tools and PSPICE.
CO2 Build various types passive element circuits and its performance using PSPICE.
CO3 Construct BJT configuration amplifiers using PSPICE.
CO4 Build various FET amplifiers circuits using PSPICE.
CO5 Make use of MATLAB functions for solving the mathematical equations.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	2	-	-	-	-	-	-	-	-	1
CO2	2	1	3	-	-	-	-	-	-	-	-	1
CO3	2	1	3	-	-	-	-	-	-	-	-	1
CO4	2	1	3	-	-	-	-	-	-	-	-	1
CO5	3	1	2	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Introduction to ECAD tools: Introduction, various ECAD tools, applications of ECAD tools Introduction to PSPICE: History, professional version, types of sources, analysis menu, circuit topology and analysis.

Unit – II

Implementation of passive circuits (RC, RL, LC, RLC) using Pspice: Voltage-current relation of an inductors, capacitors, series and parallel connections of initially uncharged capacitors and inductors, phasor relation for a resistor, capacitor, inductors. Charging and discharging responses of capacitors and inductors, natural responses of RLC circuits.

Unit – III

Implementation of active circuits using PSPICE: Diodes, transistor switches, BJT amplifiers-CE amplifier, CC amplifier, differential amplifier, and tuned amplifier, JFET amplifiers, MOSFET amplifiers-common source amplifier, common drain amplifier.

Unit – IV

Introduction to MATLAB: Array of numbers, MATLAB for plotting, functions in MATLAB, Vectors and matrices, linear equations geometry and statics, polynomials equations, Iterative solution of equations

Unit – V

MATLAB Simulink: Introduction to Simulink, model of momentum law, capacitor discharge, a mass spring dash spot system, series RLC circuit.
Applications of frequency domain: Introduction, signals, DFT, power spectrum, trigonometric expansion of signals, high frequency signals.

Text Books:

1. Circuit analysis with PSPICE, Nassir H. Sabah, 2017.
2. MATLAB and Simulink, Adrian B. Biran, CRC press Taylor& Francis group.

Reference Books:

1. Electronics Circuits and Systems, Owen Bishop, 4th edition, 2011.
2. MATLAB for Electrical and computer engineering, Roland Priemer, 2013.

Web Links:

1. https://www.mccormick.northwestern.edu/documents/students/undergraduate/introduction-to-matlab.pdf
2. https://vdocument.in/orcad-pspice-course-material.html

QUANTUM SCIENCE
(Open Elective – II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231EC6O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Explain the fundamental postulates and mathematical formulation of quantum mechanics.
CO2 Analyze quantum phenomena such as wave-particle duality, uncertainty, and tunneling.
CO3 Apply Schrödinger's equation to simple physical systems and interpret the results.
CO4 Understand the role of quantum theory in semiconductors, nanomaterials, and modern electronics.
CO5 Describe the basic principles of quantum computing and its potential applications.

CO–PO Mapping:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	1	-	-	-	-	-	-	-	-	-
CO5	2	2	2	1	1	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I: Fundamentals of Quantum Mechanics

Introduction to quantum theory, Limitations of classical mechanics, Wave-particle duality, de Broglie wavelength, Heisenberg's uncertainty principle, Concept of wave function and operators, Expectation value, Time-dependent and time-independent Schrödinger equations.

UNIT – II: Quantum States and Applications

Particle in a one-dimensional box, Energy quantization, Potential step and barrier, Quantum tunneling, Harmonic oscillator (qualitative), Quantum confinement in low-dimensional systems (quantum wells, wires, and dots).

UNIT – III: Quantum Electronics

Quantum transitions, Absorption, spontaneous and stimulated emission, Population inversion, Laser principle, Einstein's coefficients, Working of LASERs (He-Ne, Semiconductor laser), Quantum cascade laser, Photonic devices and detectors based on quantum effects.

UNIT – IV: Quantum Materials and Devices

Quantum Free electron theory, Fermi energy and density of states, Band formation in solids, Semiconductors, Quantum Hall effect, Quantum dots, Spintronics and quantum tunneling devices.

UNIT – V: Introduction to Quantum Computing

Qubits and superposition, Quantum entanglement, Quantum gates and circuits, Quantum algorithms (qualitative discussion on Deutsch-Jozsa and Shor’s algorithm), Quantum communication and cryptography, Emerging applications of quantum technology.

Text Books:

1. David J. Griffiths, Introduction to Quantum Mechanics, Pearson Education.
2. S. Singh, Quantum Mechanics: Fundamentals and Applications, New Age International.
3. Ajoy Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, Springer.

Reference Books:

1. Leonard Susskind & Art Friedman, Quantum Mechanics: The Theoretical Minimum, Basic Books.
2. Richard P. Feynman, Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher, Penguin.
3. John Preskill, Quantum Computation and Information, Lecture Notes (Caltech).

Web Links:

1. https://nptel.ac.in/courses/115106086
2. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/
3. https://qiskit.org/textbook
4. https://quantum.country
5. https://www.khanacademy.org/science/physics/quantum-physics

WEB TECHNOLOGIES
(Open Elective-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1: Develop static web pages using HTML and CSS.
CO 2: Apply JavaScript for Client side validations and Node.JS to learn server side applications using JavaScript.
CO 3: Make use of Angular JS for developing dynamic and responsive web pages.
CO 4: Utilize React JS for developing dynamic and responsive web pages.
CO 5: Create and deploy secure, usable database driven web applications using PHP and MySQL/MongoDB.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	2	-	-	-	-	-	-	-	-	-
CO2	2	-	2	-	-	-	-	-	-	-	-	-
CO3	3	-	3	-	2	-	-	-	-	-	-	-
CO4	2	-	2	-	2	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

HTML, HTML5, CSS, CSS3 HTML: Basic Syntax, Standard HTML Document Structure, Basic Text Markup, HTML styles, Elements, Attributes, Heading, Layouts, HTML Media, Iframes, Images, Links, Lists, Tables, Forms, GET and POST method, HTML 5, Dynamic HTML. CSS: Cascading style sheets, Levels of Style Sheets, Style Specification Formats, Selector Forms, Box Model, Conflict Resolution, CSS3.

Unit – II

JavaScript & XML Javascript - Introduction, Primitives, Variables – var, let, const, Operations and Expressions, Control Statements, Functions, Objects (Predefined - String, Number, Array, Date, Math, Random, RegExp, User Defined – Definition, Properties, Methods, Display, Accessors, Constructors), Events, Pattern Matching using Regular Expressions, Working with XML: Document type Definition (DTD), XML schemas, XSLT, XML and
CSS, Document object model, Parsers - DOM and SAX.

Unit – III

Node JS & Angular JS Node.js- Introduction, Advantages, Process Model, Modules, HTTP Module, File system, URL module, NPM, Events, Upload Files, Email. Angular JS – Introduction, Expressions, Modules, Directives, Model, Data Binding, Controllers, Scopes, Filters, Services, HTTP, Tables, Select, Events, Forms, Validation, API, W3.CSS, Includes, Routing, SQL, DOM, Application.

Unit – IV

React JS React JS – Introduction, Displaying "Welcome React", Introducing JSX, Rendering Elements, Components and Props, State and Lifecycle, Handling Events, Conditional Rendering, Lists and Keys, Forms, Lifting State Up, Composition vs Inheritance, Thinking in React.

Unit – V

PHP PHP Programming - Introduction, Creating and Running PHP Script. Variables, Constants, DataTypes, Operators. Controlling Program Flow - Conditional and Loop statements, Arrays, Functions, Client-Server Scripting – XAMPP/LAMP Introduction, Running PHP Script in XAMPP, Super Globals, Working with Form Data, Database Connectivity – MySQL Introduction using XAMPP in Command Mode and GUI, Working with MySQL Queries, Integrating PHP and MySQL to work with Form Data. No SQL Database - MongoDB Introduction, Create and Drop Database, Create and Drop Collection, Data Types, Insert, Query, Update, Delete, Integrating PHP with MongoDB.

Text Books:

1. Programming the World Wide Web, 7th Edition, Robet W Sebesta, Pearson.
2. Pro Mean Stack Development, 1st Edition, ELadElrom, Apress O'Reilly.
3. React Explained, 2020 Edition, Zac Gordon, OSTraining.
4. MongoDB – The Definitive Guide, 2nd Edition, Kristina Chodorow,O'Reilly.

Reference Books:

1. Web Technologies, HTML, JavaScript, PHP, Java, JSP, XML and AJAX, Black book, 1st Edition, Dream Tech.
2. An Introduction to Web Design, Programming, 1st Edition, Paul S Wang, Sanda S Katila, Cengage Learning.

Web Links:

1. https://www.w3schools.com/ (html, css, js, xml, nodejs, angular, react, php)
2. https://www.angular.io/docs
3. https://www.reactjs.org/docs/getting-started.html
4. https://www.university.mongodb.com/

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INTRODUCTION TO DATA SCIENCE

(Open Elective-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231DS6O01	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO 1: Apply principles of NumPy and Pandas to the analysis of data.
CO 2: Make use of various file formats in loading and storage of data
CO 3: Identify and apply the need and importance of pre-processing techniques
CO 4: Show the results and present them in a pictorial format
CO 5: Facilitate new solutions for visualization of datasets by using different plotting techniques.

Mapping of course outcomes with program outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-
CO4	2	2	-	-	2	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-

Mapping of course outcomes with program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	1	-

UNIT I Data science: definition, Datafication, Exploratory Data Analysis, The Data science process, A data scientist role in this process. NumPy Basics: The NumPy ndarray: A Multidimensional Array Object, Creating ndarrays ,Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Data Processing Using Arrays, Expressing Conditional Logic as Array Operations, Methods for Boolean Arrays , Sorting , Unique.

UNIT II Getting Started with pandas: Introduction to pandas, Library Architecture, Features, Applications, Data Structures, Series, DataFrame, Index Objects, Essential Functionality Reindexing, Dropping entries from an axis, Indexing, selection, and filtering),Sorting and ranking, Summarizing and Computing Descriptive Statistics, Unique Values, Value Counts, Handling Missing Data, filtering out missing data.

UNIT III Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats,Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in MongoDB.

.**UNIT IV Data Wrangling:** Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap , Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values.

UNIT V Plotting and Visualization: A Brief matplotlib API Primer, Figures and Subplots, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File,Plotting Functions in pandas, Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots.

Text Books:

1. Wes McKinney, “Python for Data Analysis”,O’REILLY, ISBN:978-1-449-31979-3, 1st edition, October 2012.
2. Rachel Schutt & O’neil, “Doing Data Science”, O’REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.

Reference Books:

1. Joel Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media, 2015
2. Matt Harrison, “Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization , O'Reilly, 2016.

Web Links:

1. https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/
2. https://en.m.wikipedia.org/wiki/Data_Science_and_Predictive_Analytics

OPERATING SYSTEMS

(Open Elective-II)

	L	T	P	C
VI Semester				
Course Code: 231IT6O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe various concepts of operating systems and system calls.
CO2: Describe the concept of program, process and thread and analyze various CPU Scheduling Algorithms and compare their performance
CO3: Solve Inter Process Communication problems by various methods
CO4: Compare various Memory Management Schemes especially paging and Segmentation in Operating System and apply various Page Replacement Techniques.
CO5: Outline File Systems implementation in Operating System.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	1	3	-	-	-	-	-	-	-	-	-	-
CO3	1	2	-	-	-	-	-	-	-	-	-	-
CO4	1	3	-	-	-	-	-	-	-	-	-	-
CO5	2	2	-	-	-	-	-	-	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	1	-

UNIT – I

Operating Systems Overview: Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems System **Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system

UNIT ‐ II

Processes: Process Concept, Process scheduling, Operations on processes, Inter-process communication. Threads and Concurrency: Multithreading models, Thread libraries, Threading issues. CPU Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

UNIT - III

Synchronization Tools: The Critical Section Problem, Peterson’s Solution, Mutex Locks, semaphores, Monitors, Classic problems of Synchronization. Deadlocks: system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

UNIT - IV

Memory- Management Strategies: Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. Virtual Memory Management: Introduction, Demand paging, Copy-on-write, Page replacement Allocation of frames, Thrashing Storage Management: Overview of Mass Storage Structure, HDD Scheduling.

UNIT - V

File System: File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File-System Mounting, Partitions and Mounting, File Sharing. Protection: Goals of protection, Principles of protection, Protection Rings, Domain of protection, Access matrix.

Text Books:

1. Operating System Concepts, Silberschatz A, GalvinPB, GagneG,10thEdition, Wiley, 201
2. Modern Operating Systems, Tanenbaum AS,4th Edition, Pearson ,2016

Reference Books:

1. Operating Systems -Internals and Design Principles, Stallings W, 9thedition, Pearson, 201
2. Operating Systems: A Concept Based Approach, D. M Dhamdhere, 3rd Edition, McGraw Hill, 2013

Web Links:

1. https://archive.nptel.ac.in/courses/106/105/106105214/
2. https://www.coursera.org/specializations/codio-introduction-operating-systems
3. https://www.codecademy.com/learn/fundamentals-of-operating-systems

Computer Organization and Architecture
(OPEN ELECTIVE-II)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231AM6O01	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the course, student will be able to:

CO1: Describe the basic structure of a computer system, various number systems and arithmetic operations

CO2: Explain the Operation of CPUs including RTL, ALU, Instruction Cycle and Buses

CO3: Demonstrate the architecture and functionality of central processing unit

CO4: Illustrate the I/O and memory organization in an efficient way.

CO5: Make use of multi processors and pipelining to improve the efficiency of computer system.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	2	-	-	-	-	-	-	-
CO2	2	1	-	-	2	-	-	-	-	-	-	-
CO3	3	1	-	-	2	-	-	-	-	-	-	-
CO4	2	1	-	-	2	-	-	-	-	-	-	-
CO5	3	2	-	-	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO / PSO	PSO 1	PSO 2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	3	-

UNIT-I

Basic Structure of Computers: Basic Organization of Computers, Historical Perspective, Bu Structures. Data Representation: Data types, Complements, Fixed Point Representation Floating - Point Representation. Other Binary Codes, Error Detection Codes.

Computer Arithmetic: Addition and Subtraction, Multiplication Algorithms, Division Algorithms

UNIT-II

Register Transfer Language and Microoperations: Register Transfer language. Registe Transfer Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro Operations, Shif Micro Operations, Arithmetic Logic Shift Unit

Basic Computer Organization and Design: Instruction Codes, Computer Register, Compute Instructions, Instruction Cycle, Memory - Reference Instructions. Input - Output and Interrupt Complete Computer Description

UNIT-III:

Central Processing Unit: General Register Organization, STACK Organization. Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

Microprogrammed Control: Control Memory, Address Sequencing, Micro Program example, Design of Control Unit.

UNIT-IV:

Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupts, Direct Memory Access

UNIT – V:

Multi Processors: Introduction, Characteristics of Multiprocessors, Interconnection Structures, Inter Processor Arbitration.

Pipeline: Parallel Processing, Pipelining, Instruction Pipeline, RISC Pipeline, Array Processor

Text Books:

1 Computer System Architecture, M. Morris Mano, Third Edition, Pearson, 2008.
2 Computer Organization, Carl Hamacher, ZvonkoVranesic, SafwatZaky, 5/e, McGraw Hill, 2002.

Reference Books:

1 Computer Organization and Architecture, William Stallings, 6/e, Pearson, 2006.
2 Structured Computer Organization, Andrew S. Tanenbaum, 4/e, Pearson, 2005.
3 Fundamentals of Computer Organization and Design, Sivarama P. Dandamudi, Springer, 2006

Web Links:

1 https://nptel.ac.in/courses/106/105/106105163/
2 https://nptel.ac.in/courses/106/106/106106092/
3 https://www.udemy.com/course/computer-architecture-computer-organization-course/
4 http://www.cuc.ucc.ie/CS1101/David%20Tarnoff.pdf

INTRODUCTION TO DRILLING TECHNOLOGY

(OPEN ELECTIVE – II)

	L	T	P	C
VI Semester				
Course Code: 231PT6O01	3	0	0	3

Course Outcomes:At the end of the course, student will be able to:

CO 1: Discuss about overview of drilling.

CO 2: Identify different types of drilling fluids and their hydraulics.

CO 3: Explain about types casing and cementation processes.

CO 4: Explain about application of directional drilling.

CO 5: Estimate the kick and explain special kick problems.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Overview of drilling: Drilling Planning Approaches- Drilling team- Types of drilling.

UNIT-II

Rotary bit technology- Drilling string basics.

Drilling fluids and hydraulics: Drilling fluid economics- Drilling fluid properties- Drilling fluid report hydraulics calculations- Bit Hydraulics- Optimization- Swab & Surge-pressures- Mud hydraulics analysis report- Lost circulation. Disposing of the drilling fluids waste and drill cuttings waste.

UNIT-III

Casing & cementation: Casing standards- Casing coupling- Cementing: Introduction cement slurries- Typical field calculations- Cementing nomenclature- Cement additives- Casing & cementing analysis report.

UNIT-IV

Directional drilling: Applications- Well planning- Down-hole motors- Deflection tools and techniques- Face orientation- Direction control with rotary assemblies- Navigation drilling systems- Horizontal wells-Fishing operations- MWD, LWD & ERD and Bi-centric bits.

UNIT-V

Stuck pipe, well control: Kicks- Kick control- Pressure control theory- BOP-Special kick problems and procedures to free the pipes and Fishing operations.

Driller's logs: Sample logs- Miscellaneous logging devices.

Text Books:

1. Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc., 1960.
2. Drilling Engineering, J.J. Azar and G.Robello Samuel, PennWell Books, 2007.
3. Working Guide to Drilling Equipment and Operations, William Lyons, Gulf Publishing, 2009.

Reference Books:

1. Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman, 1985.
2. Drilling Engineering: A Complete Well Planning Approach, Neal Adams, Tommie Charrier Pennwell, 1985.
3. Practical Well Planning and Drilling Manual, Steve Devereux, Pennwell, 1998.

Web Links:

1. https://onepetro.org/books/book/74/chapter/14371674/Introduction-to-Well-Planning
2. https://onepetro.org/books/book/74/chapter/14367439/Fluid-Mechanics-for-Drilling
3. https://www.scribd.com/document/335022086/Casing-and-Cement-Theory
4. https://www.drillopedia.com/direction-drilling-applications
5. https://www.academia.edu/17285077/Well_Control_Manual

INTRODUCTION TO WELL COMPLETIONS

(OPEN ELECTIVE-II)

		L	T	P	C
VI Semester					
Course Code:	**231PT6O02**	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the course, student will be able to:

CO 1: Discuss about functions of completions.
CO 2: Identify different types of perforation techniques.
CO 3: Explain about various completion equipment.
CO 4: Discuss about General Procedure and considerations of DST and Tubing string design.
CO5: Explain about well servicing and stimulation system.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Well completion: Types of wells- Completion functions- Types of completion.

UNIT-II

Mechanical aspects of well testing- Cased hole logging equipment and application and perforation methods and perforation equipment.
Packers: Function- Application- Proper selection- water / gas shut off, horizon separation etc.

UNIT-III

Completion equipment (SSD, SSSV, mandrels, locks etc.)- Data acquisition in wells- Fibre optics- Permanent gauges- Memory gauges- SCADA systems- Intelligent completion equipment.

UNIT-IV

Tubing string design (dimension, materials and connections etc.) based on pressure, temperature, operating conditions- Media- Safety requirements.
Drill Stem Testing: General Procedure and considerations- Test tool components and arrangement-Analysis of Test data.

UNIT-V

HPHT and horizontal well completions- Workover equipment wireline- Snubbing unit- Coil tubing completion and work over design and execution.
Introduction to well servicing and stimulation system – Objectives and applications.

Text Books:

1. Well Completion and Servicing, D. Perrin, Micheal Caron, Georges Gaillot, Editions Technip, 1999.
2. Primer of Well Service, Workover and Completion, Petroleum Extension Service (PETEX), University of Texas at Austin, 1997.
3. Well Testing, John Lee, Society of Petroleum Engineers, 1982.

Reference Books:

1. Well Completion Design, Jonathan Bellarby, Elsevier, 2009.
2. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham & Trotman, Inc., 1986.
3. Advanced Well Completion Engineering, Wan Renpu, Gulf Professional Publishing, 2011.

Web Links:

1. https://www.slideshare.net/slideshow/well-completionspptx/256626844
2. https://www.scribd.com/presentation/454225251/Well-logging-perforation
3. https://www.scribd.com/document/742870395/H03440-Completion-Solutions-Catalog
4. https://www.scribd.com/document/517200042/Tubing-string
5. https://www.slideshare.net/slideshow/well-completion-well-intervention-stimulation-and-workover/92609098

INTRODUCTION TO PETROLEUM PRODUCTION ENGINEERING

(OPEN ELECTIVE – II)

	L	T	P	C
VI Semester				
Course Code: 231PT6O03	3	0	0	3

Course Outcomes: At the end of the course, student will be able to:

CO 1: Explain about petroleum production system.
CO 2: Discuss about reservoir deliverability
CO 3: Explain about Choke performance
CO 4: Design of transportation system
CO 5: Explain about artificial lift methods.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Petroleum production system - Introduction to Petroleum Industry, Reservoir Engineering, Well Design and Drilling, Production Equipment and Facilities, Production Techniques

UNIT-II

Reservoir deliverability - Introduction to Reservoir Deliverability

UNIT-III

Choke performance - Well Deliverability-Forecast of well production

UNIT-IV

Production decline analysis. Transportation system: Design and Selection

UNIT-V

Artificial lift methods: Basics and Design of Sucker rod pumping - Gas lift - Other artificial lift methods.

Production Stimulation: Well problem identification - Matrix acidizing- Hydraulic fracturing-

Text Books:

1. Petroleum Production Engineering: A computer Assisted Approach, Boyun Guo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books, 2007. 2. Petroleum Production Systems, M. J. Economides, A. Daniel Hill & C. E. Economides, Prentice- Hall, N. J – 07488, 1994.

Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. The Technology of Artificial Lift Method, Brown, K.E., Volume 1, PennWell Books, 1977.

Web Links:

1. https://www.scribd.com/document/381408982/Petroleum-Production
2. https://www.globalspec.com/reference/33548/203279/chapter-3-reservoir-deliverability
3. https://www.scribd.com/document/367547540/5-Choke-Performance-Pages-59-67
4. https://onlinelibrary.wiley.com/doi/10.1155/2021/6638135
5. https://www.slideshare.net/slideshow/introduction-artificial-lift/107960240

MINERAL ECONOMICS

(OPEN ELECTIVE – II)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231MI6O01	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO 1: Explain the economic significance of the mineral industry and analyze factors influencing mineral prices and national mineral policies.

CO 2: Classify mineral reserves and resources, apply geostatistical tools for estimation, and interpret demand trends through market surveys.

CO 3: Illustrate conservation methods, sampling techniques, and evaluate mineral losses, dilution, and recovery in economic terms.

CO 4: Conduct mine valuation using static and dynamic investment appraisal methods and analyze cost components in mine budgeting and finance.

CO 5: Assess mineral taxation systems, understand international trade in minerals, and evaluate the structure and challenges of mineral information systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

UNIT-I

General: Economic importance of the mineral industry; Risky nature of the mining industry; Demand and Supply analysis, National mineral policy;

Mineral price and pricing: International monetary system, Factors affecting mineral price, kinds of price quotation, Mineral price index, Mineral prices.

UNIT-II

Mineral Resource/Reserve: Concept, classification and estimation of reserves. Applications of Geostatistics.

Mineral inventory: concept, characteristic features, composition and economic significance; Estimation of life index.

Demand analysis and Market survey: Meaning and law of demand; methodology of demand analysis, Market survey.

UNIT-III

Conservation of mineral resources – Means of conservation and limitations in the scope of Conservation

Mine Sampling: Definition, purpose and scope, Preparation of samples, methods and computations; Application of statistical methods in sampling.

b - Classification and incorporation of losses, co-efficient of completeness of mineral extraction, Dilution and recovery

Examination of mineral properties: Definition, purpose, type and scope of examination.

UNIT-IV

Mine valuation: Basic concept, Earlier approaches to mine valuation, recent approaches to evaluation **Investment Appraisal**: Elements of investment appraisal, Static methods of investment appraisal, Dynamic methods of appraisal, discounted cash flow analysis

Mining costs: Capital and operating costs; Factors affecting operating cost; Methods of estimating future costs; Standard cost and forecast; Budget and budgetary control.

Mine finance: Capital – its importance, various forms and formation; mine accountancy and book keeping.

UNIT-V

Mineral Taxation System: Theory of taxation on minerals, Mineral tax designing, Types of mineral taxes, Taxes affecting mineral sector

Internal and External Trade: Taxes and duties; Imports and exports; International investment and trade in mineral materials & products.

Mineral information system: Data-information-informatics-data base, Mineral information system in India and problems, Mineral information system in outside India.

TEXT BOOKS:

1. Alwyn E. Annels, Mineral Deposit Evaluation: A Practical Approach, Chapman Hall, 1991.
2. Deshmukh R.T. Mine and Mineral Economics, Emdee Publishers, 1986.
3. Arogyaswamy, R.N.P. Courses in Mining Geology, Oxford and IBH Publishing Co., 1994.

REFERENCES:

1. Sloan, D.A., Mine Management, Chapman and Hall, London, 1983.
2. Chatterjee, K.K., Mineral economics, Wiley Eastern, 1992.
3. Park, R.J., Examination and Valuation of mineral property
4. How to read a balance sheet ILO 1992.

Web Links:

1. https://pubs.usgs.gov/circ/1953/0231/report.pdf
2. https://www.min.int/impact/whatis.shtml
3. https://www3.nd.edu/~cneal/planetearth/Chapt-15-Marshak.pdf

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LANDSLIDES & SLOPE STABILITY ENGINEERING
(OPEN ELECTIVE – II)

		L	T	P	C
VI Semester					
Course Code:	**231MI6O02**	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the Course, Student will be able to:

CO 1:	Classify types of mine slopes and slope failures, and identify key factors affecting slope stability for effective slope investigation planning.
CO 2:	Acquire and interpret geological and geotechnical data required for evaluating highwall slope stability, including shear strength characteristics.
CO 3:	Explain water flow mechanisms through various materials in mine slopes, and apply seepage analysis using flow nets and permeability estimation.
CO 4:	Apply analytical and probabilistic methods for the design and stability assessment of pit slopes, waste dumps, and backfills.
CO 5:	Analyze slope failure mechanisms using physical, empirical, and numerical models; evaluate stabilization and monitoring techniques with case study applications.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

UNIT-I
Introduction

Types and formation of slopes in surface mines, pit slope vis-à-vis mine economics, mechanism of common modes of slope failure, factors influencing stability of slopes, and planning of slope stability investigations.

UNIT-II
Geotechnical Information

Geotechnical data required for highwall slope stability studies. Collection of Geological Data and their interpretation for stability studies of highwall slopes.

Shear Strength

Shear strength of intact rock, discontinuity surfaces, filled discontinuities and rock-mass - estimation and determination; Surface roughness, joint roughness coefficient – estimation and determination.

UNIT-III

Water Flow

Concepts of water flow through a material and its permeability; water flow through rock-mass, water flow through soil type material and broken spoil material; Estimation and measurement of permeability and water pressure; Graphical solution of seepage problems (flow nets), seepage forces and seepage patterns under different conditions.

UNIT-IV

Analysis and Design of Pit Slopes and Waste Dumps

Slope stability assessment methods and techniques; Analysis and design criteria and methodology for highwall slopes and backfill and waste dumps; Probabilistic approaches of slope analysis and design.

UNIT-V

Mechanisms of slope failures

Field investigations and data collection. Design of slopes - physical, empirical, probabilistic methods, analytical (limit equilibrium analysis) and numerical (continuum models, discontinum and crack propagation models) modeling.

Stabilization and reinforcement of slopes. Slope failure monitoring-modern techniques (SSR). Software for slope stability analysis. Case studies

Text Books:

1. Hoek, E. and Bray, J.W; Rock Slope Engineering; John Wiley & Sons; New York; 1984
2. Brawner, C.O; Stability in surface mining, SME of USA; New York, 1982.

References:

1. Giani, F; Rock Slope Stability Analysis; Balkema; Rotterdam; 1992.
2. Fundamentals and applications of rock mechanics, Deb.D and Verma A.K, PHI Publications.

Web Links:

1. http://www.rocscience.com/learning/resource-library/books-by-r-e-goodman
2. http://www.sciencedirect.com/topics/earth-and-planetary-sciences/rock-mechanics
3. https://www.brighthubengineering.com/geotechnical-engineering/96483-rock-mechanics-defined/

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REMOTE SENSING AND GIS

(OPEN ELECTIVE – II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231MI6O03	**3**	**0**	**0**	**3**

Course Outcomes:At the end of the course, student will be able to:

CO1:	Explain the evolution of Remote Sensing and GIS, the energy interactions in the atmosphere and earth surface features.
CO2:	Elaborate on photogrammetry and various satellites.
CO3:	Interpret the images for preparation of thematic maps.
CO4:	Develop GIS based raster and vector data models.
CO5:	Explain navigation applications based on GCS and GPS systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	1	-		-	-	2	-	-	-
CO2	2	1	-	1	-	-	-	-	2	-	-	-
CO3	2	1	-	1	-	-	-	-	2	-	-	-
CO4	3	2	-	1	-	-	-	-	2	-	-	-
CO5	3	2	-	1	-	-	-	-	2	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

UNIT – I

Introduction to Remote sensing: Basic concepts of remote sensing, interaction with atmosphere, energy interaction with the earth surfaces, characteristics of remote sensing systems, types of resolutions, types of sensors, airborne remote sensing, space borne remote sensing, image data characteristics, digital image data formats-band interleaved by pixel, band interleaved by line, band sequential, IRS, LANDSAT, SPOT & Recent satellite.

UNIT – II

Image analysis: Introduction, elements of visual interpretations, digital image processing-image preprocessing, image enhancement, image classification, supervised classification, unsupervised classification.

UNIT – III

Geographic Information System: Basic Principles, components, application areas of GIS, map projections. Data entry and preparation: spatial data structures, raster and vector data formats, data inputs, data manipulation, data retrieval, data analysis and data display.

UNIT – IV

Spatial data analysis: Introduction, overlay function-vector overlay operations, raster overlay operations, arithmetic operators, comparison and logical operators, conditional expressions, overlay using a decision table, network analysis-optimal path finding, network allocation, network tracing.

UNIT – V

Applications: Land cover and land use, agriculture, forestry, geology, geomorphology, urban & transportation, Hydrology and Water Resources: Flood zoning and mapping, groundwater prospects, groundwater quality monitoring and potential recharge zones, watershed management of application with case studies.

Text Books:

1. ‘Remote Sensing and Image Interpretation, by Lillesand, T.M, R.W. Kiefer and J.W. Chipman, Wiley India Pvt. Ltd., (2015), 7th Edition.
2. ‘Remote Sensing - Models and Methods for Image Processing’ by Robert A Schowenger, Elsevier publishers, (2009).
3. ‘Fundamentals of Remote Sensing’ by George Joseph, Universities Press, (2013) 3rd Edition.
4. ‘Fundamentals of Geographic Information Systems’ by Michael N. Demers, Wiley India Pvt. Ltd, (2012) 4th Edition.
5. ‘Remote Sensing and GIS’, by Bhatta B, Oxford University Press, (2011) 2nd Edition’.

GEOSTATISTICS

(OPEN ELECTIVE – II)

VI Semester	**L T P C**
Course Code: 231MI6O04	**3 0 0 3**

Course Outcomes:At the end of the Course, Student will be able to:

CO 1:	Explain the stages of mineral exploration, sampling methods, and classical ore reserve estimation techniques.
CO 2:	Apply classical statistical distributions and understand the foundational principles and scope of geostatistics in mineral resource evaluation.
CO 3:	Construct and interpret semi-variograms and co-variograms, address modeling challenges, and apply basic Kriging methods for resource estimation.
CO 4:	Analyze advanced geostatistical concepts including anisotropy, non-stationarity, and estimation variances for accurate grade control and mine planning.
CO 5:	Utilize geostatistical tools for exploration optimization, mineral inventory computation, grade-tonnage modeling, and simulate real-world case studies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PO	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

UNIT – I

Introduction to mineral exploration: Significance and necessity; Prospecting and exploration criteria; Exploration strategy and design - stages of mineral exploration; theory and methods of sampling; resources and reserves - terminology and classification schemes; conventional methods of ore estimation.

UNIT - II

Classical statistical distributions: normal and lognormal, and their applications in resource evaluation. Geo-statistics: definition; schools of thought; stationarity assumptions and regionalized variables; what, when and why of Geo-statistics.

UNIT - III

Semi-variogram and co-variogram: definitions, characteristics, and computations in one, two and three dimensions; mathematical models; associated difficulties viz. anisotropy, non-stationarities, regularization, presence of nugget effect and presence of trend. Extension, estimation and dispersion variance; calculation by discretization and auxiliary functions. Kriging: definition and derivation of Kriging system of equations. Practice of semi-variogram modeling; practice of Kriging - steps and procedure. An introduction to advanced Geo-statistics.

UNIT - IV

Advanced Geo-statistics: Practical difficulties associated with semi-variography, viz. anisotropy, non-stationarity, regularization, misclassified tonnage; grade control plan. presence of nugget effect and presence of trend. Extension, Estimation and Dispersion variances: definitions, methods of calculations and applications; Screen Effect.

UNIT - V

Geo-statistical applications: optimization of exploration drilling; calculation of mineral inventory; establishment of grade-tonnage relations; misclassified tonnage; grade control plan. Geostatistical conditional simulation - theory and approach. Geo-statistical case studies of selected mineral deposits.

Text Books:

1. Sarma DD. Geo statistics with applications in earth sciences. Springer publications. 2009.

Reference Books:

1. Journel AG and Huijbregts C J. Mining geo statictics. Academic press. 1981.
2. Andereson F. Geo statictics by example approach using R. 2006.

Web Links:

1. https://pdfcoffee.com/surpac-tutorialpdf-pdf-free.html
2. https://baixardoc.com/documents/surpac-introduction-tutorial-system%20software-
3. https://www.brighthubengineering.com/geotechnical-engineering/96483-rock-mechanics-

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ENGINEERING PROPERTIES OF AGRICULTURAL PRODUCE

(Open Elective-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231AG6O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO 1:	Calculate the basic engineering properties of a biological material.
CO 2:	Analyze the flow behavior of biological materials and force deformation.
CO 3:	Analyze the Maxwell and Kelvin model equations in the rheology for important biological materials
CO 4:	Explain the applications of frictional and aerodynamic properties in the design of processingequipment.
CO 5:	Explain the applications of electrical and thermal properties in the design of processing equipment

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	1	1	-	1	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

Unit - I

Physical Properties: Introduction and application of engineering properties of biological material. Physical properties of different food commodities and aided products – importance. Shape and size – criteria for describing shape and size. Roundness and sphericity – Volume and density – Specific gravity – Bulk density. Porosity – surface area – measurement of the same.

Unit – II

Rheology: Introduction to rheology, basic concepts, Classification of rheology, ASTM standard definition of terms. Rheological Properties, Flow behavior of biological materials, force deformation curve; linear elastic limit, yield point, bio-yield point and rupture point. Stress relaxation and creep behavior. Visco-elasticity and visco-plasticity.

Unit – III

Rheological models: Introduction to mechanical models. Kelvin and maxwell models. Electrical equivalence of mechanical models. Rheological equations of maxwell model, generalized maxwell model, kelvin model and generalized kelvin model. Difference between kelvin and maxwell model. Viscosity; Measurement of viscosity using viscometer, types of viscometer, problems on viscometer.

Unit – IV

Frictional Properties: Basic concepts, effect of load sliding velocity. Friction in agricultural materials, measurement. Rolling resistance, angle of internal friction and angle of repose. Applications of frictional properties in design of processing equipment. Aerodynamic Properties: Importance of aerodynamic properties in Agricultural Processing equipments with examples. Terminal velocity and drag coefficient; frictional drag and profit drag or pressure drag. Terminal velocity of different grains, working of pneumatic conveyor based on aerodynamic properties.

Unit – V

Electrical properties: Di-electrical properties; Dielectric loss factor and dielectric constant. Applications and role of electrical properties in food processing. Thermal Properties: Introduction to thermal properties; Specific heat, thermal conductivity, thermal diffusivity, latent heat of vaporization, latent heat of fusion, sensible heat, enthalpy and heat energy calculation.

Text Books:

1. Physical properties of plant and animal materials, Mohsenin N N, Gordon and Breach SciencePublishers, New York, 2nd edition ,1986.
2. Engineering Properties of Foods, Rao M A, Syed S H Rizvi and Ashim K Datta, CRC Press – Taylor& Francis Group, Boca Raton, FL, 4th edition, 2014

Reference Books:

1. Food and Process Engineering Technology, Wilhelm LR, Suler W A and Brusewitz, G H, American Society of Agricultural Engineers (ASAE), St. Joseph, Ml.
2. Engineering Properties of Biological Materials, O.P. Singhal and D.V.K. Samuel, SarojPrakashan,Allahabad, 1st edition, 2003.

Web Links:

1. http://ecourses.iasri.res.in/email_authentication.aspx?Degree_Id=04
2. http://ecoursesonline.iasri.res.in/course/view.php?id=25
3. http://www.cigr.org/documents/CIGRHandbookVol4.pdf
4. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1011
5. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1013

PLASTIC APPLICATIONS IN AGRICULTURE

(Open Elective-II)

	L	T	P	C
VI Semester	**L**	**T**	**P**	**C**
Course Code: 231AG6O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Assess types and quality of plastics used in soil and water conservation.
CO2: Design, estimation and laying of plastic films in lining of canal, reservoir and water Harvesting Ponds.
CO3: Design, estimation and installation of green, poly and shade net houses, low tunnels etc.
CO4: Explain plastics application in drying, preservation, handling and storage of agricultural produce.
CO5: Outline plastic usage with hands on experience through visit to a greenhouse and farmers field.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	-	-	-	3	-	-	-	2	-
CO2	3	2	1	-	-	-	1	-	-	-	-	-
CO3	3	2	1	-	-	-	1	-	-	-	-	-
CO4	3	1	-	2	-	1	-	-	-	-	-	-
CO5	3	1	-	2	-	1	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	-	2
CO5	1	-

Unit - I

Introduction of plasticulture - types and quality of plastics used in soil and water conservation, production agriculture and post harvest management. Quality control measures. Present status and future prospective of plasticulture in India. Water management - use of plastics in in-situ moisture conservation and rain water harvesting. Plastic film lining in canal, pond and reservoir. Design, estimation and laying of plastic films in lining of canal, reservoir and water harvesting Ponds.

Unit – II

Plastic pipes for irrigation water management, bore-well casing and subsurface drainage. Study of plastic components of drip and sprinkler irrigation systems, laying and flushing of laterals. Use of polymers in control of percolation losses in fields. Soil conditioning - soil solarisation, effects of different colour plastic mulching in surface covered cultivation.

Unit – III

Nursery management - Use of plastics in nursery raising, nursery bags, trays etc. Controlled environmental cultivation - plastics as cladding material, green / poly / shade net houses, wind breaks, poly tunnels and crop covers. Design, estimation and installation of green, poly and shade net houses, low tunnels etc.

Unit-IV

Plastic nets for crop protection - anti insect nets, bird protection nets. Plastic fencing. Plastics in drying, preservation, handling and storage of agricultural produce, innovative plastic packaging solutions for processed food products. Plastic cap covers for storage of food grains in open. Silage film technique for fodder preservation.

Unit-V

Use of plastics as alternate material for manufacturing farm equipment and machinery. Plastics for aquacultural engineering and animal husbandry - animal shelters, vermi-beds and inland fisheries. Agencies involved in the promotion of plasticulture in agriculture at national and state level. Human resource development in particular applications.

Text Books:

1. Dubois. 1978. Plastics in Agriculture. Applied Science Publishers Limited, Essex, England. y Manas Chanda, Salil K. Roy. 2008. Plastics Fundamentals, Properties, and Testing. CRC Press.
2. Charles A. Harper. 2006. Handbook of Plastics Technologies. The Complete Guide to Properties and Performance. McGraw-Hill, New Delhi.
3. Central Pollution Control Board. 2012. Material on Plastic Waste Management. Parivesh Bhawan, East Arjun Nagar, Delhi-110032.
4. Brown, R.P. 2004. Polymers in Agriculture and Horticulture. RAPRA Review Reports : Vol. 15, No. 2, RAPRA Technology Limited, U.K

Reference Books:

1. Brahma Singh, Balraj Singh, Naved Sabir and Murtaza Hasan. 2014.Advances in Protected Cultivation. New India Publishing Agency, New Delhi.
2. Shankar, A.N. 2014. Integrated Horticulture Development in Eastern Himalayas, Plasticulture in Agri- Horticulture Systems, 241-247.
3. Ojha,T.P. and Michael, A.M., 2012, Principles of Agricultural Engineering - I. Jain Brothers, Karol Bagh, New Delhi.
4. Pandey, P.H. 2014. Principles and Practices of Agricultural Structures and Environmental Control. Kalyani Publishers, Ludhiana, India.

Web Links:

1. https://krishi.icar.gov.in/jspui/bitstream/123456789/42008/1/Article%201.pdf

2. https://ec.europa.eu/eip/agriculture/sites/default/files/eipagri_fg_plastic_footprint_minipaper_c_final.pdf

Cloud Computing Lab
(Common to CSE & IT)

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231CS6L01	**0**	**0**	**3**	**1.5**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Identify various service models, delivery methods, and underlying technologies in cloud computing environments.
CO2: Classify cloud-based services utilizing virtual machines and containers based on their characteristics and use cases.
CO3: Analyze the challenges and constraints of developing and deploying cloud-based applications.
CO4: Summarize advanced topics such as serverless computing and cloud simulation frameworks.
CO5: Implement programming paradigms to solve real-world and scientific problems using cloud service platforms.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	3	-	-	-	-	-	-	2
CO2	3	3	3	2	3	-	-	-	-	-	-	2
CO3	3	2	2	3	2	-	-	-	-	2	-	2
CO4	3	2	3	3	3	-	-	-	-	2	-	2
CO5	3	3	3	3	3	-	-	-	-	2	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	3
CO4	2	3
CO5	2	3

List of Experiments:

1. Lab on web services
2. Lab on IPC, messagaging, publish/subscribe
3. Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows8 or above.
4. Install a C compiler in the virtual machine created using VirtualBox and execute Simple Programs.
5. Create an Amazon EC2 instance and set up a web-server on the instance and associate an IP address with the instance. In the process, create a security group allowing access to port 80 on the instance.
6. Do the same with OpenStack.
7. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
8. Start a Docker container and set up a web-server (e.g. apache2 or Python based Flask micro web framework) on the instance. Map the host directory as a data volume for the container.

9. Find a procedure to transfer the files from one virtual machine to another virtual machine. Similarly, from one container to another container.
10. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
11. Install Hadoop single node cluster and run simple applications like word count.
12. Utilize Open FaaS – Serverless computing framework and demonstrate basic event driven function invocation.
13. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

Text Books:

1. Mastering Cloud Computing-Rajkumar, Buyya,Christian, Vecchiola,Thamarai Selvi,Shivananda Poojara,Satish N.Srirama 2nd Edition, McGraw Hill, 2024, ISBN: 978-9355329509.

2. Distributed and Cloud Computing -Kai Hwang, Geoffrey C. Fox, Jack J. Dongarra 1st Edition, Elsevier, ISBN-13**:** 978 9381269237

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier ISBN-13: 978 0128128107.
2. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, Wiley ISBN-13: 978 1118002209.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
2. https://docs.docker.com/reference/
3. https://docs.openfaas.com/

Cryptography & Network Security Lab

VI Semester **L T P C**

Course Code: 231CS6L02 **0 0 3 1.5**

Course Outcomes: At the end of the course, Student will be able to

CO1: Demonstrate bitwise operations through basic cryptographic transformations.

CO2: Develop programs using stream and block cipher techniques.

CO3: Make use of symmetric techniques for providing security to data at network level.

CO4: Apply asymmetric encryption algorithms such as RSA and key exchange protocols like Diffie-Hellman to simulate secure communication

CO5: Implement cryptographic hash functions and digital signature to ensure data integrity

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	-	-	-	-	-	1	1	-	-
CO2	2	2	2	-	-	-	-	-	1	1	-	-
CO3	2	2	2	-	-	-	-	-	1	1	-	-
CO4	2	2	2	-	-	-	-	-	1	1	-	-
CO5	2	2	2	-	-	-	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

List of Experiments:

Week - 1

1.1) Write a C program that contains a string (char pointer) with a value \Hello World'. The program should XOR each character in this string with 0 and displays the result.

Week - 2

2.1) Write a C program that contains a string (char pointer) with a value \Hello World'. The program should AND or and XOR each character in this string with 127 and display the result.

Week - 3

3.1)Write a Java program to perform encryption and decryption using the following algorithms:

a) Ceaser Cipher
b) Substitution Cipher
c) Hill Cipher.

Week - 4

4.1) Write a Java program to implement the DES algorithm logic

Week – 5

5.1)Write a C/JAVA program to implement the BlowFish algorithm logic

Week - 6

6.1)Write a C/JAVA program to implement the Rijndael algorithm logic.

Week - 7

7.1)Using Java Cryptography, encrypt the text "Hello world" using BlowFish. Create your own key using Java key tool.

Week - 8

8.1) Write a Java program to implement RSA Algorithm

Week – 9

9.1)Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript. Consider the end user as one of the parties (Alice) and the JavaScript application as other party (bob).

Week - 10

10.1)Calculate the message digest of a text using the SHA-1 algorithm in JAVA.

List of Augmented Experiments:

11. Write a C Program to implement Elliptic Curve Cryptographic Algorithm
12. Write a C Program to implement Eucledian Algorithm to find GCD
13. Write a C Program to implement NSA Digital Signature Algorithm

Reference Books:

1. Applied Cryptography: Protocols, Algorithms, and Source Code in C,Bruce Schneier,ISBN: 978-1119096726
2. Beginning Cryptography with Java, David Hook,ISBN: 978-0764596339

Web Links:

1.https://www.udemy.com/course/learn-cryptography-basics-in-python/?kw=cryptogr&src=sac

2.https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944155613184002015_shared/overview

SOFT SKILLS

		L	T	P	C
Semester: VI		**L**	**T**	**P**	**C**
Course Code:	**231CS6S01**	**0**	**1**	**2**	**2**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Solve the problems on Time & Work, Time & Distance by simple methods.
CO2: Derive the conclusions, assumptions and arguments from the available information.
CO3: Write technical reports and emails for professional communication.
CO4: Solve problems on Permutations & Combination, Probability.
CO5: Participate confidently in a formal discussion and present themselves effectively.
CO6: Comprehend the techniques of skimming and scanning for effective communication.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	2	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-	-
CO6	-	1	-	-	-	-	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

APTITUDE:

Number System, LCM & HCF, Ratio & Proportion, Averages, Problems on Ages, Partnership, Percentages, Profit and Loss, Simple Interest, Compound Interest, Time and Work, Pipes and Cisterns, Mixture and Allegations, Time, Speed and Distance, Problems on Trains, Boats and Streams, Mensuration – I, Mensuration - II

REASONING:

Number Series, Letter Series, Number Analogy, Letter Analogy, Odd Man Out, Logical Sequence of Words, Coding and Decoding, Ranking Test, Alphabet Test, Direction Test, Blood Relations, Calendar, Clocks, Cubes and Dice, Coded Inequalities, Venn Diagrams, Syllogisms, Non - Verbal Reasoning, Seating Arrangement

VERBAL ABILITY:

Introduction to soft skills, How to improve communication?, Parts of Speech, Mind your language towards better English, Vocabulary Expansion, Written communication skill practice, Grammatical use, Concept of 4 step method for presentation, Present Tense, Grammar in use, Group discussion, Reading Comprehension, Past Tense, Future Tense, Grammatical use, Self-introduction, Letters, E-Mail & Report writing, Error correction, Effective Communication

Text Books:

1. Quantitative Aptitude – Dr. R. S. Aggarwal, S CHAND.
2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal.
3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND.

Reference Books:

1. Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications
2. Analytical Reasoning – Jaikishan and Premkishan Arihant Publications.
3. A New Approach to Objective English – R. S. Dhillon DGP Publications.

Web Links:

1. www.indiabix.com
2. www.bankersadda.com

***

Technical Paper Writing &IPR

VI Semester	**L**	**T**	**P**	**C**
Course Code: 231MC6T01	**2**	**0**	**0**	**-**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the structure of the technical paper and its components

CO2: Review the literature and acquire the skills to write a technical paper for first submission.

CO3: Understand the process and development of IPR.

CO4: Create awareness about the scope of patent rights.

CO5: Analyze the new developments in IPR include the latest software.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	-	-	-	-	2	2	2	2	2	2	1
CO2	-	-	-	-	-	2	2	2	2	2	2	1
CO3	-	-	-	-	-	2	2	2	2	2	2	1
CO4	-	-	-	-	-	2	2	2	2	2	2	1
CO5	-	-	-	-	-	2	2	2	2	2	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I
Planning and preparation

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

Unit – II

Literature review

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. Key skills needed when writing a Title, Abstract, Introduction, a Review of the Literature, the Methods, the Results, the Discussion, and the Conclusions. Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Unit – III

Process and Development

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

Unit – IV

Patent Rights

Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases, Geographical Indications

Unit – V

New Developments In IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies.

Text Books:

1. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.

Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
2. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’ s book.

3. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
4. Mayall, “Industrial Design”, McGraw Hill, 1992.

Web Links:

1. https://aits-tpt.edu.in/wp-content/uploads/2023/08/English-for-Research-Paper-Writing-20AOE9901-min.pdf
2. https://www.scribbr.com/academic-writing/repetition-redundancy/
3. https://www.archives.gov/federal-register/write/legal-docs/ambiguity.html

AUGMENTED REALITY & VIRTUAL REALITY

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7T01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the fundamentals and evolution of Augmented Reality (AR), its displays, and tracking systems.
CO2: Apply computer vision techniques and interaction methods in AR systems.
CO3: Explain the principles of Virtual Reality (VR), human perception, and geometric modeling.
CO4: Analyze human visual perception and rendering techniques in immersive virtual environments.
CO5: Evaluate motion simulation and audio rendering in VR systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	1	-	2
CO2	3	3	2	-	3	-	-	-	-	1	-	2
CO3	3	2	2	-	2	-	-	-	-	1	-	2
CO4	3	3	2	2	3	-	-	-	-	2	-	3
CO5	2	2	2	-	3	-	-	-	-	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	3
CO2	3	3
CO3	2	3
CO4	2	3
CO5	3	3

UNIT - I

Introduction to Augmented Reality: Augmented Reality - Defining augmented reality, history of augmented reality, Examples, Related fields.

Displays: Multimodal Displays, Visual Perception, Requirements and Characteristics, Spatial Display Model, Visual Displays.

Tracking: Tracking, Calibration, and Registration, Coordinate Systems, Characteristics of Tracking Technology, Stationary Tracking Systems, Mobile Sensors.

UNIT - II

Computer Vision for Augmented Reality: Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Outdoor Tracking.

Interaction: Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Augmented Paper, Multi-view Interfaces, Haptic Interaction.

Software Architectures: AR Application Requirements, Software Engineering Requirements, Distributed Object Systems, Dataflow, Scene Graphs.

UNIT - III

Introduction to Virtual Reality: Defining Virtual Reality, History of VR, Human Physiology and Perception.

The Geometry of Virtual Worlds: Geometric Models, Axis-Angle Representations of Rotation, Viewing Transformations.

Light and Optics: Basic Behavior of Light, Lenses, Optical Aberrations, The Human Eye, Cameras, Displays.

UNIT - IV

The Physiology of Human Vision: From the Cornea to Photoreceptors, From Photoreceptors to the Visual Cortex, Eye Movements, Implications for VR.

Visual Perception: Visual Perception - Perception of Depth, Perception of Motion,

Perception of Color Visual Rendering: Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates, Immersive Photos and Videos.

UNIT - V

Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection.

Interaction: Motor Programs and Remapping, Locomotion, Social Interaction.

Audio: The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Textbooks:

1. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN: 9332578494.
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2023, ISBN: 978-1107198937.

Reference Books:

1. Allan Fowler-AR Game Development, 1st Edition, A press Publications, 2018, ISBN 978-1484236178.
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002, ISBN: 978-0128183991.
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009, ISBN: 978-0123749437.
4. Designing for Mixed Reality, Kharis O'Connell Published by O'Reilly Media, Inc., 2016, ISBN:9781491962381.
5. Sanni Siltanen- Theory and applications of marker-based augmented reality. Julkaisija – Utgivare Publisher. 2012. ISBN 978-951-38-7449-0.
6. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer, 2005, ISBN: 978-1852339586.

Web Links:

1. https://archive.nptel.ac.in/courses/121/106/121106013/
2. https://www.shiksha.com/online-courses/foundation-course-on-virtual-reality-and-augmented-reality-course-nptel816

HUMAN RESOURCES & PROJECT MANAGEMENT
(Common to CSE, IT, AIML, CSE(DS))

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231HS7T01	**2**	**0**	**0**	**2**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Explain the concepts, functions, and emerging trends in Human Resource Management including HR planning, recruitment, and selection.
CO2:	Identify the HR development practices such as training, performance appraisal, career development, and HR accounting.
CO3:	Describe the fundamentals of project management including project types, life cycle and resource management.
CO4:	Apply appropriate strategies for project implementation and control considering organizational and human aspects.
CO5:	Evaluate project implementation and review using performance evaluation and abandonment analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	2	1				2		2				1
CO2	2	2	1						2	1		1
CO3	2	2		1				2	2	1		1
CO4	1	1	2	2	1				2	1	3	1
CO5	1	1	1	2					2	1	3	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	**PSO1**	**PSO2**
CO1	**-**	**-**
CO2	**-**	**-**
CO3	**-**	**-**
CO4	**-**	**-**
CO5	**-**	**-**

Unit – I

HRM: Nature, Scope, Concept of HRM, Functions of HRM, Role of HR manager, emerging trends in HRM, E-HRM, HR audit models, ethical aspects of HRM. HR Planning, Demand and Supply forecasting of HR, Job Design, Recruitment, Sources of recruitment, Selection- Selection Procedure.

Unit – II

HRD, HR accounting, Models, Concept of Training and Development, Methods of Training. Performance Appraisal: Importance Methods of performance appraisal, Career Development and Counseling, group interaction.

Unit – III

Basics of Project Management, Concept, resource management, Project environment, Types of Projects, project networks-DPR, Project life cycle, Project proposals, Monitoring project progress, Project appraisal and Project selection, 80-20 rules, production technology, communication matrix.

Unit – IV

Identify various project types and their unique management challenges and apply appropriate management strategies for each. Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

Unit – V

Project Implementation and Review: Forms of project organization, project planning, project control, human aspects of project management, prerequisites for successful project implementation, project review, performance evaluation, abandonment analysis

Text Books:

1. Robert L. Mathis, John H. Jackson, Manas Ranjan Tripathy, Human Resource Management, Cengage Learning 2016.
2. Sharon Pande and Swapnalekha Basak, Human Resource Management, Text and Cases, Vikas Publishing, 2e, 2016.
3. Stewart R. Clegg, Torgeir Skyttermoen, Anne Live Vaagaasar, Project Management, Sage Publications, 1e, 2021
4. K. Nagarajan, Project Management, New Age International Publishers, 8e, 2017.

Reference Books:

1. Subba Rao P, “Personnel and Human Resource Management-Text and Cases”, Himalaya Publications, Mumbai, 2013.
2. K Aswathappa, “Human Resource and Personnel Management”, Tata McGraw Hill, New Delhi, 2013.
3. Prasanna Chandra, “Projects, Planning, Analysis, Selection, Financing, Implementation and Review”, Tata McGraw Hill, New Delhi, 1998.
4. Vasanth Desai, “Project Management”, 4th edition, Himalaya Publications, 2018.
5. Lalitha Balakrishnan, Gowri, “Project Management”, Himalaya Publishing house, New Delhi, 2022.

Web Links:

1. www.managementstudyguide.com
2. www.citehr.com
3. www.nptel.ac.in/courses/122106032
4. www.btechguru.com/courses--nptel--basic-course

SOFTWARE ARCHITECTURE & DESIGN PATTERNS
(Professional Elective-IV)
(Common to CSE, IT & CSE(DS))

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7E08	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Understand the fundamental principles of design patterns and object-oriented development
CO2:	Analyze system requirements and model conceptual classes and relationships for object-oriented design
CO3:	Apply structural design patterns to develop scalable and reusable software components
CO4:	Develop interactive systems using MVC architecture and enhance them with design pattern-based features.
CO5:	Implement distributed object-oriented systems using Java RMI, Web Services, and service-oriented architectures.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	3	2	-	-	-	-	-	-	2
CO2	2	2	3	2	2	-	-	-	-	-	-	1
CO3	2	1	1	1	3	-	-	-	-	-	-	1
CO4	2	3	-	2	2	-	-	-	-	-	-	2
CO5	2	3	1	1	2	-	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO	1	-
CO	1	-
CO	1	-
CO	1	-
CO	1	-

UNIT - I

Introduction: What is a design pattern? Describing design patterns, the catalog of design pattern, organizing the catalog, how design patterns solve design problems, how to select a design pattern, how to use a design pattern What is object oriented development? key concepts of object oriented design other related concepts, benefits and drawbacks of the paradigm

UNIT – II

Analysis a System: Overview of the analysis phase, stage 1 gathering the requirements functional requirements specification, defining conceptual classes and relationships, using the knowledge of the domain Design and Implementation, discussions and further reading

UNIT - III

Design Pattern Catalog: Structural patterns, Adapter, bridge, composite, decorator, facade, flyweight, proxy.

UNIT - IV

Interactive systems and the MVC architecture: Introduction The MVC architectural pattern, analyzing a simple drawing program designing the system, designing of the subsystems, getting into implementation, implementing undo operation drawing incomplete items, adding a new feature pattern based solutions.

UNIT - V

Designing with Distributed Objects: Client server system, java remote method invocation, implementing an object oriented system on the web, Web services (SOAP, Restful), Enterprise Service Bus

Text Books:

1. Object oriented analysis, design and implementation, brahma dathan, sarnath rammath, universities press.
2. Design patterns, Erich Gamma, Richard helan , Ralph johman , john vlissides, PEARSON Publication.

Reference Books:

1. Pattern Oriented Software Architecture, Frank Bachmann, Regine Meunier , Hans Rohnert, Volume 1.
2. Anti Patterns: Refactoring Software, Architectures and Projects in Crisis, William J Brown et al., John Wiley.

Web Links:

1. https://nptel.ac.in/courses/106105224
2. https://www.javatpoint.com/designpatterns
3. https://tinyurl.com/hhywdjx8
4. https://core.ac.uk/download/pdf/36753454.pdf

BLOCKCHAIN TECHNOLOGY
(Professional Elective-IV)
(Common to CSE, IT & CSE(DS))

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7E03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Interpret the core principles, architecture, consensus protocols, and cryptocurrency fundamentals in blockchain ecosystems.

CO2: Analyze public blockchain frameworks and the industrial significance of smart contracts on Ethereum.

CO3: Evaluate the features and applications of private and consortium blockchains along with blockchain-based fundraising mechanisms like ICOs.

CO4: Examine blockchain security challenges and application domains including IoT, healthcare, finance, and supply chain.

CO5: Develop blockchain solutions using Python and Hyperledger Fabric platforms based on real-world industry case studies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	-	-	-	2
CO2	2	3	1	2	-	-	-	-	-	-	-	2
CO3	2	3	2	1	-	-	-	-	-	-	-	2
CO4	3	2	2	2	-	2	1	-	-	-	-	2
CO5	3	2	3	2	3	-	-	-	2	2	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	2
CO3	-	2
CO4	1	2
CO5	-	2

UNIT - I:

Fundamentals of Blockchain: Introduction, Origin of Blockchain, Blockchain Solution, Components of Blockchain, Block in a Blockchain, The Technology and the Future.

Blockchain Types and Consensus Mechanism: Introduction, Decentralization and Distribution, Types of Blockchain, Consensus Protocol.

Cryptocurrency: Bitcoin, Altcoin and Token: Introduction, Bitcoin and the Cryptocurrency, Cryptocurrency Basics, Types of Cryptocurrencies, Cryptocurrency Usage.

UNIT – II:

Public Blockchain System: Introduction, Public Blockchain, Popular Public Blockchains, The Bitcoin Blockchain, Ethereum Blockchain.

Smart Contracts: Introduction, Smart Contract, Characteristics of a Smart Contract, Types of Smart Contracts, Types of Oracles, Smart Contracts in Ethereum, Smart Contracts in Industry.

UNIT – III:

Private Blockchain System: Introduction, Key Characteristics of Private Blockchain, Private Blockchain, Private Blockchain Examples, Private Blockchain and Open Source, E-commerce Site Example, Various Commands (Instructions) in E-commerce Blockchain, Smart Contract in Private Environment, State Machine, Different Algorithms of Permissioned Blockchain, Byzantine Fault, Multichain.

Consortium Blockchain: Introduction, Key Characteristics of Consortium Blockchain, Need of Consortium Blockchain, Hyperledger Platform, Overview of Ripple, Overview of Corda.

Initial Coin Offering: Introduction, Blockchain Fundraising Methods, Launching an ICO, Investing in an ICO, Pros and Cons of Initial Coin Offering, Successful Initial Coin Offerings, Evolution of ICO, ICO Platforms.

UNIT – IV:

Security in Blockchain: Introduction, Security Aspects in Bitcoin, Security and Privacy Challenges of Blockchain in General, Performance and Scalability, Identity Management and Authentication, Regulatory Compliance and Assurance, Safeguarding Blockchain Smart Contract (DApp), Security Aspects in Hyperledger Fabric.

Applications of Blockchain: Introduction, Blockchain in Banking and Finance, Blockchain in Education, Blockchain in Energy, Blockchain in Healthcare, Blockchain in Real-estate, Blockchain in Supply Chain, The Blockchain and IoT. Limitations and Challenges of Blockchain.

UNIT – V:

Blockchain Case Studies:

Case Study 1 – Retail,

Case Study 2 – Banking and Financial Services,

Case Study 3 – Healthcare,

Case Study 4 – Energy and Utilities.

Blockchain Platform using Python: Introduction, Learn How to Use Python Online Editor, Basic Programming Using Python, Python Packages for Blockchain.

Blockchain platform using Hyperledger Fabric: Introduction, Components of Hyperledger Fabric Network, Chain codes from Developer.ibm.com, Blockchain Application Using Fabric Java SDK.

Text Books:

1. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, Universities Press, 2020.

Reference Books:

1. Blockchain Blue print for Economy, Melanie Swan, SPD Oreilly.
2. Blockchain for Business, Jai Singh Arun, Jerry Cuomo, Nitin Gauar, Pearson Addition Wesley.

Web Links:

1. https://onlinecourses.swayam2.ac.in/aic21_ge01/preview
2. https://github.com/blockchainedindia/resources
3. .https://github.com/HyperledgerHandsOn/trade-finance-logistics

DEEP LEARNING

(Professional Elective-IV)
(Common to CSE & IT)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231IT7E02	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Understand AI and ML fundamentals, classical ML models, and evaluation techniques
CO2: Explain deep learning concepts, biological inspiration, and training strategies
CO3: Build neural network models using Keras and TensorFlow for classification tasks
CO4: Implement CNNs and RNNs using PyTorch for representation learning
CO5: Analyze advanced deep learning models and real-world applications

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1							2
CO2	3	2	1	1	2							2
CO3	2	2	3	2	3				1	1		2
CO4	2	3	3	2	3				1	1		2
CO5	2	3	3	3	3	1	1		1	1		3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	3
CO5	-	3

UNIT I:
Fundamentals of Deep Learning: Artificial Intelligence, History of Machine learning: Probabilistic Modeling, Early Neural Networks, Kernel Methods, Decision Trees, Random forests and Gradient Boosting Machines, **Fundamentals of Machine Learning:** Four Branches of Machine Learning, Evaluating Machine learning Models, Overfitting and Underfitting. [**Text Book 2]**

UNIT II:
Introducing Deep Learning: Biological and Machine Vision, Human and Machine Language, Artificial Neural Networks, Training Deep Networks, Improving Deep Networks. [

UNIT III:

Neural Networks: Anatomy of Neural Network, **Introduction to Keras:** Keras, TensorFlow, Theano and CNTK, Setting up Deep Learning Workstation, Classifying Movie Reviews: Binary Classification, Classifying newswires: Multiclass Classification. [**Text Book 2**]

UNIT IV:

Convolutional Neural Networks: Nerual Network and Representation Learing, Convolutional Layers, Multichannel Convolution Operation, **Recurrent Neural Networks:** Introduction to RNN, RNN Code, PyTorch Tensors: Deep Learning with PyTorch, CNN in PyTorch. [**Text Book 3]**

UNIT V:

Interactive Applications of Deep Learning: Machine Vision, Natural Language processing, Generative Adversial Networks, Deep Reinforcement Learning. [**Text Book 1**]

Deep Learning Research: Autoencoders, Deep Generative Models: Boltzmann Machines Restricted Boltzmann Machines, Deep Belief Networks. [**Text Book 1**]

Text Books:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courvile, MIT Press, 2016
2. Deep Learning with Python, Francois Chollet, December 2017, Manning Publications, ISBN: 9781617294433
3. Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence, Jon Krohn, Grant Beyleveld, Aglaé Bassens, September 2019, Addison-Wesley Professional, ISBN: 9780135116821
4. Deep Learning from Scratch, Seth Weidman, September 2019, O'Reilly Media, Inc., ISBN: 9781492041412

Reference Books:

1. Artificial Neural Networks, Yegnanarayana, B., PHI Learning Pvt. Ltd, 2009.
2. Matrix Computations, Golub, G.,H., Van Loan,C.,F, JHU Press,2013.
3. Neural Networks: A Classroom Approach, Satish Kumar, Tata McGraw-Hill Education, 2004.

Web Link:

1. https://onlinecourses.nptel.ac.in/noc20_cs62/preview
2. https://www.analyticsvidhya.com/blog/2024/07/mcculloch-pitts-neuron/?utm_source=chatgpt.com
3. https://www.cse.iitm.ac.in/~miteshk/CS7015/Slides/Handout/Lecture2.pdf?utm_source=chatgpt.com
4. https://medium.com/edureka/neural-network-tutorial-2a46b22394c9
5. https://www.datacamp.com/tutorial/multilayer-perceptrons-in-machine-learning?utm_source=chatgpt.com
6. https://www.digitalocean.com/community/tutorials/intro-to-optimization-momentum-rmsprop-adam?utm_source=chatgpt.com
7. https://dennybritz.com/posts/wildml/recurrent-neural-networks-tutorial-part-1/?utm_source=chatgpt.com

INTERNET OF THINGS
(Professional Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7E06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the evolution and foundational technologies that enabled the emergence of the Internet of Things.

CO2: Demonstrate understanding of IoT sensors, actuators, and device processing strategies.

CO3: Compare various IoT connectivity and communication technologies used for data exchange.

CO4: Analyze the need for interoperability and the role of fog computing in IoT applications.

CO5: Evaluate current challenges, paradigms, and real-world applications of IoT in domains like agriculture and vehicles.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	-	-	-	-	-	2
CO2	3	3	2	-	3	-	-	-	-	-	-	2
CO3	3	3	2	2	3	-	-	-	-	-	-	2
CO4	2	2	3	2	3	-	-	-	-	-	1	2
CO5	2	3	3	2	2	2	-	-	-	-	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT I:

Predecessors of IoT: Introduction, Wireless Sensor Networks, Machine-to-Machine Communications, Cyber Physical Systems

Emergence of IoT: Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT

UNIT II:

IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, Sensing Types, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics

IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading.

UNIT III:

IoT Connectivity Technologies: Introduction, IEEE 802.15.4, Zigbee, Thread, ISA100.11A, WirelessHART, RFID, NFC,DASH7, Z-Wave, Weightless, Sigfox, LoRa, NB-IT, Wi-Fi, Bluetooth

IoT Communication Technologies: Introduction, Infrastructure Protocols, Discovery Protocols, Data Protocols, Identification Protocols, Device Management, Semantic Protocols.

UNIT IV:

IoT Interoperability: Introduction, Standards, Frameworks

Fog Computing and Its Applications: Introduction, View of Fog Computing Architecture, Fog Computing in IoT, Selected Applications of Fog Computing

UNIT V:

Paradigms, Challenges, and the Future: Introduction, Evolution of New IoT Paradigms, Challenges Associated with IoT, Emerging Pillars of IoT

IoT Case Studies: Agricultural IoT, Vehicular IoT

Text Books:

1. Introduction to IoT, Sudip Misra, Anandarup Mukhaerjee, Arjit Roy, Cambridge University Press, 2021
2. Internet of Things: Architecture, Design Principles and Applications, Rajkamal, McGraw Hill Higher Education

Reference Books:

1. Fog and Edge Computing: Principles and Paradigms, Rajkumar Buyya (Editor), Satish narayana Srirama (Editor) , ISBN: 978-1-119-52498-4.
2. Getting Started with the Internet of Things, CunoPfister , Oreilly .

Web Links:

1. https://onlinecourses.nptel.ac.in/noc18_cs46/preview
2. https://online.stanford.edu/courses/xee100-introduction-internet-things
3. https://www.arm.com/resources/education/education-kits/internet-of-things
4. https://www.coursera.org/specializations/iot

AGILE METHODOLOGIES
(Professional Elective-V)
(Common to CSE, IT, AIML & CSE(DS))

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7E01	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Describe Agile values and principles, and explain how they address traditional software development challenges.

CO2: Apply Agile practices to enhance project delivery, customer collaboration, and team communication.

CO3: Analyze Scrum roles, ceremonies, and planning techniques for effective iterative development.

CO4: Evaluate Extreme Programming (XP) practices for adaptive planning, continuous integration, and incremental design.

CO5: Demonstrate the use of Lean, Kanban, and JIRA tools to manage Agile workflows and improve process efficiency..

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2				2				1		2	
CO2	2		2		2				2	2		1
CO3	3	2	3		2				2	2		2
CO4	2	2	3		2				2			1
CO5	2	2	2	2	3				2			2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	3
CO3	3	3
CO4	3	3
CO5	2	3

UNIT I :

Learning Agile: Agile, Getting Agile into your brain, Understanding Agile values, No Silver Bullet, Agile to the Rescue. A fractured perspective, The Agile Manifesto, Understanding the

Elephant, Where to Start with a New Methodology. **The Agile Principles:** The 12 Principles of Agile Software, The Customer Is Always Right, Delivering the Project.

UNIT II :

Scrum Methodology- Scrum Process, Scrum Roles, Scrum Ceremonies (Sprint Planning/Daily Scrum, Product Backlog Grooming, Sprint Review, Sprint Retrospective Release planning and Budgeting, Agile Metrics, Agile Estimation, Planning Poker Method, Concept of Story Points.

UNIT III :

Agile Processes and Hybrid Agile Frameworks:

Other Agile Processes: Lean production –, Kanban, SCRUMBAN, Crystal, Feature Driven Development, Adaptive Software Development, Extreme Programming – method overview, lifecycle, roles, artifacts, and practices.

Safe Agile Methodology- Safe Agile concepts, DevOps- ART, PIs & RTE concepts.

UNIT IV:

Agile Tool Support (Introduction): Overview of Agile project management tools, JIRA fundamentals, issue types, epics, user stories, sprint creation, Kanban boards, backlog management, basic reports (burndown, velocity).

UNIT V:

The Agile Coach: Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.

Practical Exposure: Creating a SCRUM board and Kanban board in JIRA, sprint setup, task tracking, and workflow visualization.

Text Books :

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.
2. Ravi Sagar, Jira Quick Start Guide: Manage Your Projects Efficiently Using the All-New Jira, Packt Publishing.

Reference Books:

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly.
2. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley.

Web Link:

1. https://www.edx.org/course/agile-software-development
2. https://www.class-central.com/course/coursera-agile-software-development-9513
3. https://www.cprime.com/resources/what-is-agile-what-is-scrum/
4. https://www.atlassian.com/agile/kanban
5. https://file.scirp.org/pdf/JCC_2017033115471602.pdf

GENERATIVE AI
(Professional Elective-V)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7E07	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the evolution, types, and ethical considerations of generative AI models.
CO2: Apply language models and prompt engineering techniques for generating and refining text using generative AI.
CO3: Analyze and implement image generation models such as GANs, VAEs, and diffusion models.
CO4: Explore creative AI applications in painting, music, and autonomous generation using deep reinforcement learning.
CO5: Utilize open-source frameworks and tools to train, fine-tune, and deploy generative AI models.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	3	-	-	-	1	-	2
CO2	3	3	2	-	3	-	-	-	-	1	1	3
CO3	3	3	3	2	3	-	-	-	-	1	1	3
CO4	2	3	3	2	3	-	-	-	-	-	1	3
CO5	3	2	3	-	3	-	-	-	-	-	2	3

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	2	-
CO4	3	-
CO5	3	-

UNIT I :

Introduction To Gen Ai: Historical Overview of Generative modelling, Difference between Gen AI and Discriminative Modeling, Importance of generative models in AI and Machine Learning, Types of Generative models, GANs, VAEs, autoregressive models and Vector quantized Diffusion models, understanding if probabilistic modeling and generative process, Challenges of Generative Modeling, Future of Gen AI, Ethical Aspects of AI, Responsible AI, Use Cases.

UNIT II:

Generative Models for Text: Language Models Basics, Building blocks of Language models, Transformer Architecture, Encoder and Decoder, Attention mechanisms, Generation of Text, Models like BERT and GPT models, Generation of Text, Autoencoding, Regression Models, Exploring ChatGPT, Prompt Engineering: Designing Prompts, Revising Prompts using Reinforcement Learning from Human Feedback (RLHF), Retrieval Augmented Generation, Multimodal LLM, Issues of LLM like hallucination.

UNIT III:

Generation of Images: Introduction to Generative Adversarial Networks, Adversarial Training Process, Nash Equilibrium, Variational Autoencoders, Encoder-Decoder Architectures, Stable Diffusion Models, Introduction to Transformer-based Image Generation, CLIP, Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V, Issues of Image Generation models like Mode Collapse and Stability.

UNIT IV:

Generation of Painting, Music, and Play: Variants of GAN, Types of GAN, Cyclic GAN, Using Cyclic GAN to Generate Paintings, Neural Style Transfer, Style Transfer, Music Generating RNN, MuseGAN, Autonomous agents, Deep Q Algorithm, Actor-critic Network.

UNIT V:

Open Source Models And Programming Frameworks: Training and Fine tuning of Generative models, GPT 4 All, Transfer learning and Pretrained models, Training vision models, Google Copilot, Programming LLM, LangChain, Open Source Models, Llama, Programming for TimeSformer, Deployment, Hugging Face.

Text Books:

1. Denis Rothman, “Transformers for Natural Language Processing and Computer Vision”, Third Edition , Packt Books, 2024

Reference Books:

1. David Foster, ”Generative Deep Learning”, O’Reily Books, 2024.

2. Altaf Rehmani, “Generative AI for Everyone”, BlueRose One, 2024.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_cs137
2. https://eicta.iitk.ac.in/product/generative-ai-stp-2025
3. https://www.coursera.org/specializations/generative-ai-engineering-with-llms
4. https://iitgenerativeai.com/iit-delhi-certificate-programme-in-generative-ai

CYBER PHYSICAL SYSTEMS
(Professional Elective-V)
(Common to CSE & IT)

	L	T	P	C
VII Semester				
Course Code: 231CS7E05	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe the fundamental concepts, motivations, and symbolic synthesis techniques used in Cyber Physical Systems
CO2: Analyze the security threats and apply appropriate cyber security mechanisms in CPS
CO3: Examine synchronization methods and distributed consensus algorithms in CPS
CO4: Apply real-time scheduling techniques considering timing parameters and system variability
CO5: Evaluate and integrate semantic models and domain-specific modeling languages for CPS

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	1	-	-	-	-	2	1	2
CO2	3	-	3	-	-	2	1	-	1	2	2	3
CO3	1	2	-	2	-	-	-	-	1	-	-	-
CO4	-	1	-	-	-	-	-	-	-	2	-	2
CO5	-	-	-	1	-	-	-	-	1	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO / PSO	PSO1	PSO2
CO1	3	-
CO2	3	2
CO3	3	2
CO4	3	1
CO5	2	3

UNIT I:

Symbolic Synthesis for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Preliminaries, Problem Definition, Solving the Synthesis Problem, Construction of Symbolic Models, Advanced Techniques: Construction of Symbolic Models, Continuous-Time Controllers, Software Tools

UNIT II:

Security of Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Cyber Security Requirements, Attack Model, Countermeasures, Advanced Techniques: System Theoretic Approaches

UNIT III:

Synchronization in Distributed Cyber-Physical Systems: Challenges in Cyber-Physical Systems, A Complexity-Reducing Technique for Synchronization, Formal Software Engineering, Distributed Consensus Algorithms, Synchronous Lockstep Executions, Time-Triggered Architecture, Related Technology, Advanced Techniques

UNIT IV:

Real-Time Scheduling for Cyber-Physical Systems: Introduction and Motivation, Basic Techniques - Scheduling with Fixed Timing Parameters, Memory Effects, Multiprocessor/Multicore Scheduling, Accommodating Variability and Uncertainty

UNIT V:

Model Integration in Cyber-Physical Systems: Introduction and Motivation, Causality, Semantic Domains for Time, Interaction Models for Computational Processes, Semantics of CPS DSMLs, Advanced Techniques, ForSpec, The Syntax of CyPhyML, Formalization of Semantics, Formalization of Language Integration.

Text Books:

1. Raj Rajkumar, Dionisio De Niz, and Mark Klein, Cyber-Physical Systems, Addison-Wesley Professional, 2016, ISBN: 978-9386873569.
2. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, ISBN: 978-0262548922.

Reference Books:

1. E.A.Lee, Sanjit Seshia, Introduction to Embedded Systems: A Cyber-Physical Systems Approach, MIT Press, ISBN: 978-9388028400.
2. Andre Platzer, Logical Foundations of Cyber-Physical Systems, (2e), Springer Publishing, 2018, ISBN: 978-3319635873.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc23_cs62/preview#:~:text=ABOUT%20THE%20COURSE:,%2C%20power%2C%20and%20industrial%20automation.
2. https://www.sciencedirect.com/topics/engineering/cyber-physical-systems
3. https://claroty.com/blog/10-examples-of-cyber-physical-systems

HIGH PERFORMANCE COMPUTING
(Professional Elective-V)
(Common to CSE, AIML & CSE(DS))

	L	T	P	C
VII Semester				
Course Code: 231DS7E05	3	0	0	3

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Analyze the evolution of Microprocessor Architectures, comparing Implicit Parallelism with explicit multi-core designs and understanding the Limitations of Memory.

CO2: Evaluate the Characteristics of Tasks and Interactions, focusing on dependency graphs and the overhead associated with data sharing between processors.

CO3: Apply advanced techniques such as Message Splitting, Pipelining, and Circular Shifts to improve the speed and scalability of parallel algorithms.

CO4: Analyze the various Sources of Overhead in parallel programs, such as contention for shared resources and communication latency, to improve code efficiency.

CO5: Design complete parallel systems that demonstrate high Speedup and Efficiency across both CPU and GPU architectures.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-
CO4	2	1	2	-	-	-	-	-	-	-	-	-
	1	1	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	2
CO3	-	3
CO4	-	2
CO5	-	2

Unit I Introduction: Motivating Parallelism, Scope of Parallel Computing, Parallel Programming Platforms: Implicit Parallelism, Trends in Microprocessor and Architectures, Limitations of Memory, System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Scalable design principles, Architectures: N-wide superscalar architectures, Multi-core architecture.

Unit II Parallel Programming: Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for

Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models, The Age of Parallel Processing, the Rise of GPU Computing, A Brief History of GPUs, Early GPU.

Unit III Basic Communication: Operations- One-to-All Broadcast and All-to-One Reduction, All to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations. Programming shared address space platforms: threads- basics, synchronization, Open MP programming

Unit IV: Analytical Models: Sources of overhead in Parallel Programs, Performance Metrics for Parallel Systems, and The effect of Granularity on Performance, Scalability of Parallel Systems, Minimum execution time and minimum cost, optimal execution time. Dense Matrix Algorithms: MatrixVector Multiplication, Matrix-Matrix Multiplication.

Unit V: Parallel Algorithms- Sorting and Graph: Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Parallelizing Quick sort, All-Pairs Shortest Paths, Algorithm for sparse graph, Parallel Depth-First Search, Parallel Best First Search. CUDA Architecture: CUDA Architecture, Using the CUDA Architecture, Applications of CUDA Introduction to CUDA C- Write and launch CUDA C kernels, Manage GPU memory, Manage communication and synchronization, Parallel programming in CUDA- C

Text Books:

1. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
2. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN-13: 978-0-13-138768-3

Reference Books:

1. Kai Hwang,” Scalable Parallel Computing”, McGraw Hill 1998, ISBN: 0070317984
2. Shane Cook, “CUDA Programming: A Developer's Guide to Parallel Computing with GPUs”, Morgan Kaufmann Publishers Inc. San Francisco, CA, USA 2013 ISBN: 9780124159884
3. David Culler Jaswinder Pal Singh, ” Parallel Computer Architecture: A Hardware/Software Approach”, Morgan Kaufmann,1999, ISBN 978-1- 55860-343-1
4. Rod Stephens, “Essential Algorithms”, Wiley, ISBN: 978-1-118-61210-1

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_ma27/preview
2. https://nptel.ac.in/courses/106108055
3. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html

INDUSTRIAL WASTE WATER MANAGEMENT
(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CE7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation.

CO2: Illustrate various treatment methods based on characteristics of waste water

CO3: Suggest treatment methods for any industrial wastewater.

CO4: Decide the need of common effluent treatment plant for the industrial area in their vicinity

CO5: Explain the treatment methods of liquid waste from various industries.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	1	-	-	2	3	-	-	-	-	-
CO2	2	-	1	-	-	3	2	-	-	-	-	-
CO3	3	-	1	-	-	1	1	-	-	-	-	-
CO4	1	-	2	-	-	1	2	-	-	-	-	-
CO5	3	-	1	-	-	2	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO2
CO1	-	1
CO2	-	1
CO3	-	1
CO4	-	1
CO5	-	1

Unit - I

Industrial water Quantity and Quality requirements:

Boiler and cooling waters-Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills.

Unit – II

Miscellaneous Treatment:

Use of Municipal wastewater in Industries – Advanced water treatment – Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour

Unit – III

Basic theories of Industrial Wastewater Management:

Industrial waste survey – Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis – Wastewater Characterization-Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes-Volume and Strength reduction – Neutralization – Equalization and proportioning-recycling, reuse, and resources recovery.

Unit – IV

Industrial wastewater disposal management:

Discharges into Streams, Lakes and oceans and associated problems, Land treatment – Common Effluent Treatment Plants: advantages and suitability, Limitations, and challenges- Recirculation of Industrial Wastes-Effluent Disposal Method

Unit – V

Process and Treatment of specific Industries:

Manufacturing Process and origin, characteristics, effects, and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants.

Text Books:

1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi,2016
2. Industrial Wastewater Treatment by KVSG Murali Krishna.

Reference Books:

1. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition, 2015
2. Wastewater Treatment- Concepts and Design Approach by G.L. Karia & R.A. Christian, Prentice Hall of India

Web Links:

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ce32/
2. https://www.un-ihe.org/online-course-industrial-effluent-treatment

BASICS OF RS&GIS
(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CE7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the evolution of Remote Sensing and GIS, the energy interactions in the atmosphere and earth surface features.

CO2: Elaborate on photogrammetry and various satellites.

CO3: Interpret the images for preparation of thematic maps.

CO4: Develop GIS based raster and vector data models.

CO5: Explain navigation applications based on GCS and GPS systems.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	-	1	-		-	2	-	-	-	-
CO2	2	1	-	1	-	-	-	2	-	-	-	-
CO3	2	1	-	1	-	-	-	2	-	-	-	-
CO4	3	2	-	1	-	-	-	2	-	-	-	-
CO5	3	2	-	1	-	-	-	2	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

History and Basic Concept of Remote Sensing:

Introduction to remote sensing: Evolution of Remote Sensing- use of hot air balloons, pigeons and platforms of remote sensing, low-medium-high altitude imaging.

Basic concepts of remote sensing: Electromagnetic spectrum and its interaction with atmosphere, energy interaction with the earth surfaces characteristics of remote sensing systems.

Unit – II

Photogrammetry; Aerial and Terrestrial; photo interpretation. Sensors; Radar imaging; colour scanners; thematic mapper. Introduction to space agencies - IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and temporal).

Unit – III

Geographic Information System:

Introduction to GIS; Components of a GIS, Geospatial Data: Spatial Data and Attribute data, Joining Spatial and Attribute data.

Image interpretation:

Introduction, elements of visual image interpretations, digital image processing- image pre-processing, image enhancement, image classification, supervised classification, unsupervised classification using GIS Environs.

Unit – IV

Data Models: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion

Unit – V

Coordinate Systems:

Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters, commonly used Map Projections. Global positioning system and various navigation applications.

Text Books:

1. Textbook of Remote Sensing and Geographical Information Systems, by Anji M. Reddy · 2018, BS Publications.
2. Remote Sensing and GIS, Basudev Bhatta, Oxford Publishers 2015

Reference Books:

1. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.
2. Introduction to Geographic Information System, Kang-Tsung Chang, McGraw- Hill 2015.

Web Links:

1. http://geology.wlu.edu/harbor/geol260/lecture_notes/notes.html
2. https://lecturenotes.in/subject/572/remote-sensing-and-gis-rsg

SAFETY ENGINEERING
(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CE7O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Develop management plans to prevent accidents in construction Industry.

CO2: Prepare plans to safe guard workers in construction of high risk Buildings.

CO3: Ensure safety while operating construction machinery.

CO4: Outline safety plans for demolition of buildings.

CO5: Prepare fire safety plans for a given building.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	1		-	-	1	-	-	-
CO2	2	3	-	-	2	-	-	-	1	-	-	-
CO3	1	2	-	-	1	-	-	2	-	-	2	-
CO4	2	2	-	-	1	-	-	2	-	-	2	-
CO5	2	2	-	-	1	-	-	-	1	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Accidents Causes and Management Systems:

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accident – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work

– quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training.

Unit – II

Hazards of Construction and Prevention:

Excavations, basement and wide excavation, trenches, shafts – scaffolding , types, causes of accidents, scaffold inspection checklist – false work – erection of structural frame work, dismantling – tunneling – blasting, pre blast and post blast inspection – confined spaces – working on contaminated sites – work over water – road works – power plant constructions – construction.

Unit – III

Working At Heights:

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings , requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones,
safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

Unit – IV

Construction Machinery:

Selection, operation, inspection and testing of hoisting cranes, mobile cranes, tower cranes, crane inspection checklist - builder’s hoist, winches, chain pulley blocks – use of conveyors
– concrete mixers, concrete vibrators – safety in earth moving equipment, excavators, dozers, loaders, dumpers, motor grader, concrete pumps, welding machines, use of portable electrical tools, drills, grinding tools, manual handling scaffolding, hoisting cranes – use of conveyors and mobile cranes – manual handling.

Unit – V

Safety in Demolition Work:

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods – interesting experiences at the construction site against the fire accidents.

Fire Safety:

Fire – fire load-control and institutional fire protection systems, Fire Hydrant and extinguishers, Electrical Hazards, protection and interlock- Discharge rod and earthling device, safety in the use of portable tools. Emergency planning and preparedness. Marking of Route Fire Exist.

Text Books:

1. Safety in the Build Environment’ by Jnathea D.Sime, London, 2010
2. Reliability Maintenance and Safety Engineering, by Gupta A K, Laxmi Publications, New Delhi.

Reference Books:

1. Construction hazard and Safety Hand book’ by Hudson, R., Butter Worth’s, 1985.
2. Construction Safety Hand Book’ by V.J.Davies and K.Thomasin,Thomas Telford Ltd., London, 1990.

Web Links:

1. nptel.ac.in/courses/105103093/
2. nptel.ac.in/courses/105103093/22

BATTERY MANAGEMENT SYSTEMS AND CHARGING STATIONS
(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EE7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1	Describe the construction and operation of different batteries for EV applications
CO2	Describe charging algorithms of different batteries and balancing methods of battery packs
CO3	Describe the different kinds of infrastructure needed in the charging stations
CO4	Describe the requirements of battery management and their maintenance.
CO5	Explain the modelling of batteries

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO12
CO1	2	3	2	-	-	1	-	-	-	-	-	1
CO2	2	3	2	-	-	1	-	-	-	-	-	1
CO3	2	2	3	-	-	1	-	-	-	-	-	1
CO4	2	2	3	-	-	1	-	-	-	-	-	1
CO5	2	2	3	-	-	1	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	1
CO4	-	1
CO5	-	1

UNIT – I
EV Batteries

Cells & Batteries, Nominal voltage and capacity, C rate, Energy and power, Cells connected in series, Cells connected in parallel. Lead Acid Batteries: Lead acid battery basics, special characteristics of lead acid batteries, battery life and maintenance, Li-ion batteries. Nickel-based Batteries: Nickel cadmium, Nickel metal hydride batteries. Sodium-Based Batteries:
Introduction, sodium sulphur batteries, sodium metal chloride (Zebra) batteries. Lithium Batteries: Introduction, the lithium polymer battery, lithium ion battery

UNIT – II
Battery Charging Strategies

Charging algorithms for a single battery: Basic terms for charging performance evaluation and characterization, CC charging for NiCd/NiMH batteries, CV charging for lead acid batteries, CC/CV charging for lead acid and Li-ion batteries, MSCC charging for lead acid, NiMH and Li-ion batteries, TSCC/CV charging for Li-ion batteries, CVCC/CV charging for Li-ion batteries, Pulse charging for lead acid, NiCd/NiMH and Li-ion batteries, Charging termination techniques, Comparisons of charging algorithms and new development; Balancing methods for battery pack charging: Battery sorting Overcharge for balancing, Passive balancing,Active balancing.

UNIT – III

Charging Infrastructure

Domestic Charging Infrastructure, Public charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

UNIT – IV

Battery-Management-System Requirements

Battery-pack topology, BMS design requirements, Voltage sense, Temperature sense, Current sense, Contactor control, Isolation sense, Thermal control, Protection, Charger control, Communication via CAN bus, Log book, SOC estimation, Energy estimation, Power estimation, Diagnostics.

UNIT – V

Battery Modelling

General approach to modelling batteries, simulation model of rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of NiCd battery model, Simulation examples.

Text Books:

1 Energy Systems for Electric and Hybrid Vehicles by K.T. Chau, IET Publications, First edition, 2016.

2 Battery Management Systems Vol. – II Equivalent Circuits and Methods, by Gregory L.Plett, Artech

House publisher, First edition 2016.

Reference Books:

1 Electric and hybrid vehicles: design fundamentals, 2nd edition, husain iqbal, crc press

2 Lithium-Ion Batteries: Fundamentals and Applications (Electrochemical Energy Storage and Conversion) 1st Edition by Yuping Wu

3 The Electric Vehicle Conversion Handbook: How to Convert Cars, Trucks, Motorcycles, and Bicycles -- Includes EV Components, Kits, and Project Vehicles Paperback – Illustrated, June 7, 2011 by Mark Warner

Web Links:

1 https://www.hydroquebec.com/data/electrification-transport/pdf/technical-guide.pdf

2 https://www.youtube.com/watch?v=eQX-iobIYmw

CONCEPT OF SMART GRID TECHNOLOGY
(Open Elective-III)

	L	T	P	C
VII Semester				
Course Code: 231EE7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Explain the concepts of smart grid and its issues in interconnection.

CO2 Explain various smart grid technologies and its usage in smart applications.

CO3 Describe the concepts of smart substations.

CO4 Analyze micro grids and distributed generation systems.

CO5 Describe the different technologies in smart grid.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	1	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	1
CO2	1	1
CO3	1	1
CO4	1	1
CO5	1	1

Unit – I

Introduction to Smart Grid: Evolution of Electric Grid - Concept of Smart Grid - Definitions - Need of Smart Grid - Functions of Smart Grid - Opportunities & Barriers of Smart Grid - Difference between conventional & smart grid - Concept of Resilient & Self-Healing Grid - Present development & International policies on Smart Grid.

Unit – II

Smart Grid Technologies: Part 1: Introduction to Smart Meters - Real Time Pricing - Smart Appliances - Automatic Meter Reading (AMR) - Outage Management System (OMS) - Plug in Hybrid Electric Vehicles (PHEV) - Vehicle to Grid - Smart Sensors - Home & Building Automation - Phase Shifting Transformers -Net Metering.

Unit – III

Smart Grid Technologies: Part 2: Smart Substations - Substation Automation - Feeder Automation. Geographic Information System (GIS) - Intelligent Electronic Devices (IED) & their application for monitoring & protection.

Smart storage like Battery Energy Storage Systems (BESS) - Super Conducting Magnetic Energy Storage Systems (SMES) - Pumped Hydro - Compressed Air Energy Storage (CAES)

Unit – IV

Micro grids and Distributed Energy Resources: Concept of micro grid - need & applications of microgrid - formation of microgrid - Issues of interconnection - protection & control of microgrid - Integration of renewable energy sources - Demand Response.

Unit – V

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI) - HomeArea Network (HAN) - Neighborhood Area Network (NAN) - Wide Area Network (WAN).

Text Books:

1. Integration of Green and Renewable Energy in Electric Power Systems - by Ali Keyhani - Mohammad N. Marwali - Min Dai Wiley - 2009.
2. The Smart Grid: Enabling Energy Efficiency and Demand Response - by Clark W.Gellings - Fairmont Press - 2009.

Reference Books:

1. The Advanced Smart Grid: Edge Power Driving Sustainability:1 by Andres Carvallo - John Cooper -Artech House Publishers July 2011
2. Smart Grid: Technology and Applications - by Janaka B. Ekanayake - Nick Jenkins - Kithsiri Liyanage- Jianzhong Wu - Akihiko Yokoyama - Wiley publishers - 2012.

Web Links:

1. https://nptel.ac.in/courses/108104052/
2. https://nptel.ac.in/downloads/108101040/
3. https://nptel.ac.in/courses/108101040/

FINITE ELEMENT METHODS
(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the concepts behind variational methods and weighted residual methods in FEM.

CO2: Solve bar and truss problems Solve bar and truss problems**.**

CO3: Solve beam problems**.**

CO4: Apply suitable boundary conditions for 2D stress analysis and develop the formulation for axi-symmetric problems and higher order iso-parametric elements.

CO5: Evaluate the concepts of steady state heat transfer analysis and dynamic analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	2	1	-	-	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Unit - I

Introduction:

Introduction to finite element method, stress and equilibrium, strain‑displacement relations, stress‑strain relations, plane stress and plane strain conditions, variational and weighted residual methods, concept of potential energy, one-dimensional problems. Analysis of Trusses: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations

Unit -II

Bar element formulation, Discretization of domain, element shapes, discretization procedures, assembly of stiffness matrix, band width, node numbering, mesh generation, interpolation functions, local and global coordinates, convergence requirements, treatment of boundary conditions.
Analysis of Trusses: Finite element modeling, coordinates and shape functions, assembly of global stiffness matrix and load vector, finite element equations, treatment of boundary conditions, stress, strain and support reaction calculations.

Unit - III

Analysis of Beams: Element stiffness matrix for Hermite beam element, derivation of load vector for concentrated and UDL, simple problems on beams.

Unit - IV

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, formulation of axisymmetric problems. Higher order and iso-parametric elements: One dimensional, quadratic and cubic elements in natural coordinates, two dimensional four node iso-parametric elements and numerical integration.

Unit - V

Steady state heat transfer analysis: one dimensional analysis of a fin.
Dynamic Analysis: Formulation of finite element model, element consistent and lumped mass matrices, evaluation of eigen values and eigen vectors, free vibration analysis

Text Books:

1. Introduction to Finite Elements in Engineering, T.R. Chandrupatla and A.D. Belegundu, PHI publications, 4th Edition, 2011.
2. A First Course in the Finite Element Method, Daryl L. Logan, Cengage Learning India Private Limited, 6th edition, 2017.

Reference Books:

1. An Introduction to the Finite Element Method, J.N. Reddy, McGraw Hill Education, 4th Edition, 2020.

2. Concepts and Applications of Finite Element Analysis, Cook et al, Wiley Publications, 4th edition, 2007.
3. Engineering Thermodynamics, P. Chattopadhyay, Oxford University Press, 1st edition, 2011.

4. Refrigeration and Air-conditioning, CP Arora, , McGraw Hill, 4th edition 2021.

Web Links:

1. https://nptel.ac.in/courses/112/104/112104193/

INTRODUCTION TO MECHATRONICS
(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe mechatronics systems and various types of sensors and transducers.

CO2: Demonstrate knowledge of solid-state devices, analog circuits, and MEMS applications

CO3: Explain the components and operation of hydraulic, pneumatic, electro-pneumatic, electro-hydraulic, mechanical, and electrical actuating system

CO4: Discuss digital electronics, microcontrollers, PLCs, and their applications in control systems.

CO5: Apply system interfacing, data acquisition, system response, and mechatronics design trends.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	1	-	-	-	-	-	-	-
CO2	2	-	-	-	1	-	-	-	-	-	-	-
CO3	2	-	-	-	1	-	-	-	-	-	-	-
CO4	2	-	1	-	2	-	-	-	-	-	-	-
CO5	2	-		-	2	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	1	-
CO3	1	-
CO4	2	-
CO5	2	-

Unit - I

Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion , force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

Unit -II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

Unit - III

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems. Mechanical actuating systems and electrical actuating systems.

Unit - IV

Digital electronics and systems, digital logic control, microprocessors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

Unit – V

System and interfacing and data acquisition, DAQS, SCADA, A-D and D-A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.

Text Books:

1. Mechatronics Integrated Mechanical Electronics Systems/KP Ramachandran & G K Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005

Reference Books:

1. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.
2. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
3. Mechatronics System Design / Devdas Shetty/Richard/Thomson.
4. Mechatronics/M. D. Singh/J. G. Joshi/PHI.

Web Links:

1. https://www.electronicshub.org/different-types-sensors/
2. https://en.wikipedia.org/wiki/Solid-state_electronics
3. http://www.htl-worldwide.com/the-difference-between-pneumatic-hydraulic-and-electrical-actuators/
4. https://www.worldscientific.com/worldscibooks/10.1142/10193

PRODUCT DESIGN AND DEVELOPMENT
(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Apply creative thinking skills for idea generation

CO2: Translate conceptual ideas into clear sketches.

CO3: Able to identify causes of failure through fault free analysis and perform failure analysis

CO4: Test a product under thermal, vibration, electrical and combined environments.

CO5: Know how to design for manufacturability

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	-	-	-	-	-	-	-	-	-	1
CO2	3	-	1	-	2	-	-	-	-	-	2	1
CO3	3	3	-	1	-	-	-	-	-	-	-	1
CO4	3	2		2	-	-	2	-	-	-	-	1
CO5	3	-	3	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

Unit – I: PRODUCT DESIGN PROCESS:

Design Process Steps, Morphology of Design. Problem Solving and Decision Making: Problem-Solving Process, Creative Problem Solving, Invention, Brainstorming, Morphological Analysis, Behavioural Aspects of Decision Making, Decision Theory, Decision Matrix, Decision Trees.
MODELING AND SIMULATION:
Triz, Role of Models in Engineering Design, Mathematical Modeling, Similitude and Scale Models, Computer Simulation, Geometric Modeling on Computer, Finite-Element Analysis.

Unit -II: PRODUCT MANAGEMENT:

The operation of product management: Customer focus of product management, product planning process, Levels of strategic planning, Wedge analysis, Opportunity search, Product life cycle Life cycle theory and practice.

PRODUCT DEVELOPMENT:

Managing new products, generating ideas, Sources of product innovation, Selecting the best ideas, the political dimension of product design, Managing the product launch and customer feedback.

PRODUCT MANAGERS AND MANUFACTURING:

Need for effective relationships, Impact of manufacturing processes on product decisions, Prototype planning, Productivity potentials, Management of product quality, Customer service levels.

Unit – III: RISK AND RELIABILITY:

Risk and Reliability: Risk and Society, Hazard Analysis, Fault Tree Analysis. Failure Analysis and Quality: Causes of Failures, Failure Modes, Failure Mode and Effect Analysis, FMEA Procedure, Classification of Severity, Computation of Criticality Index, Determination of Corrective Action, Sources of Information, Copyright and Copying. Patent Literature.

Unit – IV: PRODUCT TESTING:

Thermal, vibration, electrical, and combined environments, temperature testing, vibration testing, test effectiveness. Accelerated testing and data analysis, accelerated factors. Weibull probability plotting, testing with censored data.

Unit – V: DESIGN FOR MANUFACTURABILITY:

Maintenance Concepts and Procedures, Component Reliability, Maintainability and Availability, Fault Isolation in design and Self-Diagnostics. Product Design for Safety, Product Safety and User Safety Concepts, Examples of Safe Designs.

DESIGN STANDARDIZATION AND COST REDUCTION:

Standardization Methodology, Benefits of Product Standardization; International, National, Association and Company Level Standards; Parts Modularization

Text Books:

1. Engineering Design, George E. Dieter, McGraw-Hill
2. Product Integrity and Reliability in Design, John W. Evans and Jillian Y. Evans,

Reference Books:

1. The Product Management Handbook, Richard S. Handscombe, McGraw-Hill
2. New Product Design, Ulrich Eppinger
3. Product Design, Kevin Otto.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_me83/preview
2. https://www.youtube.com/watch?v=HN9GtL21rb4&t=6s

ADVANCED MATERIALS
(Open Elective-III)

VII Semester	L	T	P	C
Course Code: 231ME7O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the materials science and engineering concepts of varied materials to understand the correlations between structure and properties.

CO2: Apply the concept of strengthening mechanisms to assess the properties of special metallic materials and alloys.

CO3: Apply the concept of strengthening mechanisms to assess the properties of polymers and composite materials.

CO4: Analyze the role of functional & smart materials in the contemporory applications covered in diverse fields of engineering and technology.

CO5: Explain advances in nanomaterials applications in varied fields with a special focus on safety, sustainability, and environmental considerations.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	3	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	3	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

Unit - I

Introduction to Materials Science and Engineering:

Introduction to materials and their classifications (metals, polymers, ceramics, composites), Atomic structure and bonding in materials, Crystal structures and defects, Mechanical properties of materials (stress, strain, hardness), Thermal, electrical, and magnetic properties, Phase diagrams and transformations.

Unit -II

Advance metallic materials & alloys:

Types of metallic alloys and their applications, Heat treatment and alloying techniques, Strengthening mechanisms (grain size, work hardening, alloying), Special metallic materials (shape memory alloys, superalloys), Corrosion and wear resistance in stainless steels.

Unit - III

Polymer and Composite Materials

Classification of polymers and their properties, Polymer processing techniques, Composite materials: types, fabrication, and properties, Reinforcement materials (fibers, nanoparticles), Applications in aerospace, automotive, biomedical fields, Environmental considerations and recyclability.

Unit – IV

Functional and Smart materials

Piezoelectric, ferroelectric, and magneto strictive materials, Shape memory alloys and polymers, Thermochromic and photochromic materials, Self-healing and self-cleaning materials, Applications in sensors, actuators, and smart systems.

Unit – V

Nanomaterials and Future Trends in Materials Science

Nanomaterials: synthesis, characterization, and properties, Carbon nanotubes and graphene, Nanocomposites and their applications, Ethical, safety, and environmental considerations, Emerging trends: 2D materials, biomaterials, and sustainable materials.

Text Books:

1. R. Balasubramaniam, “Callister’s Materials Science and Engineering,” 2nd Edition, G. E. Dieter, "Mechanical Behavior of Materials," 3rd Edition, McGraw-Hill, 1986.

Reference Books:

1. L. M. Nieckele, "Advanced Materials: Properties, Processing, and Applications," CRC
2. R. W. Cahn and P. Haasen (Eds.), "Physical Metallurgy," 4th Edition, Elsevier, 1996.
3. S. C. Sharma, "Advanced Materials and Their Applications," Dhanpat Rai Publishing
4. V. Raghavan, "Materials Science and Engineering," PHI Learning, 2014.

Web links:

1. https://ocw.mit.edu/courses/3-051j-materials-for-biomedical-applications-spring-2006/
2. https://www.youtube.com/playlist?list=PLbRMhDVUMngdzwQyMgoUgdaGBqi_p4nVM
3. https://www.coursera.org/specializations/materials-science-for-advanced-technological-

SMART MANUFACTURING

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O05	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, students will be able to:

CO1: Learn about smart manufacturing systems' components and handle them more effectively in the context of Industry 4.0

CO2: Develop an understanding of smart machines and smart sensors

CO3: Apply IoT to Industry 4.0, and they can make a system tailor-made as per the requirements of the industry

CO4: Develop an understanding of the concepts of Digital Twin to apply Artificial Intelligence and Machine Learning concepts in Manufacturing

CO5: Explain the concepts of AR/VR and Metaverse platform

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	2	1	-	2	2	-	-	-	-	-	2
CO2	2	2	1	-	2	2	-	-	-	-	-	2
CO3	2	2	1	-	2	2	-	-	-	-	-	2
CO4	2	2	1	-	2	2	-	-	-	-	-	2
CO5	2	2	1	-	2	2	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – 1

Concepts of Smart Manufacturing: Definition and key characteristics of smart manufacturing, corporate adaptation processes, manufacturing challenges, challenges vs technologies, Stages in smart manufacturing. Minimizing six big losses in manufacturing with Industry 4.0, and their benefits.

UNIT – 2

Smart Machines and Smart Sensors: Concept and Functions of a Smart, Machine Salient features and Critical Subsystems of a Smart Machine, Smart sensors; smart sensors ecosystem, need, benefits and applications of sensors in industry, Introduction to IoT, IIoT, and Cyber physical systems, Sensing for Manufacturing Process in IIoT, Block Diagram of an IIoT Sensing Device, Sensors in IIoT Applications, Smart Machine Interfaces,

UNIT – 3

IoT connectivity for Industry 4.0: Industrial communication requirement and its infrastructure, an overview of different types of networks, mesh network in industrial IoT, IoT protocols and the internet, TCP/IP (transmission control protocol/internet protocol) model, IoT connectivity standards: common protocols, application layer protocols, internet/network layer protocols, physical layer IoT protocols, choosing the right IoT connectivity protocol.

UNIT – 4

Digital Twin: Introduction, applications of digital twins, impact zones of digital twins in manufacturing (factories/plants and OEMs), advantages of digital twins, basic steps of digital twin technology

Machine Learning (ML) and Artificial Intelligence (AI) in Manufacturing: Introduction, benefits and applications of ML in industries, common approaches of ML; supervised and unsupervised, semi-supervised and reinforced ML.

UNIT – 5

Metaverse – Basic concepts, AR/VR, Social Metaverse, Industrial Metaverse, How Web 3.0 is changing the Internet, Asset Classes Inside the Metaverse, Land, Coins, Characters/ Avatars, Skins, Utility, Industries Disrupted by the Metaverse, Smart wearables.

Text Books:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008
2. Tom M. Mitchell, Machine Learning, McGraw Hill, 2013
3. Ethem Alpaydin, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press, 2004.
4. Aurélien Géron, Hands on Machine Learning with Scikit-Learn and TensorFlow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O’ Reilly Media, 2017
5. S. Kaushik, Artificial Intelligence, Cengage Learning India,

Reference Books:

1. Elaine Rich, Kevin Knight and Shivashankar B. Nair, Artificial Intelligence, 3/e, McGraw Hill Education, 2008.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, 2012.
3. M.C. Trivedi, A Classical Approach to Artifical Intelligence, Khanna Publishing House,New Delhi, 2018.
4. Artificial Intelligence and Machine Learning, Principles and applications by Vinod Chandra S.S., Anand Hareendran S., PHI 2011.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_cs91/preview
2. https://onlinecourses.nptel.ac.in/noc25_cs147/preview
3. https://onlinecourses.nptel.ac.in/noc25_cs146/preview

DISCRETE TIME SIGNAL PROCESSING

(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EC7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Summarize Discrete Time Signals and Systems.

CO2 Illustrate the functionality of fourier series and fourier transform

CO3 Apply DFT properties to evaluate the given sequence.

CO4 Make use of FFT Algorithms for DFT computation.

CO5 Interpret the basic structures of FIR and IIR digital filters.

CO6 Extend the single rate digital signal processing to multirate digital signal processing

Mapping of Course Outcomes with Program Outcomes:

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO / PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit - I

Introduction to Digital Signal Processing:

Discrete time signals & sequences, linear shift invariant systems, stability, and causality. Linear constant coefficient difference equations. Frequency domain representation of discrete time signals and systems.

Unit - II

Discrete Fourier Series & Fourier Transforms:

Properties of discrete Fourier series, DFS representation of periodic sequences, Discrete Fourier transforms: Properties of DFT, linear convolution of sequences using DFT,Computation of DFT.

Unit - III

Fast Fourier Transforms:

Fast Fourier Transforms (FFT) - Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT.

Unit - IV

Realization Of Digital Filters:

Review of Z-transforms, Applications of Z-transforms, solution of difference equations - digital filters, Block diagram representation of linear constant-coefficient difference equations, Basic structures of IIR systems, Transposed forms, Basic structures of FIR systems, System function.

Unit - V

Multirate Digital Signal Processing:

Decimation, Interpolation, Sampling rate conversion, Implementation of sampling rate conversion.

Text Books:

1. Digital Signal Processing, Principles, Algorithms and Applications:John G. Proakis, Dimitris G. Manolakis, Pearson Education/PHI, 2007.
2. Discrete Time Signal Processing, A. V. Oppenheim and R. W. Schaffer,PHI,2010

Reference Books:

1. Fundamentals of Digital Signal Processing using MATLAB, Robert.Schilling,Sandra L. Harris, Thomson, 2007.
2. Digital Signal Processing, P.Ramesh Babu, SciTech Publications, 6th Edition,2014.
3. Digital Signal Processing, Tarun Kumar Rawat, Oxford University Press, 1stEdition, 2015.
4. Multirate Systems and Filter Banks, P.P.Vaidyanathan, Pearson, 1st Edition.

Web Links:

1. https://www.tutorialspoint.com/digital_signal_processing/index.htm
2. https://nptel.ac.in/courses/117/102/117102060/(Digital Signal Processing - Video course, Coordinator BY Prof. S.C. Dutta Roy Department of Electrical Engineering IIT Delhi)

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LINEAR AND DIGITAL IC APPLICATIONS
(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EC7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1	Construct Op Amps using the differential amplifier and other improvement circuits.
CO2	Explain parameters related to measurement of Op-Amp characteristics.
CO3	Construct the circuits for different linear and non-linear applications using Op-Amp.
CO4	Construct the circuits for different Data conversion and Filtering applications using Op-Amp.
CO5	Compare different digital logic families.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	1	3	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	2	2	3	-	-	-	-	-	-	-	-	2
CO4	2	2	3	-	-	-	-	-	-	-	-	2
CO5	3	2	2	-	-	-	-	-	-	-	-	2

Unit – I

Introduction to Integrated Circuits: Integrated Circuits Types, Classification, Package Types, Temperature ranges and Power supplies. Differential Amplifier-DC And AC analysis of differential amplifier configurations, circuits for improving CMRR, Necessity of swamping resistors, Cascaded Differential Amplifier Stages and Level translator.

Unit – II

Characteristics of Op-Amps: Block Diagram of a Op-Amp, Pin diagram, symbolic representation and features of 741 IC, Ideal and practical characteristics of an Op-Amp, Equivalent circuit of an Op-Amp, Define the terms input offset voltage and current, input bias current, CMRR, Slew Rate, PSRR, etc, Virtual ground concept, DC characteristics, AC characteristics and Measurement of Op-Amp parameters.

Unit – III

Linear and Non-Linear Applications of Op- Amps: Inverting and Non-inverting amplifier, Integrator and differentiator, Difference amplifier, Instrumentation amplifier, AC amplifier, V to I, I to V converters, Buffers. Non-Linear Applications-Comparators, Multivibrators, Triangular and Square wave generators, Log and Anti- log Amplifier, Precision rectifiers.

Unit – IV

D-A and A-D Converters: Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs parallel Comparator type ADC, counter type ADC, Successive Approximation ADC and dual slope ADC.DAC and ADC Specifications.
Active Filters: Introduction, Butter worth filters – 1st order, 2nd order LPF, HPF filters. Band pass, Band reject and All pass filters.

Unit – V

Digital Logic Families and Interfacing: Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families. Bipolar logic, transistor-transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic.

Text Books:

1. Op Amps and Linear Integrated Circuits, Ramakant A. Gayakwad,4th Edition, PHI, Pearson Education, 2015.
2. Linear Integrated Circuits– D. Roy Choudhry, Shail Jain, New Age International(p)Ltd, 5th Edition, 2018.
3. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 4th Edition, 2008.

Reference Books:

1. Design with Operational Amplifiers & Analog Integrated Circuits-Sergio Franco, McGrawHill,1988.
2. OPAMPS and Linear Integrated Circuits concepts and Applications, James MFiore, Cengage Learning India Ltd, 2010.
3. Operational Amplifiers & Linear Integrated Circuits–R.F.Coughlin & Fredrick Driscoll, PHI, 6th Edition, 2001.
4. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, Zvonko Vranesic, McGrawHill, 3rd Edition, 2017.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2. https://ocw.mit.edu/courses/6-01sc-introduction-to-electrical-engineering-and-computer-science-i-spring-2011/pages/unit-3-circuits/op-amps/

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PRINCIPLES OF EMBEDDED SYSTEMS

(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EC7O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Summarize the building blocks of an embedded system.

CO2 Interpret the hardware modules required to design an embedded system.

CO3 Infer the firmware design approaches for an embedded system.

CO4 Illustrate the hardware integration with firmware.

CO5 Outline the process of embedded system development.

CO6 Choose the tools for embedded system implementation and testing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	-
CO6	2	3	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit - I

Introduction: Embedded system-Definition, History of Embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system-core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

Unit - II

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, multi processors architectures.

Unit - III

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development

languages, Interrupt sources, ISR concept, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C.

Unit - IV

Real Time Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

Hardware Software Co-Design:

Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

Unit - V

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/ Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools.

Embedded System Implementation and Testing: The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine.

Text Books:

1. Embedded Systems, Shibu.K. V, Tata McGraw Hill Education Private Limited, 2013.
2. Embedded Systems-Architectures, Programming and Design, Raj Kamal, Tata McGraw Hill Publications.

Reference Books:

1. Embedded System Design, Frank Vahid and Tony Givargis, John Wiley Publications, 2013.
2. Hardware Software Co-Design Principles and Practice, J. Staunstrup, Springer Publications
3. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, 2013.

Web Links:

1. https://www.iitk.ac.in/tkic/workshop/sensors-and-actuators/ppt/sandeep.pdf
2. http://www.artistembedded.org/docs/Events/2006/ChinaSchool/1_ESIntroduction.pdf
3. http://web.cecs.pdx.edu/~mperkows/temp/hardware-software-codesign.pdf
4. http://www.inf.ed.ac.uk/teaching/courses/es/PDFs/RTOS.pdf
5. http://www.vtt.fi/inf/pdf/publications/2004/P526.pdf

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CYBER SECURITY

(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the cyber security and security management methods to maintain security protection
CO2: Illustrate the nature of secure software development and operating systems.
CO3: Summarize the Network management and cloud computing security issues.
CO4: Analyze the data privacy techniques and data management.
CO5: Illustrate the legal and social issues related to cyber security.

Mapping of Course Outcomes with Program Outcomes:

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	-	-	2	-	-	2	-	-	-	-
CO2	2	3	-	2	2	-	-	-	-	-	-	-
CO3	1	2	-	2	3	-	-	-	-	-	-	-
CO4	1	2	-	3	2	-	-	-	-	-	-	-
CO5	2	1	-	**2**	-	-	-	3	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO / PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Introduction: Introduction to Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control, and Cryptography, Authentication, Access Control, Cryptography. Programs and Programming: Unintentional (Non-malicious) Programming Oversights, Malicious Code—Malware, Countermeasures.

Unit – II

Web Security: User Side, Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. Operating Systems Security: Security in Operating Systems, Security in the Design of Operating Systems, Rootkit.

Unit – III

Network Security: Network Concepts, Threats to Network Communications, Wireless Network Security, Denial of Service, Distributed Denial-of-Service Strategic Defenses: Security Countermeasures, Cryptography in Network Security, Firewalls, Intrusion Detection and Prevention Systems, Network Management . Cloud Computing and Security: Cloud Computing Concepts, Moving to the Cloud, Cloud Security Tools and Techniques, Cloud Identity Management, Securing IaaS.

Unit – IV

Privacy: Privacy Concepts, Privacy Principles and Policies, Authentication and Privacy, Data Mining, Privacy on the Web, Email Security, Privacy Impacts of Emerging Technologies, Where the Field Is Headed. Management and Incidents: Security Planning, Business Continuity Planning, Handling Incidents, Risk Analysis, Dealing with Disaster.

Unit – V

Legal Issues and Ethics: Protecting Programs and Data, Information and the Law, Rights of Employees and Employers, Redress for Software Failures, Computer Crime, Ethical Issues in Computer Security, Incident Analysis with Ethics Emerging Topics: The Internet of Things, Economics, Computerized Elections, Cyber Warfare.

Text Books:

1. Pfleeger, C.P., Security in Computing, Prentice Hall, 5th edition.
2. Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons.

Reference Books:

1. Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice, McGrawHill.
2. Whitman, Michael E. and Herbert J. Mattord. Roadmap to Information Security for IT and Infosec Managers. Boston, MA: Course Technology.
3. Information Security, Mark Rhodes, Ousley, 2 nd edition, MGH.

Web Links:

1. https://www.edx.org/micromasters/ritx-cybersecurity.
2. https://www.coursera.org/specializations/cyber-security.
3. https://www.nptel.ac.in/courses/106105031/.
4. http://bedford-computing.co.uk/learning/wp-content/uploads/2016/08/
5. https://www.wileyindia.com/cyber-security-understanding-cybercrimescomputer-forensics-and-legal- perspectives.html

BIG DATA ANALYTICS

(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231DS7O01	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Illustrate big data challenges in different domains.

CO2: Use various techniques for mining data stream.

CO3: Demonstrate Building blocks of Hadoop.

CO4: Choose map reduce approach to solve big data Problems.

CO5: Make use of Pig and Hive to structure and work with big Data.

CO6: Make use of Spark tool to work with bigdata.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	2	-	-	-	-	-	-	-
CO2	2	3	-	1	2	-	-	-	-	-	-	-
CO3	2	1	-	3	2	-	-	-	-	-	-	-
CO4	3	2	-	2	2	-	-	-	-	-	-	-
CO5	2	3	-	2	2	-	-	-	-	-	-	-
CO6	2	2	-	1	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit- I

Introduction: Introduction to bigdata: Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

Unit- II

Stream Processing: Mining data streams: Introduction to Streams Concepts, Stream Data Model and Architecture, Stream Computing, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting One ness in a Window, Decaying Window, Real time Analytics Platform (RTAP) Applications.

Unit‑III

Introduction to Hadoop: Hadoop: History of Hadoop, the Hadoop Distributed File System, Components of Hadoop Analyzing the Data with Hadoop, Scaling Out, Hadoop Streaming, Design of HDFS, Java interfaces to HDFS Basics, Developing a Map Reduce Application, How Map Reduce Works, Anatomy of a Map Reduce Job run, Failures, Job Scheduling, Shuffle and Sort, Task execution, Map Reduce Types and Formats, Map Reduce Features Hadoop environment.

Unit‑ IV

Pig: Hadoop Programming Made Easier: Admiring the Pig Architecture, Going with the Pig Latin Application Flow, Working through the ABCs of Pig Latin, Checking out the Pig Script Interfaces, Scripting with Pig Latin.

Working with Hive Data Types, Creating and Managing Data bases and Tables, Seeing How the Hive Data Manipulation Language Works with examples, Querying and Analyzing Data.

Unit‑ V

Spark: Installing Spark, Spark applications, Jobs, stages and Tasks, Resilient Distributed datasets, Shared Variables, Anatomy of a Spark job run.

Text Books:

1. Hadoop: The Definitive Guide, Tom White, 4th Edition, O’ reilly, 2012.
2. Hadoop for Dummies, Dirkde Roos, PaulC.Zikopoulos, RomanB.Melnyk, Bruce Brown, Rafael Coss, John Wiley& Sons, 2014.
3. Anand Raja ramanand Jeffrey David Ullman, “Mining of Massive Datasets”, CUP, 2012

Reference Books:

1. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley& sons,2012.
2. Paul Zikopoulos, Dirkde Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, “Harness the Power of Big Data: The IBM Big Data Platform”, Tata Mc Graw Hill Publications, 2012.
3. Arshdeep Bahga and Vijay Madisetti, “Big Data Science& Analytics: A Hands On Approach “,VPT, 2016.
4. Learning Spark: Lightning Fast Big Data Analysis Paper back,Holden Karau

Web Links:

1. Hadoop:http://hadoop.apache.org/
2. Hive:https://cwiki.apache.org/confluence/display/Hive/Home
3. http://nptel.ac.in/courses/106106142/
4. https://hortonworks.com/tutorial/how-to-process-data-with-apache-hive/
5. https://databricks.com/spark/getting-started-with-apache-spark

INTERNET OF THINGS

(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231IT7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1: Explain the fundamental concepts of internet of things.

CO2: Illustrate diversified layered architectures and design principles for IoT/M2M.

CO3: Identify appropriate network layer protocols used in IoT

CO4: Illustrate the scope of data organizing and business models and process.

CO5: Describe the role of bigdata, cloud computing and data analytics in a typical IoT system.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	2	1	-	1	-	-	-	-	-	-	-
CO3	2	2	1	-	-	-	-	-	-	-	-	-
CO4	2	1	2	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	1	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT-I:

The Internet of Things: An Overview of Internet of things, Internet of Things Technology, behind IoTs Sources of the IoTs, M2M Communication, Examples of IoTs, Design Principles for Connected Devices.

UNIT-II:

Modified OSI Stack for the IoT/M2M Systems, ETSI M2M domains and High- level capabilities, Communication Technologies, Data Enrichment and Consolidation and Device Management Gateway Ease of designing and affordability.

UNIT-III:

Design Principles for the Web Connectivity for connected-Devices, Web Communication protocols for Connected Devices, Message Communication protocols for Connected Devices, Web Connectivity for connected-Devices.

UNIT-IV:

Data Acquiring, Organizing and Analytics in IoT/M2M, Applications /Services /Business Processes, IOT/M2M Data Acquiring and Storage, Business Models for Business Processes in the Internet of Things, Organizing Data, Transactions, Business Processes, Integration and Enterprise Systems.

UNIT-V:

Data Collection, Storage and Computing Using a Cloud Platform for IoT/M2M Applications/Services, Data Collection, Storage and Computing Using cloud platform Everything as a service and Cloud Service Models, IOT cloud-based services using the Xively (Pachube/COSM), Nimbits and other platforms Sensor, Participatory Sensing, Actuator, Radio Frequency Identification, and Wireless, Sensor Network Technology, Sensors Technology, Sensing the World.

Text Books:

1. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education.
2. Vijay Madisetti, Arshdeep Bahga, Internet of Things A Hands-On- Approach,2014

Reference Books:

1. An Introduction to Internet of Things, Connecting devices, Edge Gateway and Cloud with Applications, Rahul Dubey, Cengage, 2019.Adrian McEwen, Designing the Internet of Things, Wiley Publishers, 2013.
2. IoT Fundamentals, Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetette, rob Barton, Jerome Henry, CISCO, Pearson, 2018.
3. Designing the Internet of Things, Adrian McEwen and Hakim Cassimally, Wiley.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_cs17/preview
2. https://arduinomakerspace.com/iot-projects-using-arduino/
3 https://www.coursera.org/specializations/iot

COMPUTER NETWORKS
(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231AM7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Identify different types of network topologies, protocols and the layers of the OSI and TCP/IP models
CO2:	Recognize the data link layer design issues and various protocols used for data transmission
CO3:	Describe MAC Sublayer and how a network can detect and correct transmission errors
CO4:	Classify and compare the major routing and congestion control algorithms
CO5:	Describe the functionality of TCP and UDP and summarize the various Application layer protocols such as http, DNS, and HTTP

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	2	-	-	-	-	-	-	-	-	-
CO2	1	2	3	-	-	-	-	-	-	-	-	-
CO3	3	1	2	-	-	-	-	-	-	-	-	-
CO4	1	2	2	3	-	-	-	-	-	-	-	-
CO5	3	1	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	POS1	POS2
CO1	2	-
CO2	3	-
CO3	2	-
CO4	1	-
CO5	2	-

UNIT-I

Introduction: Computer network and components, Types of Computer Networks, Network Software, Reference Models: OSI Reference Model, TCP/IP Reference Model, Comparison between OSI and TCP/IP Models; Example Networks: The ARPANET, Internet., Transmission Media, Guided and Un-guided media.

UNIT-II

Data Link Layer: Data Link Layer Design Issues: Services Provided to Network Layer, Framing, Error Control and Flow Control; Error Detection and Correction: Error Correcting Codes, Error Detecting Codes; Elementary Data Link Protocols, Sliding Window Protocols: One-Bit Sliding Window Protocol, Protocol Using Go Back N and

Selective Repeat.

UNIT-III

The Medium Access Control Sublayer (MAC): Channel Allocation Problem: Static Channel Allocation, Dynamic Channel Allocation; Multiple Access Protocol: ALOHA, Carrier Sense Multiple Access Protocols, Collision-Free Protocols, Limited Contention Protocol.

UNIT-IV

The Network Layer: Network Layer Design Issues, Routing Algorithms: The Optimality Principle, Shortest Path Routing, Flooding, Distance Vector Routing, Link State Routing, Hierarchical Routing, Congestion Control Algorithms: General Principles of Congestion Control, Congestion Prevention Policies. The Network Layer in Internet-The IP Protocol, IP Address IPV4, IPV6.

UNIT - V

The Transport Layer: Services Provided to Upper Layer; Elements of Transport Protocols: Connection Establishment, Connection Release; The Internet Transport Protocols: UDP and TCP Protocol, TCP Connection Establishment, TCP Connection Release.

The Application Layer: DNS- Domain Name System, Electronic Mail: Architecture and Services, The World Wide Web: Architectural Overview; Web documents: Static Web Document, Dynamic Web Document; Hyper Text Transfer Protocol (HTTP).

Text Books:

1 Andrew S. Tanenbaum, Computer Networks, 5th Edition, Pearson Education, 2016.
2 Behrouz A Forouzan, Data Communications and Networking, 4th Edition, McGraw-Hill- 2006

Reference Books:

1 S Keshav, An Engineering approach to computer Networking, 2nd Edition, Pearson Education
2 J.F.Kurose, K.W.Ross, Computer Networking a Top-Down approach featuring the internet, 2nd Edition, Pearson Education.

Web Links:

1 https://nptel.ac.in/courses/106105081
2 https://www.coursera.org/learn/fundamentals-network-communications
3 nptel.ac.in/courses/106/106/106106091/

PIPELINE ENGINEERING

(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231PT7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO 1: Illustrate Fluid physical properties and flow in pipes
CO 2: Derive the single phase fluid flow equations
CO 3: Determine the flow regime and pressure drop calculations.
CO 4: Estimation of pressure loss across control valves
CO 5: Explain the design aspects of subsea and buried pipelines.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Unit-I:

Fluid flow and piping: Bernoulli"s theorem, Fluid physical properties, Flow in pipes and Reynolds number, Pressure loss due to friction, Friction factor and effect of pipe roughness, Equivalent length of valves and fittings, Compressibility of gas.

Unit-II:

Single Phase Flow: Transmission line gas flow - Isothermal flow, flow equation: The AGA equations, The Weymouth equation, Panhandle A equation, Panhandle B equation; Low Pressure gas flow; Plant piping gas flow.

Unit-III:

Two Phase Flow: Flow regime determination; Pressure drop calculation- Frictional component, Elevation component; Liquid Holdup.

Liquid Slugging- Purpose of separators, Mechanism of slug generation, Slug catchers, Pigging.

Unit-IV:

Pipe, Fittings and Valves: Usual industry pipe sizes and classes practice, total line pressure drop. Pressure drop in fittings, valves, connections. Incompressible fluid, use of k factors, validity of k values. Laminar flow, piping systems, resistance and flow coefficients of valves, nozzles andorifices.

Alternate calculation basis for piping system friction head loss: liquids, equivalent feet concept. Friction pressure drop for non-viscous liquids. Estimation of pressure loss across control valves: Usage of various methods. Friction loss for water flow in pipe system

Pipe flow system with liquid of specific gravity other than water; Friction pressure drop for compressible fluid flow; Pressure drop for vapor system, alternate solution to compressible flow problems, friction drop for air, steam flow TJsing babcock formula.

Unit-V:

Sonic conditions, limiting flow of gases and vapors, gas flow through sharp- edged orifice, sonic velocity and friction drop for compressible natural gas in long pipelines. Complex pipe system handling natural gas, factors of safety for design basis. Design aspects of subsea and buried pipelines; Material selection.

Text Books:

1. GPSA Engineering Data Book, Volume 2, 12 Edition, 2003.
2. Ludwig‟s Applied Process Design for Chemical and Petrochemical Plants, Volume 1, 4th Edition, A. Kayode Coker, Elsevier, 2007
3. Piping and Pipeline Calculations Manual, Construction, Design, Fabrication and Examination, Philips Ellenberger, Elsevier, 2010.

Reference Books:

1. Liquid pipeline hydraulics; E. Sashi Menon; Marcel Dekker Inc.; 2004.
2. Gas-pipe hydraulics; E. Sashi Menon; CRC Press-Taylor & Francis Publications; 2005.
3. Flow of fluids, Crane, 7th edition,1988

Web Links:

1. https://www.scribd.com/presentation/424126821/08-Fluid-Flow
2. https://www.slideshare.net/slideshow/single-phase-gas-flow-correlations/141745504
3. https://pure.unileoben.ac.at/portal/files/1851003/AC07138243n01vt.pdf
4. https://www.katmarsoftware.com/articles/pipe-fitting-pressure-drop.htm
5. https://blog.fluidflowinfo.com/a-study-of-choked-flow-in-gas-piping-systems-2/

INTRODUCTION TO SEISMIC METHODS

(OPEN ELECTIVE-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231PT7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO 1:	Illustrate the Geophysical exploration methods
CO 2:	Differentiate between Seismic Refraction and Seismic Reflection
CO 3:	Explain the application of seismic refraction method.
CO 4:	Estimation of Seismic Reflection methods and its applications
CO5:	Explain the recent advances in seismic methods.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I:

Introduction to Geophysical methods: used in oil Industry with emphasis on seismic methods and their historical back ground , basic concepts and the present status of these methods in the industry.

UNIT-II:

Historical back ground of seismic methods: Different types of these methods namely Seismic Refraction, Seismic Reflection, and well seismic methods, Different types of seismic waves.

UNIT-III:

Seismic refraction methods: Geometry of a Refracted wave, single layer and two layer case. Recording instruments & energy sources- Corrections to refraction data Interpretation. Application of seismic refraction method in calculating statics for application in reflection survey.

UNIT IV

Seismic Reflection methods: Geometry of reflected ray path: Single horizontal reflector- The reflection seismograph and seismogram (Seismic traces)- Importance of seismic reflection survey over seismic refraction survey technique.

Field procedures & principles- Receivers and sources. Field Layouts. Time corrections applied to seismic data- Data processing - Introduction to 2D & 3D data acquisition. - Common depth point (CDP) profiling & stacking- data interpretation of reflection data for identification of drillable structures. Marking of reflectors (different lithologic units in the subsurface, construction of time and depth structures maps and calculation of reserves based on these identified structures. AVO and seismic inversions.

UNIT V:

Brief introduction to recent advances in seismic methods namely 4D seismic methods, Virtual Reality Centers for interpretation. Well seismic shooting for velocity determination and Vertical Seismic Profiling (VSP) and their importance

Text Books:

1. Introduction to Geophysical Prospecting, Milton B. Dobrin, and Carl H. Savit, 4thEdition, McGraw Hill, 1988.
2. Outlines of Geophysical Prospecting: A Manual for Geologists, M.B. Ramachandra Rao, EBD Educational Pvt Ltd., 1993.
3. Field Geophysics, John Milsom and Asger Eriksen, 4thEdition, John Wiley, 2011.

Reference Books:

1. Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip 1991.
2. Fundamentals of Geophysics, Lowri, W., Cambridge University Press. (1997).
3. Applied Geophysics, Telford, W. M, Geldart L.P., Sheriff, R.E., Keys, D.A. (1990).

Web Links:

1. https://www.slideshare.net/slideshow/presentation-on-geophysical-methods/63210936
2. https://pburnley.faculty.unlv.edu/GEOL452_652/seismology/notes/SeismicNotes01SIntro.html
3. https://www.slideshare.net/slideshow/seismic-refraction-method-lec22/62542437
4. https://escweb.wr.usgs.gov/share/mooney/1989_Seismic%20methods.pdf
5. https://pubs.geoscienceworld.org/seg/geophysics/article/71/4/SI139/107262/The-virtual-source-method-Theory-and-case-studyThe

INTRODUCTION TO ARTIFICIAL LIFT METHODS

(Open Elective-III)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231PT7O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO 1: Illustrate the Purpose of artificial lift selection

CO 2: Explain about Sucker rod lift system and its advantages and disadvantages

CO 3: Differentiate between continuous and intermittent gas lift advantages and limitations.

CO 4: Explain about design process of Electrical submersible pumps

CO 5: Apply the skills for the selection and type of artificial lift method.

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO 1	PO 2	PO 3	PO4	PO5	PO6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Introduction: Definition and Purpose of artificial lift selection-Reservoir pressure and well productivity-reservoir fluids-Types of artificial lift.

UNIT-II

Sucker Rod lift: Sucker rod lift system-polished rod motion-load to the pumping unit-pump deliverability and power requirement-sucker rods-steel sucker rods-pony rods-FRP sucker rods-Non-API sucker rods-criteria for rod string design, advantages and limitations-Trouble shooting sucker rod lift installation.

UNIT-III

Gas lift: Gas lift system-gas compression requirements sonic flow-subsonic flow- volumetric efficiency-stage compression-gas lift valve design-selection of gas lift valves-pilot valve continuous and intermittent gas lift advantages and limitations.

UNIT-IV

Electrical submersible pumps: Electrical submersible pumps. (ESP)- Principle - hydraulic piston pumping-ESP design-ESP advantages and limitations.

UNIT -V

Hydraulic Jet pumping: Hydraulic Jet pumping-selection of jet pump-advantages and disadvantages.

Selection of artificial lift method: artificial lift method selection-gas lift vs pump assisted lift installation and replacement of artificial lift-maintenance of artificial lift.

Text Books:

1. Petroleum Production engineering: A computer assisted approach, Boyun GUO, William C. Lyons, Ali Ghalambor, Elsevier Science and Technology books 2007.
2. Petroleum Engineering Handbook-Production Operations Engineering, Volume 4, Joe Dunn Clegg and Larry W. Lake, SPE, 2014.

Reference Books:

1. Petroleum production systems, M.J. Economides, A. Daniel Hill & C. E. Economides, Prentice-Hall, N.J-07488, 1994.
2. The Technology of Artificial Lift Method, Brown, K.E, Volume 1-4, Penn Well Books, Tulsa, Oklahoma, 1977.
3. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University, 2014.

Web Links:

1. https://www.learntodrill.com/post/artificial-lift-system-functions
2. https://www.laxmiudyog.com/index.php?page=liftequip
3. https://medwinpublishers.com/PPEJ/PPEJ16000121.pdf
4. https://www.slideshare.net/slideshow/electrical-submersible-pump-esp/79169708
5. https://onepetro.org/books/book/76/chapter/14379495/Artificial-Lift-Selection

MINE WASTE MANAGEMENT

Open Elective -III

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

- CO1: Identify and classify different types of mining wastes and develop appropriate waste management plans.
- CO2: Apply efficient methods for handling and transporting waste rock dumps in mining operations.
- CO3: Design and evaluate tailings storage facilities complying with safety standards and environmental regulations.
- CO4: Conduct site investigations, stability assessments, and implement monitoring systems for waste structures.
- CO5: Implement waste reuse, reclamation, and closure strategies for sustainable mine waste management.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction: Basic introduction to Terminologies, Sources, Nature and Characteristics of different types of waste generated during mining.

Types of waste dumps: Based on i) material types, ii) construction method iii) overall configuration and topographic constraints iv) Location (Internal/External) v) Geo-chemical properties. Method of design & construction. Introduction to Life of mine (LoM) mine waste management plans and handling strategy.

UNIT – II

Mine Waste Rock Dumps (WRDs): Nature and Type of coarse waste generated from surface mines. Methods and Practices of overburden waste handling, management and storage in open cast and open pit mines. Waste sources and management in underground mines Handling and Transportation of waste rocks: Methods, Techniques (dumper/draglines), Cost-benefit analysis, Dumping methods (top-down/bottom-up).

UNIT – III

Tailing Storage Facilities (TSFs): Key Terminologies, Sources of mine tailings, Physical & Chemical properties. Mode of tailings material handling (slurry transportation)

Type of TSFs: Upstream/Downstream/Centreline/Modified centreline

Washery rejects: Types, Nature and Characteristics of washery rejects, fly ash/bottom ash Basic design principle of Tailing dams and ash pond/dykes, Governing standards and Indian Regulations

UNIT – IV

Site selection & Material characterization for waste dumps and tailing dams: factor affecting site selection, site investigation and material testing (physical, geotechnical, geochemical) in WRDs & TSFs, sample collection, testing and analysis
Stability assessment in mine waste & tailing dams: Different modes of failures in waste dumps and tailing dams, Risk assessment and hazard classification
Stability analysis: Acceptance criteria, Stability requirement and risk involved. Numerical techniques and methods for stability assessment, Basics of Dam Run-out/Breach modelling
Instrumentation and monitoring in WRDs & TSFs structures: Requirements, Types, Advantages and Limitations, Introduction to state-of-the-art monitoring practices.

UNIT – V

Re-use and utilization of mine waste: Possible re-use of mine waste for civil, domestic purpose, notable examples of waste to wealth (India & Abroad). Introduction to Tailings re-mining practices.
Closure of WRDs and TSFs: Closure requirements (technical/environmental), Reclamation at waste dumps, Short-to-long-term environmental challenges and mitigation

Text Books:

1. P. Mark Hawley, John Cunning, Guidelines for Mine Waste Dump and Stockpile Design, CRC Press , ISBN 9781138197312
2. Vick, Steven G, Planning, Design, and Analysis of Tailings Dams, BiTech Publisher , ISBN 0-921095-12-0

Reference Books:

1. Lottermoser, Bernd, Mine Wastes-Characterization, Treatment and Environmental Impacts, Springer , ISBN 978-3-642-12418-1
2. Geoffrey E. Blight, Geotechnical Engineering for Mine Waste Storage Facilities, CRC Press , ISBN 9780367577216
3. Environmental Geology, Ghosh R. & Chatterjee D. S., Capital Publishing Co. New Delhi.
4. Water Resources Engineering Larry W. M., Publisher John Wiley and Sons
5. Water Resources Engineering - Ray K. L., Franzini J.B., Freyberg D.L., George Tchobanoglous G. & Hill M.G., 4th Ed.
6. Hydrology and Water Resources Engineering, Garg S.K., Khanna Publishers
7. Hydrology- Das M.M. & Saikia M.D., PHI Learning Pvt. Ltd., New Delhi.
8. SME Mining Reference Handbook, Lowrie R., SME Publication 2002.
9. Mining engineers Handbook, Peele R.

Web Links:

1. https://www.slideshare.net/slideshow/mine-waste-management-243991332/243991332
2. https://www.unep.org/resources/report/mine-tailings-storage-safety-guidelines
3. https://www.researchgate.net/publication/319944560_Mine_Waste_Management_Practices

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SUSTAINABLE DEVELOPMENT IN MINING INDUSTRY

Open Elective -III

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O02	**3**	**0**	**0**	

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain sustainable development principles and regulatory requirements applicable to the mining sector.
CO2: Evaluate mining policies and their influence on sustainable mining practices nationally and globally.
CO3: Apply clean technologies and resource recovery methods to enhance mining sustainability.
CO4: Implement water and air pollution control measures and monitor environmental quality in mining operations.
CO5: Develop and manage mine closure plans, land reclamation projects, and promote biodiversity conservation in mining areas.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO
CO1	1	3	-	-	-	-	1	1	-	-	-	-
CO2	1	3	-	-	-	-	1	1	-	-	-	-
CO3	1	3	-	-	-	-	1	1	-	-	-	-
CO4	1	3	-	-	-	-	1	1	-	-	-	-
CO5	1	3	-	-	-	-	1	1	-	-	-	-

UNIT – I

Concept of Sustainable development for mining industry-Sustainable development –a perspective of mineral professional community. International sustainability reporting and tools for measurement of sustainability. Milos statement on Sustainable mineral industry. Legislative measures for sustainable development- MMDR Act- star rating of Indian mines (Non-coal), Environmental responsibility – Corporate social responsibility. District mineral fund, its collection, utilization etc.

UNIT – II

Current status of mining practices and their impact on sustainability. Mining and environmental frame work, National mineral policies in mineral based countries. Indian national mineral policy, its historical development with the changing goals and sustainable practices. Issues of leases, auctions for mineral development in India.

UNIT – III

Clean coal technologies, Coal bed methane, abandoned coal mine methane, Underground gasification of coal. Leaching of old dumps and recovery of metals. Recycling of metals.
Application of new techniques for sustainable development

UNIT – IV

Mine water- Water conservation Acts and rules in India. New Initiatives in mines. Underground mine water, Water pollution and control measures, Phyto-remediation, Sewage and effluent treatment plants, their use and benefits. Air quality in open pit mines, dust control measures, noise levels- pollution, monitoring and control.

UNIT – V

Bio-diversity- Land reclamation and plantation. Mine closure plan- Collection and disbursement of Mine closure fund for both open pit and underground mines in India.
Best mining practices for Sustainable mining. - Case studies. Innovative practices for achievement of sustainability. Benefits of sustainability.

Text Books:

1. MMRD Act 2015 and amendments, Ministry of Mines
2. Mineral concession Rules

Reference Books:

1. Guidelines of MOEF and Climate change - Annual reports of MOEF&CC, Ministry of Mines, Ministry of Coal in India,
2. Sustainable mining practices –A global perspective by Vasudevan Rajaram, Subijoy Dutta, Krishna Paremeswaran, ISBN-90-5809-689-0

Web Links:

1. **https://www.slideshare.net/slideshow/sustainable-mining-practices-240275756/240275756**
2. https://www.teriin.org/sites/default/files/files/Sustainable_Mining_Practices_India.pdf
3. **https://www.unep.org/resources/report/green-mining-sustainable-mining-practices**

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MINE RECLAMATION

Open Elective -III

VII Semester **L** **T** **P**
Course Code: 231MI7O03 **3** **0** **0**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe environmental problems caused by mining and assess the impact of mining machinery on the environment.
CO2: Evaluate land degradation and plan for effective waste disposal and tailings impoundment.
CO3: Apply land reclamation techniques, including soil conservation and vegetation restoration for disturbed mining sites.
CO4: Implement engineering and biological reclamation methods for mine closure and land restoration.
CO5: Develop environmental management plans and ensure compliance with environmental laws, standards, and corporate social responsibility practices in mining.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	-

UNIT – I

Recent changes in development paradigms; concepts of carrying capacity and sustainable development; environmental problems caused by mining and influencing factors. Environmental aspects of various Mining Machines.

UNIT – II

Land Degradation; land use categories; pre-mining investigations; landscape planning and visual impact; waste disposal, overburden dumps and tailings impoundment.

UNIT – III

Land reclamation procedures; Influence of type of deposit, topography and equipment; top soil characteristics; top soil removal and storage; application of mulches, stabilizing agents and fertilizers;

Land Reclamation: Re-vegetation and restoration methodologies; Plant species selection; Reclamation methods by using different combination of equipment, Case studies of coal and metalliferous mine dumps/spoils.

UNIT – IV

Engineering and biological reclamation; afforestation of mine areas, tailing ponds, mine closure and amenity banks; best practices of mined out land reclamation.

UNIT – V

Corporate Social Responsibility towards mine closure and reclamation: Concepts and principles. Environmental policies and laws: Environmental management systems, environmental impact assessment and environmental management planning; base line studies, environmental audit, ISO 14001, OHSAS.

Text Books:

1. Dr. B.B. Dhar, Environmental Management of Mining Operations. Pub
2. Bulk Handling in Open Pit Mines & Quarries: Reinhard H. Wohlbier
3. Coal Mines Regulations, 1957 and Metalliferous Mines Regulations, 1961
4. Introductory Mining Engineering: Howard L. Hartman

Reference Books:

1. Modern Coal Mining Technology: Samir Kumar Das
2. Opencast Mining – Technology and Integrated Mechanization: V.V. Rzhevsky
3. Opencast Mining – Unit Operations: V.V. Rzhevsky
4. SME Hand Books
5. Surface Mining: G.B. Misra
6. Surface Mining Technology: Samir Kumar Das
7. Proceeding of the National & International Seminars/Symposium organized in concernwith mine environment.

Web Links:

1. https://www.slideshare.net/slideshow/environmental-impacts-of-mining-and-land-reclamation/238259964/238259964
2. https://www.fao.org/3/i6426e/i6426e.pdf
3. https://www.slideshare.net/slideshow/environmental-management-in-mining-industry/250032112/250032112

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IMPACTS OF MINING ON ENVIRONMENT
Open Elective -III

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain environmental management principles and global/local environmental issues affecting mining.
CO2: Identify types of pollution, assess their impacts, and recommend control and preventive measures.
CO3: Analyze land pollution challenges, tailing management techniques, and implement mine closure plans.
CO4: Apply environmental management tools including EIA, audits, and economic analysis for mining operations.
CO5: Demonstrate knowledge of key environmental legislation and regulatory compliance for mining projects.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	-	3	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-
CO5	-	3	-	-	-	-	-	-	-	-	-	-

UNIT – I
Introduction: Goals, strategies and tools for environmental management – systems approach to environmental management – environmental guideline – National Policies on environment with respects to mining activities – Global and Local environmental issues – resource degradation – desertification – Industrialization, Objectives of Sustainable Development.
Structure of the atmosphere – ozone layer depletion – Acid rain – Greenhouse gases and global warming Ambient Air quality and emission standards, Air quality Sampling and monitoring, Dispersion of air pollutants.

UNIT – II
Environmental Pollution – I: Environmental Pollutants due to surface – Air, Water, Noise, Sources and Classification of pollutants including dust and their effect on human health, Sources, hazards, sampling and analysis, standards, instrumentation and measurement of pollutants including dust, Air born dust modeling, Control and preventive measures for air pollution including for dust, , Water pollution standards, Noise standards – Measurement – Noise Impact Index assessment, Control and preventive measures for water, noise pollution. Pollution due to blast and equipment vibrations their monitoring, prevention and control.

UNIT – III
Environmental Pollution – II: Land pollution, land for alternation dealing with mind out land,
re-vegetation, tailing management, tailing dams, method and construction, land use plan, Mine closure planning. Textural classification and properties of soil. Impact of pollution on human health, miner's diseases and their social impact.

UNIT – IV
Environmental Management: Environmental quality objectives, Emission and ambient standards – Minimum National standards – International environmental standards – ISO

14000 – EIA Notification – Sitting of Industries – Environmental management plans, Environmental impact assessment, Environmental management system audits, Environmental economics – Principles of cost benefit analysis – Valuing the Environment – Environmental Accounting, Environmental administration- training awareness and competence, Mine subsidence, its prediction and control.

UNIT – V

Environmental Legislations: Environmental laws, the Environmental (Protective) Act, 2004,
The Water Act (1974), The Air act (1981), The Forest Act 1927, The forest conservation act
1980, Power and responsibilities of regularity agencies and occupation consent to establish and operate wild life protection act and rules, Environmental clearance procedure for a mining
Project.

Text Books:

1. Manahan S.E. Environmental Science and Technology.
2. Mackenthun, K.M. Basic Concepts in Environmental Management, Lewis Publications,London, 1998.

Reference Books:

1. Noel de Nevers, Air Pollution Control Engg., McGraw Hill, New York, 1995
2. Anjaneyulu,Y. Air Pollution & Control Technologies, Allied Publishers (P) Ltd, India, 2002.
3. Nick Hanley, Jaison F. Shogren and Ben White. Environmental Economics – In Theory and Practice, Macmillan India Ltd, New Delhi, 1999.
4. Roger Perman, Yue Ma and James McGilvray. Natural Resources and Environmental Economics, Second edition, Addison Wesley Longman Ltd, Singapore, 1997

Web Links:

1. https://nptel.ac.in/courses/124/105/124105076/downloads/Lecture_Notes_Environmental_Management_Mining.pdf
2. https://www.academia.edu/38723281/Environmental_Management_Pollution_Control_in_Mining_Industries
3. https://moef.gov.in/wp-content/uploads/2023/04/guidelines_for_environmental impact assessment_emp.pdf

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WATER HARVESTING AND SOIL CONSERVATION STRUCTURES

(Open Elective-III)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231AG7O01	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Recommend the short term and long-term runoff harvesting at appropriate places in watershed.
CO2: Design criteria and cost estimation of farm ponds.
CO3: Explain the functions of soil erosion control structures.
CO4: Apply the concept hydraulic jump, runoff measuring structures and various permanent gully control structures.
CO5: Estimate the load analysis on various components of soil conservation structures.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	-	-	1	-	-	-	-	-	-	-
CO2	1	-	-	-	1	1	-	-	-	-	1	-
CO3	2	1	-	-	1	1	-	-	-	-	-	-
CO4	2	1	1	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

Unit - I

Water harvesting -principles, importance and uses. Water harvesting techniques – classification based on source, storage and use. Runoff harvesting – short-term and long-term techniques. Short-term harvesting techniques - contour bunds, semicircular hoop, trapezoidal bunds, graded bunds, rock catchment and ground catchment. Long term harvesting techniques- purpose and design criteria

Unit – II

Structures - farm ponds - dug-out and embankment reservoir types, tanks and subsurface dykes. Farm pond - components, site selection, design criteria, capacity, embankment, mechanical and emergency spillways, cost estimation and construction. Percolation pond - site selection, design and construction details. Design considerations of nala bunds.

Unit – III

Soil erosion control structures - introduction, classification and functional requirements. Design of Gabion structures. Permanent structures for soil conservation and gully control – check dams, drop, chute and drop inlet spillways - design requirements, planning for design, design procedures - hydrologic, hydraulic and structural design and stability analysis.

Unit – IV

Hydraulic jump and its application. Drop spillway - applicability, types - straight drop, box-type inlet spillways - description, functional use, advantages and disadvantages, straight apron and stilling basin outlet, structural components and functions.

Chute spillway - description, components, energy dissipaters, design criteria of Saint Antony Falls (SAF) stilling basin and its limitations. Drop inlet spillway - description, functional use and design criteria.

Unit – V

Loads on head wall, variables affecting equivalent fluid pressure, triangular load diagram for various flow conditions, creep line theory, uplift pressure estimation, safety against sliding, overturning, crushing and tension.

Text Books:

1. Michael, A.M. and T.P. Ojha. 2003. Principles of Agricultural Engineering. Volume II. 4th Edition, Jain Brothers, New Delhi.
2. Singh Gurmel, C. Venkataraman, G. Sastry and B.P. Joshi. 1996. Manual of Soil and Water Conservation Practices. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
3. Suresh, R. 2014. Soil and Water Conservation Engineering. Standard Publisher Distributors, New Delhi.

Reference Books:

1. Murthy, V.V.N. 2002. Land and Water Management Engineering. 4th Edition, Kalyani Publishers, New Delhi.
2. Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1993. Soil and Water Conservation Engineering.4th Edition, John Wiley and Sons Inc. New York.

Web Links:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=125071
2. http://ecoursesonline.iasri.res.in/course/view.php?id=54
3. https://nptel.ac.in/courses/126/105/126105012/
3. https://www.fao.org/land-water/water/water-management/water-storage/en/

BASICS OF SOIL MECHANICS

(Open Elective-IV)

VII Semester **L T P C**

Course Code: 231CE7O04 **3 0 0 3**

Course Outcomes: At the end of the course, student will be able to:

CO1: Explain physical properties of soil and its determination
CO2: Determine the various index properties and the classification of soil
CO3: Assess the stress developed due to various loads and soil conditions
CO4: Explain the various compaction methods and the determination of permeability
CO5: Explain the concept of consolidation, compressibility and settlement calculation

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	2	-	-	-	1	-	-	-	2	-	-
CO2	1	3	-	-	-	-	-	2	-	1	-	-
CO3	1	2	-	-	-	-	-	2	-	1	-	-
CO4	1	2	-	-	-	-	-	2	-	1	-	-
CO5	1	2	-	-	-	1	-	-	-	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Physical Properties of Soil: Three phase system - phase diagram - physical properties Functional Relationships between **Course Outcomes:** At the end of the Course, Student will be able to: physical properties-determination of water content, specific gravity, In-situ density-Relative density

Unit - II

Plasticity Characteristics of soil: Consistency, Atterberg's limits and their determination liquid limit, plastic limit, shrinkage limit - Index Properties-Activity-Free swell index. Soil Classification: Soil classification- need and criteria for soil classification-IS Particle size classification-Classification tests-grain size analysis - hydrometer analysis- grain size distribution curve - Unified Soil Classification- Indian Standard Soil classification- Coarse grained soils- Fine grained soils-Plasticity chart.

Unit – III

Effective stress: Stresses due to self-weight-total, neutral and effective stresses – Pressure diagrams under different soil conditions. Stresses due to applied loads: Boussinesq theory-Concentrated load-Strip footing- circular footing- Rectangular footing-Newmark's influence chart - Pressure bulb-Significant depth Westergaard's theory - 2:1 distribution method

Unit – IV

Compaction: Principle of compaction, OMC and MDD, Lab tests-IS light weight and heavy weight compaction tests, Factors affecting compaction - zero air void line-Effect of compaction on engineering properties of soils - Field compaction control – Proctor's Needle.

Permeability and Seepage: types of soil water, Permeability-Darcy's law-Factors effecting permeability- laboratory tests-Average permeability of stratified soils. Seepage pressure critical hydraulic gradient -quick sand condition.

Unit – V

Consolidation: Definition and significance-mechanism-Terzaghi's soil-spring analogy -lab consolidation test– e-log p curve-Coefficient of compressibility-coefficient of volume change-compression index- determination of consolidation settlement – Terzaghi's theory of 1D consolidation- Time-settlement calculations. Determination of coefficient of consolidation-time fitting methods – Pre-consolidation pressure- normally consolidated and over consolidated clays-secondary consolidation.

Text Books:

1. Arora, K.R. (2019), "Soil Mechanics and Foundation Engineering", Standard Publishers, Delhi
2. Gopal Ranjan and Rao, A.S.R., "Basic and Applied Soil Mechanics", New Age Ltd. International Publisher New Delhi (India) 2016

Reference Books:

1. Craig, R.F. (2019), "Soil Mechanics", McGraw hill, New Delhi
2. Narasinga Rao, B.N.D. (2015), Soil Mechanics and Foundation Engineering, Wiley Publishers

Web Links:

1. http://nptel.ac.in/courses/105103097/

CONSTRUCTION MATERIALS AND EQUIPMENTS

(Open Elective-IV)

	L	T	P	C
VII Semester	**3**	**0**	**0**	**3**
Course Code: 231CE7O05				

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the tests on stones, cement and aggregates.
CO2: Explain the concepts of strength and durability testing on mortar and concrete.
CO3: Compare the properties of most common and advanced building materials.
CO4: Selection of Automation techniques in construction industry.
CO5: Analyze benefits of robotics versus conventional construction equipment.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	-	3	-	-		-	-	-	-	-	-
CO2	1	2	1	3	-	-	-	-	-	-	-	-
CO3	-	1	-	2	-	-	-	-	-	-	-	-
CO4	1	2	1	3	-	-	-	-	-	-	-	-
CO5	-	1	-	2	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	3
CO2	-	3
CO3	-	3
CO4	-	3
CO5	-	3

Unit - I

Stones, Bricks and Concrete Blocks: Stone as building material–Criteria for selection– Tests on stones– Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks–Compressive Strength–Water Absorption–Efflorescence–Bricks for special use–Refractory bricks–Cement, Concrete blocks– Light weight concrete blocks. Nano Aggregate – RCA (Recylced Concrete Aggregate) – RCCA.

Unit – II

Lime, Cement, Aggregate and Mortar: Lime - Preparation of lime mortar - Cement - Ingredients - Manufacturing process - Types and Grades - Properties of cement and Cement mortar - Hydration - Compressive strength - Tensile strength - Fineness - Soundness and consistency - Setting time - Industrial byproducts - Fly ash - Aggregates - Natural stone aggregates - Crushing strength - Impact strength - Flakiness Index - Elongation Index - Abrasion Resistance - Grading - Sand Bulking.

Concrete Ingredients - ManufacturingProcess - Batchingplants - RMC - Propertiesoffresh concrete - Slump - Flow and compaction Factor - Properties of hardened concrete - Compressive, Tensile and shear strength - Modulus of rupture - Tests - Mix specification

Unit - III

Modern materials: Glass - Ceramics - Sealants for joints - Fibre glass reinforced plastic - Clayproducts - Refractories - Compositematerials - Types - Applicationsoflaminarcomposites - Fibre textiles - Geo membrane sand Geotextiles for earth reinforcement.

Unit - IV

Introduction: Unique features of construction equipment, Need of construction Equipment, past history. Construction equipment: Capacity, Feasibility, owning and operating cost and Productivity of Different Equipment: Excavators, Pavers, Plastering machines; Pre-stressing jacks and grouting equipment; Cranes and Hoists, Concrete Batching Plants, etc.

Unit - V

Automation in Construction Industry: Need and Benefit of automation: Automation in Canal lining, Automation in Construction of Highway, Automation in concrete technology. Robotics in Construction: Use of robots for construction activities like Brick laying, Demolition, Material Handling, Structural steel cutting, Rebar tying/bending, Form work mould making, 3D printing- print complex, layered, parts and objects of homes, buildings, bridges and roads.

Text Books:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2018.
2. Rajput.R.K.,"Engineering Materials",S.ChandandCompanyLtd.,2018.

Reference Books:

1. Jagadish.K.S,"AlternativeBuildingMaterialsTechnology",NewAgeInternational,2017.
2. Gambhir.M.L.,&NehaJamwal.,"BuildingMaterials,products,propertiesandsystems",TataMcGrawHillEducationsPvt.Ltd,NewDelhi,2019.

Web Links:

1. https://nptel.ac.in/courses/105/102/105102012/
2. https://nptel.ac.in/courses/105/106/105106176/

NATURAL DISASTER MANAGEMENT & MITIGATION

(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CE7O06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the aspects of disaster management and adopt remedial measures
CO2: Explain disaster risk assessment and coping measures.
CO3: Explain the vulnerability conditions
CO4: Assess the impact of hazards on structures
CO5: Adopt the rehabilitation procedures

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	-	-	-	-	-	-	2	-	-	-	-
CO2	-	1	-	-	-	3	-	2	-	-	-	-
CO3	-	1	-	-	-	-	-	2	-	-	-	-
CO4	2	-	-	-	-	3	-	2	-	-	-	-
CO5	2	-	-	-	-	3	-	2	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Introduction Concept of Disaster Management. Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels.

Unit ‑ II

Overview of Disaster Situations in India Vulnerability of profile of India and Vulnerability mapping including disaster ‑ prone areas, communities, places. Disaster preparedness ‑ ways and means; skills and strategies; rescue, relief reconstruction. Case Studies: Lessons and Experiences from Various Important Disasters in India and Biological disasters ‑ SARS-spread and transmisstions -pandemic, endemic and epidemic.

Unit ‑ III

Flood and Drought Disaster Raising flood damage, assessing flood risk, flood hazard assessment, flood impact assessment, flood risk reduction options. Drought and development, relief management and prevention, drought mitigation and management- integrating technology and people.

Unit ‑ IV

Landslide and Earthquake Disaster Land slide hazards zonation mapping and geo environmental problems associated with the occurrence of landslides. The use of electrical resistivity method in the study of landslide.

Causes and effects of earthquakes. Secondary effects. Criteria for earthquake resistant design.

Unit ‑ V

Cyclone and Fire Disaster Cyclone occurrence and hazards. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Types of fire. Fire safety and firefighting method, fire detectors, fire extinguishers. Rehabilitation: Rehabilitation programmes, Management of Relief Camp.

Text Books:

1. Disaster Management, RB Singh (Ed), Rawat Publications, 2000.
2. Disaster Management Future Challenges and Opportunities, Jagbir Singh, I.K International publishing house

Reference Books:

1. Natural Hazards in the Urban habitat by Iyengar, CBRI, Tata McGraw Hill
2. Natural Disaster management, Jon Ingleton (Ed), Tulor Rose, 1999

Web Links:

1. https://www.youtube.com/watch?v=2v7N5a3tLgE
2. https://www.youtube.com/watch?v=5KtVocJfVGw

CONCEPTS OF POWER QUALITY
(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EE7O03	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1	Differentiate between different types of power quality problems and sources of voltage sag, voltage swell.
CO2	Explain about the sources of transient over voltages in a power system.
CO3	Explain about the Long – Duration Voltage Variations and Flickering.
CO4	Analyse the Harmonic distortion and solutions and their indices.
CO5	Explain the concepts of distributed generation technologies.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	1	3	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

Introduction - Terms & Definitions

Overview of power quality – Concern about the power quality – General classes of power quality and voltage quality problems – Transients – Long-duration voltage variations – Short-duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations – Voltage Sags – Voltage Swell.

UNIT – II

Transient Over Voltages:

Sources of Transient Over voltages - Principles of Over voltage protection- Devices for Over voltage protection – Utility Capacitor Switching Transients - Utility System Lightning Protection – Managing Ferro resonance – Switching Transient Problems with Loads.

UNIT – III

Long – Duration Voltage Variations:

Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application – Regulating utility voltage with distributed resources – Flicker.

UNIT – IV

Harmonic distortion and solutions:

Voltage distortion vs. Current distortion –Harmonic indices: THD - TDD and True Power Factor– Sources of harmonics – Effect of harmonic distortion – Impact on capacitors, transformers, motors and meters – Concept of Point of common coupling – Passive and active filtering – Numerical problems.

UNIT – V

Distributed Generation and Monitoring:

Resurgence of distributed generation – DG technologies – Interface to the utility system – Power quality issues and operating conflicts – DG on low voltage distribution networks.

Monitoring:

Power quality monitoring and considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data.

Text Books:

1. Electrical Power Systems Quality - Dugan R C - McGranaghan M F – Santoso S - and Beaty H W - Second Edition - McGraw–Hill - 2012 - 3rd edition.
2. Electric power quality problems – M.H.J.Bollen IEEE series-Wiley india publications – 2011.
3. Power Quality Primer - Kennedy B W - First Edition - McGraw–Hill - 2000.

Reference Books:

1 Understanding Power Quality Problems: Voltage Sags and Interruptions - Bollen M HJ - First Edition - IEEE Press; 2000.

2 G. T, Heydt, "Electric Power Quality", Stars in a Circle Publications, 1991 Power System Harmonics - Arrillaga J and Watson N R - Second Edition - John Wiley & Sons - 2003.

3 Electric Power Quality control Techniques - W. E. Kazibwe and M. H. Sendaula ‑ Van Nostrad Reinhold - New York.

4 Harmonics and Power Systems ‑Franciso C.DE LA Rosa‑CRC Press (Taylor & Francis).

Web Links:

1 https://nptel.ac.in/courses/108107157

2 https://onlinecourses.nptel.ac.in/noc21_ee103/preview

QUANTUM SCIENCE AND TECHNOLOGY
Open Elective-IV

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EE7O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain core principles of quantum mechanics and their technological implications.
CO2: Analyze quantum phenomena like superposition and entanglement.
CO3: Apply mathematical tools to model and solve quantum systems.
CO4: Demonstrate understanding of quantum algorithms and quantum circuits.
CO5: Evaluate potential applications and challenges in quantum communication and sensing.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-

UNIT – I

Fundamentals of Quantum Mechanics: Historical background: Blackbody radiation, photoelectric effect, and Compton scattering; Dual nature of light and matter; De Broglie hypothesis; Schrödinger equation; Free particle, infinite potential well, step potential; Operators and observables: position, momentum, Hamiltonian; Commutation relations and uncertainty principle; Quantum postulates and measurement theory; Eigenvalues, eigenfunctions..

UNIT – II

Quantum Information Theory: Classical vs. quantum information; Qubit representation using Bloch sphere; Quantum superposition and quantum entanglement; Dirac notation (bra-ket), tensor products, and composite systems; Bell states and EPR paradox; Quantum gates: Pauli-X, Y, Z; Hadamard; Phase; T; CNOT; Quantum circuit models and notation; Measurement in computational basis; Quantum teleportation and no-cloning theorem; Quantum state tomography (introductory).

UNIT – III

Quantum Computing: Classical computing review and limitations; Quantum parallelism and interference; Deutsch and Deutsch-Jozsa algorithms; Grover’s search algorithm, Oracle and amplitude amplification; Shor’s factoring algorithm (overview and significance);

Quantum Fourier Transform (QFT); Quantum error correction: Bit-flip, phaseflip, and Shor’s 9-qubit code; Introduction to quantum programming: Qiskit, Cirq, IBM Quantum Experience (overview).

UNIT – IV

Quantum Communication: Introduction to quantum cryptography; Quantum key distribution (QKD): BB84 protocol; Entanglement-based QKD: Ekert protocol (E91); Eavesdropping and security of QKD; Quantum teleportation (circuit and protocol); Quantum dense coding; Quantum networks and entanglement swapping; Role of quantum repeaters; Single-photon sources and detectors; Implementation challenges (loss, decoherence, noise).

UNIT – V

Quantum Technologies and Applications: Quantum sensors: magnetometry, gravimetry; Quantum metrology: standard time, atomic clocks; Quantum imaging and lithography; Quantum materials: topological insulators, graphene, quantum dots; NV centers in diamonds for sensing; Hardware platforms: Superconducting qubits, Trapped ions, Photonic quantum processors; Quantum supremacy and NISQ era; Global initiatives: IBM, Google, DWave, IonQ, India’s NQM; Ethical concerns and future prospects.

Text Books:

1. "Quantum Computation and Quantum Information" by Michael A. Nielsen and Isaac L. Chuang
2. "Quantum Mechanics: Concepts and Applications" by Nouredine Zettili

Reference Books:

1. Vedran Dunjko, Jacob M. Taylor and Hans J. Briegel, “*Quantum-Enhanced Machine Learning”*, Physical Review Letters 117 (13).
2. Maria Schuld and Nathan Killoran, *Quantum machine learning in feature Hilbert spaces*, Phys. Rev. Lett. 122

Web Links:

1. https://nptel.ac.in/courses/104104082
2. https://nptel.ac.in/courses/115104096
3. https://nptel.ac.in/courses/122106034

*****

OPTIMIZATION TECHNIQUES
(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Understand the classical optimization techniques

CO2: Learn numerical methods for optimization

CO3: Get insights into genetic algorithm and its variants

CO4: Know the applications of optimization in mechanical engineering

CO5: Understand the concept of reliability

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	2	-	1	-	-	-	-	-	-	-
CO2	3	3	2	-	1	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	1	-	-	-	-	-
CO5	2	1	2	-	1	-	1	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	-	1
CO3	-	1
CO4	-	1
CO5	-	1

Unit - I

Classical Optimization Techniques: Single variable optimization with and without constraints, multi – variable optimization without constraints, multi – variable optimization with constraints –

method of Lagrange multipliers, Kuhn-Tucker conditions, merits and demerits of classical optimization techniques.

Unit -II

Numerical Methods for Optimization: Nelder Mead's Simplex search method, Gradient of a function, Steepest descent method, Newton's method, Pattern search methods, conjugate method, types of penalty methods for handling constraints, advantages of numerical methods

Unit - III

Genetic Algorithm (GA) : Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,

Genetic Programming (GP): Principles of genetic programming, terminal sets, functional sets, differences between GA & GP, random population generation, solving differential equations using GP.

Multi-Objective GA: Pareto's analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems

Unit – IV

Applications Of Optimization In Design And Manufacturing Systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Unit – V

Reliability: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis.

Text Books:

1. Engineering Optimization by S.S.Rao, 3rd edition, New Age Publishers,2013, ISBN13 978-8122427233
2. Reliability Engineering by L.S.Srinath, East west publishers,2005, ISBN13 978-8176710480

Reference Books:

1. Genetic algorithms in Search, Optimization, and Machine learning – D.E.Goldberg, Addison-Wesley Publishers
2. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers
3. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers
4. An Introduction to Reliability and Maintainability Engineering by CE Ebeling, Waveland Printers Inc., 2009

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_me10/preview
2. https://www.coursera.org/learn/operations-research-modeling

ADVANCED MANUFACTURING PROCESSESS
(Open Elective-IV)

	L	T	P	C
VII Semester				
Course Code: 231ME7O07	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Explain the working principle of various nonconventional machining processes and their applications.
CO2:	Explain the working principles of additive manufacturing methods.
CO3:	Understand various surface treatment techniques and processing of ceramics.
CO4:	Gain the knowledge on advanced coating processes.
CO5:	Describe various fabrication methods for microelectronic devices.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	1	2	-	-	-	-	-	1
CO2	3	-	-	-	1	2	-	-	-	-	-	1
CO3	3	-	-	-	1	2	-	-	-	-	-	1
CO4	3	-	-	-		2	-	-	-	-	-	1
CO5	3	-	-	-	1	2	-	-	-	-	-	1

Mapping Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

Unit - I

Advanced Machining Processes: Introduction, AJM, WJM, EDM, ECM, LBM, EBM, & PAM – principle, working, advantages, limitations, Process Parameters & capabilities and applications.

Unit –II

Additive Manufacturing: Working principles, methods- stereo lithography, LENS, LOM, laser sintering, fused deposition method, applications and limitations, direct and indirect rapid tooling techniques.

Unit – III

Surface Treatment: Scope, cleaners, methods of cleaning, surface coating types, electro forming, chemical vapour deposition, physical vapour deposition, thermal spraying methods, ion implantation, diffusion coating, ceramic and organic methods of coating, and cladding methods.

Processing of Ceramics: Applications, characteristics, classification, processing of particulate ceramics, powder preparations, consolidation, hot compaction, drying, sintering, and finishing of ceramics, areas of application.

Unit – IV

Processing of Composites: Composite layers, particulate and fiber reinforced composites, elastomers, reinforced plastics, processing methods for MMC, CMC, polymer matrix composites.

Processing of Nanomaterials: Introduction, top-down vs bottom-up techniques, ball milling, lithography, plasma arc discharge, pulsed laser deposition, sputtering, sol-gel, molecular beam epitaxy.

Unit – V

Fabrication of Microelectronic Devices:

Crystal growth and wafer preparation, film deposition, oxidation, lithography, bonding and packaging, reliability and yield, printed circuit boards, surface mount technology, integrated circuit economics.

Text Books:

1. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven R. Schmid, Pearson Education, 8th Edition, 2023.
2. Process and Materials of Manufacturing, R. A. Lindburg, Prentice Hall India Learning Private Limited, 4th Edition, 1990.

Reference Books:

1. Advanced Machining Processes, V. K. Jain, Allied Publications, 2002.
2. Introduction to Nanoscience and Nano Technology, K. K. Chattopadhyay & A. N. Banerjee, PHI Learning, 2009.

3. MEMS & Micro Systems Design and Manufacture, Tai Run Hsu, McGraw Hill Education, 1st edition, 2017.
4. Introduction to Manufacturing Processes, John A Schey, McGraw-Hill Education, 3rd edition, 1999.

Web Links:

1. https://archive.nptel.ac.in/courses/112/107/112107077/ .
2. https://archive.nptel.ac.in/courses/112/103/112103306/
3. https://archive.nptel.ac.in/courses/112/105/112105053/
4. https://home.iitk.ac.in/~mohite/ae681.html
5. https://archive.nptel.ac.in/courses/113/104/113104102/
6. https://archive.nptel.ac.in/courses/103/106/103106075/

TOTAL QUALITY MANAGEMENT
(Open Elective-IV)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O08	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the quality management philosophies and frameworks.

CO2: Explain quality costs and leadership.

CO3: Explain the concepts of customer focus, continuous quality improvement and supplier partnership

CO4: Apply various TQM tools to improve management processes

CO5: Calculate process capability index in TQM process

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	1	3	3	2	2	3	2	3	1	1
CO2	3	2	3	2	2	1	2	1	3	2	2	2
CO3	3	3	2	1	3	2	3	1	1	1	2	2
CO4	3	2	2	2	1	3	2	2	2	1	3	1
CO5	3	1	2	1	2	2	2	2	2	2	2	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	3
CO2	3	3
CO3	2	2
CO4	2	2
CO5	2	3

Unit – I

Introduction: Definition of Quality, Factors effecting quality, Quality management, Quality Dimensions, four phases of quality, Total Quality, Salient features of Total Quality Management

(TQM)-definition of TQM, Elements of TQM, Principles of TQM, Pillars of TQM, Traditional Approach and TQM Approach. Characteristics of TQM: TQM Enablers, Approaches, relevance, Barriers to TQM Implementation

Unit –II

Quality costs: Cost classification, Basic cost of quality. Applications and Importance of quality cost. Quality leadership: Quality of leadership, Quality of successful leader, leadership for TQM, Deming Philosophy, Contributions of Gurus of TQM

Unit – III

Customer Focus: Customer Complaints and suggestions, panels, Customer satisfaction, Customer Perception of Quality, Customer driven quality circles, Customer focus and activities, needs and expectations, Organizations action from the customer point of view.

Continuous Quality Improvement - Juran Trilogy, PDCA Cycle, Kaizen- kaizen suggestion's, program introduction at workplace, principles of kaizen. Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development

Unit – IV

TQM Tools: **Bench marking - Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) - House of Quality, QFD Process, Benefits. Taguchi Quality Loss Function.**

Total Productive Maintenance (TPM) - Concept, Improvement Needs, FMEA -Stages of FMEA, the seven tools of quality, Process Capability- Concept, Methods of calculating process capability, Process capability index, Concept of six sigma.

Unit – V

Need for ISO9000-ISO9001-2008 Quality System- Elements, documentation Quality Auditing–QS9000-ISO14000-Concepts, Requirements and Benefits–TQM, Implementation in manufacturing and service sectors.

Text Books:

1. Total Quality Management, Dale HB ester field, Pearson,4th Edition 2015
2. Total Quality Management,K.C.Arora,S.K.Kataria&sons,NewDelhi,2016
3. Total Quality Management, Subburaj Ramaswamy, TataMcgraw HillPublishing

   Company Ltd., 2005

Reference Books:

1. Management Quality-Concepts and Tasks, Narayana V and Sreenivasan N.S.,New age publishers;1st edition(1January2005).
2. Statistical Quality Control, SeventhEdition, RichardS.Leavenworth & Eugene LodewickGrant,7th Edition,TataMcgrawHill,2015
3. Total QualityManagement, Subburaj Ramasamy, TataMcGrawHill Publishing CompanyLtd., NewDelhi, 2005.

Web Links:

1. https://nptel.ac.in/courses/110/105/110105039/ -
2. https://nptel.ac.in/courses/110/104/110104085/
3. https://nptel.ac.in/courses/110/104/110104080/#

OPERATIONS MANAGEMENT

(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O09	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to

CO1 Formulate and solve real industrial problems using Graphical and Simplex methods
CO2 Interpret Transportation and sequencing problems
CO3 Solve replacement problems and analyze queuing models
CO4 Solve game theory and deterministic inventory problems
CO5 Interpret Statistics knowledge to design problems

Mapping of Course Outcomes with Program Outcomes:

CO/PSO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	1	1	-	-	2	-	-	-	-	1	-
CO2	1	1	1	-	-	1	-	-	-	-	1	-
CO3	3	2	1	-	-	1	-	-	-	-	1	-
CO4	2	1	1	-	-	2	-	-	-	-	1	-
CO5	2	1	1	-	-	2	-	-	-	-	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO 2
CO1	-	2
CO2	-	2
CO3	-	2
CO4	-	2
CO5	-	2

UNIT – 1

INTRODUCTION - definition– characteristics and phases – types of operation research models – applications.
Linear programming: Problem formulation – graphical solution – simplex method – artificial variables techniques -two–phase method, big-M method – duality principle.

UNIT – 2

TRANSPORTATION PROBLEM: Formulation – optimal solution, unbalanced transportation problem – degeneracy, assignment problem – formulation – optimal solution - variants of assignment problem- travelling salesman problem.
SEQUENCING – Introduction – flow –shop sequencing – *n* jobs through two machines – *n* jobs through three machines – job shop sequencing – two jobs through 'm' machines.

UNIT – 3

REPLACEMENT THEORY: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.
GAME THEORY: Introduction – mini. max (max. mini) – criterion and optimal strategy – solution of games with saddle points – rectangular games without saddle points – 2 x 2 games – dominance principle – m x 2 & 2 x n games -graphical method.

UNIT – 4

WAITING LINES: Introduction – single channel – poison arrivals – exponential service times – with infinite population and finite population models– multichannel – poison arrivals – exponential service times with infinite population single channel.
PROJECT MANAGEMENT: Basics for construction of network diagram,Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) – PERT Vs. CPM, determination of floats- Project crashing and its procedure.

UNIT – 5

RELIABILITY: Concepts of Engineering Statistics, risk and reliability, probabilistic approach to design, reliability theory, design for reliability, numerical problems, hazard analysis

Text Books:

1. Operations Research-An Introduction/Hamdy A Taha/Pearson publishers
2. Operations Research –Theory & publications / S.D.Sharma Kedarnath/McMillan publishers India Ltd

Reference Books:

1. Introduction to O.R/Hiller & Libermann/TMH
2. Operations Research /A.M. Natarajan, P. Balasubramani, A. Tamilarasi /Pearson Education.
3. Operations Research: Methods & Problems / Maurice Saseini, ArhurYaspan& Lawrence Friedman/Wiley
4. Operations Research / R.Pannerselvam/ PHI Publications.
5. Operations Research / Wagner/ PHI Publications.

Web Links:

1. https://nptel.ac.in/courses/110/106/110106062/
2. https://ocw.mit.edu/courses/sloan-school-of-management/15-760a-operations-management-summer-2002/

ENERGY AUDITING
(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231ME7O10	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Understand the classification of Energy and importance of Energy Conservation.
CO2:	Illustrate energy auditing methodologies
CO3:	Understand Material and Energy balance and carry out Material and energy balance
CO4:	Determine Energy Performance assessment of equipment
CO5:	Perform financial analysis for determining simple payback period

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	1	3	2	3	2	2	3	1	1
CO2	3	2	2	2	2	2	2	3	3	2	3	1
CO3	3	3	2	3	2	3	1	2	2	2	2	2
CO4	3	2	3	2	1	1	2	2	1	1	1	1
CO5	3	2	1	2	1	2	1	1	2	1	2	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	3	3
CO3	2	2
CO4	2	3
CO5	1	3

Unit – I

INTRODUCTION: Classification of Energy – Primary and Secondary Energy, Commercial Energy and Noncommercial Energy and Renewable & Non-renewable energy; Various forms of Energy – potential (stored energy) and kinetic(working) energy; Basics of Electrical energy and thermal energy; Energy and Environment; Energy Conservation and its importance.

Unit –II

ENERGY MANAGEMENT: Definition and objectives of Energy Management, Energy Audit – types and methodology; need for energy audit; energy auditing methodology; Benchmarking energy performance; Maximizing system efficiency; Energy Audit Instruments.

Unit – III

MATERIAL AND ENERGY BALANCE: Basic principles of material and energy balance; Sankey diagram and its use; Material balances; Energy balances; Carrying out material and energy balance.

Unit – IV

ENERGY PERFORMANCE ASSESSMENT: Purpose and parameters of performance of (a) boilers, (b) furnaces, (c) turbines, (d) fans and blowers, (e) pumps, (f) compressors and (g) lighting. Detailed performance analysis of boilers and pumps.

Unit – V

PERFORMING FINANCIAL ANALYSIS: Introduction, fixed and variable costs, Interest charges, simple pay-back period, discounted cash flow methods- Net Present Value method and Internal rate of return method; Factors affecting analysis

Text Books:

1. General Aspects of Energy Management & Energy Audit,, National Certificate Examination for Energy Managers and Energy Auditors, National Productivity Council of India
2. Energy Performance Assessment for Equipment and Utility systems, National Certificate Examination for Energy Managers and Energy Auditors, National Productivity Council of India

Reference Books:

1. Murphy, W.R. , Mckay, G. (1982) 'Energy Management ', London: Butterworth-Heinemann
2. K. Smith, C.B. (Ed. 4) (1981). 'Energy Management Principles : applications, benefits, savings', Amsterdam : Pergamon Press
3. Witte, L. C. (1988), ' Industrial energy management and utilization ', Washington: Hemisphere Pub. Corp

Web Links:

1. https://sustainabilityeducationacademy.com/free-online-energy-audit-course/
2. https://coursevania.com/courses/introduction-to-energy-auditing/
3. https://www.cdgtraining.com/courses/Certified-Energy-Auditor-CEA-Course-66f78d2e6560e62a1e6ef941

FUNDAMENTALS OF IMAGE PROCESSING

(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EC7O04	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Infer the fundamental components of digital image processing.

CO2 Illustrate image enhancement techniques.

CO3 Compare image restoration techniques.

CO4 Infer the color image processing methods.

CO5 Make use of morphological operators for image processing.

CO6 Interpret image segmentation techniques.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit - I

Introduction: Introduction to Image Processing, Fundamental steps in digital image processing, components of an image processing system, image sensing and acquisition, image sampling and quantization, some basic relationships between pixels, an introduction to the mathematical tools used in digital image processing.

Unit - II

Image Enhancement and Restoration: Background, Some basic intensity transformation functions, histogram processing, fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters, combining spatial enhancement methods, A model of the image degradation/restoration process, Noise models, Inverse filtering, Minimum mean square error (Wiener) filtering.

Unit - III

Color image processing: color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening, noise in color images.

Unit - IV

Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, basic morphological algorithms for boundary extraction, thinning, gray-scale morphology, Segmentation using morphological watersheds

Unit - V

Image segmentation: Fundamentals, point, line, edge detection, thresholding, and region - based segmentation, Image segmentation based on color.

Text Books:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. Anil K.Jain, "Fundamentals of Digital Image Processing" , Prentice Hall of India, 9th Edition, Indian Reprint, 2002.

Reference Books:

1. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing" , Tata McGraw-Hill Education, 2011
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis" , PHI, 2009.

Web Links:

1. http://www.imageprocessingplace.com/.
2. http://nptel.ac.in/courses/117105079/(Prof.P.K.Biswas,IIT, Kharagpur)
3. https://sisu.ut.ee/imageprocessing/avaleht
4. https://www.coursera.org/learn/digital#ratings (Fundamentals of digital image and video processing, Aggelos K. Katsaggelos, University of North western)
5. https://www.coursera.org/courses?languages=en&query=image+processing

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ELECTRONIC MEASUREMENT TECHNIQUES
(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EC7O05	**3**	**0**	**0**	**3**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1 Outline the performance characteristics of measuring Instruments.
CO2 Make use of transducers for physical parameter measurement.
CO3 Select signal generators and wave analyzers for the given application.
CO4 Interpret the working principle of oscilloscopes.
CO5 Choose a suitable bridge for parameter measurement.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1		
CO2		
CO3		
CO4		
CO5		

Unit – I
Performance Characteristics of Instruments:

static characteristics, Accuracy, Resolution, Precision, Expected value, Error, Sensitivity, errors in measurement, Dynamic characteristics- speed of response, fidelity, lag, dynamic error, DC voltmeters, multi range, range extension/Solid state and differential voltmeters, AC voltmeters- multi range, range extension, shunt, thermocouple type RF ammeter, Ohmmeters series type, shunt type, multi-meter for voltage, current, and resistance measurements.

Unit – II
Transducers:

Active and passive transducers, resistance, capacitance, inductance, strain gauges, LVDT, piezo electric transducers, Resistance thermometers, thermocouples, thermistors, sensistors, Measurement of physical parameters-force, pressure, velocity, humidity, moisture, speed, proximity and displacement, data acquisition systems

Unit – III

Signal Generators &Wave Analyzers:

Fixed and variable, AF oscillators, standard and AF sine and square wave signal generators, Function generators, square, pulse, Random noise, sweep, arbitrary wave form, Wave analyzers, Harmonic distortion analyzers, spectrum analyzers, Digital Fourier analyzers.

Unit – IV

Oscilloscopes:

digital storage oscilloscope, Lissajous method of frequency measurement, standard specifications of Oscilloscope, probes for Oscilloscope, active and passive, attenuator type.

Unit – V

AC Bridges:

Measurement of Inductance, Maxwell's bridge, Anderson bridge, Measurement of Capacitance, Schering bridge, Wheatstone bridge, Wein bridge, Errors and precautions in using bridges, Q meter.

Text Books:

1. Electronic Instrumentation, H.S.Kalsi, 2nd edition, Tata MCgraw Hill, 2004
2. Modern electronic Instrumentation and measurement techniques, A.D.Helfric,W.D.Cooper, 5th edition, PHI, 2002.

Reference Books:

1. Electronic Instrumentation and measurements,DavidA.Bell, 2nd edition, PHI, 2003
2. Electronic test Instruments, analog and digital measurements, Robert A.Wittie, 2nd edition, Pearson education, 2004.
3. Electronic measurements and Instrumentations, K.Lal Kishore, Pearson education, 2005

Web Links:

1. https://www.allaboutcircuits.com/textbook/alternating-current/chpt-12/ac-bridge-circuits/
2. https://www.science-ebooks.com/bridge-circuit.html

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SENSORS AND ACTUATORS
(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231EC7O06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1 Classify various sensors/transducers based on their applications.

CO2 Categorize various types of Resistive, Inductive and Capacitive Sensors.

CO3 Analyze various approaches, procedures and results related to Thermal sensors.

CO4 Analyze various approaches, procedures and results related to Magnetic sensors.

CO5 Examine the radiation sensors based on their characteristics.

CO6 Apply Smart Sensors in the field of Communication, Automation and Manufacturing

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	1	-	-	-	-	-	-	-	-	-
CO2	2	3	2	1	-	-	-	-	-	-	-	-
CO3	2	3	2	2	-	-	-	-	-	-	-	-
CO4	2	3	2	2	-	-	-	-	-	-	-	-
CO5	2	3	2	2	-	-	-	-	-	-	-	-
CO6	2	2	3	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-
CO6	-	-

Unit – I

Sensors / Transducers:

Principles ‐ Classification ‐ Parameters ‐ Characteristics ‐ Environmental Parameters (EP) ‐ Characterization. Mechanical and Electromechanical Sensors: Introduction ‐ Resistive Potentiometer ‐ Strain Gauge ‐ Resistance Strain Gauge ‐ Semiconductor Strain Gauges - Inductive Sensors: Sensitivity and Linearity of the Sensor ‐Types-Capacitive Sensors:‐ Electrostatic Transducer‐ Force/Stress Sensors Using Quartz Resonators ‐ Ultrasonic Sensors.

Unit – II
Thermal Sensors:

Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermo sensors – Helium Low Temperature Thermometer – Nuclear Thermometer – Magnetic Thermometer – Resistance Change Type Thermometric Sensors – Thermo emf Sensors – Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors.

Magnetic sensors: Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magneto resistive Sensing – Semiconductor Magneto resistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors – Angular/Rotary Movement Transducers – Synchros – Synchro- resolvers - Eddy Current Sensors – Electromagnetic Flow meter – Switching Magnetic Sensors SQUID Sensor

Unit-III

Radiation Sensors:

Introduction – Basic Characteristics – Types of Photo sensistors /Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors.

Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential – Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization-– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media. Radiation Sensors – Quartz Crystal Thermoelectric Sensors – NQR Thermometry – Spectroscopic Thermometry – Noise Thermometry – Heat Flux Sensors.

Unit – IV
Smart Sensors:

Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation

Sensors-Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors –– Sensors for Manufacturing –Sensors for environmental Monitoring.

Unit – V
Actuators:

Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Presure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators

Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection Electrical Actuation Systems- Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

Text Books:

1. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.
2. W. Bolton – "Mechatronics" –Pearson Education Limited.

Reference Books:

1. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.
2. Hardware Software Co-Design Principles and Practice, J. Staunstrup, Springer Publications
3. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, 2013.

Web Links:

1. https://www.iitk.ac.in/tkic/workshop/sensors-and-actuators/ppt/sandeep.pdf
2. https://www.hella.com/techworld/ae/Technical/Sensors-and-actuators-204/
3. https://www.leanix.net/en/blog/iot-devices-sensors-and-actuators-explained

***

INTRODUCTION TO MACHINE LEARNING

(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain the fundamental usage of the concept Machine Learning system with an emphasis on statistical learning

CO2: Demonstrate various regression techniques and linear models for binary classification

CO3: Analyze the role of Ensemble Learning Methods and Support Vector Machines in Machine Learning

CO4: Illustrate the Clustering Techniques and Dimensionality Reduction Models in Machine Learning

CO5: Discuss the Neural Network Models and Fundamentals concepts of Deep Learning

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	1	-	-	2	-	-	-	-	-	-	-
CO2	2	2	1	-	3	-	-	-	-	-	-	-
CO3	1	2	1	3	-	-	-	-	-	-	-	-
CO4	1	3	1	2	-	-	-	-	-	-	-	-
CO5	2	1	1	-	3	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit - I

Introduction- Artificial Intelligence, Machine Learning, Deep learning, Types of Machine Learning Systems, Main Challenges of Machine Learning.Statistical Learning: Introduction, Supervised and Unsupervised Learning, Training

and Test Loss, Tradeoffs in Statistical Learning, Estimating Risk Statistics, Sampling distribution of an estimator, Empirical Risk Minimization.

Unit – II

Supervised Learning(Regression/Classification):Basic Methods: Distance based Methods, Nearest Neighbours, Decision Trees, Naive Bayes, Linear Models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Binary Classification: Multiclass/Structured outputs, MNIST, Ranking.

Unit – III

Ensemble Learning and Random Forests: Introduction, Voting Classifiers, Bagging and Pasting, Random Forests, Boosting, Stacking.Support Vector Machine: Linear SVM Classification, Nonlinear SVM ClassificationSVM Regression, Naïve Bayes Classifiers.

Unit – IV

Unsupervised Learning Techniques: Clustering, K-Means, Limits of K-Means, Using Clustering for Image Segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN, Gaussian Mixtures. Dimensionality Reduction: The Curse of Dimensionality, Main Approaches for Dimensionality Reduction, PCA, Using Scikit-Learn, Randomized PCA, Kernel PCA.

Unit – V

Neural Networks and Deep Learning: Introduction to Artificial Neural Networks with Keras, Implementing MLPs with Keras, Installing TensorFlow 2, Loading and Preprocessing Data with TensorFlow.

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019
2. Data Science and Machine Learning Mathematical and Statistical Methods,Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman,25th November 2020

Reference Books:

1. Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, 2012.
2. Stephen Marsland, "Machine Learning -An Algorithmic Perspective", Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Andreas C. Müller and Sarah Guido "Introduction to Machine Learning with Python: A Guide for Data Scientists", Oreilly

Web Links:

1. https://www.deeplearning.ai/machine-learningyearning/
2. https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
3. https://onlinecourses.nptel.ac.in/noc21_cs24/preview
4. https://www.udemy.com/course/machinelearning/

DATA VISUALIZATION

(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231DS7O02	3	0	0	3

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Identify and recognize visual perception and representation of data.

CO2: Illustrate about projections of different views of objects.

CO3: Apply various Interaction and visualization techniques.

CO4: Analyze various groups for visualization.

CO5: Apply visualizations for volumetric data to present them graphically.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	-	-	-	-	-	-	-	-	-
CO2	1	2	-	3	-	-	-	-	-	-	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	-
CO4	1	3	-	-	-	-	-	-	-	-	-	-
CO5	1	2	2	3	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	1	-
CO4	2	-
CO5	2	-

Unit- I

Introduction To Data Visualizations And Perception: Introduction of visual perception, visual representation of data, Gestalt principles, Information over load.

Unit- II

Visual Representations: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Unit-III

Classification Of Visualization Systems: Classification of visualizeation systems, Interaction and visualization techniques mis leading,Visualization of one, two and multi-dimensional data, text and text documents.

Unit- IV

Visualization Of Groups: Visualization of groups, trees, graphs, clusters, networks, software, Meta phorical visualization. Various visualization techniques, data structures used in data visualization.

Unit- V

Visualization Of Volumetric Data And Evaluation Of Visualizations: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geo graphic information, GIS systems, collaborative visualizations, evaluating visualizations

Text Books:

1. Ward, Grinstein, Keim, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick, 2nd edition, AK Peters, Ltd 2015.

Reference Books:

1. Tamara Munzner, Visualization Analysis & Design,1st edition, AK Peters Visualization Series 2014
2. Scott Murray, Interactive Data Visualization for the Web, 2nd Edition, 2017

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_mg67/preview
2. https://www.coursera.org/learn/datavisualization
3. https://www.udemy.com/course/data-visualization-foundations/
4. https://www.udemy.com/course/masteringd3js/

CLOUD COMPUTING

(Open Elective-IV)

	L	T	P	C
VII Semester	L	T	P	C
Course Code: 231IT7O02	3	0	0	3

Course Outcomes:At the end of the Course, Student will be able to:

CO1: Explain cloud computing concepts, service models (IaaS, PaaS, SaaS), and deployment models (public, private, hybrid).

CO2: Analyze cloud-enabling technologies including distributed computing, virtualization, and SOA.

CO3: Evaluate virtualization technologies and container platforms such as Docker and Kubernetes.

CO4: Assess the major challenges in cloud computing, including security, interoperability, and fault tolerance.

CO5: Describe advanced cloud topics like serverless computing, IoT integration, and DevOps practices.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	2
CO2	2	3	2	-	-	-	-	-	-	-	-	2
CO3	2	2	3	2	2	-	-	-	-	-	-	-
CO4	2	3	-	3	2	1	1	-	-	-	-	2
CO5	3	2	2	2	2	-	-	-	-	1	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO /PSO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	3	2
CO4	3	1
CO5	2	3

UNIT – I

Introduction to Cloud Computing Fundamentals

Cloud computing at a glance, defining a cloud, cloud computing reference model, types of services (IaaS, PaaS, SaaS), cloud deployment models (public, private, hybrid), utility computing, cloud computing characteristics and benefits, cloud service providers (Amazon Web Services, Microsoft Azure, Google App Engine).

UNIT – II

Cloud Enabling Technologies

Ubiquitous Internet, parallel and distributed computing, elements of parallel computing, hardware architectures for parallel computing (SISD, SIMD, MISD, MIMD), elements of distributed computing, Inter-process communication, technologies for distributed computing, remote procedure calls (RPC), service-oriented architecture (SOA), Web services, virtualization.

UNIT – III

Virtualization and Containers

Characteristics of virtualized environments, taxonomy of virtualization techniques, virtualization and cloud Computing, pros and cons of virtualization, technology examples (XEN, VMware), building blocks of containers, container platforms (LXC, Docker), container orchestration, Docker Swarm and Kubernetes, public cloud VM (e.g. Amazon EC2) and container (e.g. Amazon Elastic Container Service) offerings.

UNIT-IV

Cloud computing challenges

Economics of the cloud, cloud interoperability and standards, scalability and fault tolerance, energy efficiency in clouds, federated clouds, cloud computing security, fundamentals of computer security, cloud security architecture, cloud shared responsibility model, security in cloud deployment models.

UNIT –V

Advanced concepts in cloud computing

Serverless computing, Function-as-a-Service, serverless computing architecture, public cloud (e.g. AWS Lambda) and open-source (e.g. OpenFaaS) serverless platforms, Internet of Things (IoT), applications, cloud-centric IoT and layers, edge and fog computing, DevOps, infrastructure-as-code, quantum cloud computing.

Text Books:

1. Mastering Cloud Computing, 2nd edition, Rajkumar Buyya, Christian Vecchiola, Thamarai Selvi, Shivananda Poojara, Satish N. Srirama, Mc Graw Hill, 2024.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.

Reference Books:

1. Cloud Computing, Theory and Practice, Dan C Marinescu, 2nd edition, MK Elsevier, 2018.
2. Essentials of cloud Computing, K. Chandrasekhran, CRC press, 2014.
3. Online documentation and tutorials from cloud service providers (e.g., AWS, Azure, GCP)

Web Links:

1. https://docs.aws.amazon.com
2. https://learn.microsoft.com/en-us/azure/
3. https://cloud.google.com/docs
4. https://nptel.ac.in/courses/106106129
5. https://nptel.ac.in/courses/106105167

SOFTWARE ENGINEERING
(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231AM7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO1:	Explain the evolution of software development and analyse life cycle models like Waterfall, RAD, Agile, and Spiral
CO2:	Apply estimation techniques and risk management for effective project management and develop SRS
CO3:	Design software using good design principles, structured analysis, and user interface methodologies
CO4:	Conduct blackbox, whitebox, and integration testing to ensure software reliability and quality
CO5:	Use CASE tools for software maintenance, reverse engineering, cost estimation, and reuse strategies

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	1	-	-	-	1
CO2	2	1	3	2	-	-	-	-	-	-	2	2
CO3	2	2	3	-	3	-	-	2	-	-	-	-
CO4	2	2	-	3	2	1	-	-	-	-	-	-
CO5	2	2	-	-	3	-	-	1	1	-	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	2
CO2	-	1
CO3	-	2
CO4	-	1
CO5	-	2

UNIT-I

Introduction: Evolution, Software development projects, Exploratory style of software developments, Emergence of software engineering, Notable changes in software development practices, Computer system engineering.

Software Life Cycle Models: Basic concepts, Waterfall model and its extensions, Rapid application development, Agile development model, Spiral model.

UNIT-II

Software Project Management: Software project management complexities, Responsibilities of a software project manager, Metrics for project size estimation, Project estimation techniques, Empirical Estimation techniques, COCOMO, Halstead's software science, risk management.

Requirements Analysis and Specification: Requirements gathering and analysis, Software Requirements Specification (SRS), Formal system specification, Axiomatic specification, Algebraic specification, Executable specification and 4GL.

UNIT-III

Software Design: Overview of the design process, How to characterize a good software design? Layered arrangement of modules, Cohesion and Coupling. approaches to software design.

Agility: Agility and the Cost of Change, Agile Process, Extreme Programming (XP), Other Agile Process Models, Tool Set for the Agile Process (Text Book 2)

Function-Oriented Software Design: Overview of SA/SD methodology, Structured analysis, Developing the DFD model of a system, Structured design, Detailed design, and Design Review.

User Interface Design: Characteristics of a good user interface, Basic concepts, Types of user interfaces, Fundamentals of component-based GUI development, and user interface design methodology.

UNIT-IV

Coding And Testing: Coding, Code review, Software documentation, Testing, Black-box testing, White-Box testing, Debugging, Program analysis tools, Integration testing**,** testing object-oriented programs, Smoke testing, and some general issues associated with testing.

Software Reliability and Quality Management: Software reliability. Statistical testing, Software quality, Software quality management system, ISO9000. SEI Capability maturity model. Few other important quality standards, and Six Sigma.

UNIT – V

Computer-Aided Software Engineering (Case): CASE and its scope, CASE environment, CASE support in the software life cycle, other characteristics of CASE tools, Towards second generation CASE Tool, and Architecture of a CASE Environment.

Software Maintenance: Characteristics of software maintenance, Software reverse engineering, Software maintenance process models and Estimation of maintenance cost.

Software Reuse: Reuse-definition, Introduction, Reason behind no reuses of ar, Basic issues in any reuse program, A reuse approach, and Reuse at organization level.

Text Books:

1. Fundamentals of Software Engineering, Rajib Mall, 5th Edition, PHI.
2. Software Engineering A Practitioner’s Approach, Roger S. Pressman, 9th Edition, McGraw Hill International Edition.

Reference Books:

1. Software Engineering, IanSommerville,10thEdition, Pearson
2. Software Engineering, Principles and Practices, Deepak Jain, Oxford University Press.

Web Links:

1. https://nptel.ac.in/courses/106105087
2. https://nptel.ac.in/courses/106101061
3. https://www.coursera.org/specializations/software-design-architecture

DEEPWATER TECHNOLOGY
(Open Elective-IV)

VII Semester **L T P C**
Course Code: 231PT7O04 **3 0 0 3**

Course Outcomes: At the end of the course, student will be able to:

CO 1: Analysis of waves and fluid-induced forces on offshore structures, Current and wind forces.
CO 2: Understand the Deepwater exploration and Deepwater drilling techniques.
CO 3: Apply the concepts of fixed platforms, compliant towers, subsea systems, extended reach wells and floating production systems.
CO 4: Extend innovative subsea completion, installation and associated problem.
CO 5: Demonstrate deep-water pipelines, flow assurance strategies and subsea innovations.

Mapping of Course Outcomes with Program Outcomes :

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO6	PO7	PO 8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes :

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I:
Introduction: Definition, Global Deep-water reserves & development activity. Technological advances. Dynamics of Offshore structure: Analysis of waves and fluid induced forces on offshore structures, Current and wind forces, Soil mechanics of seabed & structures.

UNIT-II:
Deep-water Exploration & Drilling: Seismic /Seabed survey, constraints in deepwater survey like geo-hazards, gas hydrate etc., Deep water drilling with emphasis on the additional inputs to normal offshore Drilling operation.

UNIT –III:
Deep-water Production System: Fixed Platforms, Compliant Towers, Subsea systems, Extended Reach Wells, Floating production systems like FPSO, FPSS, TLPS, Spar platform and FSO.

UNIT-IV:

Deep-water applications of Subsea Technology: Subsea completion, X-mas tree, Control systems, Manifolds, Templates, ROV, Deepwater installation vessels with DP system and associated problems – Offshore mobile units, station- keeping methods like mooring and dynamic positioning system.

UNIT-V:

Deep-water pipelines, Umbilical's & emerging Deep-water Technologies:
Issues in Deep-water pipeline design, Rigid and Flexible flow lines, pipe-in-pipe, Deep-water Risers and their configurations, Pipeline installation methods, Umbilical's-functions, configurations and installation, Flow assurance strategies, Innovative floating production concepts, subsea processing, subsea separation and any new innovations.

Text Books:

1. Subsea Engineering Handbook, Yong bai and Qiangbai, Gulf Professional Publishing, 2010.
2. Offshore Petroleum Drilling and Production, By Sukumar Laik, 1st Edition, Published June 30, 2020 by CRC Press.
3. Deepwater Petroleum Exploration & Production by William L. Leffler, Richard Pattarozzi, Gordon Sterling Penn Well Books, 2003.

Reference Books:

1. Floating Drilling: Equipment and Its Use, by Riley Sheffield Volume 2 of Floating Drilling and Volume 2 of Practical drilling technology-1980
2. Handbook On Nondestructive Testing of Concrete By V.M. Malhotra And N.J. Carino, Second Edition Crc Press-2004
3. Offshore Handbook Vol.1 to 5:Gulf Pub. Co.
4. Offshore Pipeline Design, Analysis, and Methods by A. H. Mousselli, Publisher, Penn Well Books, 1981.
5. Drilling and Producing Offshore, by R. Stewart Hall, Publisher, Pennwell Corp- 1984.

Web Links:

1. https://www.civil.iitb.ac.in/~mcdeo/waves_book1/wave.pdf
2. https://sut.org/wp-content/uploads/2017/09/OSIG-Guidance-Notes-2017-online-version.pdf
3. https://www.slideshare.net/slideshow/oil-gas-offshore-platform-overview-with-details/270656574
4. https://isomase.org/OCAri/Book/Introduction%20to%20Subsea%20Tree/Introduction%20to%20Subsea%20Tree.pdf
5. https://www.scrivenerpublishing.com/cart/title.php?id=576

INTRODUCTION TO ACIDIZING AND HYDRO-FRACTURING
(OPEN ELECTIVE-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231PT7O05	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO 1: Apply the modelling of hydraulic fractures for different reservoirs.
CO 2: Assess fracturing fluid properties and their usage.
CO 3: Analyze the fracturing fluid proppant characteristics.
CO 4: Apply the methods of matrix acidization and fracture acidization.
CO 5: Apply the concepts of hydraulic fracturing and its design

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I:

Modelling of hydraulic fractures: Conservation laws and constitutive equations, fracture propagation models, fluid flow modelling, acid fracturing.

UNIT-II:

Fracturing fluid chemistry: Water base fluids, oil base fluids, multiphase fluids, additives execution.

UNIT-III:

Fracturing fluid proppant and characterization: Rheology, shear and temperature effects on fluid properties, foam fracturing fluids, slurry rheology, proppant transport, fluid loss, formation and fracture damage, and proppants.

UNIT-IV:

Matrix acidization and fracture acidization: Well Stimulation acids, matrix acidizing carbonate formations, fracture acidizing carbonate formations, Acid–rock interaction, sandstone acidizing design, carbonate acidizing design.

UNIT-V:

Hydraulic Fracturing: Introduction, formation fracturing pressure, fracture geometry, productivity of fractured wells, stimulated reservoir volume (SRV) - hydraulic fracturing design.

Text Books:

1. Reservoir Stimulation, Michael. J. Economides, Kenneth G. Nolte, 2nd Edition, Prentice Hall, 1989.

Reference Books:

1. Oil Well Stimulation, Robert S. Schechter, Prentice Hall, 1992.
2. Modern Fracturing Enhancing Natural Gas Production, Michael J. Economides, Tony Martin, ET Publishing, 2007.

Web Links:

1. https://link.springer.com/article/10.1007/s40948-025-00986-8
2. https://onepetro.org/books/book/34/chapter/10917733/Fracturing-Fluids-and-Additives
3. https://www.sciencedirect.com/topics/materials-science/fracturing-fluid
4. https://pubs.acs.org/doi/10.1021/acsomega.3c07132
5. https://www.mdpi.com/1996-1073/14/22/7727

INTRODUCTION TO RESERVOIR ENGINEERING

(Open Elective-IV)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231PT7O06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the course, student will be able to:

CO 1:	Apply the basic concepts in reservoir engineering.
CO 2:	Perform basic PVT analysis of various types of fluids for wells.
CO 3:	Carry out the calculations in material balance and estimate the reserves of various sands of the reservoir from well data.
CO 4:	Apply the Darcy' s Law and derive deliverability equations for various types of reservoirs.
CO 5:	Learn about water Influx methods

Mapping of Course Outcomes with Program Outcomes

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	2	-	2
CO2	2	-	-	-	-	-	-	-	-	2	-	2
CO3	2	-	-	-	-	-	-	-	-	2	-	2
CO4	2	-	-	-	-	-	-	-	-	2	-	2
CO5	2	-	-	-	-	-	-	-	-	2	-	2

Mapping of Course Outcomes with Program Specific Outcomes

CO / PSO	PSO 1	PSO 2
CO1	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT-I

Basic concepts in reservoir engineering: Calculation of hydrocarbon volumes- Fluid pressure regimes- Oil recovery and recovery factor -Volumetric gas reservoir engineering – Application of the real gas equation of state - Gas material balance and recovery factor and its conceptual coherence with drive mechanisms - Hydrocarbon phase behavior.

UNIT-II

PVT analysis for oil: Definition of the basic PVT parameters – Collection of fluid samples - Determination of the basic parameters in the laboratory and conversion for field operating conditions - Alternative manner of expressing PVT lab analysis results - Complete PVT analysis.

UNIT-III

Material balance applied to oil reservoirs: General form -The material balance expressed as a linear equation - Reservoir drive mechanisms - Solution gas drive- Gas cap drive- Natural water drive- compaction drive and related pore compressibility phenomena.

UNIT-IV

Darcy's law and applications: Darcy's law and field potential- Sign convention- Units and unit conversion- Real gas potential – Datum pressures- Different flow regimes- Linear &Radial steady state flow - Pseudo-steady flow- Unsteady state flow- Derivation of deliverability equations – estimation of reservoir permeability - Two phase flow- Effective and relative permeabilities.

UNIT-V

Natural water influx: Steady state water influx methods- Unsteady state water influx theory of Hurst and Van Everdingen and its application in history matching – The approximate water influx theory of Fetkovich for finite aquifers and predicting the amount of water influx – Application of influx calculation techniques to steam soaking.

Text Books:

1. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science, 1978 (17thImpression 1998).
2. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.
3. B. C. Craft – M. Hawkins, Ronald E. Terry & J. Brandon Rogers, 3rd revised Edition, Prentice Hall, New York, 2014.

Reference Books:

1. Petroleum Engineering: Principles and Practice, J.S Archer & C.G. Wall, Graham &Trotman Inc. 1986.
2. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing, 2006.

Web Links:

1. https://www.scribd.com/document/636059075/Untitled
2. https://www.academia.edu/15328765/3_FLUID_SAMPLING_AND_ANALYSIS_OF_LABORATORY_DATA_3_1_Introduction
3. https://www.academia.edu/8462037/OIL_RECOVERY_MECHANISMS_AND_THE_MATERIAL_BALANCE_EQUATION\
4. https://byjus.com/physics/darcys-law/

https://petrowiki.spe.org/Water_influx_models

PRINCIPLES OF MINERAL ENGINEERING
Open Elective-IV

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Describe the fundamentals and limitations of mineral dressing and microscopic analysis.
CO2: Apply crushing and grinding methods for effective mineral liberation.
CO3: Perform sizing and classification to analyze particle size distribution.
CO4: Select appropriate gravity concentration and flotation methods for mineral processing.
CO5: Develop beneficiation flow sheets and apply sampling and coal washing techniques.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	-	-	1	1	1	-
CO2	3	2	-	-	-	-	-	-	1	1	1	-
CO3	3	2	-	-	-	-	-	-	1	1	1	-
CO4	3	2	-	-	-	-	-	-	1	1	1	-
CO5	3	2	-	-	-	-	-	-	1	1	1	-

UNIT – I
Scope, objectives and limitations of Mineral Dressing; Role of microscopic study.
Comminution and Liberation: Theory and practice of crushing & grinding; Conventional units used-their fields of application and limitation

UNIT – II
Sizing and Classification: Laws of setting of solids in fluid; Laboratory methods of sizing and interpretation of sizing data; Industrial sizing by screens; Types of classifiers; Classification as means of sizing by screens

UNIT – III
Gravity concentration Methods- Jigging, Flowing film concentration like spirals and shaking
table, Heavy Media separation; Theory, applications and limitations of each method; Introductory Froth Flotation, physico-chemical, principles underlying flotation-reagents, flotation machines; Flotation of sulphides, oxides and non-metals..

UNIT – IV
Electrical Methods of Concentration: Electrostatic and magnetic methods, their principles of operation, fields of application and limitations.
Dewatering and drying: Thickening, filtration and drying

UNIT – V
Coal washing: Coal washability, crushing, sizing and cleaning of coal.
Sampling: Importance and methods used in ore-dressing.
Beneficiation and flow sheet of common minerals like copper, lead, zinc, gold, chromium, Aluminium etc.

Text Books:

1. Gaudin, A. M. (1939). Principles of mineral dressing. McGraw-Hill Book Company.
2. H.G. Vijendra, Handbook on Mineral Dressing. Pub: Vikas Publishing house New-Delhi

Reference Books:

1. Jain, S. K. (2018). Mineral processing (2nd ed.). CBS Publishers & Distributors.
2. Rao, G. S. R. (2017). Mineral processing: Including mineral dressing, experiments and numerical problems. I.K. International Publishing House Pvt. Ltd.

Web Links:

1. https://www.nptel.ac.in/courses/105/105/105105171/
2. https://miningandblasting.files.wordpress.com/2009/09/mineral_processing_notes.pdf
3. https://www.slideshare.net/slideshow/mineral-processing-ore-dressing/24049712

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MINING INSTRUMENTATION

Open Elective-IV

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O06	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Identify and apply electrical instruments for accurate measurement and monitoring in mining systems.
CO2: Use appropriate pressure and flow measurement devices for different operational needs.
CO3: Measure vibration, velocity, humidity, and level parameters using relevant instruments.
CO4: Operate and interpret readings from analysers for environmental and process control.
CO5: Implement rock mechanics instrumentation techniques in both underground and surface mining operations.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	-	-	-	-	-	-	-	-	1	-	-
CO2	3	3	-	-	-	-	-	-	-	1	-	-
CO3	3	3	-	-	-	-	-	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-

UNIT – I

Electrical Instruments: Basic Concepts: Sensitivity, range, reproducibility and accuracy, drift, absolute and relative measurements, error, environmental factors and planning for instrumentation. Accuracy, precision, resolution, sensitivity, linearity, span and range - Dynamic characteristics. Ammeters (MI & MC), Volt meters, Watt meters (Dynami), Energy

Meters, Megger, Power Factor meters, Earth resistance measurement. and thermocouples, Inclinometers.

UNIT – II

Pressure Measurements and Flow Measurements: Unit of Pressure – Manometers Different types, - Elastic type pressure gauges and sensors– Bourdon tube – Bellows – Diaphragm – Elastic elements with LVDT and strain gauge, deformation gauge – Capacitive type pressure

gauge – Measurement of vacuum – McLeod gauge – Thermal conductivity gauge – Ionisation

gauge. Piezometer, Flow meters – Variable head type flow meter – Orifice plate – Venture tube – Positive displacement flow meter: Nutating disc, Reciprocating piston, oval gear and helix type flow meter – Rotameter – Mass flow meters.

UNIT – III

Vibration, Humidity, Velocity and Level Measurements: Mechanical type vibration measuring instruments – Seismic instruments as an accelerometer – Vibrometers – Geo-phones. Humidity – Hot wire electro type hygrometer – Dew cell – Electrolysis type hygrometer. Anemometer, Velometer, Pitot static tube, Sound level meter, microphone, Lux meter; Level measurements: – Float gauges - Displacer type – D/P methods -Bubbler system Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement – Differential pressure method and Hydrastep method -Solid level measurement...

UNIT – IV

Analyzers: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyzer
– Sodium analyzer – Silica analyzer – Turbidity meter – Gas analyzer – O2, NOx – H2S analyzer – CO and CO2 monitor, Dust & Smoke measurement. IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. hydrocarbons, nitrogen oxides,
Sulphur dioxide estimation - Calibration methods.

UNIT – V

Rock Mechanics Instrumentation: Different types of Load cells, stress capsules, Flat jack, tape extensor meters, convergence indicators and recorders, borehole deformation gauges of different types, depth indicators. Seismic measurements, Applications in Mining: Coal mining – bord and pillar development, depillaring and Longwall, Metal mining and opencast mining applications, rock slope instrumentation.

Text Books:

1. De, N.K. and Sen, P.K. 'Electric Drives' Prentice Hall of India Private Ltd, 2002.
2. Subramaniam, V. 'Electric Drives' Tata McGraw Hill , New Delhi,2007

Reference Books:

1. Dubey, G.K. 'Fundamentals of Electrical Drives' Narosa, Second Edition.
2. Morrris, A.S. Principles of Measurement and Instrumentation, Print ice-Hall of India Pvt., Ltd. New Delhi, 1999.
3. Doeblin, E.O. Measurement Systems Application & Design, Tata McGraw Hill Publishing Co., New. Delhi, 1999.

Web Links:

1. **https://www.nptel.ac.in/courses/108/106/108106165/**
2. https://engineeringinterviewquestions.com/wp-content/uploads/2019/08/industrial-instrumentation-notes.pdf
3. **https://miningandblasting.files.wordpress.com/2009/09/rock_mechanics_instrumentation.pdf**

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MINE SAFETY & ERGONOMICS

Open Elective-IV

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O07	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Demonstrate knowledge of historical safety practices and major global mining disasters.
CO2: Apply risk assessment techniques and HIRA methodology in identifying and controlling mining hazards.
CO3: Utilize advanced risk analysis methods such as FMEA, HAZOP, FTA, and Markov Models.
CO4: Analyze mine accidents using safety engineering theories, ANN, and SEM tools.
CO5: Evaluate and implement ergonomic principles to improve safety and productivity in mining environments.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-	-

UNIT – I
Introduction: Historical Developments of Mine Safety in India and Abroad; Need for Approving, Safety Engineering Approach in Mining, Industry; Engineering Safety Goals; Mine Safety Facts and Figures; Worldwide Major Mine Disasters.

UNIT – II
Risk Management: Risk Management Related Terms and Definitions; Basic Concept of Risk,
Reliability and Hazard Potential; Risk Components and Types; Risk Management Objectives; Risk Management Process; Functions of a Risk Manager; Common Errors in Risk Management; Risk Estimates for Selective, Events; Hazards Identification and Risk Assessment (HIRA) Methodology; Implementation of HIRA and its Controls & Review;
Advantages of Risk Management

UNIT – III
Statistical Methods of Risk analysis: Basic Risk Analysis Methods based on Frequency Rates and Severity of Accidents Appraisal of advanced techniques - Preliminary Hazards Analysis (PHA); Hazards and Operability Analysis (HAZOP); Failure Mode and Effect Analysis (FMEA); Failure Mode Effect and Critical Analysis (FMECA); Job Safety Analysis (JSA); Fault Tree Analysis (FTA); Markov Model (MM) – An Important Risk analysis Tool.

UNIT – IV
Analyzers: Dissolved Analyzer: Conductivity meter – pH meter – Dissolved oxygen analyzer
System Safety Engineering Concept in Mine Safety: An Introduction to Systems Safety Engineering; Different School of Thoughts in Accident Causations - Domino Model; Behavioral Accident Model based on the human perception; Epidemiological Accident

Models, Normal Accident Theory; The Swiss Cheese Model; Systems-Theoretic Accident Modeling and Process (STAMP); In-depth Study of Accidents Due to Various Causes; Application of Structural Equation Modelling (SEM) and Artificial Neural Network (ANN) in Determining the Accident Causation in Mines. Safety audits and control: Objectives of safety audit in mines; Different steps in safety audit; Risk control procedures.

UNIT – V

Mine Ergonomics: Domain, Philosophy and Objective of Mine Ergonomics; Ergonomics/ human, Factors fundamentals; Work physiology, and stress; Human body- structure and, function, anthropometrics; Posture and movement; Posture and Job Relation – Work Posture

Analysis using OWAS, Method; Oxygen Consumption and Workload Analysis of Mine Workers..

Text Books:

1. Engineering Safety: Fundamentals, Techniques and Applications by B. S. Dhillon; World Scientific Publisher.
2. Mine Health and Safety Management – Edited by Michael Karmis.
3. Kejriwal, B. K., Safety in mines, Lovely Prakashan.

Reference Books:

1. Dhillon, B. S. (2008). Mining equipment reliability, maintainability, and safety (Springer Series in Reliability Engineering). Springer.
2. Dhillon, B. S. (2010). Mine safety: A modern approach (Springer Series in Reliability Engineering). Springer..

Web Links:

1. https://www.dgms.gov.in/writereaddata/UploadFile/History_of_Mine_Safety_in_India.pdf
2. https://miningandblasting.files.wordpress.com/2009/09/risk_management_in_mining.pdf
3. https://www.slideshare.net/slideshow/system-safety-engineering-and-risk-analysis/23457298

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MINERAL EXPLORATION

Open Elective-IV

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MI7O08	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Explain fundamental concepts of geological prospecting and exploration techniques.
CO2: Apply appropriate sampling and ore reserve estimation methods in exploration.
CO3: Identify geochemical cycles and pathfinder elements used in mineral exploration.
CO4: Interpret geochemical survey results and recognize geochemical anomalies.
CO5: Evaluate exploration data across geological, feasibility, and economic dimensions.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-	-

UNIT – I

Geological Prospecting and Exploration: Definitions and Principles; Methods of Prospecting; Methods of Exploration.

UNIT – II

Sampling: theory and methods; Geological plans and sections for orebody evaluation; Exploration drilling, drill core logging and sampling Cut-off grade concepts and applications;
Resources and Reserves. Estimation of reserves – methods and practice.

UNIT – III

Geochemical Exploration: Introduction, Geochemical cycle, geochemical mobility and association of elements. Pathfinder and target elements for geochemical exploration. Principles of geophysical exploration methods.

UNIT – IV

Primary and secondary dispersions of elements; Determination of background, and geochemical anomalies; Geo-chemical methods of mineral exploration: Procedures for geochemical sampling; Interpretation of geochemical surveys. Indian case studies.

UNIT – V

Collection of data along Geological (G), Feasibility (F) and Economic (E) axes during various stages of exploration.

Text Books:

1. Techniques in Mineral Exploration: Reedman, J H., 1979. Applied Science Publishers Ltd, UK
2. Exploration and Mining Geology (2nd Ed.), Peters, W.C. 1987. John Wiley & Sons, New York.

Reference Books:

1. Tables for Mineral Identification, Sharma, N L and Agarwal Y K.
2. Ore Geology and Industrial minerals- An introduction (III edn.) Geo-science, A.M.

Web Links:

1. https://www.nptel.ac.in/courses/105/105/105105076/
2. https://miningandblasting.files.wordpress.com/2009/09/mineral_exploration_notes.pdf
3. https://www.slideshare.net/slideshow/geochemical-exploration/23792569

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AGRICULTURAL STRUCTURES AND PROTECTED CULTIVATION

(Open Elective-IV)

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231AG7O02	**3**	**0**	**0**	**3**

Course Outcomes: At the end of the Course, Student will be able to:

CO1: Classify the poultry houses, dairy barn planning and requirements.

CO2: Differentiate the different grain storage structures.

CO3: Classify polyhouses based on construction materials.

CO4: Apply different irrigation techniques in green house.

CO5: Plan fertilizer scheduling, rate of application of fertilizers and methods of application.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	-	-	-	-	1	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	-
CO3	1	-	2	-	-	-	-	-	-	-	1	-
CO4	2	-	1	-	-	-	-	-	-	-	-	-
CO5	-	-	-	2	-	-	1	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO 1	PSO 2
CO1	1	2
CO2	-	2
CO3	2	-
CO4	3	-
CO5	3	-

Unit - I

Planning and layout of farmstead. Scope, importance and need for environmental control, physiological reaction of livestock environmental factors, environmental control systems and their design, control of temperature, humidity and other air constituents by ventilation and other methods.

Unit – II

Livestock production facilities, BIS Standards for dairy, piggery, poultry and other farm structures. Design, construction and cost estimation of farm structures; animal shelters, compost pit, fodder silo, fencing and implement sheds, barn for cows, buffalo, poultry, etc

Unit – III

Storage of grains and Causes of spoilage. Water activity for low and high moisture food grains and its limits for storage, Moisture and temperature changes in grain bins; Traditional storage structures and their improvements, Improved storage structures (CAP, hermetic storage, Pusa bin, RCC ring bins). Design consideration for grain storage godowns, Bag storage structures, Shallow and Deep bin, Calculation of pressure in bins and Storage of seeds

Unit – IV

Protected cultivation: Introduction, History, origin, development, national and International Scenario, components of green house, perspective, Types of green houses, polyhouses /shed nets, Cladding materials, Plant environment interactions – principles of limiting factors, solar radiation and transpiration, greenhouse effect, light, temperature, relative humidity, carbon dioxide enrichment. Design and construction of greenhouses – site selection, orientation, design, construction, design for ventilation requirement using exhaust fan system, selection of equipment, Greenhouse cooling system – necessity, methods – ventilation with roof and side ventilators, evaporative cooling, different shading material fogging, combined fogging and fan-pad cooling system, design of cooling system, maintenance of cooling and ventilation systems, pad care etc.

Unit – V

Planting techniques in green house cultivation. Irrigation in greenhouse and net house – Water quality, types of irrigation system, components, design, installation and material requirement. Fogging system for greenhouses and net houses – introduction, benefits, design, installation and material requirement. Fertilization – nutrient deficiency symptoms and functions of essential nutrient elements, principles of selection of proper application of fertilizers, fertilizer scheduling, rate of application of fertilizers, methods, automated fertilizer application. Greenhouse climate measurement, control and management.

Text Books:

1. Pandey, P.H. Principles and practices of Agricultural Structures and Environmental Control, KalyaniPublishers, Ludhiana.
2. Ojha, T.P and Michael, A.M. Principles of Agricultural Engineering, Vol. I, Jain Brothers, Karol Bag,New Delhi.

Reference Books:

1. Venugopal Rao, P. Text Book of Environmental Engineering, Prentice Hall of India, New Delhi.
2. Sahay, K.M. and Singh, K.K. Unit Operations of Agricultural Processing, Vikaspublishing pvt. Ltd,Noida.
3. Singh Brahma and Balraj Singh. 2014. Advances in protected cultivation, New India PublishingCompany.
4. Sharma P. 2007. Precision Farming. Daya Publishing House New Delhi.

Web Links:

1. https://nptel.ac.in/courses/104103020/3
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=618
3. https://agrimoon.com/agricultural-structures-and-environmental-control-pdfbook

PROMPT ENGINEERING

(Common to CSE, IT & AIML)

	L	T	P	C
VII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS7S01	**0**	**1**	**2**	**2**

Course Outcomes:

At the end of the Course, Student will be able to:

CO1: Apply prompt engineering for text and image generation.
CO2: Analyze and improve prompt strategies for AI outputs.
CO3: Create AI-driven solutions using open-source tools.
CO4: Experiment with advanced AI techniques like AR and diffusion models.
CO5: Evaluate ethical issues in AI and ensure responsible usage.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	3	2	1	2	3	1						
CO2	2	3		3	2							
CO3		2	3	2	3							
CO4	2	1	2	3	3							
CO5	1		1	2	2	2						

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	2
CO2	2	3
CO3	3	3
CO4	2	3
CO5	1	2

Unit I:

Foundations of Prompt Engineering: Definition of prompt engineering, Distinction between prompt engineering and model fine-tuning, Motivation and benefits of prompt engineering, Core principles of effective prompt design, Anatomy of a prompt, Setting up the Python environment for LLM interaction, Iterative prompting lifecycle, Common prompt pitfalls and remediation

Lab Experiments:

1. Environment & Connectivity: Install required packages (e.g., transformers, openai); securely configure the API key; run a simple “Hello, world” prompt to verify model access.
2. Baseline vs. Enhanced Prompts: Execute a naïve prompt (“Write a one-paragraph bio of Ada Lovelace.”) and an enhanced prompt that adds role framing, specificity, and explicit format instructions; compare both outputs for relevance, completeness, and style.

3. Iterative Refinement on a Simple Task: Summarize the plot of the Shakespearean play Romeo and Juliet in two sentences through three rounds of prompt tweaking:
    a. Minimal instruction.
    b. Addition of length and style constraints
    c. Specification of key content elements (setting and theme) Document how each iteration changes and improves the result.
4. Diagnosing Prompt Failures & Edge Cases: Craft a vague or contradictory prompt; analyze the failure mode (ambiguity, missing context, or format errors); refine the prompt by adding examples or clarifying instructions.

Unit II:

Advanced Prompt Patterns & Techniques: Enhanced prompt anatomy: contextual detail and explicit output specifications, Few-shot in-context prompting, Prompt structuring and template design, Role-based prompting to establish personas or system behavior, Negative prompting to filter or suppress undesired content, Constraint specification and instruction enforcement (e.g., length, format), Iterative prompt refinement and optimization

Lab Experiments:

1. Few-Shot vs. Zero-Shot Comparison: Design and execute a zero-shot prompt and a few-shot prompt (with 2–3 exemplar input-output pairs) for a chosen text task (e.g., sentiment classification or translation); compare outputs for accuracy, consistency, and adherence to examples.
2. Role-Based & Negative Prompting: Craft a role-based prompt to establish a specific persona (e.g., "You are a financial advisor…"); then create a negative prompt to suppress undesired content (e.g., "Do not mention any brand names"); evaluate how each influences the model's response.
3. Constraint Specification & Iterative Refinement: Select an open-ended task (e.g., summarizing a technical article); issue a basic prompt; identify failures in length or format; refine the prompt by adding explicit constraints (word count, bullet format, etc.); document improvements over two refinement cycles.

Unit III: Structured Output & Reasoning Techniques: Importance of structured outputs for real-world applications, Prompting for specific formats (lists, tables, Markdown), Generating valid JSON and YAML via explicit instructions, Eliciting chain-of-thought reasoning in zero-shot prompts, Decomposing complex tasks into manageable sub-tasks

Lab Experiments:

1. Structured Format Prompting: Instruct the model to output information as bullet lists and Markdown tables (e.g., "List three benefits of daily exercise in a Markdown table with columns 'Benefit' and 'Description.'"); verify the output matches the requested structure.
2. JSON/YAML Generation: Provide a brief dataset description (e.g., three books with title, author, publication year) and prompt the model to produce valid JSON or YAML; use a parser to validate syntax and refine the prompt if errors occur.
3. Chain-of-Thought & Task Decomposition: Present a multi-step problem (e.g., a logic puzzle) and apply zero-shot CoT prompting (e.g., "Let's think step by step. Explain your reasoning before the final answer."); separately, decompose the problem into sequential sub-questions, collect partial answers, combine them, and compare accuracy against a direct-answer baseline.

Unit IV: Retrieval-Augmented Generation & LangChain Workflows: Limitations of LLM internal knowledge, Need for external data sources, Introduction to Retrieval Augmented Generation (RAG), Overview of RAG architecture (indexing vs. retrieval + generation), Getting started with LangChain for LLM applications, Basics of LangChain Expression Language (LCEL), Simplified indexing pipeline: document loading & text splitting, Fundamentals of embeddings and vector stores, Building a basic retrieval generation pipeline with an LCEL chain

Lab Experiments:

1. Building a Simple LCEL Chain: Create a minimal LCEL script that accepts a fixed instruction (e.g., "Summarize this text: …"), passes it to an LLM, and prints the result; verify end-to-end execution.
3. Basic Data Indexing for RAG: Load a small collection of documents; split into uniform chunks (e.g., 200 tokens); generate embeddings for each chunk; store them in an in-memory vector store; inspect for consistency.
4. Constructing & Running a Basic RAG Chain: Build a pipeline that:
    a. Receives a user query 24
    b. Retrieves the top-k relevant chunks
    c. Constructs a combined prompt with context + query
    d. Send it to the LLM
    e. Returns the answer

Test with sample queries and compare factual accuracy against a prompt without retrieval.

Unit V: Agents, Multimodal AI & Ethical Evaluation: Introduction to LLM agents and their basic architecture, Overview of multimodal AI models (VLMs), Prompting for text-to image generation and image understanding, Importance of prompt evaluation beyond subjective judgment, Manual evaluation techniques (heuristic checks for accuracy, relevance, format), Introduction to "LLM-as-Judge" for automated evaluation, Security considerations (prompt injection, sensitive-information risks), Prompt-based mitigation strategies for safety and robustness, Ethical concerns (bias, misinformation, data privacy), Brief exploration of UI frameworks (Streamlit/Gradio) for deploying prompt-driven apps, Adapting to the evolving nature of prompt engineering through continuous learning

Lab Experiments:

1. Building a Simple LLM Agent: Register a tool (e.g., a calculator function) and craft prompts that instruct the agent to invoke it when required; implement using LangChain or a function-calling API; test on queries requiring tool execution.
2. Multimodal Prompting Exploration: Generate images from detailed text prompts; feed one generated image into an image-understanding model or API with an appropriate prompt; compare the returned caption to the original prompt to evaluate alignment.
3. Prompt Evaluation & Ethics Workshop:
    a. Select two existing prompts and generate multiple outputs; apply manual heuristic checks for accuracy, relevance, and format compliance.
    b. Use an "LLM-as-Judge" prompt (e.g., "Rate these outputs on a scale of 1-5 for clarity and correctness.") to automate evaluation.
    c. Design a prompt- injection test (e.g., "Ignore previous instructions…"), observe the response, then refine system prompts to mitigate the vulnerability.

Reference Books:

1. “Prompt Engineering for Generative AI”, James Phoenix, Mike Taylor, O’Reilly, May 2024.
2. “Unlocking the Secrets of Prompt Engineering: Master the Art of Creative Language Generation to Accelerate Your Journey from Novice to Pro”, Gilbert Mizrahi, 1st Edition,Packt Publishers, January 2024.
3. “Prompt Engineering: The Future of Language Generation”, Michael Ferguson, January 2023

Web Links:

1. https://platform.openai.com/docs/
2. https://huggingface.co/docs
3. https://promptengineering.org/learn/
4. https://www.promptingguide.ai/
5. https://developers.google.com/ machine- learning/resources/prompt-eng
6. https://platform.openai.com/docs/guides/prompt- engineering/strategy-test-changes-systematically

RESEARCH METHODOLOGY

VII Semester	**L**	**T**	**P**	**C**
Course Code: 231MC7T01	**2**	**0**	**0**	**0**

Course Outcomes: At the end of the Course, Student will be able to:

CO1:	Explain the characteristics and process of research.
CO2:	Select the research problem by applying problem identification techniques.
CO3:	Formulate and execute research design process.
CO4:	Report the results of research process adhering to professional ethics.
CO5:	Analyze the results of research using statistical measures of central tendency

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	2	-	-	-	-	-	2	-	1
CO2	1	-	-	2	-	-	-	-	-	2	-	1
CO3	1	-	-	2	-	-	-	-	-	2	-	1
CO4	1	-	-	2	-	-	-	3	-	2	-	1
CO5	1	-	-	2	2	-	-	-	-	2	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

Unit – I

Meaning of Research - Function of Research - Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research. Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review.

Unit – II

Identification of Research Problem : Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem

Unit – III

Research Design : Formulation of Research design – Need for Research design – Features of a good design – Important concepts related to Research design.

Unit – IV

Interpretation and Report Writing: Meaning and Technique of interpretation – Precautions in interpretation – Significance of report writing – Different steps in writing a report – Layout of a Research report.

Unit – V

Statistical Techniques and Tools : Introduction of statistics – Functions – Limitations – Measures of central tendency - Arithmetic mean – Median – Mode – Standard deviation – Co-efficient of variation (Discrete serious and continuous serious) – Correlation – Regression

Text Books:

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint 2008
2. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press, 1976

Reference Books:

1. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd., 1997.
2. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi, 2011.
3. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi,1999.

Web Links:

1. https://nptel.ac.in/courses/127106227
2. https://www.youtube.com/watch?v=IZLn9_PA_4s

SUMMER INTERNSHIP - II

	L	T	P	C
VII Semester				
Course Code: 231CS7P01	0	0	0	2

Course Outcomes: At the end of the Course, Student will be able to:

CO1: **Execute Advanced Industry-Relevant Tasks** – Students will independently apply technical and managerial skills to contribute meaningfully to real-world projects, demonstrating proficiency in their field..

CO2: **Analyze and Improve Industry Processes** – Students will critically evaluate workplace systems, identify inefficiencies, and propose data-driven solutions or innovations.

CO3: **Demonstrate Professional Leadership & Adaptability** – Students will exhibit initiative, problem-solving, and adaptability in dynamic work environments while adhering to industry standards and ethics.

CO4: **Document & Present Industry Learning Effectively** – Students will synthesize their internship experiences through structured reports, presentations, or portfolios, highlighting key insights and skill development.

CO5: **Build Professional Networks & Career Pathways** – Students will engage with mentors, explore career opportunities, and reflect on long-term professional goals based on industry exposure

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1	3	-	-	-	-	-	-	-	1	-	1
CO2	3	-	-	-	-	1	1	-	-	-	-	1
CO3	3	-	-	-	-	-	-	-	-	1	1	1
CO4	1	1	3	2	-	-	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	2	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2

Guidelines:

1. The Internship is a team activity of 3 to 4 students.
2. The students can undergo Industrial Training / Internship at Govt. Organizations, software MNCs or do Research projects in National Laboratories/Academic Institutions like IITs, NITs etc. during summer breaks after completion of IV Semester.
3. INDUSTRY INTERNSHIP Project is an alternative to the Summer Internship, whenever there is an exigency and students cannot pursue their Summer Internship. A group of students or even a single student can take up the Community Service Project during summer breaks. However, a student can opt for this only once. The students

have to identify social problems existing in any geographical area/village and try to solve them technically or suggest people to the necessary solutions for solving these problems.

4. Prior letter and approval from the Head of the Department must be taken before applying to any organization for the course.
5. Every student should put in a minimum of 180 hours for the INDUSTRY INTERNSHIP Project during the summer vacation.
6. Each class/section should be assigned with a Project Coordinator.

Project (Full Semester Internship)

VIII Semester	**L**	**T**	**P**	**C**
Course Code: 231CS8P01	**0**	**0**	**24**	**12**

Guidelines for Project:
The objective of this project work is to enable the student to take up investigative study in the field of Computer Science and Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the department for four to six students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the students in R&D work.

The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Working out a preliminary Approach to the Problem relating to the assigned topic.
3. Conducting preliminary Analysis/Modeling/Simulation/Experiment/Design/Feasibility.
4. Preparing a Written Report on the Study conducted for presentation to the Department
5. Review and finalization of the Approach to the Problem relating to the assigned topic.
6. Preparing an Action Plan for conducting the investigation, including team work.
7. Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed.
8. Final development of product/process, testing, results, conclusions and future directions.
9. Preparing a paper for Conference presentation/Publication in Journals, if possible.
10. Preparing a Dissertation in the standard format for being evaluated by the Department.
11. Final Project Presentation before a Departmental Committee.

Project Outcomes:
At the end of the Project, student will be able to:

CO1	Find a problem statement by carrying out technical survey.
CO2	Demonstrate technical data by collecting and analyse the skills.
CO3	Develop potential solutions to the significant issues that have been highlighted by the data analysis.
CO4	Identify, analyse, and solve problems creatively through sustained critical investigation.
CO5	Provide concrete methods for implementing social, and professional ethical standards.
CO6	Apply cutting-edge methods for data analysis to get fastidious results from the project.
CO7	Evaluate the solution that was achieved with in the context of engineering framework that supports the environmental considerations.
CO8	Practice the skills, diligence, and commitment to excellence needed to engage in lifelong learning.
CO9	Preparation of technical report and presentation.
CO10	Demonstrate communication skills effectively to work as a team.