

PROGRAM CURRICULUM

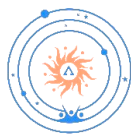
ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

(in Collaboration with Microsoft)

for

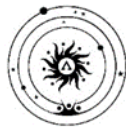
B. TECH. FOUR YEAR DEGREE PROGRAM

(Applicable for the batches admitted from A.Y 2025-26)



ADITYA UNIVERSITY

Aditya Nagar, ADB Road, Surampalem - 533 437



ADITYA UNIVERSITY

B.Tech. in Department of Artificial Intelligence and Machine Learning

VISION

To be a leading hub in Artificial Intelligence through excellence in education, innovation, and sustainable practices.

MISSION

M1: Deliver cutting-edge AI education with advanced tools, techniques, and industry collaboration to address global challenges.

M2: Nurture creativity, research, and lifelong learning for personal and professional excellence.

M3: Promote ethical leadership and sustainability to build a responsible AI ecosystem.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Apply emerging tools and technologies to solve interdisciplinary problems.

PEO2: Advance in education and research by applying innovative ideas and project-based learning.

PEO3: Work collaboratively and establish leadership with ethical, social, and financial accountability.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Apply core engineering, computing principles, AI and programming skills to develop efficient software solutions.

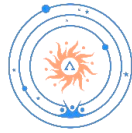
PSO2: Utilize emerging technologies to solve real-world challenges in industry and society with innovation and responsibility.

PROGRAM OUTCOMES (PO's)

The 11 Program Outcomes are described as below.

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

- PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 **Problem analysis:** Identify, formulate, review 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 system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- PO5 **Engineering tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- PO6 **The Engineer and the world :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- PO7 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
- PO8 **Individual and collaborative teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- PO9 **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.
- PO10 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- PO11 **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.



Department of Artificial Intelligence and Machine Learning

B.Tech (AI&ML) in Collaboration with Microsoft Program Curriculum-2025 (Applicable for the batches admitted from the A.Y.2025-26)

UG Programs Offered

- B. Tech in (Artificial Intelligence and Machine Learning)
- Minor Stream offered in B.Tech (Artificial Intelligence and Machine Learning) in Analytics and Security - Collaboration with Microsoft
- B. Tech in (Artificial Intelligence and Machine Learning) with
 - Minor degree in Civil Engineering.
 - Minor degree in Electrical and Electronics Engineering
 - Minor degree in Mechanical Engineering
 - Minor degree in Electronics and Communication Engineering
 - Minor degree in Petroleum Technology
 - Minor degree in Mining Engineering
 - Minor degree in Agricultural Engineering
 - Minor degree in Entrepreneurship Development and Incubation
 - Minor degree in Quantum Technologies

Credit Division Category-wise

S.No	Broad Category of Course	UGC	Credits
1	Major Core Courses (MCC)	80	85
2	Minor Stream Courses (MSC)	32	32
3	Multidisciplinary Courses (MDC)	9	9
4	Ability Enhancement Courses (AEC)	8	9
5	Skill Enhancement Courses (SEC)	9	5
6	Value Added Courses (VAC)	6-8	4
7	Summer Internships (SI)	2-4	4
8	Full Semester Internship (PROJ)	12	12
9	Mandatory Courses (MC)		0
10	Certification Courses (CC)		0
Total Credits to be earned for B.Tech Degree		160	160

Foundation Courses – FC

Intermediate-level Courses - IC

Advanced Courses – AC

Major Core Courses (MCC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501CS71	Computer Organization & Architecture	FC	2	1		3	50	50	100	DLD
2501PH02	Modern Physics	FC	2		1	3	50	50	100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501IT42	Programming with Python	FC	2		2	4	50	50	100	PPSC
2501CS01	Programming for Problem Solving using C	FC	2		2	4	50	50	100	-
2501CS03	Data Structures	FC	2		2	4	50	50	100	PPSC
2501IT01	Business Intelligence Lab	FC			2	2	50	50	100	-
2501MA08	Discrete Mathematics	IC	2	1		3	50	50	100	LAC
2501MA09	Probability & Statistics	IC	2	1		3	50	50	100	LAC
2501AI02	Artificial Intelligence	IC	2		1	3	50	50	100	-
2501CS08	Object Oriented Programming through C++	IC	2		2	4	50	50	100	PPSC
2501IT05	Database Management Systems	IC	2		2	4	50	50	100	PPSC
2501AI03	Data Mining	IC	1		2	3	50	50	100	-
2501IT06	Java Programming	IC	2		2	4	50	50	100	PPSC
2501CS09	Language Processors	IC	2	1		3	50	50	100	PPSC
2501IT07	Agile Software Engineering	IC	2		1	3	50	50	100	PPSC
2501CS13	Operating Systems	IC	2		1	3	50	50	100	-
2501CS07	Computer Networks	IC	2		1	3	50	50	100	-
2501AI05	Machine Learning	IC	2		2	4	50	50	100	DAE
2501CS10	Advanced Data Structures & Algorithm Analysis	AC	2		1	3	50	50	100	DS
2501AI11	Deep Learning	AC	2		2	4	50	50	100	DAE
2501AI20	Natural Language Processing & Prompt Engineering	AC	1		2	3	50	50	100	ML
2501AI21	Reinforcement Learning & Gen AI	AC	1		2	3	50	50	100	ML
2501AI04	Big Data Analytics	AC	2		1	3	50	50	100	DM
Total			46	6	33	85				

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE01	Basic Electrical & Electronics Engineering	FC	2		2	4	50	50	100	-
2501EC95	Digital Logic Design	FC	2	1		3	50	50	100	-
2501MB01	Engineering Economics & Management	FC	2			2	50	50	100	-
Total			6	1	2	9				

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EN01	Essential Cognitive Skills for Engineers	FC			1	1	100	-	100	-
2501EN02	Advanced Cognitive Skills for Engineers	FC			1	1	100	-	100	ECSE-I
2501UC07	Design Thinking	FC			1	1	100	-	100	-
2501UC08	Universal Human Values	FC	2			2	100	-	100	-
2501UC09	Technical Paper Publication	AC			2	2	100	-	100	-
2501AI35	Student Activity Based Learning	AC				2				
Total			2		5	9				

Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS17	Object Oriented Analysis & Design using UML	IC			2	2	50	50	100	ASE
2501AI34	Web Application Development using MERN Stack	AC			2	2	50	50	100	-
2501CS19	CI/CD using DevOps	AC			1	1	100	-	100	-
Total					5	5				

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS04	Internet of Things	FC			1	1	50	50	100	-
2501AI06	Data Analysis Essentials	IC			2	2	50	50	100	PP
2501UC11	Employability Skills-I	FC			3	0	100	-	100	-
2501UC13	Employability Skills-II	FC			3	0	100	-	100	ES-I
2501UC14	Employability Skills-III	IC			3	0	100	-	100	ES-II
2501UC15	Employability Skills-IV	IC			3	0	100	-	100	ES-III
2501UC16	Employability Skills-V	AC			3	1	100	-	100	ES-IV
Total							18	4		

Summer Internships (SI)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AI22	Summer Internship-I	IC			2	2	100	-	100	-
2501AI23	Summer Internship-II	AC			2	2	100	-	100	-
Total							4	4		

Full Semester Internship (PROJ)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AI25	Full Semester Internship	AC			12	12	50	50	100	-
Total							12	12		

Mandatory Courses (MC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AC01	Environmental Science	FC	2			0	100	-	100	-
2501AC02	Constitution of India	FC	2			0	100	-	100	-
2501AC03	Research Methodology	FC	2			0	100	-	100	-
2501AC04	Intellectual Property Rights & Patents	FC	2			0	100	-	100	-
2501AC05	Indian Knowledge Systems	FC	2			0	100	-	100	-
Total			10			0				

Minor Stream: Analytics and Security (In Collaboration with Microsoft)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AI36	Network Security Essentials	FC	2			2	50	50	100	-
2501AI37	Introduction to System Design	IC	2		1	3	50	50	100	-
2501AI38	Introduction to Generative AI	IC	2		1	3	50	50	100	-
2501AI39	Cloud Security Essentials	IC	2		1	3	50	50	100	-
2501AI40	Cyber Security Essentials	IC	2		1	3	50	50	100	-
2501AI41	Fundamentals of Block Chain	IC	2		1	3	50	50	100	-
2501AI42	AI for Cyber Threat Intelligence	IC	2		1	3	50	50	100	-
2501AI43	Generative Adversarial Networks Fundamentals	AC	2		1	3	50	50	100	-
2501AI44	AI in Healthcare Security	AC	2		1	3	50	50	100	-
2501AI45	Advanced Topics in Generative AI	AC	2		1	3	50	50	100	-
2501AI46	Ethical AI and Responsible Computing	AC	2		1	3	50	50	100	-
Total					32	32				

Certification Courses

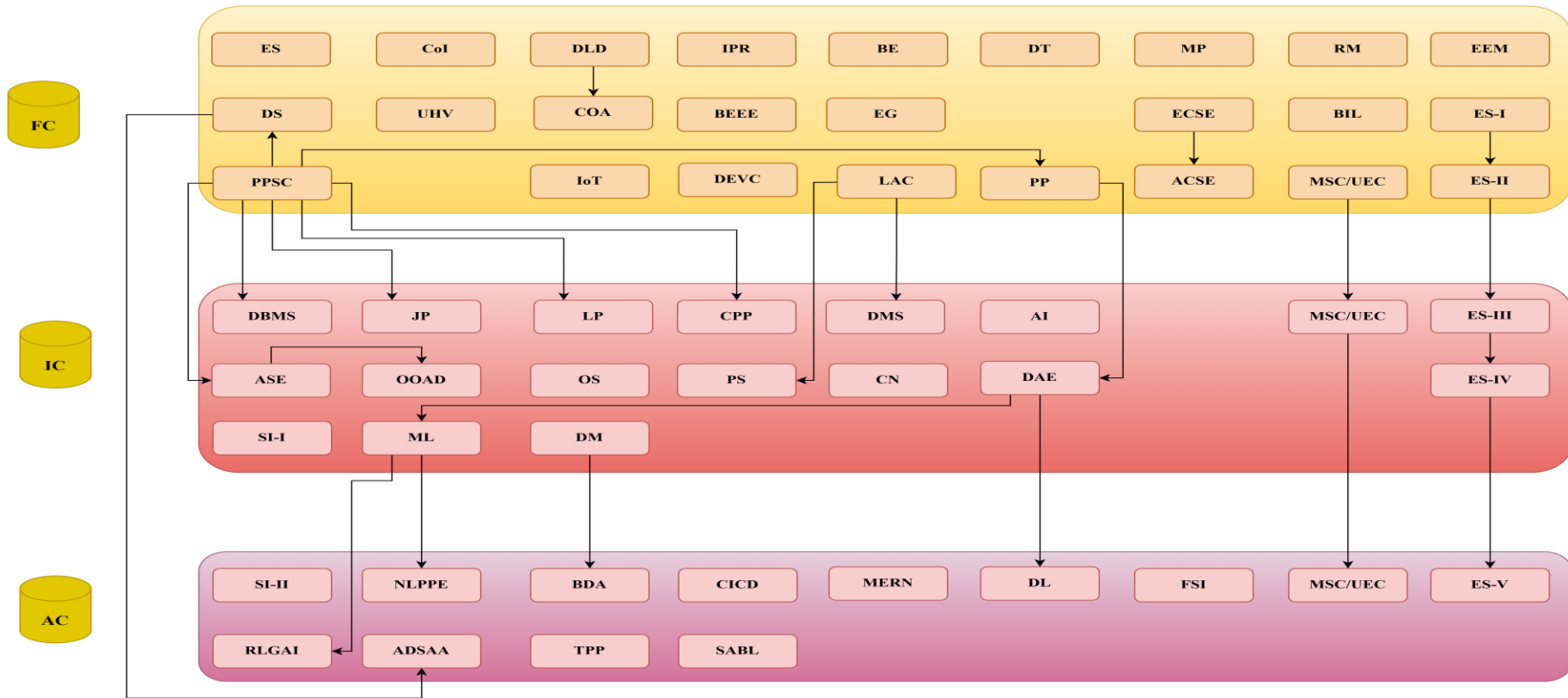
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
	Project Based Learning – Certification AZ-900 : Microsoft Azure Fundamentals	AC			2					-
	Project Based Learning - Certification AI-901: Azure AI Fundamentals	AC			2					-
	Project Based Learning - Certification DP-900: Azure Data Fundamentals	AC			2					-
	Project Based Learning - Certification AI-103: Azure AI App and Agent Developer	AC			2					-
	Project Based Learning - Certification AI-300: Azure MLOps Engineer	AC			2					-
	Project Based Learning - Certification AI-200: Azure AI Cloud Developer	AC			2					-
	Project Based Learning - Certification DP-800: Azure SQL AI Developer Associate	AC			2					-
Total										
					14					

Foundation Courses (FC)					
Course Title	Category	L	T	P	C
Linear Algebra & Calculus	MCC	2	1		3
Differential Equations & Vector Calculus	MCC	2	1		3
Computer Organization & Architecture	MCC	2	1		3
Modern Physics	MCC	2		1	3
Engineering Graphics	MCC	1		2	3
Programming with Python	MCC	2		2	4
Programming for Problem Solving Using C	MCC	2		2	4
Data Structures	MCC	2		2	4
Business Intelligence Lab	MCC			2	2
Basic Electrical & Electronics Engineering	MDC	2		2	4
Digital Logic Design	MDC	2	1		3
Engineering Economics & Management	MDC	2			2
Essential Cognitive Skills for Engineers	AEC			1	1
Advanced Cognitive Skills for Engineers	AEC			1	1
Design Thinking	AEC			1	1
Universal Human Values	AEC	2			2
Internet of Things	VAC			1	1
Employability Skills-I	VAC			3	0
Employability Skills-II	VAC			3	0
Environmental Science	MC	2			0
Constitution of India	MC	2			0
Research Methodology	MC	2			0
Intellectual Property Rights & Patents	MC	2			0
Biology for Engineers	MC	2			0
Courses from Minor Stream(s)	MSC				3

Intermediate-Level Courses (IC)					
Course Title	Category	L	T	P	C
Discrete Mathematics	MCC	2	1		3
Probability & Statistics	MCC	2	1		3
Artificial Intelligence	MCC	2		1	3
Object Oriented Programming through C++	MCC	2		2	4
Database Management Systems	MCC	2		2	4
Data Mining	MCC	1		2	3
Java Programming	MCC	2		2	4
Language Processors	MCC	2	1		3
Agile Software Engineering	MCC	2		1	3
Operating Systems	MCC	2		1	3
Computer Networks	MCC	2		1	3
Machine Learning	MCC	2		2	4
Object Oriented Analysis & Design using UML	SEC			2	2
Data Analysis Essentials	VAC			2	2
Employability Skills-III	VAC			3	0
Employability Skills-IV	VAC			3	0
Summer Internship – I	SI			2	2
Courses from Minor Stream(s)	MSC				3

Advanced Courses (AC)					
Course Title	Category	L	T	P	C
Advanced Data Structures & Algorithm Analysis	MCC	2		1	3
Deep Learning	MCC	2		2	4
Natural Language Processing & Prompt Engineering	MCC	1		2	3
Reinforcement Learning & Gen AI	MCC	1		2	3
Big Data Analytics	MCC	2		1	3
Technical Paper Publication	AEC			2	2
Student Activity Based Learning	AEC				2
Web Application Development using MERN Stack	SEC			2	2
CI/CD using DevOps	SEC			1	1
Employability Skills-V	VAC			3	1
Summer Internship – II	SI			2	2
Full Semester Internship	PROJ			12	12
Courses from Minor Stream(s)	MSC				3

**B.Tech (AI&ML) Program Curriculum
Pre-requisites Flowchart**



FC-Foundation Courses

ES-Environmental Science
CoI-Constitution of India
DLD-Digital Logic Design
IPR- Intellectual Property Rights & Patents
BE- Biology for Engineers
DT- Design Thinking
MP- Modern Physics
RM-Research Methodology
EEM- Engineering Economics & Management
DS- Data Structures
UHV- Universal Human Values
COA- Computer Organization & Architecture
BEEE- Basic Electrical & Electronics Engineering
EG- Engineering Graphics
ECSE- Essential Cognitive Skills for Engineers
ITAI- Business Intelligence Lab
ES-I- Employability Skills-I
PPSC- Programming for Problem Solving Using C
IoT- Internet of Things
DEVC- Differential Equations & Vector Calculus
LAC- Linear Algebra & Calculus
PP- Programming with Python
ES-II-Employability Skills-II

IC-Intermediate-Level Courses

DBMS- Database Management Systems
JP- Java Programming
LP- Language Processors
CPP-Object Oriented programming through C++
DMS- Discrete Mathematics
AI- Artificial Intelligence
ES-III- Employability Skills-III
ASE- Agile Software Engineering
OOAD- Object Oriented Analysis & Design using UML
OS- Operating Systems
PS- Probability & Statistics
CN- Computer Networks
DAE- Data Analysis Essentials
ACSE-Advanced Cognitive Skills for Engineers
ES-IV-Employability Skills-IV
SI-1- Summer Internship – I
ML- Machine Learning
DM- Data Mining

AC-Advanced Courses

SI-II- Summer Internship – II
NLPPE- Natural Language Processing & Prompt Engineering
BDA- Big Data Analytics
CI/CD- CI/CD using DevOps
MERN- Web Application Development using MERN Stack
DL- Deep Learning
FSI- Full Semester Internship
ES-V-Employability Skills-V
RLGAI- Reinforcement Learning & Gen AI
ADSAA- Advanced Data Structures & Algorithm Analysis
TPP- Technical Paper Publication
SABL-Student Activity Based Learning

MSC- Minor Stream Courses

Suggestive Semester-wise Curriculum

I SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA01	Linear Algebra & Calculus	MCC	FC	2	1		3	3
2501CS01	Programming for Problem Solving Using C	MCC	FC	2		2	4	6
2501IT01	Business Intelligence Lab	MCC	FC			2	2	4
2501EC95	Digital Logic Design	MDC	FC	2	1		3	4
2501EE01	Basic Electrical & Electronics Engineering	MDC	FC	2		2	4	6
2501EN01	Essential Cognitive Skills for Engineers	AEC	FC			1	1	2
2501UC08	Universal Human Values	AEC	FC	2			2	2
	Project Based Learning – Certification AZ-900 : Microsoft Azure Fundamentals	CC	FC			2	0	4
Total				10	2	9	19	31

II SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA02	Differential Equations & Vector Calculus	MCC	FC	2	1		3	3
2501PH02	Modern Physics	MCC	FC	2		1	3	4
2501CS03	Data Structures	MCC	FC	2		2	4	6
2501ME01	Engineering Graphics	MCC	FC	1		2	3	5
2501CS71	Computer Organization & Architecture	MCC	FC	2	1		3	3
2501IT42	Programming with Python	MCC	IC	2		2	4	6
2501EN02	Advanced Cognitive Skills for Engineers	AEC	FC			1	1	2
2501UC07	Design Thinking	AEC	FC			1	1	2
2501UC11	Employability Skills-I	VAC	FC			3	0	6
2501AC01	Environmental Science	MC	FC	2			0	2
	Project Based Learning - Certification AI-901: Azure AI Fundamentals	CC	FC			2	0	4
Total				13	2	14	22	43

III SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA09	Probability & Statistics	MCC	IC	2	1		3	3
2501CS10	Advanced Data Structures & Algorithm Analysis	MCC	AC	2		1	3	4
2501AI02	Artificial Intelligence	MCC	IC	2		1	3	4
2501CS08	Object Oriented Programming through C++	MCC	IC	2		2	4	6
2501IT05	Database Management Systems	MCC	IC	2		2	4	6
2501IT07	Agile Software Engineering	MCC	IC	2		1	3	4
2501AI06	Data Analysis Essentials	VAC	IC			2	2	4
2501UC13	Employability Skills-II	VAC	FC			3	0	6
2501AC02	Constitution of India	MC	FC	2			0	2
	Project Based Learning - Certification DP-900 : Azure Data Fundamentals	CC	IC			2	0	4
Total				14	1	14	22	43

IV SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA08	Discrete Mathematics	MCC	IC	2	1		3	3
2501AI03	Data Mining	MCC	IC	1		2	3	5
2501IT06	Java Programming	MCC	IC	2		2	4	6
2501CS13	Operating Systems	MCC	IC	2		1	3	4
2501AI36	Minor Stream Course-1 Network Security Essentials	MSC	FC	2			2	2
2501AI37	Minor Stream Course-2 Introduction to System Design	MSC	FC	2		1	3	4
2501AI34	Web Application Development using MERN Stack	SEC	AC			2	2	4
2501UC14	Employability Skills-III	VAC	FC			3	0	6
2501AC03	Research Methodology	MC	FC	2			0	2
	Project Based Learning - Certification AI-103 : Azure AI App and Agent Developer	CC	IC			2	0	4
Total				13	1	13	20	40

V SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501CS07	Computer Networks	MCC	IC	2		1	3	4
2501AI05	Machine Learning	MCC	IC	2		2	4	6
2501AI38	Minor Stream Course-3 Introduction to Generative AI	MSC	IC	2		1	3	4
2501AI39	Minor Stream Course-4 Cloud Security Essentials	MSC	IC	2		1	3	4
2501AI40	Minor Stream Course-5 Cyber Security Essentials	MSC	IC	2		1	3	4
2501MB01	Engineering Economics & Management	MDC	FC	2			2	2
2501CS17	Object Oriented Analysis & Design using UML	SEC	IC			2	2	2
2501UC15	Employability Skills-IV	VAC	FC			3	0	6
2501AI22	Summer Internship-I	SI	IC			2	2	4
2501AC04	Intellectual Property Rights & Patents	MC	FC	2			0	2
	Project Based Learning - Certification AI-300 : Azure MLOps Engineer	CC	IC			2	0	4
Total				14	0	15	22	42

VI SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501AI11	Deep Learning	MCC	AC	2		2	4	6
2501AI20	Natural Language Processing & Prompt Engineering	MCC	AC	1		2	3	5
2501CS09	Language Processors	MCC	IC	2	1		3	3
2501AI41	Minor Stream Course-6 Fundamentals of Block Chain	MSC	IC	2		1	3	4
2501AI42	Minor Stream Course-7 AI for Cyber Threat Intelligence	MSC	IC	2		1	3	4
2501AI43	Minor Stream Course-8 Generative Adversarial Networks Fundamentals	MSC	IC	2		1	3	4
2501CS19	CI/CD using DevOps	SEC	AC			1	1	2
2501CS04	Internet of Things	VAC	FC			1	1	2
2501AC05	Indian Knowledge Systems	MC	FC	2			0	2
	Project Based Learning - Certification AI-200 : Azure AI Cloud Developer	CC	AC			2	0	4
Total				13	1	11	21	36

VII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501AI21	Reinforcement Learning & Gen AI	MCC	AC	1		2	3	5
2501AI04	Big Data Analytics	MCC	AC	2		1	3	4
2501AI44	Minor Stream Course-9 AI in Healthcare Security	MSC	AC	2		1	3	4
2501AI45	Minor Stream Course-10 Advanced Topics in Generative AI	MSC	AC	2		1	3	4
2501AI46	Minor Stream Course-11 Ethical AI and Responsible Computing	MSC	AC	2		1	3	4
2501AI23	Summer Internship-II	SI	AC			2	2	4
	Project Based Learning - Certification DP-800: Azure SQL AI Developer Associate	CC	AC			2	0	4
Total				9	0	10	17	29

VIII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501UC09	Technical Paper Publication	AEC	AC			2	2	4
2501UC16	Employability Skills-V	VAC	FC			3	1	6
2501AI35	Student Activity Based Learning	AEC	AC				2	4
2501AI25	Full Semester Internship	PROJ	AC			12	12	24
Total				0	0	17	17	38

Total Credit: 160.

*** To acquire a minor degree, a student has to earn 20 credits in addition to the 160 credits.**

Minor Degree in Civil Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE25	Repair & Rehabilitation of Structures	FC	3			3	50	50	100	-
2501CE43	Building Planning & Computer-Aided Drawing	FC			2	2	50	50	100	-
2501CE27	Green Buildings	FC	3			3	50	50	100	-
2501CE40	Fundamentals of Soil Behaviour	FC	2	1		3	50	50	100	-
2501CE54	Railway Engineering (or)	FC	3			3	50	50	100	-
2501CE47	Docks & Harbour Engineering									
2501CE36	Environmental Impact & Risk Management	IC	3			3	50	50	100	-
2501CE37	(or) Environmental Management									
2501CE56	Urban Transportation Planning (or)	IC	3			3	50	50	100	-
2501CE49	Intelligent Transportation Systems.									
TOTAL			17	1	2	20				

Minor Degree in Electrical and Electronics Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE55	Operation & Control of Electric machines	FC	2			2	50	50	100	BEEE
2501EE56	Fundamentals of Power Electronics	FC	2			2	50	50	100	BEEE
2501EE13	Electrical Measurements & Instrumentation	FC	2	1	1	4	50	50	100	ENA-1/BEEE
2501EE53	Electric Power Generation, Transmission & Distribution Systems	IC	3			3	50	50	100	ENA-1/BEEE
2501EE34	Alternative Energy Sources (or)	IC	3			3	50	50	100	EPGDS/ BEEE/ ISM
2501EE27	Utilization of Electrical Energy									
2501EE37	Hybrid Electric Vehicles (or)	AC	3			3	50	50	100	FPE/ OCEM
2501EE35	Special Electric machines									
2501EE43	Electrical Safety (or)	AC	3			3	50	50	100	EPGDS/ PSA

2501EE30	Methods & Algorithms for Intelligent Control										
TOTAL			18	1	1	20					

Minor Degree in Mechanical Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME74	Basic Mechanical Engineering	FC	2			2	50	50	100	-
2501ME04	Engineering Thermodynamics	IC	2	1		3	50	50	100	SSP/ MP
2501ME77	Introduction to Automobile Engineering (or)	IC	3			3	50	50	100	SSP/ MP
2501ME78	Mechanics of Solids									
2501ME12	Heat Power Engineering (or)	IC	2	1		3	50	50	100	ETD
2501ME40	Refrigeration & Air									
2501ME75	Production Technology	IC	3			3	50	50	100	EW
2501ME76	Metallurgy & Material Science	IC	3			3	50	50	100	SSP/ MP
2501ME79	Theory of Machines (or)	AC	3			3	50	50	100	SSP/ MP
2501ME80	Advanced Engineering Metrology									
TOTAL			18	2		20				

Minor Degree in Electronics and Communication Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EC87	Fundamentals of Communications	FC	2		1	3	50	50	100	-
2501EC88	Fundamentals of Signal Processing	FC	2		1	3	50	50	100	-
2501EC89	Analog & Digital Circuits	IC	2			2	50	50	100	BEEE
2501EC42	Wireless LAN's & PAN's	IC	2	1	0	3	50	50	100	-
2501EC90	Linear & Digital IC Applications (or)	IC	3			3	50	50	100	ADC
2501EC91	Sensors & Actuators									
2501EC92	Embedded Microcontrollers (or)	IC	2		1	3	50	50	100	ADC, PPSC
2501EC93	Digital System Design									
2501EC67	Introduction to Internet of things (or)	AC	2		1	3	50	50	100	EM, WLAN's & PAN's
2501EC74	Modern Wireless Communications		3			3	50	50	100	FC
TOTAL			15	1	4	20				

Minor Degree in Petroleum Technology

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT27	Introduction to Petroleum Engineering	FC	3			3	50	50	100	-
2501PT35	Unit Operations in Petroleum Industry	FC	3			3	50	50	100	-
2501PT47	Fundamentals of Geology & Reservoir Engineering	IC	3			3	50	50	100	-
2501PT48	Fundamentals of Drilling & Production Engineering (or)	IC	2			2	50	50	100	-
2501PT16	Unconventional Hydrocarbon Resources		2			2				
2501PT49	Natural Gas Hydrates (or)	AC	2			2	50	50	100	-
2501PT05	Fundamentals of Liquefied Natural Gas		2			2				
2501PT50	Artificial Lift Techniques (or)	AC	3			3	50	50	100	-
2501PT03	Enhanced Oil Recovery		2	1						
2501PT12	Petroleum Refinery Engineering	AC	2		2	4	50	50	100	-
TOTAL			17	1	2	20				

Minor Degree in Mining Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN03	Development of Mineral Deposits	FC	3			3	50	50	100	-
2501MN41	Green Mining	FC	3			3	50	50	100	-
2501MN06	Surface Mining	IC	3			3	50	50	100	DMD
2501MN24	Drilling & Blasting	IC	3			3			100	DMD
2501MN07	Underground Coal Mining Technology (or)	IC	3			3	50	50	100	DMD
2501MN08	Underground Metal Mining Technology									
2501MN14	Mine Legislation & General Safety (or)	AC	3			3	50	50	100	UCMT / UMMT
2501MN28	Environmental Pollution & Control									
2501MN45	Industrial Safety Practices (or)	AC	2			2	50	50	100	-
2501MN46	Ground Control									
TOTAL			20			20				

Minor Degree in Agricultural Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AE82	Fundamentals of Renewable Energy Sources	FC	3			3	50	50	100	
2501AE83	Post-harvest Engineering of Cereal Crops	FC	3			3	50	50	100	
2501AE84	Ground Water Hydrology	FC	3			3	50	50	100	
2501AE85	Micro Irrigation Systems	IC	2			2	50	50	100	
2501AE86	Surface Water Hydrology (or)	IC	3			3	50	50	100	GWH
2501AE87	Land & Water Management Engineering									
2501AE88	Agricultural Process Engineering & Food Quality (or)	AC	3			3	50	50	100	PHECC
2501AE89	Post-harvest Engineering for Horticultural Produce									
2501AE90	Agricultural Machinery & Equipment (or)	AC	3			3	50	50	100	FRES
2501AE91	Design of Bio-energy systems									
TOTAL			20			20				

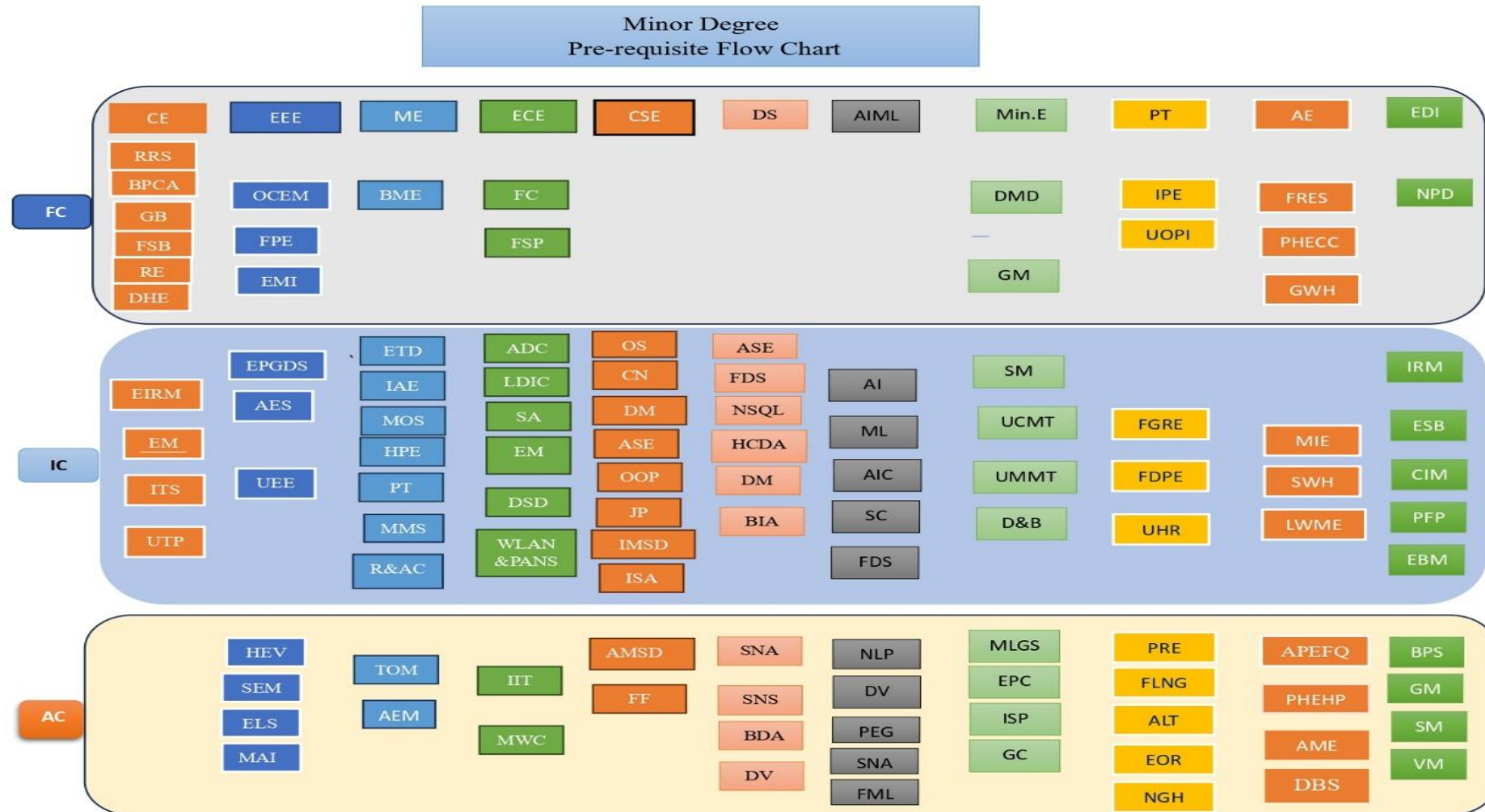
Minor Degree in Entrepreneurship Development & Incubation

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MB07	New Product Development	FC	3			3	50	50	100	-
2501MB08	Entrepreneurship & Small Business Management	IC	2			2	50	50	100	-
2501MB09	Insurance & Risk Management	IC	3			3	50	50	100	-
2501MB10	Change & Innovations Management	IC	3			3	50	50	100	-
2501MB11	Personal Financial Planning (or)	IC	3			3	50	50	100	-
2501MB12	E-Business management									
2501MB13	Business Policy & Strategic Management	AC	3			3	50	50	100	-
2501MB14	(or) Green Marketing									
2501MB15	Startup Management (or)	AC	3			3	50	50	100	-
2501MB16	Venture Management									

TOTAL	20		20				
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Minor Degree in Quantum Technologies

S.No.	Course Code	Course Name	L	T	P	C	Semester
Mandatory Courses							
1	251EC097	Survey of Quantum technologies and Application	3	0	0	3	IV
2	251EC098	Foundations of Quantum Technologies	3	0	0	3	V
3	251EC099	Basic Programming Lab (or)	1	0	2	3	V
	251EC100	Basic Laboratory Course for Quantum Technologies					
4	251EC101	Quantum Algorithms and Cryptography	12 week 3 Credit - NPTEL MOOC			3	VII/VIII
Any One course from the below							
5	251EC102	Introduction to Quantum Computation	3	0	0	3	VI
6	251EC103	Introduction to Quantum Communication	3	0	0	3	VI
7	251EC104	Introduction to Quantum Sensing	3	0	0	3	VI
8	251EC105	Introduction to Quantum Materials	3	0	0	3	VI
Any One course from the below							
9	251EC106	Engineering Foundations of Quantum Technologies	3	0	0	3	VII
10	251EC107	Solid State Physics for Quantum Technologies	3	0	0	3	VII
11	251EC108	Quantum Optics	3	0	0	3	VII
12	251EC109	Quantum Cybersecurity	3	0	0	3	VII
13	251EC110	Quantum Machine Learning	3	0	0	3	VII
Total			18	0	0	18	



Dept.	FOUNDATION COURSE		INTERMEDIATE- LEVEL COURSE		ADVANCED COURSE		
CE	RRS	Repair & Rehabilitation of Structures	EIRM	Environmental Impact & Risk Management			
	BPCA	Building Planning & Computer-Aided Drawing	EM	Environmental Management			
	GB	Green Building	UTP	Urban Transportation Planning			
	FSB	Fundamental of Soil Behaviour	ITS	Intelligent Transportation Systems			
	RE	Railway Engineering					
	DHE	Docks & Harbour Engineering					
EEE	OCEM	Operation control of Electric Machines	AES	Alternative Energy Sources	MAI	Methods & Algorithms for Intelligent Control	
	FPE	Fundamentals of Power Electronics	EPGDS	Electric Power Generation & Distribution Systems	HEV	Hybrid Electric Vehicles	
	EMI	Electrical Measurements & Instrumentation	UEE	Utilization of Electrical Energy	SEM	Special Electric Machines	
					ES	Electrical Safety	
ME	BME	Basic Mechanical Engineering	ETD	Engineering Thermodynamics	TOM	Theory of Machines	
			IAE	Introduction to Automobile Engineering	AEM	Advanced Engineering Metrology	
			MOS	Mechanics of Solids			
				HPE	Heat Power Engineering		
				PT	Production Technology		
				MMS	Metallurgy & Material Science		
				R&AC	Refrigeration & Air Conditioning		
ECE	FC	Fundamentals of Communications	ADC	Analog & Digital Circuits	IIT	Introduction to Internet of things	
			LDIC	Linear & Digital IC Applications			
			SA	Sensors & Actuators			
	FSP	Fundamentals of Signal Processing	EM	Embedded Microcontrollers	MWC	Modern Wireless Communications	
			DSD	Digital System Design			
			WLAN & PAN	Wireless LANS & PANS			
CSE			ASE	Agile Software Engineering	WADM S	Web Application Development using MERN Stack	
			OOP	Object Oriented Programming through C++			
			OS	Operating Systems	FF	Flutter Fundamentals	
			CN	Computer Networks			
			JP	Java Programming			
			PC++	Programming with C++			
			ISA	Information Security Analysis and Audit			
			DM	Data Mining			
DS			DM	Data Mining	SNA	Social Network Analysis	
			FDS	Fundamentals of Data Science	DV	Data Visualization	
			ASE	Agile Software Engineering	BDA	Big Data Analytics	
			NSQL	NoSQL Databases	SNSW	Social Networks and Semantic Web	
			BIA	Business Intelligence &			

				Analytics		
			HCDA	Health Care Data Analysis		
AIML			ML	Machine Learning	DV	Data Visualization
			AI	Artificial Intelligence	PEG	Prompt Engineering and GenAI
			AI C	AI Chatbot	SNA	Social Network Analysis
			FDS	Fundamentals of Data Science	FML	Federated Machine Learning
			SC	Soft Computing	NLP	Natural Language Processing
Min.E	DMD	Development of Mineral Deposits	SM	Surface Mining	MLGS	Mine Legislation and General Safety
	GM	Green Mining	UCMT	Underground Coal Mining Technology	EPC	Environmental Pollution & Control
			UMMT	Underground Metal Mining Technology	ISP	Industrial Safety Practices
			DB	Drilling & Blasting	GC	Ground Control
PT	IPE	Introduction to Petroleum Engineering	FGRE	Fundamentals of Geology and Reservoir Engineering	PRE	Petroleum Refinery Engineering
	UOPI	Unit operations in Petroleum Industry	FDPE	Fundamentals of Drilling and Production Engineering	FLNG	Fundamentals of Liquefied Natural Gas
					NGH	Natural Gas Hydrates
			UHR	Unconventional Hydrocarbon Resources	ALT	Artificial Lift Techniques
				EOR	Enhanced Oil Recovery	
Ag.E	GWH	Ground Water Hydrology	LWME	Land and Water Management	DBS	Design of Bio-Energy Systems
	PHEC	Post-harvest Engineering of Cereal Crops	SWH	Surface Water Hydrology	PHEHP	Post-Harvest Engineering for Horticultural Produce
			MIE	Micro Irrigation Systems		
	FRES	Fundamentals of Renewable Energy Sources			AME	Agricultural Machinery and Equipment
				APEFQ	Agriculture Process Engineering and Food Quality	
EDC	NPD	New Product Development	ESB	Entrepreneurship and Small Business Management	BPS	Business Policy & Strategic Management
			CIM	Change & Innovations Management	GM	Green Marketing
			PFP	Personal Financial Planning	SM	Startup Management
			EBM	E-Business Management	VM	Venture Management
			IRM	Insurance and Risk Management		

Major Core Courses (MCC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501CS71	Computer Organization & Architecture	FC	2	1		3	50	50	100	DLD
2501PH02	Modern Physics	FC	2		1	3	50	50	100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501IT42	Programming with Python	FC	2		2	4	50	50	100	PPSC
2501CS01	Programming for Problem Solving using C	FC	2		2	4	50	50	100	-
2501CS03	Data Structures	FC	2		2	4	50	50	100	PPSC
2501IT01	Business Intelligence Lab	FC			2	2	50	50	100	-
2501MA08	Discrete Mathematics	IC	2	1		3	50	50	100	LAC
2501MA09	Probability & Statistics	IC	2	1		3	50	50	100	LAC
2501AI02	Artificial Intelligence	IC	2		1	3	50	50	100	-
2501CS08	Object Oriented Programming through C++	IC	2		2	4	50	50	100	PPSC
2501IT05	Database Management Systems	IC	2		2	4	50	50	100	PPSC
2501AI03	Data Mining	IC	1		2	3	50	50	100	-
2501IT06	Java Programming	IC	2		2	4	50	50	100	PPSC
2501CS09	Language Processors	IC	2	1		3	50	50	100	PPSC
2501IT07	Agile Software Engineering	IC	2		1	3	50	50	100	PPSC
2501CS13	Operating Systems	IC	2		1	3	50	50	100	-
2501CS07	Computer Networks	IC	2		1	3	50	50	100	-
2501AI05	Machine Learning	IC	2		2	4	50	50	100	DAE
2501CS10	Advanced Data Structures & Algorithm Analysis	AC	2		1	3	50	50	100	DS
2501AI11	Deep Learning	AC	2		2	4	50	50	100	DAE
2501AI20	Natural Language Processing & Prompt Engineering	AC	1		2	3	50	50	100	ML
2501AI21	Reinforcement Learning & Gen AI	AC	1		2	3	50	50	100	ML
2501AI04	Big Data Analytics	AC	2		1	3	50	50	100	DM
Total			46	6	33	85				

Linear Algebra & Calculus

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501MA01	L	T	P	C
	2	1	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 differential calculus for one and several variable 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	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	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT-I

System of linear equations: Vector Space, Linear Independence, Rank of a matrix by echelon form, normal form, Inverse of Non-singular matrices by Gauss-Jordan method, Solutions of Linear Systems: Existence, Uniqueness, Solving the system by Gauss elimination method.

Practice(Using any computational tool):

1. Variables, arithmetic operations, elementary mathematical functions.
2. Defining row vector, column vector, Arithmetic operations on matrices
3. finding transpose of a matrix, inverse of a matrix, determinant of a matrix
4. rank of a matrix, , solving system of linear equations.

UNIT-II

Eigenvalues, Eigenvectors : Eigenvalues and properties(without proof), Eigenvectors, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), Quadratic forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation, Nature of Quadratic forms.

Practice(Using any computational tool):

1. Computing eigen values and eigen vectors, matrix diagonalization..

UNIT-III

One Variable Calculus:Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

Several Variable Calculus: Limit, Continuity, partial derivatives and their geometrical interpretation.

Practice(Using any computational tool):

1. Basics of plotting,Plot graphs of single variable functions

UNIT-IV

Functions of several variables:Total differential and differentiability,derivatives of composite and implicit functions,derivatives of higher order and their commutativity,Euler's theorem on homogeneous functions , Taylor's and Maclaurin's expansion of functions of two variables. Jacobians, maxima and minima, constrained maxima/minima problems using Lagrange's method of multipliers.

Practice(Using any computational tool):

1. Plot graphs of various multi variable functions.

UNIT – V

Multiple Integrals: 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).

Practice(Using any computational tool):

1. Plotting the region of Integration

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

- 1 Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
- 2 Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 5th Edition, 2018. ISBN-13. 978-1292174341

Reference Books:

- 1 Advanced Engineering Mathematics, Michael Greenberg, Pearson publishers, 9th edition. ISBN-13. 9788177585469
- 2 Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907

Web Links:

- 1 <https://archive.nptel.ac.in/courses/111/104/111104137/>
- 2 <https://archive.nptel.ac.in/courses/111/107/111107108/>
- 3 <https://www.khanacademy.org/math/linear-algebra/>
- 4 <https://www.khanacademy.org/math/multivariable-calculus>

Differential Equations & Vector Calculus
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

L T P C

Course Outcomes:

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

- CO1:** Solve the linear differential equations of first order and apply in various engineering problems.
- CO2:** Solve the linear differential equations of higher order and apply in various engineering problems.
- CO3:** Solve the linear 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	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	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT-I

Ordinary Differential Equations of First Order and First Degree: Solution of first order linear differential equations, exact differential equations and equations reducible to exact differential equations, Orthogonal Trajectories, Modelling of RL- circuit.

Practice(Using any computational tool) :

1. Solving the first order initial value problems using **odesolver** and plot the solution curves

UNIT-II

Linear Differential Equations of Higher Order: Solution of linear differential equations with constant coefficients, method of variation of parameters, solution of simultaneous linear differential equations.

Equations reducible to Linear differential equations with constant coefficients: Cauchy's homogeneous Linear Equations, Legendere's Linear Equations. Study of oscillations arising in LCR circuit (free oscillations and forced oscillations).

Practice(Using any computational tool) :

1. Solving the second order initial value problems using **odesolver** and plot the solution curves.

UNIT-III

Partial Differential Equations: Solution of linear PDE of first order by Lagrange's method, solution of homogeneous linear PDE of higher order with constant coefficients.

UNIT-IV

Vector Differentiation: Gradient of a scalar field, finding angle between two surfaces, directional derivative. Divergence and solenoidal fields. Curl and irrotational fields, Finding Scalar Potential.

Practice(Using any computational tool) :

1. Plotting of surfaces, 3D-plots, plotting vector fields.

UNIT – V

Vector Integration: Line integrals, work done by a force, conservative force field, surface integral, flux, volume integral. Green's theorem, Stoke's theorem and Gauss divergence theorem.

Students are advised to use any computational / AI Tool like Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

- 1 Advanced Engineering Mathematics, E. Kreyszig, John Willey & Sons, 10th Ed., 2018. ISBN 978-0470458365
- 2 Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021). ISBN 978-9383214204

Reference Books:

- 1 Advanced Engineering Mathematics, Dennis G. Zill, Jones & Bartlett Learning, 2018, 6th Edition. ISBN 978-1284105902.
- 2 Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill Education, 11'th Ed., 2017. ISBN 978-9339216016.

Web Links:

- 1 <https://www.classcentral.com/course/differential-equations-engineers-13258>
- 2 <https://archive.nptel.ac.in/courses/111/106/111106100/>
- 3 <https://www.khanacademy.org/math/differential-equations>
- 4 <https://archive.nptel.ac.in/courses/111/101/111101153/>
- 5 <https://archive.nptel.ac.in/courses/111/105/111105122/>

Computer Organization & Architecture
(Common to CSE, IT, AIML & CSE (DS))

L T P C

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
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, 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, Zvonko Vranesic, Safwat Zaky, 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>

Modern Physics

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

L T P C

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 the concepts of LASER's and Optical fibres with applications.
- CO3:** Explain the fundamental concepts of Quantum behavior of matter
- CO4:** Differentiate various electron theories to understand the properties of solids
- CO5:** Explain the basic concepts of Semiconductors and identify the type of semiconductors using Hall effect.

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

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 – Applications.

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

Practice:

1. Determination of Radius of curvature of a plano convex lens using Newton's Rings.
2. Measurement of Width or thickness of a thin wire by forming interference fringes.
3. Determination of Wavelength of light source using Diffraction grating by normal incidence method.
4. Resolving power of grating.
5. Determination of wavelength of light by using prism

UNIT-II
Lasers & Optical Fibres

Lasers: Introduction - Characteristics of Lasers – Spontaneous and Stimulated emission of radiation – population inversion- Einstein's coefficients – Relation - significance - Pumping Mechanisms - Ruby laser – Helium-Neon laser - Applications.

Optical Fibers: Introduction – Principle of propagation in Optical Fiber – Angle of acceptance – Expression for Numerical Aperture and condition for propagation – Classification of Optical fibers - Applications.

Practice:

1. Determination of Wavelength of He-Ne laser source by using diffraction grating.

UNIT-III

Quantum Mechanics Introduction – Matter waves – de Broglie’s hypothesis – Davisson and Germer Experiment - Heisenberg’s Uncertainty Principle – interpretation of wave function – Schrödinger Time dependent and Time Independent wave equations– Particle in a potential box.

UNIT-IV

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

Band theory of solids: Bloch Theorem – Origin of energy bands in crystalline solids – classification of crystalline solids.

Practice:

1. Study the variation of magnetic field along the axis of a circular coil carrying current by using Stewart and Gee’s apparatus.
2. Determination of Frequency of electrically maintained tuning fork by Melde’s apparatus.

UNIT – V

Semiconductor Physics Introduction – Intrinsic semiconductors – density of charge carriers – Electrical conductivity –Fermi level - extrinsic semiconductors - P-type & N-type semiconductors-Density of charge carriers (Qualitative) - Dependence of Fermi energy on carrier concentration and temperature–Hall effect-Hall coefficient - Applications of Hall effect–Drift and Diffusion currents - Einstein’s equation

Semiconductor Devices Working of PN junction diode – Zener diode Forward and reverse bias Zener diode -Metal-Oxide-Semiconductor (MOS) structure- Capacitance-voltage characteristics-MOSFET structure - I–V characteristics.

Practice:

1. Determination of V-I characteristics and Breakdown voltage of a Zener diode.
2. Determination of Energy band gap of a semiconductor by using P-N junction diode.
3. Study the relation between Temperature and resistance and finding the constants A & B of a thermistor.
4. Determine the resistivity of a semiconductor by four probe method.

Text Books:

- 1 Engineering Physics by M N Avadhanulu & T.V.S. Arun Murthy, S Chand &Company Ltd, 1st edition 2024. ISBN: 978-93-5870-932-3

- 2 Engineering Physics” by Satyendra Sharma and Jyotshna Sharma, Pearson publications, ISBN: 978-81-3151-178-7

Reference Books:

- 1 Concepts of Modern Physics by Authur Beiser, Shobhit Mahajan and S Rai Choudhary, McGraw Hill, ISBN: 9789351341857
- 2 Engineering Physics by M.R. Srinivasan, New Age international publishers, ISBN: 978-1848290501
- 3 “Optics” by Ajoy Ghatak, McGraw Hill Education, 6th Edition, ISBN: 978-9390113590

Web Links:

- 1 <http://nptel.ac.in/courses/122107035/11>
- 2 [http://nptel.ac.in/courses/115102023/-](http://nptel.ac.in/courses/115102023/)
- 3 <https://phet.colorado.edu/en/simulations/category/physics>
- 4 <http://physicsgecg.blogspot.in/p/reading-materials.html>

Engineering Graphics

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

L T P C

Course Code: 2501ME01

1 0 2 3

Course Outcomes:

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

- CO1:** Apply the principles of engineering drawing to construct Engineering curves
CO2: Construct projections of points and lines.
CO3: Demonstrate visualization skills of projections of planes.
CO4: Demonstrate visualization skills of projections of solids and development of surfaces
CO5: Construct isometric and orthographic views of simple solids.

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	1	-	2	-	-	-	1	1	-
CO2	3	2	1	-	2	-	-	-	1	1	-
CO3	3	2	1	-	2	-	-	-	1	1	-
CO4	3	2	1	-	2	-	-	-	1	1	-
CO5	3	2	1	-	2	-	-	-	1	1	-

Practice:

1. **Introduction to Engineering Graphics**
 - a. Introduction to AutoCAD, Dimensioning, elements of dimensioning, system of dimensioning, Conventions in Drawing.
2. **Construction of Cycloids and Involutes**
 - a. Construction of Cycloid, Epicycloid and Hypocycloid
 - b. Involute of a pentagon and circle
3. **Introduction to Orthographic projection**
 - a. Principles of Projection
 - b. Orthographic Projection – Four Quadrants
 - c. First angle & Third angle Projection with examples Reference plane, importance of reference lines or Plane
 - d. Projections of a point situated in any one of the four quadrants
4. **Projection of straight lines-I**
 - a. Projections of straight lines parallel to both reference planes.
 - b. Projections of straight lines perpendicular to one reference plane and parallel to other reference plane
 - c. Projections of straight line parallel to one plane & inclined to another plane
5. **Projection of straight lines-II**
 - a. Projections of straight line inclined to both reference planes
6. **Projection of planes**
 - a. Regular planes perpendicular to both reference planes, Parallel to one reference plane and inclined to the other reference plane
 Ex: Rectangle, Pentagon, Hexagon and Rhombus.

7. Projections of Planes

- a. Projections of Planes inclined to both reference planes Ex: Rectangle, Pentagon, Hexagon and Rhombus etc.

8. Projection of solids

- a. Axis Perpendicular to H.P and Axis Perpendicular to V.P
Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone
- b. Axis Parallel to H.P and V.P
Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

9. Projection of Solids

- a. Projection of Solids with axis inclined to one reference plane and parallel to another plane
Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

10. Development of Surfaces

- a. Development of a Prisms and Cylinder simple cases

11. Development of Surfaces

- a. Development of Pyramids and Cone simple cases

12. Conversion of Isometric views to Orthographic views

- a. Practice figure -1
- b. Practice figure -2

Additional Practice:**1. Conversion of Isometric views to Orthographic views**

- a. Practice figure – 3
- b. Practice figure - 4

2. Conversion of Orthographic views to Isometric views

- a. Practice figure - 1
- b. Practice figure - 2

Text Books:

- 1 Engineering Drawing, N. D. Bhatt, Charotar Publishing House, 54th edition, 2024, ISBN : 9789385039706.
- 2 Engineering Drawing and Graphics , Venugopal, New Age Publications, 2nd edition, 2019, ISBN: 9788122415452.

Reference Books:

- 1 Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2021, ISBN: 978-9385983177.
- 2 Computer Aided Engineering Graphics, T. Jeyapooan, Vikas Publishing house, New Delhi, 1st Edition, 2023, ISBN : 9789356743199.

Web Links:

- 1 <https://nptel.ac.in/courses/112103019/>
- 2 <https://academy.autodesk.com/authenticated-home-user>
- 3 <https://www.sciencedirect.com/book/9780080108391/engineering-drawing-from-thebeginning>

Programming with Python
(Common to CSE, IT, AI&ML and DS)

L T P C

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

- CO1:** Develop programs using fundamental concepts in python.
- CO2:** Solve problems using control statements and string methods.
- CO3:** Develop real time applications using data structures and functions.
- CO4:** Apply Object Oriented Programming concepts and files.
- CO5:** Build various applications using GUI and exceptions.

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	2	2	3	-	-	-	-	-	-	-	1
CO2	2	2	3	-	-	-	-	-	-	-	1
CO3	3	-	2	-	-	-	-	-	-	-	1
CO4	2	1	2	-	-	-	-	-	-	-	1
CO5	1	1	2	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	-
CO2	3	-
CO3	2	-
CO4	2	-
CO5	1	-

UNIT – I

Programming: 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.

Practice:

1. Basic Programs.
 - a. Convert weight from kilograms to pounds.
 - b. Input three numbers; compute total and average.
 - c. Use a for loop to print 8, 11, 14, ..., 89.
 - d. Accept user name and repeat it n times.
 - e. Print a triangle of height n using *.
2. Decision Structures and Loops.
 - a. Generate a random number (1-10), and ask the user to guess it.

- b. Accept two float values; print “Close” if difference ≤ 0.001 , else “Not Close”.
- c. Check if a string contains any vowels.
- d. Input a large number and insert commas (e.g., 1000000 \rightarrow 1,000,000).
- e. Insert * in expressions like $3x+4y$ to get $3*x+4*y$.

UNIT – II

Control Statements: 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.

Practice:

1. Conditional and Looping Constructs
 - a. Check if the year is a leap year or not.
 - b. Simulate a basic calculator using conditionals.
 - c. Display electricity bill based on consumption slabs.
 - d. Check if a number is prime and print all primes in a range.
 - e. Check for Armstrong number, Palindrome.
2. Loop-based Patterns and String Logic
 - a. Print a number pyramid.
 - b. Accept two strings of same length and interleave their characters.
 - c. Count vowels, consonants, digits in a string.
 - d. Convert strings: lowercase \leftrightarrow uppercase, toggle case.

UNIT – III

List and Dictionaries: 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.

Practice:

1. Working with Lists and Strings
 - a. Generate 20 random numbers; print min, max, avg, even count.
 - b. Generate a list of factors for a given integer.
 - c. Generate 100 random 0s and 1s; find longest run of 0s.
 - d. Remove duplicates from a list.
 - e. Menu-based unit converter (feet \leftrightarrow inches, yards, etc.)
2. Matrix and String Processing
 - a. Create and print matrices; add, multiply two matrices.
 - b. Reverse, concatenate, and find length of strings.
 - c. Count digit frequency in a string.
 - d. Print each word in a sentence on a new line.
 - e. Lower Triangular Matrix.

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.

Practice:

1. OOP – Classes and Methods
 - a. Create a Product class with dynamic pricing and stock update.
 - b. Create a Time class to convert seconds → minutes, hours.
 - c. Define Converter class for unit conversions (e.g., inches → feet).
2. File Handling
 - a. Read email addresses from file and print as semicolon-separated list.
 - b. Read temperatures from a file and convert them to Fahrenheit.
 - c. Count character frequencies in a file.
 - d. Count how many times each word appears in a file.
3. Additional OOP
 - a. Implement a class for pow(x, n).
 - b. Define a class to reverse a string word-by-word.

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.

Practice:

1. GUI and Exceptions
 - a. Build a file-open dialog and display content in a text box.
 - b. Demonstrate try/except/else blocks..
 - c. Show file handling using try/finally and with statements.
2. Integrated Problem Solving
 - a. Implement the Hangman game using string logic and loops.
 - b. Recursively reduce a number to a single-digit sum (e.g., $4683 \rightarrow 4+6+8+3=21 \rightarrow 2+1=3$).
 - c. Validate recursively whether an input is a well-formatted list.

Additional Practice:**1. Hangman**

The Goal: Despite the name, the actual “hangman” part isn’t necessary. The main goal here is to create a sort of “guess the word” game. The user needs to be able to input letter guesses. A limit should also be set on how many guesses they can use. This means you’ll need a way to grab a word to use for guessing. (This can be grabbed from a pre-made list. No need to get too fancy.) You will also need functions to check if the user has actually inputted a single letter, to check if the inputted letter is in the hidden word (and if it is, how many times it appears), to print letters, and a counter variable to limit guesses

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

numbers.

3. Write a program to find sum of digits of a number till you get single digit sum.

Example:

Input : 142 (Hint: $1+4+2=7$)

Output : 7

Input : 4683 (Hint: $4+6+8+3=21 \Rightarrow 2+1=3$)

Output : 3

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://onlinecourses.nptel.ac.in/noc21_cs32/preview/

Programming for Problem Solving using C

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

L T P C

Course Code: 2501CS01

2 0 2 4

Course Outcomes:

At the end of the course, 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 given problems.
- CO3:** Solve complex problems using arrays and strings.
- CO4:** Develop modular programming using functions.
- CO5:** Demonstrate dynamics memory allocations and file handling using file 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
CO1:	2	3	2	1	3	-	-	2	-	-	1
CO2:	2	3	2	1	3	-	-	2	-	-	1
CO3:	2	3	2	1	3	-	1	2	-	-	1
CO4:	2	3	2	1	3	-	1	2	-	-	1
CO5:	2	3	2	1	3	-	1	2	-	-	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

UNIT – I

Introduction to Programming and Problem Solving: Introduction to Programming Languages, Basics of a Computer Program- Algorithms, Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms, flowcharts (Using Dia Tool), pseudo code.

Structure of C Program, Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, operators, keywords, identifiers, Type Conversion, and Casting.

Practice 1:

1.
 - 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.
 - e. Objective: Learn about the syntax of reading from stdin and writing to stdout.
<https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true>
 - f. Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.

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.

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.

UNIT – II

Control Structures: Simple sequential programs, Conditional Statements (if, if-else, else if ladder, switch), Loops (for, nested for loop, while, do-while), break and continue, goto statement.

Practice:

1. Conditional Statements
 - a. Objective: Understand if and else Conditional statements in C.
<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.
2. Loops
 - a. Objective: Learn the usage of the for loop in C.
<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. Objective: Print a pattern of numbers using Loops.

- <https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true>
- g. Construct a Pyramid pattern.

UNIT – III

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

Sorting Techniques: bubble sort, selection sort.

Searching Techniques: linear, Binary search.

Practice:

1. 1-Dimensional Arrays
 - a. 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. 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.
2. 2-Dimensional 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.
3. Hacker Rank
 - a. 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
Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
 - c. Objective:Digit Frequency find the frequency of each digit in the given string.
<https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true>
 - d. Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.

UNIT – IV

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

Practice: Functions in C

1. Objective: Learn simple usage of functions.
<https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true>
2. Objective: Fibonacci Numbers using recursive function.
<https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem>

3. Objective: N^{th} factorial using recursion.
<https://www.hackerrank.com/contests/ccc-veltech-practice-set-ende/challenges/factorial-using-recursion-1>
4. Objective: Find the super digit of the integer.
<https://www.hackerrank.com/challenges/recursive-digit-sum/problem>
5. Implement LCM
6. Objective: Calculate the Nth term of series.
<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>

UNIT – V

Pointer: Introduction to Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, functions & pointers modifying parameters inside functions using pointers, Command line Arguments, Dynamic memory allocation, Null Pointer, generic pointer, dangling pointer.

File Handling: Introduction to Files, Using Files in C, Reading from Text Files, Writing to Text Files, Random File Access.

Practice:

1. Pointers
 - a. Objective: learn to implement the basic functionalities of pointers in C.
<https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true>
 - b. Objective: Learn using Pointers with Arrays and Functions.
<https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true>
 - c. 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. Objective: Dynamic Handling requests by a Librarian to place the books in the shelves.
<https://www.hackerrank.com/challenges/dynamic-array-in-c/problem?isFullScreen=true>
2. File handling concepts
 - a. Write text into and read text from a file.
 - b. Write text into and read text from a binary file using fread() and fwrite().
 - 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.

Additional Practice:

1. Variadic functions in C
Objective: Understanding variable number of arguments
<https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true>
2. Small Triangles, Large Triangles
Objective: Print sorted by their areas
<https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true>
3. Permutations of Strings

Objective: print all strings permutations in strict lexicographical order

<https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true>

Text Books:

- 1 Programming in C, Rema Theraja, Oxford, 2nd edition. ISBN 93-5497-9
- 2 "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall. ISBN 13: 9780131103627

Reference Books:

- 1 Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education. ISBN.No: 9352604172
- 2 Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill. ISBN No. 0071367993
- 3 Let Us C Yashwanth, Kanetkar, Eighth edition, BPB Publications. ISBN No. 1934015253
- 4 Programming in C A-Practical Approach Ajay Mittal. Pearson Education. ISBN No. 9788131729342
- 5 R G Dromey How to Solve It by Computer (Prentice-Hall International Series in Computer Science. ISBN-13 : 978-0134340012

Web Links:

- 1 <https://www.hackerrank.com/>
- 2 https://onlinecourses.nptel.ac.in/noc22_cs40/preview
- 3 <https://archive.nptel.ac.in/courses/106/104/106104128/>

Data Structures
 (Common to EEE, ECE, CSE, IT, AIML & CSE (DS))

Course Code: 2501CS03	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Utilize structure, union to handle heterogeneous data.
- CO2:** Illustrate Time and Space complexities for different searching and sorting Algorithms
- CO3:** Demonstrate various operations on Linked Lists
- CO4:** Explain different operations on Stack and Queue with applications.
- CO5:** Demonstrate the importance and various operation on non-linear data 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
CO1	1	1	2	-	-	-	-	-	1	1	-
CO2	1	1	2	2	-	-	-	-	1	1	-
CO3	1	2	2	1	-	-	-	-	1	1	-
CO4	1	1	2	1	-	-	-	-	1	1	-
CO5	1	1	2	2	-	-	-	-	1	1	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Structures and Unions: Introduction, Nested Structures, Arrays of Structures, Structures and Functions, Self-Referential Structures, Unions, Enumerated Data Type – enum variables, Using Typedef keyword, Bit Fields.

Data Structures: Introduction to Data Structures, Types of Data Structures.

Practice:

1. Write a C program to find the total, average of n students using structures
2. Copy one structure variable to another structure of the same type.
3. Read student name and marks from the command line and display the student details along with the total.

UNIT-II

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.

Sorting Techniques: Quick sort, Merge sort, Radix sort

Practice:

1. Implement Merge sort using arrays.
2. Implement Quick sort using arrays
3. Implement Radix Sort using arrays

UNIT-III

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

Practice:

1. Single Linked List: Perform different operations in single linked list.
2. Reversing a single linked list
3. Perform different operations in double linked list
4. Circular Linked List

UNIT-IV

Stacks: Introduction to stacks: properties and operations, implementing stacks using arrays and linked lists, applications of stacks.

Queues: Introduction to queues: properties and operations, Types of Queues, implementing queues using arrays and linked lists, applications of queues.

Practice:

1. Stack and its operations using arrays and Linked List
2. Implement a program to evaluate a postfix expression.
3. Queue and its operations using arrays and Linked List
4. Implement Circular Queue using Arrays

UNIT – V

Non-linear Data Structures:

Trees: Definition of tree, Tree Terminology, types of trees, Binary tree traversals, Binary Search Tree – Insertion, Deletion.

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

Practice:

1. Implement Binary search tree (BST).
2. Implement Binary search Tree (BST) Traversals.
3. Graph Traversal using Breadth First Search (BFS)
4. Graph Traversal using Depth First Search (DFS)

Additional Practice:

1. Using a structure for transporting some boxes through a tunnel
2. Delete duplicate-value nodes from a sorted linked list
3. Convert an infix expression into postfix expression
4. De Queue Implementation

Text Books:

- 1 Data Structures using C, Rema Theraja, Oxford University Press, 3rd edition. ISBN:9789354979453
- 2 Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN:9789358704730.

Reference Books:

- 1 The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
- 2 Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407
- 3 Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition. ISBN:978-0198099307

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/datastructures/>
- 4 <https://www.coursera.org/specializations/data-structures-algorithms>
- 5 <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

Business Intelligence Lab

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501IT01	L	T	P	C
	0	0	2	2

Course Outcomes:

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

- CO1:** Utilize Excel and Power BI for data analysis, visualization, and reporting.
- CO2:** Apply various data analysis techniques in Excel and Power BI to extract meaningful insights from datasets
- CO3:** Create clear and compelling visualizations using Excel and Power BI to communicate data-driven insights.
- CO4:** Develop data models in Power BI to organize and analyze data efficiently.
- CO5:** Design interactive dashboards in Power BI to facilitate data exploration and decision-making.

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	2	2	-	-	2	-	-	-	1	1	1
CO2	2	3	-	-	2	-	-	-	1	1	2
CO3	2	2	-	-	2	-	-	-	1	1	2
CO4	1	2	1	-	2	-	-	-	1	1	2
CO5	1	2	1	-	2	-	-	-	1	1	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

1. Introduction to Excel

- a. Overview of Excel and its capabilities for data analysis
- b. Basics of Excel: Navigating the interface, entering data, formatting cells
- c. Introduction to functions and formulas: SUM, AVERAGE, IF, VLOOKUP, etc.
- d. Importing data into Excel from different sources: CSV, text files.

2. Data Analysis with Excel

- a. Data manipulation techniques: Sorting, filtering, and grouping data
- b. Advanced functions and formulas: INDEX/MATCH, SUMIFS, COUNTIFS etc.
- c. Data visualization with Excel: Creating charts and graphs
- d. Using PivotTables for data summarization and analysis

3. **Advanced Excel Features**
 - a. Introduction to Excel tables and structured references
 - b. Working with named ranges and dynamic ranges
 - c. Excel data validation techniques

4. **Introduction to Power BI**
 - a. Overview of Power BI and its advantages over Excel for large datasets
 - b. Installing Power BI Desktop
 - c. Understanding the Power BI interface: Navigation, ribbons, and panes
 - d. Importing data into Power BI Desktop from various sources

5. **Data Preparation in Power BI**
 - a. Introduction to Power Query for data transformation
 - b. Cleaning, shaping, and filtering data in Power Query Editor

6. **Data Preparation in Power BI**
 - a. Combining data from different sources
 - b. Loading data into Power BI model.

7. **Data Modelling in Power BI**
 - a. Understanding relationships between tables
 - b. Creating calculated columns and measures using DAX

8. **Data Modelling in Power BI**
 - a. Introduction to DAX functions: CALCULATE, FILTER, RELATED, etc.
 - b. Working with date and time functions in DAX

9. **Visualization Basics in Power BI**
 - a. Creating basic visualizations: Bar charts, line charts, pie charts, etc.
 - b. Customizing visualizations: Formatting, titles, legends, etc.

10. **Visualization Basics in Power BI**
 - a. Using slicers and filters to interact with visualizations
 - b. Adding drilldown capabilities to visualizations

11. **Advanced Visualizations and Dashboards in Power BI**
 - a. Exploring advanced visualizations: TreeMap, Waterfall chart, KPIs, etc.
 - b. Creating custom visuals from the marketplace

12. **Advanced Visualizations and Dashboards in Power BI**
 - a. Designing effective dashboards: Layout, arrangement, and organization
 - b. Adding interactivity with bookmarks and drillthrough

Additional Practice:

1. **Basic Data Analysis:** Import a dataset into Excel and perform basic data analysis tasks such as sorting, filtering, and creating simple charts to visualize the data.
2. **Expense Tracker:** Create a spreadsheet to track your expenses. You can have columns for date, item description, category, and amount. Use formulas to calculate totals and analyze your spending habits.
3. **Data modeling and extracting statistics from dataset:** Connecting Power BI to

local data files and cloud servers (COVID19 dataset will be imported into the Power BI for visualization).

Text Books:

- 1 Learn Power BI - Second Edition: A comprehensive, step-by-step guide for beginners to learn real-world business intelligence 2nd Edition, ISBN: 9781801811958.
- 2 Power BI Beginner: Zero to Hero in Power BI Desktop by Philip Seamark, ISBN: 1691641227.

Reference Books:

- 1 Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life" by Devin Knight and Siddharth Mehta.
- 2 Learn Power BI: A Beginner's Guide to Analyzing Data and Creating Reports with Power BI" by Murilo Miranda.

Web Links:

- 1 <https://learn.microsoft.com/en-us/power-bi/>
- 2 <https://support.microsoft.com/en-us/excel>
- 3 <https://cce.sydney.edu.au/course/MSE1>
- 4 <https://cce.sydney.edu.au/course/PBBA>

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

Course Code: 2501MA08	L	T	P	C
	2	1	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:** Apply basic counting techniques to solve the combinatorial problems.
- CO4:** Solve recurrence relations by various methods.
- CO5:** Apply the concepts of Graph theory to find Euler paths, Hamiltonian paths and demonstrate different traversal methods for trees.

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

UNIT-I

Logic: Propositional Logic: Statements and logical connectives, Well-Formed Formulas, Truth Tables, Tautologies, Equivalence of Formulas, Duality Law, Tautological Implications, Normal Forms, Theory of Inference for Statement Calculus. Predicate Logic: Statement Functions, Variables, and Quantifiers; Inference Theory for Predicate Calculus.

Practice(Using any computational tool) :

1. Construct the truth table calculator taking two inputs, P and Q, and calculate AND, OR and NOT.

UNIT-II

Relations: Properties of Binary Relations, Relation Matrix, Digraph, Operations on Relations, Partition and Covering, Transitive, Closure, Warshall Algorithm, Equivalence Relation, R-Equivalence Class, partially ordered sets, Hasse Diagrams.

UNIT-III

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

UNIT-IV

Recurrence Relations: Formation of Recurrence Relations, Solving Recurrence Relations by Substitution and Generating Functions, Method of Characteristic Roots.

Practice (Using any computational tool):

1. Compute the n^{th} Fibonacci number

UNIT – V

Graph Theory: Basic Concepts of Graphs, Matrix Representation of Graphs: Adjacency Matrix, Incidence Matrix, Isomorphic Graphs, Paths and Circuits, Euler and Hamilton Graphs, Planar Graphs, and Euler's Formula.

Trees: Tree Properties, Spanning Trees, BFS Algorithm, DFS Algorithm, Minimal Spanning Trees, and Kruskal's Algorithm, Graph coloring, chromatic number.

Practice (Using any computational tool):

1. BFS and DFS algorithms.

Text Books:

- 1 Discrete Mathematics and its Applications with Combinatorics and Graph Theory, Kenneth H. Rosen, McGraw Hill Education (India) Private Limited. ISBN 9780070681880.
- 2 Discrete Mathematical Structures with Applications to Computer Science, J. P. Tremblay and R. Manohar, Tata Mc Graw Hill. ISBN 978-0074631133

Reference Books:

- 1 Discrete Mathematical Structures, Bernard Kolman, Robert C. Busby and Sharon Cutler Ross, PHI. ISBN 978-9332549593.
- 2 Mathematical Foundations of Computer Science, S. Santha, E. V. Prasad, Cengage Publishers. ISBN 978-8131515938.

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/>

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

Course Code: 2501MA09	L	T	P	C
	2	1	0	3

Course Outcomes:

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

- CO1:** Apply Baye’s theorem
- CO2:** Apply various Probability distributions for both discrete and continuous random variables
- CO3:** Compute mean and variance of sample means with replacement and without replacement and maximum errors.
- CO4:** Apply various tests to test the hypothesis concerning mean, Proportion, variance and attributes.
- CO5:** Apply the concepts of correlation and regression to the given statistical data.

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

UNIT-I

Probability and Random Variables:

Probability – Conditional probability and Baye’s Theorem-Random variables – Discrete and Continuous random variables-Mathematical Expectation, Variance and Moment generating function.

Practice(Using any computational tool):

1. Calculation of Mean and Variance.

UNIT-II

Probability Distributions:

Distribution function –Binomial, Poisson, Normal and Exponential distributions.

Practice(Using any computational tool):

1. Discrete and continuous probability distributions (Binomial, Poisson, normal and exponential distributions)

UNIT-III

Data Analytics and Sampling Theory:

Data science –Collection of data – primary and secondary data – Types of variables:

dependent and independent Categorical and Continuous variables – Data visualization – Measures of Central tendency(Mean,mode and median) – Measures of Variability (spread or variance).

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

Practice (Using any computational tool):

1. Finding measures of variability and central tendency (mean, median, mode, arithmetic mean, geometric mean, Variance)
2. Data visualization (Construction of bar charts, pie charts).
3. Construction of confidence intervals

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 – Tests concerning one mean and two means (Large and Small samples) – Tests on proportions, Chi-Square and F test.

Practice(Using any computational tool):

1. Z-test, t-test and Chi-square test

UNIT – V

Correlation and Regression: Method of least squares – Straight line - nonlinear curves– parabola -Exponential – Power curves-Correlation – Karl Pearson’s correlation coefficient – rank correlation – regression– regression coefficients and properties (without proof) – regression lines.

Practice(Using any computational tool):

1. Finding correlation coefficient and regression lines.

*Students are advised to use any Programming language/computational tool/AI tool like Python,Excel, PowerBI ,Wolfrum Alpha, Symbolab, Mathway, etc., for the practice

Text Books:

- 1 Miller and Freund’s, Probability and Statistics for Engineers, 9/e, Pearson, 2020. ISBN 978-9353945237
- 2 Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN **978-9351611738**

Reference Books:

- 1 Probability, Statistics and Random processes, T.Veerrajan, Tata McGraw-Hill.ISBN 978-0070669253
- 2 Probability and statistics by T.K.V. Iyengar, S. Chand publishers,2022 ISBN 9789355010643
- 3 Modern Statistics: Intuition, Math, Python, R by Mike X Cohen.ISBN 9798867723736

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc21_ma74/preview
- 2 <http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html>
- 3 <https://www.khanacademy.org/math/statistics-probability>
- 4 <https://www.geeksforgeeks.org/statistics-with-python/>
- 5 <https://www.coursera.org/learn/inferential-statistical-analysis-python?specialization=statistics-with-python>

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

Course Code: 2501AI02	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Illustrate the historical development of AI, key milestones and contributors.
- CO2:** Apply the basic principles of AI in problem solving
- CO3:** Apply Local Search Algorithms and Optimization Techniques.
- CO4:** Choose the appropriate representation of Knowledge.
- CO5:** Summarise the expert systems and real time 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
CO1	3	-	-	1	-	-	-	1	1	-	1
CO2	3	2	-	2	-	-	-	1	1	-	1
CO3	3	2	1	2	1	-	-	1	1	-	1
CO4	2	-	1	-	-	-	-	1	1	-	-
CO5	2	2	1	1	1	-	-	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Introduction: What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Practice:

1. Introduction to LISP :
 - To demonstrate simple recursive functions and list manipulation in LISP
2. Introduction to Prolog :
 - Provide a brief introduction to Prolog syntax, including facts, rules, and queries.

UNIT-II

Problem formulation: Problem Definition Production systems, Control strategies, Search strategies. Problem characteristics, ProblemSolving Agents, Example Problems, Searching

for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies

Practice:

1. Implementation of DFS for water jug problem using LISP/PROLOG
2. Implementation of BFS for tictactoe problem using LISP/PROLOG

UNIT-III

Problem solving methods: Problem graphs, Matching, Indexing and Heuristic functions Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions, , Constraints satisfaction – Measure of performance and analysis of search algorithms. Game playing.

Practice:

1. Implementation of TSP using heuristic approach using LISP/Prolog
2. Implementation of Hillclimbing to solve 8 Puzzle Problem

UNIT-IV

Knowledge representation: Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logicStructured representation of knowledge Basic plan generation systems – Strips Advanced plan generation systems – K strips Strategic explanations Why, why not and how explanations.

Practice:

1. Design a semantic network to represent knowledge about a specific domain, such as animals or transportation systems. Experiment with different node types, relationships, and attributes to encode information effectively. Implement a Python / LISP code for this program.
2. Create a framebased representation for a simple domain like a restaurant. Define frame templates for entities like menu items, customers, and orders, along with slots for attributes such as price, ingredients, and customer preferences.

UNIT – V

Expert Learning: Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

Practice:

1. Using PYTHON / LISP , develop an expert system to help users plan travel itineraries, including transportation, accommodation, and activities. Utilize knowledge about travel destinations, transportation options, and user preferences to generate personalized travel plans.
2. Using PYTHON / LISP , create an expert system to assist students in selecting courses, majors, or career paths based on their interests, skills, and academic performance. Use knowledge about educational programs, career prospects, and academic requirements to make personalized recommendations.

Text Books:

- 1 Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig , Pearson, 3rd Edition, ISBN: 978-9332543515
- 2 Artificial Intelligence: Structures and Strategies for Complex Problem Solving by George F. Luger, 2nd Edition, ISBN: 978-0805347807

Reference Books:

- 1 Artificial Intelligence, Saroj Kaushik, Cengage Learning India, ISBN: 978-8131510995
- 2 Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw Hill, ISBN: 978-0-07-052263-3
- 3 Artificial Intelligence: Foundations for Computational Agents, David Poole and Alan Mackworth, Cambridge University Press, ISBN: 978-1107195394

Web Links:

- 1 <https://nptel.ac.in/courses/106105077>
- 2 <https://nptel.ac.in/courses/106106126>
- 3 <https://aima.cs.berkeley.edu>

Object Oriented Programming through C++
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501CS08	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Make use of C and C++ programming constructs to demonstrate OOP concepts.
- CO2:** Develop applications using constructor and destructor.
- CO3:** Apply C++ features for problem solving.
- CO4:** Apply inheritance concepts and file I/O to solve a given problem.
- CO5:** Design C++ classes using templates and STL.

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

UNIT – I

Introduction to C++: Differences between C and C++, Disadvantages of Conventional Programming, Evolution of C++, Key Concepts of Object Oriented Programming, Structure of C++ program , Advantages of OOP, scope resolution Operator, Namespace.

Practice:

1. Find the roots of a quadratic equation.
2. Find factorial of a given number using recursion
3. Implement scope resolution and namespaces.
4. Illustrate the use of default arguments and access specifiers

UNIT – II

Classes and Objects: Declaring Objects- Access Specifiers and their Scope, Defining Member Function, Rules for Inline Functions, static Member Variable, static Member Function, Friend functions, overloading Member Function, Array of Objects, Object as Parameter, Object as return type, Nested class, Introduction to Constructors and Destructor, Characteristics of Constructor and Destructor, Application with Constructor, Constructor with Arguments, Copy Constructor, Anonymous Objects.

Practice:

1. Program to illustrate inline functions and function overloading.
2. Program to illustrate friend function
3. Program to illustrate the use of Constructors and Destructors.
4. Program illustrating Constructor overloading.
5. Program illustrating Copy Constructor.

UNIT – III

Operator Overloading: Introduction, The Keyword Operator, Rules for Overloading Operators, Overloading Unary Operator, Overloading Binary Operator, Overloading using friend function.

Inheritance: Introduction, Reusability, Types of Inheritance, Virtual Base Classes, Object as a Class Member, Abstract Classes, Advantages and Disadvantages of Inheritance. Pointer to Class- Pointer Object, this Pointer, Pointer to Derived Classes and Base Class.

Binding Polymorphisms and Virtual Functions: Introduction, Binding in C++, Virtual Functions, Rules for Virtual Function, Abstract classes, Virtual Destructor

Practice:

1. Overload Unary, and Binary Operators using member function.
2. Overload Unary, and Binary Operators using friend function.
3. Incorporate various forms of Inheritance i. Single Inheritance ii. Multiple Inheritances
iii. Multi-level inheritance iv. Hierarchical Inheritance v. Hybrid inheritance
4. Order of execution of constructors and destructors in inheritance.
5. Illustrate the use of object as a class member, pointer to a class, this pointer and Virtual Base Class.
6. Illustrate virtual functions.
7. Implement pure virtual function and calculate the area of different shapes by using abstract class.

UNIT – IV

Generic Programming with Templates: Introduction, Need for Templates, Definition of class Templates, Normal Function Templates, Overloading of Template Function, Bubble Sort Using Function Templates, Difference between Templates and Macros, Linked list with

templates

Practice:

1. Illustrate the use of function template.
2. Implement template class.
3. Implement class templates with multiple parameters.

UNIT – V

Exception Handling: Introduction, Principles of Exception Handling, The Keywords try throw and catch, Multiple Catch Statements.

Files: Stream I/O ,Reading and writing to Files.

Overview of Standard Template Library: Introduction, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps

Practice:

1. Implement Exceptions handling.
2. Illustrate the use of multiple catch statements.
3. Implement List, Vector and its Operations.
4. Implement Deque and its Operations.
5. Implement Map and its Operations.

Additional Practice:

1. Develop a C++ program for flight booking system
2. Develop Qt application containing slider and spin box in which a slider responds to changes in the spin box.
3. Develop a Qt application for creating a text pad.
4. Develop a C++ program with maximum of 20 characters, that your user will be guessed and will show only asterisks (*) on the screen. The user will input or enter one character at a time. And for every correct character, the asterisk will be replaced by that character until all the characters or the mystery word/s will reveal. Your program will accept a maximum three (3) errors or mistakes in entering/inputting character otherwise the mystery word/s will be viewed. Sample Output: Output: ***** Enter your character: e
Output: ***e**e
Enter your character: a Output: sorry! the character is not existing. you still have 2 chances
Enter your character: s Output: s**e**e
Enter your character: c Output: sc*e*ce
Enter your character: i Output: scie*ce
Enter your character: n Output: science

Text Books:

- 1 The Complete Reference C++, Herbert Schildt, Fourth Edition, TMH ISBN-13:978-0070532465, and the ISBN-10 is 007053246X.
- 2 The C++ Programming Language, Bjarne Stroustrup, Fourth Edition, Pearson ISBN 978-0321563842

Reference Books:

- 1 A First Book Of C++, Gary Bronson, Fourth Edition, Cengage Learning ISBN-10. 8131532712 and ISBN-13. 978-8131532713
- 2 C++ Primer Plus By Stephen Prata, Sixth Edition, Pearson ISBN: 978-0321776402
- 3 C++ Programming:From Problem Analysis To Program Design, Ds Malik,Eighth Edition, Cengage Learning ISBN: 9781337102087

Web Links:

- 1 <http://nptel.ac.in/courses/106105151/>
- 2 <http://www.geeksforgeeks.org/c-plus-plus/>
- 3 https://infyspringboard.onwingspan.com/web/en/viewer/html/lex_auth_01350157284861542410101
- 4 <https://www.udemy.com/course/beginning-c-plus-plus-programming/>

Database Management Systems
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT05

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Describe the Fundamental concepts of DBMS.
- CO2:** Interpret relational database using SQL.
- CO3:** Make use of normalization techniques for database design.
- CO4:** Illustrate the mechanisms of transaction management.
- CO5:** Optimize database performance with advanced indexing, query optimization, and robust backup and recovery 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
CO1	3	3	3	-	1	-	-	1	-	-	-
CO2	3	3	3	2	2	1	-	1	-	-	-
CO3	3	3	3	3	3	2	-	-	-	-	1
CO4	3	3	3	1	2	1	-	-	-	-	-
CO5	3	3	3	3	3	2	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	3	3
CO2	3	2
CO3	3	2
CO4	3	1
CO5	3	2

UNIT-I

Introduction to DBMS: History and Architecture, Data Independence, Data Models, Levels of abstraction, structure of DBMS.

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.

Practice

1. Familiarization with installation of any DBMS.
2. Implementing a University Database System

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

BASIC SQL: Simple Database schema, data types, table definitions (create, alter), different DML operations (insert, delete, update), basic SQL querying (select and project) using where clause, arithmetic & logical operations, SQL functions(Date and Time, Numeric, String conversion).

Practice

1. Querying and modifying the database using Data Manipulation Language commands - select, insert, update, delete.
2. Implementation of Aggregate Functions – sum, avg, min, max, count. Use group-by and having clause.

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.

SQL: 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.

Practice

1. Perform join operations – natural join, equi-join, outer join, left outer join, right outer join, inner join and assess the impact of query plans on the performance of join heavy queries.
2. Perform set operations - union, intersection, set difference.
3. Implementation of correlated sub-queries and nested queries
4. Creating and querying views and materialized views.

UNIT-IV

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).

Transaction Concept: Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Storage, Recovery and Atomicity, Recovery algorithm.

Practice

1. Implement SQL queries on a normalized database schema based on the provided schema. For this example: use the schema for a university database, which includes:
 - Students (StudentID, StudentName, Major)
 - Courses (CourseID, CourseName, Credits)
 - Enrollments (StudentID, CourseID, EnrollmentDate)
 - Instructors (InstructorID, InstructorName, Phone)
 - Course_Instructors (CourseID, InstructorID)
2.
 - a. Implementation of Data Control Language commands – grant and revoke.

- b. Implementation of Transaction Control Language commands - commit, save point, and rollback.

UNIT – V

Database Tuning: Indexing Techniques, **B+ Trees:** Search, Insert, Delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, **Hash Based Indexing:** Tree base Indexing, Comparison of File Organizations, Indexes and Performance Tuning.

Query Optimization: Introduction, Query Optimization algorithms, Backup and Recovery.

Practice

1. How to Create a Primary , Secondary Index on a Column?
2. How to Retrieve Data Using an Index?
3. How to Insert Data and Update Indexes?
4. How to Delete Data and Impact on Indexes?

Note: The student must Complete & Submit a Database Foundations Certificate Course offered by Oracle Academy at the end of the Practice Session.

Text Books:

- 1 Database System Concepts ,Abraham Silberschatz, Henry Korth, and S. Sudarshan, McGraw-Hill , 8th Edition., ISBN-13: 978-1260230508.
- 2 Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Mc Graw-Hill, 4th Edition, ISBN: 978-1260091195.

Reference Books:

- 1 Fundamentals of Database Systems ,R Elmasri, S Navathe, Addison-Wesley.6th edition, ISBN: 978-0136086208..
- 2 Database Management Systems ,Ramakrishna Gehrke,Mcgraw Hill Publication,3rd Edition, ISBN: 978-0072465631 .
- 3 Introduction to Database Systems, C J Date, Pearson, 9th Edition, ISBN: 978-0133970777.

Web Links:

- 1 <https://academy.oracle.com/pages/coursedescription/Oracle%20Academy%20Database%20Foundations%20Course%20Description.pdf>
- 2 <https://www.w3schools.com/sql/>
- 3 https://onlinecourses.nptel.ac.in/noc22_cs91/

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

Course Code: 2501AI03	L	T	P	C
	1	0	2	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:** Apply preprocessing 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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	2	-	1	-	-	1	1	-	2
CO2	2	2	2	-	2	-	-	1	1	-	2
CO3	2	2	3	-	1	-	-	1	1	-	2
CO4	2	2	3	-	1	-	-	1	1	-	2
CO5	2	2	3	-	1	-	-	1	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Data Warehousing and Online Analytical Processing:

Data Warehouse: Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute Oriented Induction.

Data Mining: What Is Data Mining, Why Data Mining, Data Mining Functionalities, Technologies Are Used, Major Issues in Data Mining, Architecture Of Data Mining Systems Classification Of Data Mining Systems.

Practice:

1. Illustrate KDD process and explore the Data Mining tool WEKA/KNIME for Data Preprocessing, Classification and Clustering.
2. Explain ETL process important for moving data in the data warehouse.

UNIT-II

Know Your Data : Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity.

Data Preprocessing : An Overview, Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

Practice:

1. Apply Statistical Descriptions and Measures of Similarity and Dissimilarity on given data
2. Apply Preprocessing for training data set related to Weather data

UNIT-III

Classification and Prediction: Classification: Basic Concepts, General Approach to Solving a Classification Problem, Decision Tree Induction, Model Overfitting, Evaluating the Performance of a Classifier, Issues Regarding Classification and Prediction

Practice:

1. Demonstrate classification rule process on given data set using id3 algorithm.
2. Demonstrate classification rule process on Student's Academic Performance Data using j48 algorithm.

UNIT-IV

Mining Frequent Patterns, Associations and Correlations: Basic Concepts and Methods, Frequent Itemset Mining Methods, Which Patterns Are Interesting?—Pattern Evaluation Methods, Association Mining to Correlation Analysis.

Practice:

1. Demonstrate Association rule generation on credit card data using apriori algorithm.
2. Demonstrate Association rule process on contact lenses. arff using FPGrowth Algorithm

UNIT – V

Cluster Analysis: Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Evaluation of Clustering, Mining Spatial, Multimedia, Text and Web Data: Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

Practice

1. Demonstrate clustering process on given dataset using simple k-means
2. Apply Hierarchical clustering process on dataset.

Additional Practice:

1. Write a program of cluster analysis using DB SCAN algorithm Python programming language

2. Demonstrate Web/Text Mining using WEKA/KNIME Tool

Capstone project:

Implement a data mining application involving data preprocessing and various data mining tasks can be achieved by focusing on a specific domain, such as retail, sales and customers, and then applying different techniques to analyse the data. This project would involve data cleaning, transformation, and various data mining tasks like clustering and association rule mining of your own data set, potentially leading to valuable insights into various area of data mining Applications.

Text Books:

- 1 Data Mining Concepts and Techniques, Jiawei Han, Micheline Kamber and Jian Pei Third Edition, Elsevier, ISBN: 978-9380931913
- 2 Introduction to Data Mining, PangNing Tan, Michael Steinbach and Vipin Kumar Pearson Education, ISBN: 978-1-292-02615-2

Reference Books:

- 1 Data Mining: Introductory and Advanced Topics, Margaret H. Dunham, 1st Edition Pearson Edn, ISBN: 978-8177587852
- 2 Data Mining Techniques and Applications An Introduction, Hongbo Du, 1st Edition, Cengage India, ISBN: 978-8131519554
- 3 Data Warehousing, Data Mining and OLAP, Alex Berson,.Stephen J. Smith, McGrawHill series, ISBN: 978-0070062726

Web Links:

- 1 <https://nptel.ac.in/courses/106105174/>
- 2 <https://www.kdnuggets.com/>
- 3 <https://www.import.io/post/datascientistsvsdataanalystswhythedistinctionmatters/>

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

Course Code: 2501IT06	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Apply Java features for problem solving.
- CO2:** Build applications using principles of OOPs, interfaces and Packages.
- CO3:** Develop programs using Exception Handling to handle run-time errors.
- CO4:** Develop applications using multithreading for inter thread communication.
- CO5:** Build JDBC applications for performing CRUD operations using MySQL.

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	2	1	1	-	1	-	-	-	1	2	1
CO2	2	1	3	-	1	-	-	-	1	2	1
CO3	2	3	2	-	1	-	-	-	1	2	1
CO4	2	2	2	-	1	-	-	-	1	2	1
CO5	2	2	3	-	1	-	-	-	1	2	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

Introduction to Java: History of Java, Features of Java Language, JVM Architecture, Java source file structure. Building Blocks of Java, Control Statements, Operators, Type Conversion, Command Line Arguments, Arrays.

Practice:

1. **Control Statements**
 - a. Select all the prime numbers within the range of 1 to 100.
 - b. Find the sum of all even terms in the Fibonacci sequence up to the given range N.
 - c. Check whether a given number is Armstrong or not.
2. **Arrays**
 - a. Sort an array of integers in ascending order.
 - b. Find the maximum and minimum element in an array.
 - c. Remove duplicate elements from an array.

UNIT-II

Concepts of Class: Class, Object, Method, Constructor, Overloading- Method and Constructor Keywords: this, static and final, String Class and its Methods, String Tokenizer, String Buffer and StringBuilder.

Practice:

1. Class Mechanism

- a. Display the details of a person. Personal details should be given in one method and the qualification details in another method.
- b. Implement constructor and constructor overloading.
- c. Implement method overloading.

2. Strings

- a. Check if a given string is a pangram (contains every letter of the alphabet at least once).
- b. Find the most frequently occurring character in a string.
- c. Find all permutations of a given string.
- d. Check if a given string is an anagram (Ex: CAT and ACT).

UNIT-III

Inheritance: Inheritance, Types of Inheritance, super and super(), Method Overriding, Using final with inheritance, abstract with Class and Method, Dynamic Method Dispatch.

Interfaces: Introduction to interface, Multiple inheritance.

Practice:

1. Inheritance & interface

- a. Implement multi level Inheritance.
- b. Implement multiple Inheritance.
- c. Find the areas of different shapes using abstract classes.

UNIT-IV

Packages: Introduction, Importing Packages and Classes, path and classpath, Access Specifiers, java.util: Collection Framework (related interfaces and classes), java.io: File Reader, File Writer, File Input Stream, File Output Stream, Buffer Reader and Buffer Writer, Wrapper Classes.

Practice:

1. Packages & java.io

- a. Import and use user defined package.
- b. Illustrate the use of protected members in a package.
- c. Copy Even numbers into Even.txt file and Odd Numbers into Odd.txt file.

2. Collection Framework

- a. ArrayList and LinkedList
- b. Iterator and Iterable
- c. Comparator and Comparable
- d. HashMap and TreeMap
- e. HashSet and TreeSet
- f. HashTable

UNIT – V

Exception Handling: Introduction, Keywords: try, catch, throw, throws and finally, Multiple Catch Clauses, Checked and Unchecked Exceptions, User Defined Exceptions.

Multithreading: Introduction, Thread Life Cycle, Creation, Priorities, Synchronization, ITC.

Java Database Connectivity: Introduction, JDBC Architecture, Types of Drivers, JDBC Environment Setup, JDBC Steps, CRUD Operations.

Practice:

1. Exception Handling

- a. Illustrate exception handling mechanism using multiple catch clauses.
- b. Make use of Built-in and user-defined Exceptions in handling a run time exception.

2. Multithreading

- a. 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. Solve Producer-Consumer problem using synchronization.

3. JDBC

- a. CRUD operations.

Additional Practice:

1. Student Management
2. Inventory Management
3. Phone Book Management

Capstone Project:

Develop a console-based quiz application in Java where questions are fetched from a database. The app should handle user login, score calculation, timer using threads, exception handling, and store results in both files and database

*** Note: The student must Complete & Submit a Java Programming Certificate Course offered by Oracle Academy at the end of the Practice Session.**

Text Books:

- 1 The Complete Reference Java, Herbert Schildt, TMH ,8th Edition, ISBN 978-1260440232.
- 2 Java one step ahead, Anita seth, B.L.Juneja, Oxford, First Edition. ISBN: 9780199459643.

Reference Books:

- 1 Introduction to java programming, by Y Daniel Liang, Pearson, Seventh Edition, ISBN: 978-8131729588
- 2 Core Java: An Integrated Approach, R.Nageswara Rao, Dream tech press, ISBN:978-9351199250

Web Links:

- 1 <https://academy.oracle.com/pages/coursedescription/Oracle%20Academy%20Java%20Programming%20Course%20Description.pdf>
- 2 <https://nptel.ac.in/courses/106/105/106105191/>
- 3 <http://java.sun.com/docs/books/tutorial/>

Language Processors
(Common to AIML & CSE(DS))

Course Code: 2501CS09

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain the equivalence between NFA, DFA and Regular Expressions
- CO2:** Illustrate the concepts of Context Free Grammars, Push Down Automata and Turing Machines
- CO3:** Analyze the phases in compilation process.
- CO4:** Apply different parsing algorithms to develop parsers for a given grammar
- CO5:** Discuss code generation and code optimization 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
CO1	3	-	1	-	-	-	-	-	-	-	-
CO2	1	2	1	-	-	-	-	-	-	-	-
CO3	1	2	1	-	-	-	-	-	-	-	-
CO4	3	-	-	1	-	-	-	-	-	-	-
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 and Regular Expressions: Formal Languages and Regular expressions, Deterministic and Non Deterministic Finite Automata, Finite Automata with ϵ moves, Equivalence of NFA and DFA, Minimization of Finite Automata, Applications of Finite Automata.

UNIT-II

Grammars , PDA and Turing Machines: Chomsky hierarchy, Properties of regular sets, Pumping Lemma for regular languages, ContextFree Grammars – Derivation trees, Ambiguous and unambiguous grammars , Left recursion, Left factoring, Pushdown Automata and ContextFree Languages, Turing machines (TM) – Turing Machine constructions – Variations of TMs.

UNIT-III

Phases of Compiler and Lexical Analyzer : Compilers Analysis of the source program The phases of a compiler Cousins of the compiler Compiler construction tools Lexical Analysis The role of the lexical analyzer Input buffering Specification of tokens Recognition of tokens A language for specifying lexical analyzers Design of a lexical analyzer.

UNIT-IV

Syntax Analysis and Syntax Directed Translation: The role of the parser Context free grammars Top down parsing Bottom up parsing Operator precedence parsing – automatic construction of efficient parser – predictive parser LR parsers Parser generators. Syntax directed definitions Construction of syntax trees Bottom up evaluation of Sattributed definitions Lattributed definitions Analysis of syntax directed definitions.

UNIT – V

Intermediate Code Generation and Code Generation: Intermediate languages Declarations Assignment statements Boolean expressions Back patching Procedure calls. Issues in the design of a code generator Runtime storage management Basic blocks and flow graphs The DAG representation of Basic Block Next use information simple code generator Register allocation and assignment –Code Optimization Peephole optimization Generating code from DAGs.

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 Compilers Principles, Techniques And Tools, Alfred V Aho, J. D. Ullman, Ravi Sethi, PEA, Second Edition, 2007, ISBN: 978-9357054119

Reference Books:

- 1 Theory of Computer Science-Automata, Languages and Computation, K. L. P. Mishra and N. Chandrasekharan, PHI, 3rd Edition, ISBN: 978-8120329683
- 2 Elements of Theory of Computation, Lewis H.P. & Papadimitriou C.H., Pearson /PHI, ISBN: 978-0132624787
- 3 Theory of Automata, Languages and Computation, Rajendra Kumar, McGraw Hill, ISBN: 978-0070702042
- 4 Compiler Construction-Principles and Practice, Kenneth C Loudon, Cengage Learning, ISBN: 978-0534939724
- 5 The Compiler Design Handbook, Y.N. Srikant and Priti Shankar, CRC Press, 2nd ed, ISBN: 978-1420043822

Web Links:

- 1 <http://nptel.ac.in/courses/111103016>
- 2 <https://nptel.ac.in/courses/106/104/106104148/>
- 3 <https://nptel.ac.in/courses/106/108/106108113/>

- 4 <https://nptel.ac.in/courses/106/104/106104123/>
- 5 <https://nptel.ac.in/courses/106/104/106104072/>

Agile Software Engineering
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501IT07	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Apply software engineering practices and evaluate different software development models to design and manage the life cycle of a Student Management System (SMS).
- CO2:** Analyze the principles of Agile methodologies and compare them with traditional models by transitioning a retail software company from Waterfall to Agile.
- CO3:** Evaluate the impact of Agile processes on requirements engineering and manage unstable requirements for a social media platform project.
- CO4:** Design and implement a comprehensive testing strategy using TDD and test automation tools in an Agile project.
- CO5:** Apply Agile design principles and execute refactoring techniques to develop maintainable and scalable software 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
CO1	2	1	-	-	2	-	-	-	-	-	-
CO2	3	2	1	1	-	-	-	2	2	2	1
CO3	2	1	1	-	-	-	-	-	-	2	1
CO4	3	2	2	1	-	-	-	2	2	2	1
CO5	1	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Introduction to Software Engineering: Define Software Engineering, The Software Process, Software Engineering Practice, Software Myths

Software Life Cycle models and Processes: Software Process, Process Classification, Phased Development Life Cycle, Software Development Process Models – The Waterfall, Spiral and Evolutionary Models, Software Project Management Process, Project Planning and Estimation, Gathering Requirements, Software Design, Software Testing, Software Quality and Reliability.

Case Study: Developing a Student Management System (SMS)

UNIT-II

Fundamentals of Agile Methodology: Theories for Agile Management, Agile Software Development, Traditional Model Vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values

Case Study: Implementing Agile Methodology in a Software Development Project

UNIT-III

Agile Processes: Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, and Extreme Programming: Method overview – lifecycle – work products, roles and practices.

Agility And Requirements Engineering: Impact of Agile Processes in RE, Current Agile Practices, Overview of RE Using Agile, Managing Unstable Requirements, Requirements Elicitation

Case Study: Agile Processes and Requirements Engineering in a Healthcare Software Project

UNIT-IV

Agile Testing: The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

Case Study: Implementing Test-Driven Development (TDD) for a Healthcare Application

UNIT – V

Agile Software Design and Development: Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.

Case Study: Refactoring an E-Commerce Backend Using Agile Design Principles

Capstone Project:

Students shall choose a real-time software application (e.g., e-commerce backend, SMS, food delivery app) and apply Agile design principles, perform refactoring, implement TDD, and use version control and CI tools. This project should be implemented as a Capstone project and submitted at the end of the course.

Text Books:

- 1 Software Engineering – Concepts and Practices: Ugrasen Suman, Cengage Learning, ISBN: 9789390555475.
- 2 Agile Software Development, Current Research and Future Directions, Springer-Verlag Berlin Heidelberg, Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), ISBN-10. 3642125743.

Reference Books:

- 1 Software Engineering, Lan Sommerville, Pearson, Ninth Edition, ISBN: 978-9332582699.
- 2 Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, David J. Anderson; Eli Schragenheim, ISBN: 978-0131424609

Web Links:

- 1 https://www.tutorialspoint.com/software_engineering/
- 2 <https://www.sciencedirect.com/science/article/pii/S0950584916303329>

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

Course Code: 2501CS13	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe basic concepts of operating systems and its structure.
- CO2:** Analyse various issues related to inter process communication like process scheduling, resource management and deadlocks.
- CO3:** Interpret the issues and challenges of memory management.
- CO4:** Illustrate concepts of Disk management and file system implementation.
- CO5:** Explain issues related to protection and security mechanisms.

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	-	-	-	-	-	-	1	1	-	-
CO2	1	3	-	1	-	-	-	2	2	-	1
CO3	1	3	-	1	-	-	-	1	2	-	1
CO4	1	3	-	1	-	-	-	1	1	-	1
CO5	2	2	-	-	-	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

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, System Boot.

Case Study: The above topics are discussed as case study in Windows/ Unix OS.

Practice:

1. Basic Linux commands
2. Implementation of System calls
3. Multi-programming Memory management Implementation of fork (), wait (), exec() and exit (), System calls

UNIT-II

Process Concept: Process scheduling, Operations on processes, Interprocess communication.

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

Multithreaded Programming: Multithreading models, Thread libraries, Threading issues

Case Study: The above topics are discussed as case study in Windows/ Unix OS.

Practice:

1. Simulate the following CPU scheduling algorithms:(a) FCFS (b) SJF
2. Simulate the following CPU scheduling algorithms:(a) Priority (b) Round Robin

UNIT-III

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

Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention.

Case Study: The above topics are discussed as case study in Windows/ Unix OS.

Practice:

1. Simulate Bankers Algorithm for Dead Lock Avoidance
2. Write a C program that illustrates two processes communicating using shared memory
3. Write C program to create a thread using pthreads library and let it run its function.
4. Write a C program to illustrate concurrent execution of threads using pthreads library

UNIT-IV

Memory Management 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.

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

Case Study: The above topics are discussed as case study in Windows/ Unix OS.

Practice:

1. Simulate the Multiprogramming with a fixed number of tasks (MFT)
2. Simulate the Multiprogramming with a variable number of tasks (MVT)
3. Simulate the FIFO page replacement algorithm
4. Simulate the LRU page replacement algorithm
5. Simulate the following File allocation strategies (a) Sequenced (b) Indexed (c) Linked

UNIT – V

Secondary Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.

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

Practice:

1. The above topics are discussed as case study in Windows/ Unix OS.

Text Books:

- 1 Operating System Concepts, Abraham Silberschatz, Peter B Galvin and Greg Gagne, John Wiley and Sons Inc, 12th Edition, ISBN: 978-0470128725
- 2 Operating Systems, William Stallings, Internals and Design Principles. Prentice-Hall, 7th Ed, ISBN: 978-9332518803

Reference Books:

- 1 Modern Operating Systems, Tanenbaum A S, Pearson Education, 3rd Edition, ISBN: 978-0136006633
- 2 Operating Systems A Concept Based Approach, Dhamdhare D M, Tata McGraw-Hill, 3rd edition, ISBN: 978-1259005589
- 3 Operating Systems, Nutt G, Pearson Education, 3rd edition, ISBN: 978-8131723593

Web Links:

- 1 <https://archive.nptel.ac.in/courses/106/106/106106144/>
- 2 <https://archive.nptel.ac.in/courses/106/105/106105214/>
- 3 <https://www.coursera.org/learn/iot/lecture/MrgxS/lecture-3-1-operating-systems>
- 4 <http://www.geeksforgeeks.org/operating-systems/>
- 5 <https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923>

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

Course Code: 2501CS07	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe network topologies, reference models and media for data transmission
- CO2:** Analyze error and flow control issues in data link layer
- CO3:** Classify MAC protocols and channelization techniques
- CO4:** Apply routing algorithms and congestion control techniques for effective data transmission
- CO5:** Analyze protocols Transport and Application Layers

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Network Overview: Interfaces, protocols and services, connection oriented and connectionless services, OSI & TCP/IP Reference Models. Local Area Networks: Topologies star, bus, ring, media access control deterministic and probabilistic, IEEE 802.x. wireless networking.

Practice:

1. Study of Network devices in detail and connect the computers in Local Area Network.

UNIT-II

Data Link Protocols: framing and data transparency, error detection & correction, flow control.

Practice:

1. Write a Program to implement the data link layer framing methods such as i) Character stuffing ii) bit stuffing.

UNIT-III

Media Access Control: Random Access: ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance

Controlled Access: Reservation, Polling, Token Passing

Channelization: Frequency division multiple Access (FDMA), Time division multiple access (TDMA), Code division multiple access (CDMA).

Practice:

1. Write a Program to implement Sliding window protocols

UNIT-IV

Routing Algorithms: The Optimality principle, Shortest path, Flooding, Distance vector, Link state, Hierarchical.

Congestion Control algorithms: General principles of congestion control, Congestion prevention policies, Approaches to Congestion Control, Traffic Aware Routing, Admission Control, Traffic Throttling, Load Shedding.

Traffic Control Algorithms: Leaky bucket & Token bucket.

Practice:

1. Programs to implements routing protocols like shortest path.

UNIT – V

IP Protocols: IP Addressing, IP & ICMP.

Transmission Control Protocol: UDP & TCP.

Application Layer: World Wide Web, HTTP, Electronic mail, Architecture, web based mail, email security, TELENET, local versus remote Logging.

Domain Name System: Name Space, DNS, SNMP.

Practice:

1. 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

Capstone Project:

Simulate and implement data link layer protocols and network routing strategies using NS2 (Network Simulator 2). It includes configuring network topologies, setting up routing protocols like AODV, DSDV, and OLSR, and analyzing their performance through metrics such as throughput, delay, and packet delivery ratio. Additionally, explore the simulation of data link layer functionalities, including MAC addressing and error detection. You may use NS2's capabilities, that insights into the behaviour of network protocols, aiding in the design and optimization of efficient communication systems.

Text Books:

- 1 Computer Networks — Andrew S Tanenbaum and David J Wetherall, Pearson Education, 5th Edition. ISBN: 978-0132126953
- 2 Data Communications and Networking – Behrouz A.Forouzan, McGraw Hill Education, 5th Edition ISBN: 978-1259064753

Reference Books:

- 1 Data Communications and Networks- Achut S Godbole, AtulKahate, McGraw-Hill Education (India) Pvt Limited, 2nd Edition. ISBN: 978-0-07-123110-7
- 2 Computer Networks, Mayank Dave, CENGAGE India, 6th Edition ISBN: 978-8131509869

Web Links:

- 1 <https://nptel.ac.in/courses/106105081>
- 2 <https://www.coursera.org/learn/fundamentals-network-communications>

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

Course Code: 2501AI05	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Outline the Concepts of Machine Learning and Statistical Learning
- CO2:** Build Regression and Classification models for given data.
- CO3:** Apply Instance based Learning techniques and SVM techniques linear and nonlinear data.
- CO4:** Apply clustering techniques on high dimensional data to group the similar entities.
- CO5:** Make use of ensemble learning techniques to improve the performance of a model.

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	2	2	-	-	2	2	-	1	1	-	-
CO2	2	2	3	-	2	2	-	1	1	-	-
CO3	3	2	3	-	2	-	-	1	1	-	2
CO4	3	2	3	-	2	-	-	1	1	-	-
CO5	2	2	2	-	2	-	-	1	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

INTRODUCTION: Machine Learning, Types of Machine Learning Systems, Main Challenges of Machine Learning. Statistical Learning: Introduction, Supervised and Unsupervised Learning, The Learning Problem, Feasibility of Learning.

Practice:

1. Installation of Jupitar/Spider notebook and working on basic commands.
2. Loading and apply key preprocessing techniques on the dataset and also analyse the dataset.

UNIT-II

Supervised Learning(Regression/Classification):Basic Methods:

Concept Learning: General-to-Specific Hypotheses Ordering, Find-S and Candidate

Elimination Algorithm, Version Space, and Inductive Bias.

Bayesian Learning: Probability Overview, MLE and MAP Estimates, Gaussian Naive Bayes Classifier, Bayesian Networks.

Instance-based Learning: k-Nearest Neighbour (kNN) Classifier, Voronoi Diagram and Distance-Weighted kNN, Distance Metrics and Curse of Dimensionality.

Practice:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Exercises to solve the real-world problems using Binary Classifier
4. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

UNIT-III

Linear Models and Regression: Linear Classification, Linear Regression, Non-linear Transformation, Logistic Regression.

Support Vector Machines: Decision Boundary and Support Vector: Optimization and Primal-Dual Problem, Soft Margin and Non-linear Decision Boundary, Kernel Functions and Radial Basis Functions introduction.

Practice:

1. Exercises to solve the real-world problems using Linear Regression
2. Exercises to solve the real-world problems using Logistic Regression
3. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of heart patients.

UNIT-IV

Classifier / Hypothesis Evaluation: Accuracy, Precision, Recall and F-Measures, Scores, Sampling, Bootstrapping and ROC, Hypotheses Testing and Cross-validation.

Unsupervised Learning:

Clustering: Partitional Clustering and Hierarchical Clustering, Cluster Types, Attributes and Salient Features, Hierarchical and Density-based Clustering Algorithms, Inter and Intra Clustering Similarity, Cohesion and Separation. MST and DBSCAN Clustering Algorithms.

Practice:

1. Develop a program for Bias, Variance, Remove duplicates , Cross Validation
2. Write a program to implement One-hot Encoding.
3. Write a program to implement Categorical Encoding.

UNIT – V

Ensemble Learning: Bagging and Boosting, Adaboost and Random Forest

Computational Learning Theory: Error and Noise Formalisms, Training vs. Testing, Theory of Generalization, PAC Learnability and VC Dimensions, Overfitting, Regularization

and Validation.

Practice:

1. Write a program to demonstrate the working of Random Forest classifier. Use appropriate dataset for Random Forest Classifier.
2. Use a sentiment analysis dataset from Twitter or other social media platforms, available on platforms like Kaggle and apply bagging and boosting techniques for prediction.

Additional Practice:

1. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
2. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

Capstone Project:

Student Performance Prediction System

Objective: Predict a student's performance (pass/fail or score range) based on input features like study time, attendance, past grades, family background, etc.

Domain: Education

Techniques & Concepts Used:

- Supervised learning (Classification – Logistic Regression, SVM)
- Data preprocessing (handling nulls, encoding categorical variables)
- Evaluation metrics (accuracy, precision, recall)

Text Books:

- 1 Hands On Machine Learning with ScikitLearn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019, ISBN: 978-1492032649
- 2 Data Science and Machine Learning Mathematical and Statistical Methods, Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, 2019, ISBN: 978-1138492530

Reference Books:

- 1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, ISBN: 9780262018029
- 2 Machine Learning Tools, Dr Muddafa Maruli Krishna, Dr A Vanathi, Final Thawaksr, Dr Lokesh P. Gangani, publisher: Book Rivers, ISBN: 978-93-5515-730-0

Web Links:

- 1 <https://www.deeplearning.ai/machinelearningyearning/>

- 2 <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>
- 3 https://onlinecourses.nptel.ac.in/noc21_cs24/preview

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

	L	T	P	C
Course Code: 2501CS10	2	0	1	3

Course Outcomes:

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

- CO1:** Analyze the algorithms efficiency and hashing techniques for searching.
- CO2:** Illustrate the concepts of search trees and operations of Priority Queues.
- CO3:** Analyze the algorithms of Divide & Conquer and Greedy paradigms.
- CO4:** Analyze the algorithms of Dynamic Programming paradigm.
- CO5:** Design the algorithms of Backtracking and Brach & Bound paradigms.

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	-	-	-	-	-	-	-	-	-
CO3	1	2	1	2	-	-	-	-	-	-	-	-
CO4	2	2	2	1	-	-	-	-	-	-	-	-
CO5	2	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

Introduction to Algorithm Analysis, Space and Time Complexity analysis, Asymptotic Notations.

Hashing: Introduction to Static Hashing, Hash Tables, Hash Functions, Different Hash Functions, Collision Resolution Techniques, Dynamic Hashing.

Practice:

1. Write a program to implement collision resolution techniques of Hash data structure.

UNIT – II

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

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

Priority Queues (Heaps): Introduction, Binary Heaps-Model and Simple Implementation, Basic Heap Operations, Other Heap Operations, Applications of Priority Queues

Practice:

1. Write a program to implement AVL tree operations
2. Write a program to implement Max heap and min heap operations

UNIT – III

Divide and Conquer: The General Method, Binary Search, Merge Sort, Quick Sort.

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

Practice:

1. Write a program to sort the given list of elements using Merge sort technique using divide and conquer approach.
2. Write a program to implement Single Source Shortest Paths using greedy approach.

UNIT – IV

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

Practice:

1. Write a program to implement 0/1 Knapsack problem using Dynamic Programming approach.
2. Write a program to implement all pairs shortest path problem using Dynamic Programming approach.

UNIT – V

Backtracking: The General Method, N-Queens Problem, Sum of Subsets problem, Graph Coloring, Hamiltonian cycles.

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

Practice:

1. Write a program to implement N-Queens problem using backtracking algorithm.
2. Write a program to implement Travelling Salesperson problem using branch and bound approach.

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, McGraw Hill
- 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>

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

Course Code: 2501AI11	L	T	P	C
	2	0	2	4

Course Outcomes:

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

- CO1:** Demonstrate the basic statistical concepts in deep learning.
- CO2:** Explain architecture and mathematical foundation for various deep neural networks.
- CO3:** Illustrate the challenges and optimization strategies in Deep Learning.
- CO4:** Build a convolutional neural network using different activation functions.
- CO5:** Build and train RNN and LSTMs using sequence modelling.

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	-	2	1	-	2	-	-	1	1	-	3
CO2	-	2	1	-	2	-	-	1	1	-	3
CO3	-	2	-	3	1	-	-	1	1	-	1
CO4	2	2	3	-	1	-	-	1	1	-	-
CO5	1	2	3	-	1	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

DEEP LEARNING CONCEPTS: Fundamentals about Deep Learning, Perception Learning Algorithms, Probabilistic modelling, Early Neural Networks, How Deep Learning different from Machine Learning, Scalars, Vectors, Matrixes, Higher Dimensional Tensors, Manipulating Tensors. Vector Data, Hyper parameters Vs Parameters - validation sets - Estimators, Bias, Variance, Overfitting and Underfitting, Introduction to Keras and TensorFlow and PyTorch.

Practice:

1. Installation and basic commands of scikit, TensorFlow and PyTorch
2. Implement Random Forest by using scikit, TensorFlow and PyTorch
3. Implement multilayer perceptron algorithm for MNIST Handwritten Digit Classification

UNIT-II

NEURAL NETWORKS : About Neural Network, Building Blocks of Neural Network, Introduction to Neural Networks, Feed-forward Networks, Deep Feed-forward Networks - Learning XOR, Gradient Based learning, Hidden Units, Back-propagation and other Differential Algorithms, Data Pre-processing for neural networks, Feature Engineering.

Practice:

1. Design a neural network for classifying movie reviews (Binary Classification) using IMDB dataset.
2. a) Design a neural Network for classifying news wires (Multi class classification) using Reuters dataset
b) Design a neural network for predicting house prices using Boston Housing Price dataset.

UNIT-III

OPTIMIZATION TECHNIQUES: Optimizers – SGD (Stochastic Gradient Descent), Mini-batch Gradient Descent, MS prop (Root Mean Square Propagation), Adagrad (Adaptive Gradient Algorithm), Adadelta (Adaptive Delta), Adam (Adaptive Moment Estimation), Adamax (Adaptive Moment Estimation with Infinity Norm).

Activation Functions : sigmoid, tanh, ReLU, leaky ReLU, Soft Max, Linear Loss Functions - cross-entropy loss, the mean-squared error, the Huber loss, the hinge loss, L2 loss, mean absolute loss Regularization – L1, L2 and drop out. Learning Rate, Normalization

Practice:

1. Implement word embeddings for IMDB dataset.
2. Implement one hot encoding of words or characters.
3. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of heart patients. Also apply the optimization techniques.
4. Write a Python program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set

UNIT-IV

CONVOLUTIONAL NEURAL NETWORK : About CNN, Building a convolutional neural network, Input Layers, Convolution Layers, Pooling Layers, Dense Layers, Backpropagation Through the Convolutional Layer, Filters and Feature Maps, Backpropagation Through the Pooling Layers, Dropout Layers and Regularization, Batch Normalization

Pre trained CNN: LeNet, Alex Net, VGG16, ResNet.

Practice:

1. Build a Convolution Neural Network for MNIST Handwritten Digit Classification.
2. a) Use a pre-trained convolution neural network (VGG16) for image classification
b) Build a Convolution Neural Network for simple image (dogs and Cats) Classification
3. Student Portfolio Creation using GitHub, Hugging Face & Kaggle

UNIT – V

RNN : Recurrent Neural Networks ,Sequence-to-Sequence Modelling – Embedding - Recurrent Neural Networks - Bidirectional RNNs, Analysing Variable Length Inputs – Tackling seq2seq Problem – Beam Search and Global Normalization – Recurrent Neural Networks (RNN)– Hidden States – Perplexity – Character-level Language Models –Modern RNNs: Gated Recurrent Units (GRU), Long Short-Term Memory (LSTM).

Practice:

1. Implement a Recurrent Neural Network for IMDB movie review classification problem.
2. Implement Boosting algorithms using scikit, Tensorflow and PyTorch

Additional Practice:

1. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
2. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

Capstone Project:

Face Mask Detection Using Convolutional Neural Networks

Objective: Detect whether a person in an image is wearing a mask or not using real-time webcam input.

Domain: Healthcare / Public Safety

Techniques & Concepts Used:

- * Image Classification (CNNs – using TensorFlow/Keras)
- * Data Augmentation & Preprocessing
- * Transfer Learning (e.g., MobileNetV2)
- * Real-time camera integration using OpenCV

Text Books:

- 1 Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, ISBN: 9780262035613
- 2 Deep learning: A practitioner's approach, Josh Patterson and Adam Gibson, O'Reilly Media, First Edition, ISBN: 978-1491914250

Reference Books:

- 1 Fundamentals of Deep Learning, Designing next generation machine intelligence algorithms, Nikhil Buduma, O'Reilly, Shroff Publishers, ISBN: 978-9352135608
- 2 Deep learning Cookbook, Practical recipes to get started Quickly, Douwe Osinga, O'Reilly, Shroff Publishers, ISBN: 978-9352137572

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc20_cs62/preview
- 2 <https://keras.io/datasets/>

Natural Language Processing & Prompt Engineering

	L	T	P	C
Course Code: 2501AI20	1	0	2	3

Course Outcomes:

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

- CO1:** Explain Text Normalization and utilize Ngram language models for various NLP tasks.
- CO2:** Explain Text preprocessing and stemming algorithms.
- CO3:** Apply similarity measures and word embedding models
- CO4:** Summarize morphology and NLP applications
- CO5:** Explain prompt engineering and its 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
CO1	2	2	1	-	1	-	-	1	1	-	2
CO2	2	2	2	-	2	-	-	1	1	-	2
CO3	2	2	3	-	1	-	-	1	1	-	2
CO4	2	2	3	-	1	-	-	1	1	-	1
CO5	2	2	3	-	1	-	-	1	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Introduction: Introduction to Natural Language Processing Overview of NLP Introduction to Levels of NLP –Regular Expressions, Text Normalization, Edit Distance Language Modelling: Ngram Language Models.

Practice:

1. Word Analysis Learn about morphological features of a word by analysing it
2. Word Generation generate word forms from root and suffix information

UNIT-II

Text Processing: Tokenization, Stemming, Text Preprocessing & Feature Representation Introduction to Corpora, Sentence Segmentation, Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modelling, Ngram Language Model, Smoothing,

Practice:

1. Implement Porter Stemming Algorithm
2. NGrams learn to calculate bigrams from a given corpus and calculate probability of a sentence

UNIT-III

Vector Semantics and Embeddings: Lexical Semantics, Vector, Words and Vectors, Cosine for measuring similarity, TFIDF: Weighing terms in the vector, Pointwise Mutual Information (PMI) , Applications of the tfidf or PPMI vector models , . Word Embeddings: Word2Vec, Glove and Fasttext, Visualizing Embeddings, Semantic properties of embeddings , Bias and Embeddings , Evaluating VectorModels .

Practice:

1. Apply term frequency"(TFIDF) to Measures the importance of a word to a specific document
2. Implement word embedding using word2vec

UNIT-IV

Morphology: Sequence Labelling for Parts of Speech and Named Entities, PartofSpeech Tagging, Named Entities and Named Entity Tagging , HMM PartofSpeech Tagging , Conditional Random Fields (CRFs), Evaluation of Named Entity Recognition Applications of NLP Machine Translation Encoder & Decoder Model, Attention Models, Question Answering Knowledge based Q&A Chatbots & Dialogue Systems, Automatic Speech Recognition and Text to Speech.

Practice:

1. Morphology understanding the morphology of a word by the use of Add Delete table.
2. POS Tagging – calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.

UNIT – V

Introduction to Prompt Engineering : What is prompt engineering and why it matters

Prompt types: explicit, implicit, and creative prompts, Best Practices for Crafting Effective Prompts.

Practical Applications of Prompt Engineering : Improving NLP Tasks with Custom Prompts, Enhancing Creativity and Diversity in AI Generated Content, Addressing AI Ethics and Bias through Thoughtful Prompt Engineering, Personalization and Adaptability in AI Generated Content.

Future Directions and Emerging Trends in Prompt Engineering : Leveraging Advanced AI Models and Techniques, The Convergence of Human and AI Creativity, The Role of Prompt Engineering in the AI Driven Economy

Practice:

1. Chunking understand the concept of chunking and get familiar with the basic chunk tagset.
2. Building Chunker the importance of selecting proper features for training a model and size of training corpus in learning how to do cunking.

Additional Practice:

1. Text normalization is a crucial process in natural language processing (NLP) that involves cleaning and preparing text data to ensure consistency and usability across different NLP tasks. By standardizing text, we reduce data variability, making it easier for NLP models to identify patterns and generate accurate predictions.
Apply text normalization to the following text
Jaron Lanier said: “It would be unfair to demand that people cease pirating files when those same people aren’t paid for their participation in very lucrative network schemes. Ordinary people are relentlessly spied on, and not compensated for information taken from them. While I’d like to see everyone eventually pay for music and the like, I’d not ask for it until there’s reciprocity.”
2. Demonstrate text smoothing using Laplace Smoothing (Additive Smoothing) for a simple bigram language model.
3. For the give documents data Interpret the documents that are closely related or similar in content, apply TFIDF and Cosine Similarity
Doc1 = "The quick brown fox jumps over the lazy dog"
Doc2 = "Never jump over the lazy dog quickly"
Doc3 = "Bright blue fox jumps quickly"
Doc4 = "The fox is quick and the dog is lazy"

Capstone Project

Sentiment Analysis and Emotion Detection in Tweets or Product Reviews

Objective: Analyze social media or review texts to detect sentiment (positive/negative) and optionally the emotion (joy, anger, etc.).

Domain: Social Media / E-commerce / Healthcare Communication

Techniques & Concepts Used:

- Text Preprocessing and Tokenization (Unit II)
- Word Embeddings (Word2Vec/FastText) (Unit III)
- Sequence Labeling for emotion classes (Unit IV)
- Prompt Engineering (for custom sentiment questions) (Unit V)

Text Books:

- 1 Speech and Language Processing, Dan Jurafsky, James H. Martin Draft of 3rd Edition, Prentice Hall 2022, ISBN: 978-0130950697
- 2 Springer Handbook of Speech Processing, Jacob Benesty, M. M. Sondhi, Yiteng Huang Springer, ISBN: 978-3662533000

Reference Books:

- 1 Speech and Language Processing, Daniel Jurafsky and James H. Martin. 2020. 3rd Edition (draft), ISBN: 978-0135041963
- 2 Foundations of Statistical Natural Language Processing, Christopher, D. Manning and Hinrich Schütze, MIT Press, ISBN: 978-0262133609

Web Links:

- 1 <https://www.nltk.org/data.html>
- 2 <https://www.analyticsvidhya.com/blog/2017/01/ultimateguidetounderstandimplement>

- 3 `naturallanguageprocessingcodesinpython/`
https://datahack.analyticsvidhya.com/contest/linguipediacodefestnaturallanguageprocessing1/?utm_source=ultimateguidetounderstandimplementnaturallanguageprocessingcodesinpython&utm_medium=blog

Reinforcement Learning & Gen AI

Course Code: 2501AI21	L	T	P	C
	1	0	2	3

Course Outcomes:

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

- CO1:** Outline the basic concepts of Reinforcement learning.
- CO2:** Identify the appropriate learning tasks for Reinforcement learning techniques.
- CO3:** Implement adversarial training techniques to train GAN models.
- CO4:** Analyse the applications of VAEs in various domains such as image generation, anomaly detection, and data imputation.
- CO5:** Evaluate the ethical considerations and societal impact of reinforcement learning and generative AI 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
CO1	2	2	-	-	2	-	-	-	1	-	-
CO2	2	2	-	-	2	-	-	-	1	-	-
CO3	3	2	-	-	2	-	-	-	1	-	-
CO4	3	2	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	1
CO3	3	1
CO4	2	-
CO5	3	1

UNIT-I

Basics of reinforcement learning (RL), RL components: agents, environments, rewards
 Markov Decision Processes (MDPs), Exploration vs. Exploitation dilemma
 Basic algorithms: Qlearning, SARSA, MonteCarlo (MC) Learning, TemporalDifference (TD) Learning, TDLambda and Eligibility Traces.

Practice:

1. Installation of TensorFlow and implement the basic programs.
2. Installation of PYTORCH and implement the basic programs.

UNIT-II

Advanced Reinforcement Learning Techniques: Deep QNetworks (DQN), Policy Gradient methods, ActorCritic architectures, Advantage ActorCritic (A2C) and Proximal Policy Optimization (PPO), Continuous action spaces and algorithms like Deep Deterministic

Policy Gradient (DDPG).

Practice:

1. Implement a simple grid world environment where an agent learns to navigate from a starting point to a goal while avoiding obstacles.
2. Train an agent to balance a pole on a cart using discrete actions such as pushing the cart left or right.

UNIT-III

Generative Adversarial Networks (GANs): Introduction to generative models, Basics of GANs: generator, discriminator ,Training GANs: adversarial training ,Variants of GANs: Conditional GANs, Wasserstein GANs, etc, Applications of GANs in image generation, style transfer, and data augmentation.

Practice:

1. Model an agent learning to drive a car up a steep mountain by applying the correct amount of throttle and braking.
2. Train an agent to play the classic game of Pong, where it learns to control a paddle to hit a ball back to the opponent while preventing it from reaching its own side.

UNIT-IV

Variational Autoencoders (VAEs): Introduction to autoencoders , Variational inference and latent variable models ,Encoder and decoder architectures in VAEs , Training VAEs: maximizing evidence lower bound (ELBO) , Applications of VAEs in image generation, anomaly detection, and data imputation.

Practice:

1. Use deep reinforcement learning to train an agent to play various Atari games, such as Breakout, Space Invaders, or PacMan.
2. Experiment with different strategies for solving the multiarmed bandit problem, where an agent must decide which arm of a slot machine to pull to maximize cumulative reward.

UNIT – V

Advanced Topics in Reinforcement Learning and Generative AI: Model based RL and world models, multiagent reinforcement learning ,Transfer learning and meta learning in RL, Adversarial attacks and defences in generative models, Ethical considerations and societal impact of RL and generative AI, LangChain Framework

Practice:

1. Train an agent to play Flappy Bird, a sidescrolling game where the agent controls the flight of a bird through a series of pipes.
2. Develop an agent capable of playing TicTacToe optimally against a human opponent or another agent.

Additional Practice:

1. Train a robotic arm to perform various tasks, such as reaching a target location or

- manipulating objects, using reinforcement learning.
2. Develop a trading agent that learns to make profitable trades in financial markets by analysing historical data and adapting its trading strategy over time

Capstone Project

Smart Traffic Signal Control Using Q-Learning

Objective: Optimize traffic signal timings at intersections to reduce vehicle waiting time using RL.

Domain: Smart Cities / Traffic Management

Techniques & Concepts Used:

- *Q-Learning (Tabular RL)
- *State and Reward Modeling
- *Traffic Simulation Environment (e.g., SUMO or custom gridworld)
- *Visualization of Learning Process
- *Performance Metrics: Average wait time, throughput

Text Books:

- 1 Reinforcement Learning An Introduction, R. S. Sutton and A. G. Barto, MIT Press, 2018, ISBN: 978-0262039246

Reference Books:

- 1 Algorithms for Reinforcement Learning, Szepesvári, Csaba, United States: Morgan & Claypool, ISBN: 978-1627050278
- 2 Markov Decision Processes, Discrete Stochastic Dynamic Programming, Puterman, Martin L., Germany, Wiley, ISBN: 978-0471727200
- 3 Artificial Intelligence, Dr. R. Sravanth Kumar, Dr. A. Mallikarjuna Reddy, Dr T. Prabhakara Rao and Dr. Gayatri Parasa Published By Pandit Publications- 2024, ISBN: 978-93-93769-74-9

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc20_cs74/preview
- 2 <https://www.coursera.org/learn/fundamentalsofreinforcementlearning>

Big Data Analytics
(Common to CSE, AIML & CSE(DS))

Course Code: 2501AI04	L	T	P	C
	2	0	1	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:** Make use of Pig and Hive to structure and work with big Data
- CO5:** Make use of Spark tool to work with big data.

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	-	1	2	-	-	1	2	-	1
CO2	2	3	-	1	2	-	-	1	2	-	1
CO3	2	1	-	3	2	-	-	1	2	-	2
CO4	2	3	-	2	2	-	-	1	2	-	2
CO5	2	2	-	1	3	-	-	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 big data: Introduction to Big Data Platform, Challenges of Conventional Systems, Intelligent data analysis, Nature of Data, Analytic Processes and Tools, Analysis vs Reporting.

Practice:

1. Hadoop File System Operations: Implement the following file management tasks in Hadoop:
 - a.) Adding files and directories
 - b.) Retrieving files
 - c.) Deleting files

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 Oneness in a Window,

Decaying Window, Real time Analytics Platform (RTAP) Applications.

Practice:

1. Loading DataSet in to HDFS for Spark Analysis.

UNIT-III

Introduction to 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.

Practice:

1. Map Reduce Word Count Hadoop Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm

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 Databases and Tables, Seeing How the Hive Data Manipulation Language Works with examples, Querying and Analyzing Data.

Practice:

1. Hive Queries a) Install Hive Framework b) Implement Hive to create, alter, and drop databases, tables
2. Hive Queries Implement hive queries and joins to perform display and retrieve the data

UNIT – V

Spark: Installing Spark, Spark applications, Jobs, stages and Tasks, Resilient Distributed data sets, Shared Variables, Anatomy of a Spark job run.

Practice:

1. Demonstrate Spark SQL on Hive
 - a. Create a SQLContext object and load the Parquet file into DataFrame
 - b. Load the Dataframe into Hive table.
 - c. Verify the created Hive table in Hive environment
 - d. Execute Spark SQL query

Text Books:

- 1 Hadoop: The Definitive Guide, Tom White, O'reilly, 4th Edition, ISBN: 978-1491901632
- 2 Hadoop for Dummies, Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk, Bruce Brown, Rafael Coss, John Wiley & Sons, ISBN: 978-1118727128

Reference Books:

- 1 Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, Bill Franks, John Wiley & sons, ISBN: 978-1118224912
- 2 Harness the Power of Big Data: The IBM Big Data Platform, Paul Zikopoulos, Dirk de Roos, Krishnan Parasuraman, Thomas Deutsch, James Giles, David Corrigan, Tata McGraw Hill Publications, ISBN: 9780071808187
- 3 Big Data Science & Analytics: A Hands On Approach , Arshdeep Bahga and Vijay Madisetti, VPT, ISBN: 978-0996025577
- 4 Learning Spark: Lightning Fast Big Data Analysis Paperback, Holden Karau, ISBN: 978-1449358624

Web Links:

- 1 Hadoop: <http://hadoop.apache.org/>
- 2 Hive: <https://cwiki.apache.org/confluence/display/Hive/Home>
- 3 <https://nptel.ac.in/courses/106106142>
- 4 <https://www.cloudera.com/servicesandsupport/tutorials.html>
- 5 <https://www.databricks.com/spark/gettingstartedwithapachespark>

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE01	Basic Electrical & Electronics Engineering	FC	2		2	4	50	50	100	-
2501EC95	Digital Logic Design	FC	2	1		3	50	50	100	-
2501MB01	Engineering Economics & Management	FC	2			2	50	50	100	-
Total			Total	6	1	2	9			

Basic Electrical & Electronics Engineering
(Common to CE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501EE01	L	T	P	C
	2	0	2	4

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 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
CO1	2	3	1	-	1	-	-	-	2	2	-
CO2	2	3	1	-	-	-	-	-	2	2	-
CO3	3	2	1	-	-	-	-	-	2	2	-
CO4	3	2	1	-	-	-	-	-	2	2	-
CO5	3	2	1	-	-	-	-	-	2	2	-

UNIT-I

DC & AC Circuits:

DC circuits: Ohm's and Kirchhoff's laws, analysis of series, parallel and series-parallel circuits excited by independent voltage sources for R, L, C parameters, current division, voltage division

AC circuits: Generation of sinusoidal voltage, frequency of generated voltage, average value, RMS value, form, and peak factors. Real power, reactive power, apparent power, and Power factor.

Practice:

1. Verification of ohms law
2. Verification of KCL and KVL
3. Verification of KCL, KVL and ohm's law using simulation

UNIT-II

Machines and Measuring Instruments: Principles and operation of DC machines, Transformers – Synchronous Machines - three Phase and single phase induction motors - Moving coil and moving iron instruments, Wheatstone bridge and Megger

Practice:

1. To study Magnetisation Characteristics of DC shunt generator
2. Measurement of Power and Power factor using Single-phase wattmeter
3. Measurement of Resistance using Wheat stone bridge

4. Measurement of Earth Resistance using Megger.

UNIT-III

Energy Resources, Electricity Bill & Safety Measures: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Thermal, Solar and Wind power generation. Calculation of electricity bill for domestic appliances. Working principle of Fuse and Miniature circuit breaker (MCB). Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Practice:

1. Calculation of Electrical Energy for Domestic Premises

UNIT-IV

Semiconductor Devices: Intrinsic semiconductors – Extrinsic semiconductors - P type and N type - P-N junction characteristics of P N Junction Diode — Zener Effect — Zener Diode and its Characteristics. working of simple zener voltage regulator and amplifier-Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics.

Practice:

1. Sketch the V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Sketch the V-I characteristics of Zener Diode and its application as voltage Regulator
3. Plot Input & Output characteristics of BJT in CE and CB configurations.
4. Obtain Frequency response of CE amplifier

UNIT – V

BASIC ELECTRONIC CIRCUITS: Block diagram description of a dc power supply, working of a half and full wave, bridge rectifier, filters.

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, XOR and XNOR. Simple combinational circuits–Half and Full Adders

Practice:

1. Implementation of half wave and full wave rectifiers.
2. Design Half Adder and Full Adder circuits.
3. Verification of truth table for Logic gates using ICs

Text Books:

- 1 Basic Electrical and Electronics Engineering, Salivahanan S, Tata McGraw Hill Education (India) Private Limited, New Delhi, ISBN: 9789389691801
- 2 Principles of Electrical Engineering, V. K. Mehta, R. Mehta, S. Chand & Company Ltd., New Delhi, ISBN-13: 9788121930888

- 3 Digital Fundamentals, Thomas Floyd, Prentice Hall, 10th Edition, ISBN: 9780132737968

Reference Books:

- 1 Electronic Devices & Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson, 11/e, ISBN: 9780135026496
- 2 Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, ISBN: 9788177000207

Web Links:

- 1 <https://nptel.ac.in/courses/108/101/108101091/> (NPTEL Video by Dr.Mahesh B. Patil from IIT Bombay)
- 2 <https://nptel.ac.in/courses/117/106/117106108/> (NPTEL Video by Prof. Nagendra Krishnapura from IIT Madras)

Digital Logic Design
(Common to CSE, IT, AIML & CSE(DS))

Course Code: 2501EC95	L	T	P	C
	2	1	0	3

Course Outcomes:

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

- CO1:** Understand various number systems, perform conversions between them, and apply binary codes in digital representations. (BTL: 2)
- CO2:** Understand basic Boolean algebra rules and simplify Boolean expressions using Karnaugh maps. (BTL: 2)
- CO3:** Design and implement basic combinational logic circuits such as adders, decoders, and multiplexers. (BTL: 3)
- CO4:** Apply the concepts of flip-flops to implement basic sequential circuits like registers, and counters. (BTL: 3)
- CO5:** Develop logic circuits using PLDs such as PROM, PAL, and PLA by utilizing programming tables. (BTL: 3)

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	-	1
CO2	2	2	-	-	-	-	-	2	1	-	1
CO3	2	2	3	1	-	-	-	2	1	-	1
CO4	2	2	3	1	-	-	-	2	1	-	1
CO5	2	2	3	1	-	-	-	2	1	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Digital Systems and Binary Numbers

Digital Systems, Binary Numbers, Number based Conversions, Octal & Hexadecimal Numbers, Complements, Signed binary Numbers, Arithmetic addition and subtraction.

Binary Codes: BCD, 2421, 8421, Excess-3, Gray codes

UNIT-II

Concept of Boolean algebra and Gate Level Minimization

Basic Definitions, Axioms and laws, Basic Theorems, Boolean Functions Simplification .

Digital logic gates, The Map Method –K-Maps(up to 4 variable). Product of Sums

Simplification, Sum of Products Simplification, Don't Care Conditions.

UNIT-III

Combinational Logic

Full adders, Full subtractor, Ripple carry adder, 4-bit Binary adder/subtractor circuit, Decoders(up to 3×8), Encoders(up to 8×3), Multiplexers(up to 8×1), De-Multiplexers(up to 1×8), One bit comparator.

UNIT-IV

Sequential Circuits

Introduction to Sequential Circuits, Latches, RS- Latch Using NAND and NOR Gates, Flipflops(RS, JK, D and T) Truth Tables.

Registers and Counters

Registers, Shift Registers, Ripple Counters – Binary Ripple counter, 3 Bit synchronous counter, Ring Counter.

UNIT – V

Programmable Logic Devices: Introduction to PLDs: PROM, PAL, PLA-Basics structures, realization of Boolean function with PLDs, comparison, merits & demerits of PROM, PAL, PLA.

Text Books:

- 1 Switching and Finite Automata Theory, ZviKohavi& Niraj K.Jha, 3rdEdition, ISBN: 978-0521857482.
- 2 Digital Design, Morris Mano, Pearson, 3rd Edition, ISBN: 978-8178085555.

Reference Books:

- 1 Modern Digital Electronics, RP Jain, Tata Mc Graw Hill, 5thEdition, 2022, ISBN: 978-9355321770.
- 2 Fundamentals of Logic Design, Charles H. Roth Jr., Jaico Publishers, ISBN: 978-0534378042.

Web Links:

- 1 <http://nptel.ac.in/courses/117/106/117106086/> (By Prof. Goutam Saha, Electronics & Electrical Communication Engineering Dept, IIT Kharagpur)
- 2 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/>.

Engineering Economics & Management
(Common to CE, EEE, ME, CSE, IT, AIML & CSE(DS))

Course Code: 2501MB01	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1:** Explain the Business Economic concepts, law of demand and forecasting methods.
- CO2:** Identify the production, cost behaviour for managerial decision making with Break-Even Point (BEP).
- CO3:** Make use of financial accounting and capital budgeting techniques for decision making.
- CO4:** Summarize management and motivational theories to renovate the practice of Management.
- CO5:** Illustrate the functional management and project management using PERT and CPM.

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	-	-	-	-	-	-	-	2	2	-	-
CO2	1	-	-	-	-	-	-	-	-	2	-
CO3	-	-	-	-	-	-	-	-	-	3	-
CO4	1	-	-	-	-	-	-	1	1	2	-
CO5	-	-	-	-	-	-	-	-	-	3	-

UNIT-I

Introduction to Managerial Economics and demand Analysis: Definition of Managerial Economics –Scope of Managerial Economics- Concept of Demand, Types of Demand, Determinants of Demand- Law of Demand and its limitations- Elasticity of Demand, Types- Demand forecasting and its Methods.

UNIT-II

Production and Cost Analyses: Concept of Production function Law of Variable Proportions-Isoquants and Isocosts -Producer Equilibrium-, cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable Costs – Cost –Volume-Profit Analysis-Determination of Breakeven point (simple problems).

UNIT-III

Introduction to Markets and Financial Accounting: Market Structures-Classification of markets, Introduction to Financial Accounting , Concepts and conventions, Accounting cycle, Journal entries and Ledger (Simple Problems), Methods of capital budgeting (Simple Problems).

UNIT-IV

Operations Management : Concept nature and importance of Management, Generic Functions of Management, Theories of Motivation, Plant location and layout, Principles of organization, SWOT analysis.

Material Management: Need for Inventory control, EOQ, ABC analysis

UNIT – V

Functional Management And Project Management: Concept of HRM , HRD and PMIR, Functions of HR Manager , Job Evaluation and Merit Rating , Marketing Management, Functions of Marketing , Channels of distributions - Development of Network , Difference between PERT and CPM, Finding Critical Path (Simple Problems)

Text Books:

- 1 Managerial Economics and Financial Analysis, A. R. Aryasri , McGraw Hill Education, ISBN: 978-0070078031
- 2 Managerial Economics and Financial Analysis', N. Appa Rao, P. Vijay Kumar, Cengage Publications, New Delhi, ISBN: 978-8131515952
- 3 Management Science by Aryasri; Publisher: Tata McGraw Hill, 2009, ISBN: 978-0070090279
- 4 Management by James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R. Gilbert 6th Ed; Publisher: Pearson Education/Prentice Hall, ISBN: 978-0131087477

Reference Books:

- 1 Principles of Marketing: A South Asian Perspective by Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshanul Haque, 13th Edition, Publisher: Pearson Education/ Prentice Hall of India, ISBN: 9788131731017
- 2 A Handbook of Human Resource Management Practice by Michael Armstrong, 2010; Publisher: Kogan Page Publishers, ISBN: 978-1789661033

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

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EN01	Essential Cognitive Skills for Engineers	FC			1	1	100	-	100	-
2501EN02	Advanced Cognitive Skills for Engineers	FC			1	1	100	-	100	ECSE-I
2501UC07	Design Thinking using AI	FC			1	1	100	-	100	-
2501UC08	Universal Human Values	FC	2			2	100	-	100	-
2501UC09	Technical Paper Publication	AC			2	2	100	-	100	-
2501AI35	Student Activity Based Learning	AC				2				
Total			2		5	9				

Essential Cognitive Skills for Engineers
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501EN01 **L T P C**
0 0 1 1

Course Outcomes:

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

- CO1:** Recognize 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, intonation and syllable division for better listening and speaking comprehension.
- CO4:** Enable them to learn and apply fundamentals of English grammar concepts for improved language
- CO5:** Make use of various types of vocabulary in different academic and professional careers

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	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

Practice:

UNIT – I Outstanding people A/B/C/D

- Speaking: Conversation about Jocelyn Bell- Burnell, Podcast: The 30-day challenge, Starting a new job, Conversation about technology
Discussing inspiring people, Asking and answering questions about challenges, Explaining a process; Checking understanding, Discussing technology.
- Reading: Articles: *Protector of the sea and The woman who reinvented children's TV*, Interviews: *30-day challenge*, Article: *Tech free!*
- Writing: Article Organizing an article
- Grammar: Review of Tenses, Questions
- Vocabulary: Character adjectives, trying and succeeding
- Pronunciation: The letter e; Word stress, Rapid speech

UNIT – II Survival A/B/C/D

- Listening: Conversation about a survival situation, Interview: The Tiger, Cooking for a friend, Talking about getting lost

Speaking	Telling a survival story, Giving advice; Asking questions, Giving compliments and responding, Discussing the natural environment
Reading	Article: Lost at sea, Leaflet: <i>How to survive...an animal attack</i> , Leaflet: <i>Be wise and survive</i>
Writing	Guidelines, organizing guidelines in a leaflet
Grammar	Narrative tenses, Future time clauses and conditionals
Vocabulary	Expressions with <i>get</i> , Animals and the environment
Pronunciation	Sound and Spelling: g, Intonation in question tags

UNIT – III Talent A/B/C/D

Listening	Conversation: learning experiences, Radio Programme: The sports gene, Making wedding plans, Interviews about sport
Speaking	Talking about something you have put a lot of effort into, Discussing sport and ways to improve performance, planning a party, Talking about popular sports
Reading	Text about learning; <i>Learning to learn</i> , Article: <i>Born to be the best</i> ; Three articles about athletes, Article: <i>Fitness: Seattle snapshot</i>
Writing	Article describing data
Grammar	Multi-word verbs, Present perfect and present perfect continuous
Vocabulary	Ability and achievement, word connected with sport
Pronunciation	Word stress, sound and spelling consonant sounds

UNIT – IV Life Lessons A/B/C/D

Listening	Interview: Psychology of money; Two monologues: Life-changing events, Two monologues; training for a job, Presenting photos, Three monologues; living in different places
Speaking	Talking about how your life has changes, Discuss experiences of training and rules, Describing photos: Expressing careful disagreement, Discussing living in a different country
Reading	Two texts about life-changing events that helped people become rich, Article: <i>Training for the emergency frontline</i> , Advert for being an international student ‘buddy’
Writing	Job application, Giving a positive impression
Grammar	<i>Used to</i> and <i>would</i>
Vocabulary	Cause and result, Talking about difficulty
Pronunciation	Sound and spelling: u

UNIT – V Chance A/B/C/D

Listening	Monologue: What are your chances?, Conversation: Talking about work, Money problems, News reports: environmental problems
Speaking	Discussing possible future events, Role Play: job interview, Explaining and responding to an idea for a café, Giving opinions on environmental problems
Reading	Quiz: <i>Are you an optimist or a pessimist?</i> ; Article: <i>Why we think we’re going to have a long and happy life</i> , Quiz: <i>The unknown continent</i> ;

Writing	Article: <i>Cooking in Antarctica</i> , Essay about protecting the environment
Grammar	For and against essay, Arguing for and against an idea
Vocabulary	Future probability, Future perfect and future continuous
Pronunciation	Adjectives describing attitude, The natural world
	Sound and spelling : <i>th</i> , Intonation groups

Text Book:

1. Cambridge Empower – Second Edition B2 Level - Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis – Jones. ISBN: 978-1107468726

Suggested Software:

- Cambridge Empower
- Soft X (K-Van Solutions)

Reference Books:

- 1 Effective Technical Communication, M Ashraf Rizvi, ISBN: 9352605780
- 2 Raymond Murphy: English Grammar in Use, Cambridge University Press. Fifth Edition, ISBN: 978-3125354241
- 3 J. Sethi & P.V. Dhamija. A Course in Phonetics and Spoken English, (2nd Ed), Kindle, 2013, ISBN: 9788120314955

Web Links:

- 1 www.cambridgeone.org/login
- 2 <https://www.britishcouncil.in/english/online>
- 3 www.englishmedialab.com

Advanced Cognitive Skills for Engineers
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501EN02	L	T	P	C
	0	0	1	1

Course Outcomes:

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

- CO1:** Recognize the basics of communication and summarize formal and informal language expressions in all aspects.
- CO2:** Establish and maintain interpersonal relationships and transmit the message through different language activities.
- CO3:** Use language effectively to prepare and demonstrate proficiency in facing various types of interviews.
- CO4:** Demonstrate and exhibit professionalism in participating in various public speaking activities like debates, group discussions and presentation skills.
- CO5:** Identify the basic elements of writing and apply the fundamentals to compose e-mails catering to different professional 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
CO1	-	-	-	-	-	-	-	-	3	-	-
CO2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	-	-

List of the Topics

UNIT – I Around the globe A/B/C/D

- | | |
|---------------|--|
| Listening | Two monologues about sightseeing tours, Interview: disappearing languages, Asking for a favour, conversation: a trip to the Grand Canyon |
| Speaking | Comparing different tourist destinations, Agreeing and disagreeing, Asking for a favour, Discussing local tourist destinations. |
| Reading | Website about four tourist destinations; Website: <i>Where to go?</i> |
| Writing | Travel blog, Using descriptive language |
| Grammar | Infinitives and <i>-ing</i> forms |
| Vocabulary | Travel and tourism, Describing changes |
| Pronunciation | Consonant clusters, Consonant sounds |

UNIT – II City living A/B/C/D

- | | |
|-----------|---|
| Listening | Interview: ‘Smart’ cities: Two monologues talking about ‘smart’ cities, Two monologues: house renovations, Flat hunting, Interviews about a new shopping centre |
|-----------|---|

Speaking	Discussing good and bad points about a city
Reading	Article: <i>Quick-slow down!</i> , Article: <i>Who puts the 'real' in reality TV?</i> Email: Complaining about an important issue.
Writing	Email of complaint, Using formal language
Grammar	<i>Too/enough; so/such</i> , Causative <i>have/get</i>
Vocabulary	Describing life in cities, Film and TV; Houses
Pronunciation	Sound and spelling: o, Stress in compound nouns

UNIT – III Dilemmas A/B/C/D

Listening	Radio programme: person finance, Three monologues about honesty, Going to the bank, Conversation about a TV programme
Speaking	Giving opinions on financial matters, Discussing moral dilemmas, Talking about hopes and worries Discussing programmes about crime
Reading	Article: <i>Is it time to give up on cash?</i> , Newspaper article: <i>The honesty experiment</i> , Review: <i>Crime with a smile</i>
Writing	Review, Organising a review
Grammar	First and second conditionals, Third conditional; <i>should have+past participle</i>
Vocabulary	Money and finance, Crime
Pronunciation	Stressed and unstressed words; Sound and spelling: <i>l</i> , Word groups

UNIT – IV Discoveries A/B/C/D

Listening	Conversation about inventions, Conversation about an email hoax, Finding the perfect flat, Four monologues about alternative medicine
Speaking	Talking about inventions, Describing a hoax or a scam or a case of fraud, Giving and receiving surprises
Reading	Article: <i>Too good to be true?</i> , Article: <i>The rise and fall of Barry Minkow</i> , Essay: <i>The Value of alternative medicine</i>
Writing	Opinion essay, Presenting a series of arguments
Grammar	Relative clauses, Reported speech; Reporting verbs
Vocabulary	Health, Verbs describing thought and knowledge
Pronunciation	Sound and spelling : <i>ui</i> , Linking and intrusion

UNIT – V Possibilities A/B/C/D

Listening	Interview about Dan Cooper, Two monologues: pursuing a dream, Celebrating good news, conversation about goals
Speaking	Telling stories about coincidences, Describing and comparing brave or amazing people, Telling an important piece of news, Talking about performing
Reading	Story: The man who disappeared; Blog: <i>The Wreck of the Titan</i> , Article: <i>Dream to help</i> , Story: Rosa's diary: <i>The ultimate goal</i>
Writing	Story, Making a story interesting
Grammar	Past modals of deduction, Wishes and regrets
Vocabulary	Adjectives with prefixes, Verbs of effort
Pronunciation	Word stress, Linking, Consonant clusters

Text Book:

1. Cambridge Empower – Second Edition B2 Level - Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis – Jones. ISBN: 978-1107468726

Suggested Software:

- Cambridge Empower
- Soft X (K-Van Solutions)

Reference Books:

- 1 Technical Communication. Raman Meenakshi, Sangeeta-Sharma. Oxford University Press.2018, ISBN: 97893549772256
- 2 Practical English Usage -Michael Swan, ISBN: 9780194202466
- 3 English Conversation Practice, Taylor Grant: Tata McGraw-Hill Education India, ISBN: 978-0070996038

Web links:

- 1 <https://www.cambridgeone.org/login>
- 2 <https://www.coursera.org/>
- 3 <https://www.skillshare.com/>
- 4 <https://www.mindtools.com/cawh8bu/communication-tools>

Design Thinking using AI

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501UC07

L	T	P	C
0	0	1	1

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:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
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

Practice using any AI tool:

Students are advised to use any AI tool like Otter AI etc for Transcribe interviews automatically and summarize user insights.

UNIT – III

Design Thinking in IT: Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenario based Prototyping

Practice using any AI tool:

Students are advised to use any AI tool like ChatGPT, Claude, Perplexity etc to define, synthesize, ideate and prototype.

UNIT – IV

DT For strategic innovations: Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design.

Practice using any AI tool:

Students are advised to use any AI tool like looka,logomkr,canva and figma etc for logo,prototyping and sketching.

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) Second Edition, ISBN: 9781133708766
- 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, Second Edition, ISBN: 978-8131529041
- 2 Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author), 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

Universal Human Values

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501UC08	L	T	P	C
	1	1	0	2

Pre Requisites: Universal Human Values (UHV-I) (desirable).

Course Objectives:

This course input is intended

1. To help the students appreciate the complementarity between 'VALUES' and 'SKILLS' and understand how ethical foundations enhance technical competence to achieve sustainable happiness, prosperity, and responsible professional growth.
2. To develop a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a right understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values (UHV) and movement towards value-based living in a natural way.
3. To highlight real-world implications of Holistic understanding of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. To encourage the students to realise their full potential and act accordingly.
5. To assist the students to live with a feeling of relationship, harmony and co-existence.

Thus, this course is intended to provide a much-needed input in value education to the young enquiring minds.

UNIT I INTRODUCTION TO VALUE EDUCATION

Lecture 1: Holistic Development and the Role of Education (Right Understanding, Relationship and Physical Facility)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 - Sharing about Oneself

Lecture 3: Self-Exploration 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.

UNIT II HARMONY IN THE HUMAN BEING

Lecture 7: Understanding Human being as the Co-existence 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 self-regulation and Health

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

UNIT III HARMONY IN THE FAMILY AND SOCIETY

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 Human-to-Human 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

UNIT IV HARMONY IN THE NATURE/EXISTENCE

Lecture 19: Understanding Harmony in Nature

Lecture 20: Interconnectedness, self-regulation 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 Co-existence at All Levels

Lecture 22: The Holistic Perception of Harmony in Existence

Tutorial 11: Practice Session PS11 - Exploring Co-existence 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 Models-Typical Case Studies

Lecture 28: Strategies for Transition towards Value-based Life and Profession

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

Course Outcomes:

Upon successful completion of the course, students will be able to

CO1: Demonstrate an understanding of basic human aspiration and the concept of Natural Acceptance and apply them in personal and professional decision-making.

CO2: Develop self-awareness and practice self-regulation.

CO3: Recognize human-human relationship (Justice) and identify human goals in society.

CO4: Appreciate the harmony in nature and existence.

CO5: Develop as socially and ecologically responsible engineers in handling problems with sustainable solutions (user-friendly and eco-friendly).

Text Books:

1. R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 3rd Revised Edition, UHV Publications, Sarva Shubha Nyas, Kanpur, 2023. ISBN: 978- 81-957703-7-3 (Printed Copy) ISBN: 978-81-957703-6-6 (e-book)
2. R R Gaur, R Asthana, G P Bagaria, *Teachers' Manual for a Foundation Course in Human Values and Professional Ethics*, 3rd Revised Edition, UHV Publications, Sarva Shubha Nyas, Kanpur, 2023.

Reference Books:

1. *Jeevan Vidya: Ek Parichaya*, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book), Annie Leonard, Free Press, 2010.
4. *The Story of My Experiments with Truth*, Mohandas Karamchand Gandhi, Fingerprint! Publishing
5. *Small is Beautiful* - E. F Schumacher, Random House, 2011.
6. *Slow is Beautiful* - Cecile Andrews, New Society Publishers, 2006
7. *Economy of Permanence* - J C Kumarappa
8. *Vivekananda* - Romain Rolland

Online Resources

1. <https://fdp-si.aicte-india.org/index.php>
2. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
3. <https://uhv.org.in/>
4. <https://www.youtube.com/@UniversalHumanValues/playlists>

Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SE E	Total	Pre- requisite
2501CS17	Object Oriented Analysis & Design using UML	IC			2	2	50	50	100	ASE
2501AI34	Web Application Development using MERN Stack	AC			2	2	50	50	100	-
2501CS19	CI/CD using DevOps	AC			1	1	100	-	100	-
Total					5	5				

Object Oriented Analysis & Design using UML

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

Course Code: 2501CS17	L	T	P	C
	0	0	2	2

Course Outcomes:

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

- CO1:** Explain the importance of system analysis and design in solving complex problems.
- CO2:** Compare object-oriented approach with traditional approach in system analysis and design.
- CO3:** Analyze the importance of modeling and design of various applications.
- CO4:** Compare various object relationships.
- CO5:** Show the role and function of each UML model in developing object-oriented 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
CO1	2	1	-	-	3	-	-	2	2	-	-
CO2	3	1	-	-	2	-	-	2	2	-	-
CO3	3	-	2	-	2	-	-	2	2	-	-
CO4	3	2	1	-	2	-	-	2	2	-	-
CO5	2	3	-	-	2	-	-	2	2	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

1. List of Case Studies:
 ATMAApplication.
 Library ManagementSystem.
 Online Book Shop.
 Customer SupportSystem.
 Point ofSale.
 Familiarization with RationalRose
2. For each case study:
 - 2.1) Identify and analyze events
 - 2.2) Identify Usecases
3. For each case study:
 - 3.1) Develop event table
 - 3.2) Identify & analyze domain classes
4. For each case study:

- 4.1) Represent use cases and a domain class diagram using Rational Rose
- 4.2) Develop CRUD matrix to represent relationships between use cases and problem domain classes
5. For each case study:
 - 5.1) Develop Use case diagrams
 - 5.2) Develop elaborate Use case descriptions & scenarios
6. For each case study
 - 6.1) develop system sequence diagrams
7. For each case study:
 - 7.1) Develop highlevel sequence diagrams for each usecase
 - 7.2) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the threelayerobjects
8. For each case study:
 - 8.1) Develop highlevel sequence diagrams for each usecase1
 - 8.2) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the threelayerobjects
9. For each case study:
 - 9.1) Develop highlevel sequence diagrams for each usecase
 - 9.2) Develop Detailed Sequence Diagrams / Communication diagrams for each use case showing interactions among all the threelayerobjects
10. For each case study:
 - 10.1) Develop highlevel Collaboration diagrams for each usecase
 - 10.2) Develop detailed collaboration diagrams for each use case showing interactions among all the threelayerobjects
11. For each case study:
 - 11.1) Develop Use case Packages.
 - 11.2) Develop component diagrams.
 - 11.3) Develop sample diagrams for other UML diagrams state chart diagrams, activity diagrams and deployment diagrams.
12. Design UML models for the following application. RestaurantSystem.

Additional practice:

Design UML models for the following Case studies.

1. Banking Application System.
2. Railway Reservation System
3. Online Movie Ticket BookingSystem.

Text Books:

- 1 Object-oriented analysis and design using UML, Mahesh P. Matha, PHI, ISBN: 9788120333222
- 2 Head first object-oriented analysis and design, Brett D. McLaughlin, Gary Pollice, Dave West, O'Reilly. ISBN: 9780596008673

Reference Books:

- 1 Object-oriented analysis and design with the Unified process, John W. Satzinger, Robert B. Jackson, Stephen D. Burd, CengageLearning, ISBN: 978-0619216436
- 2 The Unified modeling language Reference manual, James Rumbaugh, Ivar Jacobson, Grady Booch, Addison Wesley, ISBN: 9780321245625

- 3 Object Oriented Analysis & Design, AtulKahate, The McGraw-Hills Companies,
ISBN: 9780070583764

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs40/preview
- 2 <https://www.quora.com/in/What-are-the-best-website-to-study-UML-for-beginners>
- 3 <https://creately.com/lp/uml-diagram-tool/>

WEB Application Development using MERN Stack
(Common to CSE, IT, AIML & CSE (DS))

Course Code: 2501AI34	L	T	P	C
	0	0	2	2

Course Outcomes:

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

- CO1:** Make use of HTML elements, CSS styles and their attributes for designing static web pages.
- CO2:** Apply JavaScript to develop dynamic web pages and validate forms.
- CO3:** Build a basic web server using Node.js and also working with Node Package Manager (NPM) & Make use of Typescript to optimize JavaScript code using strict type checking
- CO4:** Make use of router, template engine and authentication using sessions to develop application in ExpressJS & components, props, stats and render data in ReactJS
- CO5:** Build a single page application using RESTful APIs in ExpressJS. & Make use of MongoDB queries

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	2	2	3	-	2	-	-	1	2	-	2
CO2	2	3	2	-	2	-	-	1	2	-	2
CO3	2	2	3	1	2	-	-	1	2	-	2
CO4	2	3	2	2	2	-	-	1	2	-	2
CO5	2	2	3	1	2	-	-	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	-

Practice:

1. Lists, Links, Images, Tables, Forms.
 - 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.
Note: Use text to link □ <https://www.aec.edu.in/>
Use image to link □ <https://www.aec.edu.in/?p=Gallery>
 - 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, to explain the working of tables. (use tags: <table>, <tr>, <th>, <td> and attributes: border, rowspan, colspan)
 - e. 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).
2. HTML 5 and Cascading Style Sheets, Types of CSS & CSS Box Model
- a. Write a HTML program, that makes use of <article>, <aside>, <figure>, <figcaption>, <footer>, <header>, <main>, <nav>, <section>, <div>, tags.
 - b. Write a HTML program, to embed audio and video into HTML web page.
 - c. Write a program to demonstrate the various ways you can reference a color in CSS.
 - d. Write a program, to explain the importance of CSS Box model using
 - i. Content
 - ii. Border
 - iii. Margin
 - iv. padding
3. Selector forms & JavaScript-internal and & I/o
- a. 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. Write a program to embed internal and external JavaScript in a web page.
 - iv. Write a program to explain the different ways for displaying output.
4. Javascript Pre-defined and User-defined Objects, Conditional & Loop Statements
- a. Write a program using document, window, math & string object properties and methods.
 - b. 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”.
 - c. Write a program to print 1 to 10 numbers using for, while and do-while loops.
5. Javascript Functions and Events & Node.js
- a. Design a appropriate function should be called to display
 - i. Factorial of that number
 - ii. Fibonacci series up to that number
 - iii. Write a program to show the workflow of JavaScript code executable by creating web server in Node.js.
 - iv. Write a program to transfer data over http protocol using http module.
 - v. Create a text file src.txt and add the following content to it. (HTML, CSS, Javascript, Typescript, MongoDB, Express.js, React.js, Node.js)
6. Typescript
- a. Write a program to understand simple and special types.
 - b. Write a program to understand function parameter and return types.
7. ExpressJS – Routing, HTTP Methods, Templating
- 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 using templating engine.
8. ExpressJS – Cookies, Sessions, Authentication, Database.
 - a. Write a program for session management using cookies and sessions.
 - b. Write a program for user authentication.
 - c. Write a program to connect MongoDB database using Mongoose and perform CRUD operations
9. ExpressJS – Templating, Form Data, Cookies, Sessions
 - a. Write a program using templating engine.
 - b. Write a program to work with form data.
 - c. Write a program for session management using cookies and sessions.
10. ReactJS – Render HTML, JSX, Props and States
 - a. Write a program to render HTML to a web page.
 - b. Write a program for writing markup with JSX.
 - c. Write a program to work with props and states.
11. ReactJS – Conditional Rendering, Rendering Lists, React Router
 - a. Write a program for conditional rendering.
 - b. Write a program for rendering lists.
 - c. Write a program for routing to different pages using react router.
12. ReactJS – Hooks, Sharing data between Components, To-do list and Quiz & MongoDB – Installation, Configuration
 - a. Write a program to understand the importance of using hooks.
 - b. Write a program for sharing data between components.
 - c. Design to-do list application.
 - d. Install MongoDB and configure ATLAS

Additional Practice:

1. Design a to-do list application using Javascript
2. Design a to-do list application using NodeJS and ExpressJS.

Note: The student must Complete & Submit a HTML5, JavaScript, TypeScript ,NodeJs & MongoDB Certificate Courses offered by Infosys Spring board at the end of the Practice Session.

Reference Books:

- 1 Programming the World Wide Web, Robert W Sebesta, Pearson, 7th Edition. ISBN 139789332518827
- 2 Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node, Vasanth Subramanian, APress, O'Reilly, 2nd edition. ISBN 9781484226520

Web Links:

- 1 https://infyspringboard.onwingspan.com/en/app/toc/lex_17739732834840810000_shared/overview (HTML5)
- 2 https://infyspringboard.onwingspan.com/en/app/toc/lex_18109698366332810000_shared/overview (Javascript)
- 3 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384329019595161635073_shared/overview (Express Js)
- 4 https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_013177169294712832113_shared/overview (MongoDB)

CI/CD using Devops
(Common to CSE, IT, AIML & CSE (DS))

Semester:	L	T	P	C
Course Code: 2501CS19	0	0	1	1

Course Outcomes:

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

- CO1:** Summarize the life cycle & principles of agile software development
- CO2:** Develop the fundamentals programs using Devops
- CO3:** Analyze the adoption of Devops in Projects and Process
- CO4:** Demonstrate the types of continuous integration and continuous delivery in Devops
- CO5:** Build an automated CICD pipeline using a stack of tools
- CO6:** Develop basic branching and merging in GIT

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	1	3	1	-	2	-	-	2	2	-	1
CO2	1	2	1	-	3	-	-	2	2	-	1
CO3	1	3	2	2	2	-	-	2	2	-	1
CO4	-	1	3	-	2	-	-	2	2	-	1
CO5	2	1	3	-	3	-	-	2	2	-	2
CO6	2	3	2	-	3	-	-	2	2	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	1	-
CO2	1	-
CO3	2	-
CO4	2	-
CO5	3	-
CO6	2	-

Practice:

1. Get an understanding of the stages in software development lifecycle, the process models, values and principles of agility and the need for agile software development. This will enable you to work in projects following an agile approach to software development.
2. Get a working knowledge of using extreme automation through XP programming practices of test first development, refactoring and automating test case writing.
3. It is important to comprehend the need to automate the software development lifecycle stages through DevOps. Gain an understanding of the capabilities required to implement DevOps, continuous integration and continuous delivery practices.

4. Configure the web application and Version control using Git using Git commands and version control operations.
5. Configure a static code analyzer which will perform static analysis of the web application code and identify the coding practices that are not appropriate. Configure the profiles and dashboard of the static code analysis tool.
6. Write a build script to build the application using a build automation tool like Maven. Create a folder structure that will run the build script and invoke the various software development build stages. This script should invoke the static analysis tool and unit test cases and deploy the application to a web application server like Tomcat.
7. Configure the Jenkins tool with the required paths, path variables, users and pipeline views.
8. Configure the Jenkins pipeline to call the build script jobs and configure to run it whenever there is a change made to an application in the version control system. Make a change to the background color of the landing page of the web application and check if the configured pipeline runs.
9. Create a pipeline view of the Jenkins pipeline used in Exercise 8. Configure it with user defined messages.
10. In the configured Jenkins pipeline created in Exercise 8 and 9, implement quality gates for static analysis of code.
11. In the configured Jenkins pipeline created in Exercise 8 and 9, implement quality gates for static unit testing.
12. In the configured Jenkins pipeline created in Exercise 8 and 9, implement quality gates for code coverage.

Additional Practice:

1. To fetch and synchronize git repository
2. To perform basic branching and merging in Git
3. To implement form validation

Reference Books:

- 1 Learning Continuous Integration with Jenkins: A beginner's guide to implementing Continuous Integration and Continuous Delivery using Jenkins - Nikhil Pathania ,Packt publication [<https://www.amazon.in/Learning-Continuous-Integration-Jenkins-Pat>, ISBN: 978-1785284830
- 2 Jenkins 2 – Up and Running: Evolve Your Deployment Pipeline for Next Generation Automation – Brent Laster, O’Reilly publication, ISBN: 978-1491979594 [<https://www.amazon.in/Jenkins-2-Running-Brent-Laster/dp/1491979593>]

Web Links:

- 1 <https://www.geeksforgeeks.org/what-is-ci-cd/>
- 2 <https://github.com/nkatre/Free-DevOps-Books-1/blob>

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS04	Internet of Things	FC			1	1	50	50	100	-
2501AI06	Data Analysis Essentials	IC			2	2	50	50	100	PP
2501UC11	Employability Skills-I	FC			3	0	100	-	100	-
2501UC13	Employability Skills-II	FC			3	0	100	-	100	ES-I
2501UC14	Employability Skills-III	IC			3	0	100	-	100	ES-II
2501UC15	Employability Skills-IV	IC			3	0	100	-	100	ES-III
2501UC16	Employability Skills-V	AC			3	1	100	-	100	ES-IV
Total					18	4				

Internet of Things

(Common to EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501CS04	L	T	P	C
	0	0	1	1

Course Outcomes:

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

- CO1:** Identify and select appropriate sensors, actuators, and boards (Arduino/Pi) for specific tasks.
- CO2:** Execute digital and analog interfacing of peripherals with embedded platforms.
- CO3:** Develop control algorithms and decision-making logic for real-time automation.
- CO4:** Configure cloud platforms and APIs for data transmission and visualization.
- CO5:** Design and build functional end-to-end IoT prototypes for real-world 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
CO1	2	1			1						
CO2	2	2	1		2						
CO3	1	2	2	1							
CO4	1	1		1	2						1
CO5	1	2	2	2	2	1	1	1	2	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

Practice:

1. Study of Arduino UNO and Raspberry Pi boards including architecture, pin configuration, power supply, communication interfaces and development environments.
2. Study of commonly used sensors and actuators such as temperature sensor, moisture sensor, LDR, ultrasonic sensor, IR sensor, PIR sensor, LED and motor. Identify their working principles and applications.
3. Design and implement basic digital input–output operations using Arduino by controlling LED/buzzer.
4. Interface an analog sensor (LDR) with Arduino and display sensor values on Serial Monitor.
5. Interface a digital sensor (Ultrasonic sensor) with Arduino and display measured values on Serial Monitor.
6. Develop conditional logic using Arduino to control LED or buzzer based on sensor threshold values.
7. Interface a servo motor with Arduino and control its angular position based on

- sensor input to demonstrate automatic gate or smart irrigation model.
8. Design and implement a multi-sensor monitoring system using Arduino to read analog and digital sensors simultaneously and display results on Serial Monitor.
 9. Create a cloud platform account, explore available IoT services and register a device (Thing) on the platform.
 10. Demonstration of IoT based system to upload sensor data to cloud platform and visualize the received data in graphical form.

Additional Practice (Any 2 from the following)

1. **Smart Lighting System:** Design a lighting system that automatically turns ON/OFF or dims lights based on human movement or surrounding light conditions to demonstrate energy saving.
2. **Intelligent Traffic Control System:** Develop an automated traffic signal system for busy roads with priority control for emergency vehicles (such as ambulances).
3. **Smart Parking System:** Create a sensor-based parking system to detect available slots and provide parking guidance or remote monitoring.
4. **Air Pollution Monitoring System:** Build an IoT-based setup using gas or environmental sensors to measure air quality and indicate whether pollution levels are safe or dangerous.
5. **Bluetooth-Based Actuator Control:** Control motors or other actuators connected to a development board using Bluetooth communication.

Reference Books:

- 1 An Introduction to Internet of Things, Connecting devices, Edge Gateway and Cloud with Applications, Rahul Dubey, Cengage, 2019. ISBN: 9789353501020
- 2 Adrian McEwen, Designing the Internet of Things, Wiley Publishers. ISBN:978-1118430620
- 3 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. ISBN:9789386873743
- 4 Internet of Things, by Vengalapudi Appala Konda and Prof. Sangareddy B. Krutakoti, Scientific International Publishing House, First Edition, 2024. ISBN: 978-93-6132-958-6.

Web Links:

- 1 <https://iotvirtuallab.github.io/vlab/Experiments/index.html>
- 2 https://onlinecourses.nptel.ac.in/noc21_cs17/preview
- 3 <https://www.electronicsforu.com/electronics-projects/internet-of-things-iot>
- 4 <https://www.coursera.org/specializations/iot>
- 5 <https://projecthub.arduino.cc/>
- 6 <https://www.edureka.co/iot-certification-training>

Data Analysis Essentials
(Common to CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501AI06	0	0	2	2

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

- CO1:** Perform various operations on NumPy arrays.
- CO2:** Importing data from different file formats using pandas
- CO3:** Draw different types of charts using matplotlib.
- CO4:** Demonstrate web scraping using python.
- CO5:** Design preprocessing techniques on loan prediction dataset.

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	2	2	-	-	2	-	-	1	2	-	-
CO2	3	2	-	-	3	-	-	1	2	-	-
CO3	2	2	-	-	3	-	-	2	1	-	-
CO4	2	2	-	-	1	-	-	1	1	-	-
CO5	2	2	-	-	2	-	-	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

Week 1: Creating a NumPy Array

- a. Basic ndarray
- b. Array of zeros
- c. Array of ones
- d. Random numbers in ndarray
- e. An array of your choice
- f. Imatrix in NumPy
- g. Evenly spaced ndarray

Week 2: The Shape and Reshaping of NumPy Array

- a. Dimensions of NumPy array
- b. Shape of NumPy array
- c. Size of NumPy array
- d. Reshaping a NumPy array
- e. Flattening a NumPy array

- f. Transpose of a NumPy array

Week 3: Expanding and Squeezing a NumPy Array

- a. Expanding a NumPy array
- b. Squeezing a NumPy array
- c. Sorting in NumPy Arrays

Week 4: Indexing and Slicing of NumPy Array

- a. Slicing 1-D NumPy arrays
- b. Slicing 2-D NumPy arrays
- c. Slicing 3-D NumPy arrays
- d. Negative slicing of NumPy arrays

Week 5: Stacking and Concatenating Numpy Arrays

- a. Stacking ndarrays
- b. Concatenating ndarrays
- c. Broadcasting in Numpy Arrays

Week 6: Perform following operations using pandas

- a. Creating dataframe
- b. concat()
- c. Setting conditions
- d. Adding a new column

Week 7: Perform following operations using pandas

- a. Filling NaN with string
- b. Sorting based on column values
- c. groupby()

Week 8: Read the following file formats using pandas

- a. Text files
- b. CSV files
- c. Excel files
- d. JSON files

Week 9: Read the following file formats

- a. Pickle files
- b. Image files using PIL
- c. Multiple files using Glob
- d. Importing data from database

Week 10: Demonstrate web scraping using python

Week 11: Perform following preprocessing techniques on loan prediction dataset

- a. Feature Scaling
- b. Feature Standardization
- c. Label Encoding
- d. One Hot Encoding

Week 12: Perform following visualizations using matplotlib

- a. Bar Graph
- b. Pie Chart
- c. Box Plot
- d. Histogram
- e. Line Chart and Subplots
- f. Scatter Plot.

Additional Practice:

1. Write a program that reads a list of temperatures from a file called temps.txt, converts those temperatures to Fahrenheit, and writes the results to a file called ftemps.txt
2. Write a program to find the greatest number that can be formed by using given set of numbers.
3. Write a program to find sum of digits of a number till you get single digit sum.
Example:
Input: 142 (Hint: $1+4+2=7$)
Output: 7
Input: 4683 (Hint: $4+6+8+3=21 \Rightarrow 2+1=3$)
Output: 3
4. Write a program to count how many times each word present in a file.

Text Books:

1. Python Data Science Handbook, Jake VanderPlas, 2nd Edition, 2022, ISBN: 978-1098121228
2. Data Analysis from Scratch with Python: Step By Step Guide, Peters Morgan, 2018, ISBN: 978-1725678095

Reference Books:

1. Python for Data Analysis, Wes McKinney, 3rd Edition 2022, ISBN: 978-1098104030
2. An Introduction to Statistical Learning: With Applications in Python, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Jonathan Taylor, 1st Edition, 2023, ISBN: 978-3031387463

Web Links:

1. <https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/>
2. <https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/>

3. <https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/>
4. <https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/>
5. <https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-explorationpython/>

Employability Skills- I

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min.E & Agri.E)

Course Code: 2501UC11	L	T	P	C
	0	0	3	0

Course Outcomes:

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

- CO1:** Apply fundamental arithmetic concepts such as number systems, LCM & HCF, ratio & proportion, and averages to solve quantitative problems efficiently.
- CO2:** Analyze number and letter series to identify logical patterns and predict subsequent elements.
- CO3:** Select the option by evaluating relationships in analogy-based problems and detecting inconsistencies in logical sequences
- CO4:** Demonstrate effective verbal communication skills by using appropriate parts of speech and tone in various interpersonal and professional contexts.

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	2	3	-	-	1	-	-	-	-	-	-
CO2	1	3	-	2	2	-	-	-	-	-	-
CO3	-	3	-	2	1	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	2	3	-	1

Aptitude:

Number System, LCM & HCF, Ratio and Proportion, Averages

Reasoning:

Number Series, Letter Series, Number Analogy, Letter Analogy, Odd Man Out, Logical Sequence of Words.

Verbal:

Introduction to soft skills, how to improve communication? Parts of Speech, Mind your language towards better English, Vocabulary Expansion

Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, **ISBN: 9789355012326**
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, **ISBN-13: 978-9352832163.**
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, **ISBN-13: 978-8121922111.**

Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, **ISBN-13 9789389957426.**

- 2 How To Crack Test of Reasoning Verbal , Non-Verbal & Analytical – Jaikishan and Premkishan,Arihant Publications, NEW EDITION 2024, ASIN : **B0CRQ9BVBC**.
- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: **978-8186651032**.

Web Links:

- 1 www.indiabix.com
- 2 www.bankersadda.com

Employability Skills- II

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min.E & Agri.E)

Course Code: 2501UC13	L	T	P	C
	0	0	3	0

Course Outcomes:

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

- CO1:** Apply percentage, profit & loss, and partnership concepts to solve real-world quantitative problems.
- CO2:** Analyze age-related problems to develop logical problem-solving strategies.
- CO3:** Evaluate logical reasoning questions including ranking, directions, and alphabet tests for accurate decision-making.
- CO4:** Solve pattern-based problems in coding and decoding to enhance analytical skills.
- CO5:** Demonstrate effective written communication using correct grammar and structured presentation 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
CO1	3	3	-	-	2	-	-	-	-	-	-
CO2	2	3	2	-	1	-	-	-	-	-	-
CO3	-	3	-	2	2	-	-	-	-	-	-
CO4	-	3	-	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	2	2	-	2

Aptitude:

Problems on Ages, Partnership, Percentages, Profit and Loss

Reasoning:

Coding and Decoding, Ranking Test, Alphabet Test, Direction Test

Verbal:

Written communication skill practice, Grammatical use, Concept of 4 step method for presentation, Present Tense

Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, **ISBN** · 9789355012326
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, **ISBN-13.** 978-9352832163.
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, **ISBN-13.** 978-8121922111.

Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, **ISBN-13** 9789389957426.
- 2 How To Crack Test of Reasoning Verbal , Non-Verbal & Analytical – Jaikishan and

- Premkishan, Arihant Publications, NEW EDITION 2024, ASIN : **B0CRQ9BVBC**
- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, isbn-13:978-8186651032

Web Links:

- 1 www.indiabix.com
- 2 www.bankersadda.com

Employability Skills- III

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min.E & Agri.E)

Course Code: 2501UC14	L	T	P	C
	0	0	3	0

Course Outcomes:

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

- CO1:** Solve financial and quantitative aptitude problems using concepts of simple and compound interest.
- CO2:** Apply logical time-work frameworks to solve real-time problems related to work efficiency and pipe systems .
- CO3:** Analyze and interpret problems related to blood relations, clocks, calendars, and coded inequalities.
- CO4:** Evaluate spatial and logical reasoning through cubes, dice, and symbolic interpretation problems.
- CO5:** Demonstrate effective communication using correct grammar, and participate actively in discussions and comprehension activities.

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	2	3	-	-	1	-	-	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-
CO3	-	3	-	2	1	-	-	-	-	-	-
CO4	-	3	-	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	2	3	-	2

Aptitude:

Simple Interest, Compound Interest, Time and Work, Pipes and Cisterns

Reasoning:

Blood Relations, Calendar, Clocks, Cubes and Dice, Coded Inequalities

Verbal:

Grammar in use, Group discussion, Reading Comprehension, Past Tense, Future Tense

Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13: 978-9352832163
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, ISBN-13: 978-8121922111

Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13: 9789389957426

- 2 How To Crack Test of Reasoning Verbal , Non-Verbal & Analytical – Jaikishan and Premkishan,Arihant Publications, NEW EDITION 2024, ASIN : **B0CRQ9BVBC**.
- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: 978-8186651032

Web Links:

- 1 www.indiabix.com
- 2 www.bankersadda.com

Employability Skills- IV

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min.E & Agri.E)

Course Code: 2501UC15	L	T	P	C
	0	0	3	0

Course Outcomes:

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

- CO1:** Apply concepts of time, speed, distance, trains, boats and streams to solve motion-related aptitude problems.
- CO2:** Solve mensuration problems involving surface area and volume in real-world contexts.
- CO3:** Analyze logical reasoning questions involving Venn diagrams and syllogisms to make valid conclusions.
- CO4:** Interpret seating arrangements and solve non-verbal reasoning questions involving patterns and spatial reasoning.
- CO5:** Demonstrate effective communication through structured self-introduction, emails, letters, reports, and grammar 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	PO 10	PO 11
CO1	3	3	-	-	2	-	-	-	-	-	-
CO2	3	3	-	-	2	-	-	-	-	-	-
CO3	-	3	-	2	2	-	-	-	-	-	-
CO4	-	3	-	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	2	2	-	2

Aptitude:

Time, Speed and Distance, Problems on Trains, Boats and Streams, Mensuration - I, Mensuration – II

Reasoning:

Venn Diagrams, Syllogisms, Non - Verbal Reasoning, Seating Arrangement

Verbal:

Grammatical use, Self-introduction, Letters, E-Mail & Report writing, Error correction, Effective Communication

Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN: 9789355012326
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13: 978-9352832163
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, ISBN-13: 978-8121922111

Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13:

- 9789389957426
- 2 How To Crack Test of Reasoning Verbal , Non-Verbal & Analytical – Jaikishan and Premkishan,Arihant Publications, NEW EDITION 2024, **ASIN : B0CRQ9BVBC**
 - 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: **978-8186651032.**

Web Links:

- 1 www.indiabix.com
- 2 www.bankersadda.com

Employability Skills- V

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501UC16	L	T	P	C
	0	0	3	1

Course Outcomes:

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

- CO1:** Apply principles of permutations, combinations, probability, and logarithms to solve quantitative aptitude problems.
- CO2:** Interpret and analyze data from charts, graphs, and statistical tables for decision-making and accuracy.
- CO3:** Evaluate logical reasoning statements involving arguments, assumptions, conclusions, and data sufficiency.
- CO4:** Solve puzzle and eligibility test problems using analytical and critical thinking skills.
- CO5:** Demonstrate effective interpersonal, communication, and time management skills for successful personal and professional interactions.

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

Aptitude:

Permutations and Combinations, Probability, Data Interpretation, Logarithms, Statistics

Reasoning:

Puzzle Tests, Eligibility Test, Data Sufficiency, Statements – Arguments, Statements – Assumptions, Statements - Course of Action, Statements – Conclusions

Verbal:

Interview skills, Grammar in use, Interpersonal Skills, Negotiation Skills, Social Skills, Problem-Solving Skills, Time Management Skills

Text Books

- 1 Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, ISBN · 9789355012326.
- 2 A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, ISBN-13: 978-9352832163
- 3 Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, ISBN-13: 978-8121922111

Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, **ISBN-13** 9789389957426.
- 2 How To Crack Test of Reasoning Verbal , Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, NEW EDITION 2024, **ASIN : B0CRQ9BVBC**.
- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: **978-8186651032**.

Web Links:

- 1 www.indiabix.com
- 2 www.bankersadda.com

Mandatory Courses (MC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AC01	Environmental Science	FC	2			0	100	-	100	-
2501AC02	Constitution of India	FC	2			0	100	-	100	-
2501AC03	Research Methodology	FC	2			0	100	-	100	-
2501AC04	Intellectual Property Rights & Patents	FC	2			0	100	-	100	-
2501AC05	Indian Knowledge Systems	FC	2			0	100	-	100	-
Total			10			0				

Environmental Science

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501AC01	L	T	P	C
	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

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	1	-	-	-	1	-	2	-	-	-	-
CO2	1	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	2	-	3	-	-	-	1
CO4	-	-	-	-	1	-	3	1	-	-	1
CO5	-	-	-	-	-	-	3	-	-	-	-

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: Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Values of biodiversity. Hot-spots of biodiversity – Threats to biodiversity. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

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, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution

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, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Environment Protection Act – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act-Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

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, ISBN: 9788173718625
2. Environmental Studies by Palaniswamy – Pearson education, ISBN: 978-9332528277

Reference Books:

1. Textbook of Environmental Science, Deeksha Dave and E.Sai Baba Reddy, Cengage Publications. ISBN: 978-8131517604
2. Textbook of Environmental Sciences and Technology by M.Anji Reddy, B.S Publication. ISBN: 9385433385
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications ISBN: 978-8170087380

Web Links:

1. <https://archive.nptel.ac.in/courses/127/105/127105018/>
2. https://onlinecourses.swayam2.ac.in/cec24_ge05/preview

Constitution of India

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501AC02	L	T	P	C
	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.

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	-	-	1	2	-	-
CO2	-	-	-	-	2	-	-	1	3	-	-
CO3	-	-	-	-	3	-	-	2	3	-	-
CO4	-	-	-	-	3	-	-	2	1	-	-
CO5	-	-	-	-	2	-	-	1	3	-	-

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
Panchayati Raj: 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. Introduction to the Constitution of India, Durga Das Basu, Prentice – Hall of India Pvt. Ltd. New Delhi. ISBN: 978-9388548861
2. Indian Constitution, Subash Kashyap, National Book Trust. ISBN: 9788123707341

Reference Books:

1. Dynamics of Indian Government & Politics, J.A. Siwach ISBN: 9788120709768
2. Indian Government and Politics, D.C. Gupta ISBN: 9780706987782
3. Constitutional Law of India , H.M.Sreevai, 4th edition in 3 volumes (Universal Law Publication). ISBN: 9788194776529

Web Links:

1. nptel.ac.in/courses/109104045/
2. nptel.ac.in/courses/101104065/

Research Methodology

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501AC03	L	T	P	C
	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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
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

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 series and continuous series) – Correlation - Regression

Text Books:

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint. ISBN: 9788122415223
2. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press. ISBN: 9780367135720

Reference Books:

1. Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd. ISBN: 978-8126530755
2. Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi. ISBN: 9788120349469
3. Fundamentals of Mathematical statistics, S.C. Gupta and V.K. Kapoor, Sultan Chand & Sons, New Delhi. ISBN: 978-8180545283

Web Links:

1. <https://nptel.ac.in/courses/127106227>
2. <https://archive.nptel.ac.in/courses/121/106/121106007/>

Intellectual Property Rights & Patents
(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT & Min.E)

Course Code: 2501AC04	L	T	P	C
	2	0	0	0

Course Outcomes:

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

- CO1:** Compare various types of Intellectual Property rights.
- CO2:** Discuss Intellectual Property and infer rights on such Intellectual Property owners
- CO3:** Explain the process of patenting
- CO4:** Apply for Trade marks and Copyrights.
- CO5:** Explain the methods to protect Trade secrets

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	1	-	-	-	-	1	-	3	-	-	2
CO2	1	-	-	-	-	1	-	3	-	-	2
CO3	1	-	-	-	-	1	-	3	-	-	2
CO4	1	-	-	-	-	1	-	3	-	-	2
CO5	1	-	-	-	-	1	-	3	-	-	2

UNIT-I

Introduction to Intellectual Property Rights (IPR): Concept of Property - Introduction to IPR – International Instruments and IPR - WIPO - TRIPS – WTO –Laws Relating to IPR - IPR Tool Kit - Protection and Regulation - Copyrights and Neighboring Rights – Industrial Property – Patents - Agencies for IPR Registration – Traditional Knowledge –Emerging Areas of IPR – Layout Designs and Integrated Circuits – Use and Misuse of Intellectual Property Rights.

UNIT-II

Copyrights and Neighboring Rights: Introduction to Copyrights – Principles of Copyright Protection – Law Relating to Copyrights - Subject Matters of Copyright – Copyright Ownership – Transfer and Duration – Right to Prepare Derivative Works –Rights of Distribution – Rights of Performers – Copyright Registration – Limitations – Infringement of Copyright – Relief and Remedy – Case Law - Semiconductor Chip Protection Act.

UNIT-III

Patents: Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Double Patenting — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related

Innovations.

UNIT-IV

Trademarks and Trade secrets: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing off Action - Introduction to Trade Secrets – General Principles - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements.

Unit – V

Cyber Law and Cyber Crime: Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers. Relevant Cases Shall be dealt where ever necessary.

Text Books:

- 1 Fundamentals of IPR for Engineers- Kompal Bansal & Parishit Bansal, B. S. Publications (Press). ISBN: 9788178002774
- 2 Intellectual Property -Deborah E.Bouchoux, Third Edition, Cengage Learning, New Delhi. ISBN: 0 340 67786 4

Reference Books:

- 1 Intellectual property rights- Prabuddha Ganuli, Tata Mcgraw hill. ISBN: 978-0070077171
- 2 Intellectual property rights M.Ashok kumar and Mohd.Iqbal Ali:, Serials Publications ISBN: 9788183871648
- 3 Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi. ISBN: 979-8886848229
- 4 Intellectual Property- Richard Stim, Cengage Learning, New Delhi. ISBN: 978-0766826656

Web Links:

- 1 <http://www.wipo.int/portal/en/index.html>
- 2 <https://indiankanoon.org/>
- 3 <http://www.ipindia.nic.in/patents.htm>
- 4 <http://www.ipindia.nic.in/trade-marks.htm>
- 5 <http://copyright.gov.in>

Indian Knowledge Systems (IKS)
(CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min. E)

Course Code: 2501AC05	L	T	P	C
	2	0	0	0

Course Outcomes:

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

- CO1:** Describe the foundations and scope of Indian Knowledge Systems.
- CO2:** Recognize major Indian contributions to knowledge, science, and culture.
- CO3:** Appreciate ethical values and sustainability rooted in Indian traditions.
- CO4:** Relate traditional knowledge to contemporary societal and technological 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
CO1	-	-	-	-	-	3	1	1	-	-	-
CO2	-	-	-	-	-	3	1	1	-	-	-
CO3	-	-	-	-	-	3	1	1	-	-	-
CO4	-	-	-	-	-	3	1	1	-	-	-
CO5	-	-	-	-	-	3	1	1	-	-	-

UNIT – I

Foundations of Indian Knowledge Systems

Meaning, scope, and importance of IKS. Sources of IKS: Vedas, Upanishads, Itihasas, Puranas, Shastras. Traditional Knowledge, Indigenous Knowledge, and Western Knowledge – comparison. Gurukula system and knowledge transmission traditions

UNIT – II

Indian Civilization and Philosophical Traditions

Overview of ancient Indian civilization (Indus Valley, Maurya, Gupta). Indian philosophical schools and ethical values. Epics: Ramayana and Mahabharata – cultural and moral significance. Religious traditions: Hinduism, Buddhism, Jainism, Sikhism

UNIT – III

Arts, Architecture and Cultural Expressions

Temple architecture: Nagara, Dravidian, Vesara. Mughal architecture and monuments. Indian classical dance forms and music traditions. Handicrafts, sculpture, painting, and iconography

UNIT – IV

Traditional Knowledge in Health, Environment and Sustainability

Ayurveda and Yoga – holistic health systems. Traditional agriculture and food practices. Water conservation methods and environmental ethics. Biodiversity conservation and sustainable living

UNIT – V

Traditional Knowledge and Contemporary Relevance

Protection of Traditional Knowledge. Traditional Knowledge (TK) and Intellectual Property Rights (overview). Role of government and national initiatives. Relevance of IKS to engineering, innovation, and entrepreneurship

Text Books:

1. **Indian Knowledge Systems**, Kapil Kapoor & Avadhesh Kumar Singh, D.K. Printworld (India) Pvt. Ltd., New Delhi. ISBN: 9788124608177.
2. **Indian Philosophy – Volume I & II**, S. Radhakrishnan, Oxford University Press, New Delhi. ISBN: 9780195698418.
3. **Science and Technology in Ancient India**, O.P. Jaggi, Atma Ram & Sons, Delhi. ISBN: 9788185694085.
4. **Indian Heritage and Culture**, Madhukar K. Bhagat, McGraw Hill Education (India). ISBN: 9789332901476.
5. **Traditional Knowledge System in India**, Yogendra K. Malik, Pearson Education India. ISBN: 9788131762219.

Reference Books:

1. **Ancient Indian Science and Technology**, Debiprasad Chattopadhyaya, History of Science, Philosophy and Culture in Indian Civilization Series. ISBN: 9788187586098.
2. **Indian Culture and Heritage**, Nitin Singhania, McGraw Hill Education. ISBN: 9789353161132.
3. **Knowledge Traditions of India**, Bhu Dev Sharma, Indian Council of Philosophical Research (ICPR). ISBN: 9788185636306.

Web Links:

1. <https://iks.aicte-india.org/>
2. <https://www.education.gov.in/iks>

Minor Stream: Analytics and Security (In Collaboration with Microsoft)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AI36	Network Security Essentials	FC	2			2	50	50	100	-
2501AI37	Introduction to System Design	IC	2		1	3	50	50	100	-
2501AI38	Introduction to Generative AI	IC	2		1	3	50	50	100	-
2501AI39	Cloud Security Essentials	IC	2		1	3	50	50	100	-
2501AI40	Cyber Security Essentials	IC	2		1	3	50	50	100	-
2501AI41	Fundamentals of Block Chain	IC	2		1	3	50	50	100	-
2501AI42	AI for Cyber Threat Intelligence	IC	2		1	3	50	50	100	-
2501AI43	Generative Adversarial Networks Fundamentals	AC	2		1	3	50	50	100	-
2501AI44	AI in Healthcare Security	AC	2		1	3	50	50	100	-
2501AI45	Advanced Topics in Generative AI	AC	2		1	3	50	50	100	-
2501AI46	Ethical AI and Responsible Computing	AC	2		1	3	50	50	100	-
Total			22		10	32				

Network Security Essentials

Course Code:2501AI36

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Explain fundamental concepts of network security and the need for secure communication.
- CO2:** Analyze the security aspects of common network protocols and apply standards.
- CO3:** Configure and use firewalls, VPNs, and IDPS for network protection.
- CO4:** Implement secure remote access, wireless security, and best practices.
- CO5:** Use tools for network security monitoring and mitigate DoS/DDoS attacks.

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	1	1	1	-	-	-	2	-	2
CO2	3	3	2	2	2	-	-	-	2	-	3
CO3	2	3	3	2	3	-	-	-	2	1	3
CO4	2	2	2	2	3	-	-	-	2	2	3
CO5	2	3	3	2	3	-	-	-	2	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 to Network Security: Introduction to network security and types of threats, CIA triad and security protocols, firewalls and IDS/IPS systems, antivirus and anti-malware solutions, VPNs and wireless security, access control models and encryption/cryptography, security policies and threat landscape, compliance and regulations, impact of breaches, and remote work with cloud security

UNIT-II

Protocols and Security Standards

TCP/IP stack and DNS resolution, HTTP methods and HTTPS encryption, Packet sniffing and IP spoofing, DNS cache poisoning and man-in-the-middle attacks, TLS/SSL protocols and secure protocol design principles, Firewall, IDS/IPS, and network access control

policies, Port scanning tools (e.g., Nmap) and zero trust architecture, Network security best practices

UNIT-III

Firewalls, VPNs, and IDPS: Stateful vs stateless firewalls and packet filtering, Next-generation firewall (NGFW) and firewall rule configuration, IPSec tunneling protocols and SSL/TLS VPNs, IDS vs IPS and detection methods (signature-based & anomaly-based), Deep packet inspection and zero-day attack detection, VPN encryption protocols and endpoint threat monitoring, Security incident response and network segmentation, Threat monitoring and prevention strategies

UNIT-IV

Wireless and Remote Security: Wi-Fi encryption and rogue access point detection, Evil twin attacks and WIDS, VPN and SSH secure tunneling, SSH key management and brute-force prevention, 2FA/MFA authentication methods, Secure remote access and zero trust, MITM attack prevention and remote desktop security, Endpoint protection and remote endpoint security

UNIT – V

Monitoring, DoS/DDoS & Best Practices:

Network traffic analysis and packet inspection, Intrusion detection and anomaly-based threat detection, Log correlation and SIEM tools, DoS/DDoS mitigation and traffic filtering, Application layer and behavioral attack detection, Access control and least privilege policies, Defense in depth and real-time alerting, Honeypots and deception technologies.

Text Books:

- 1 Information Security Fundamentals by IBM ICE Publications.
- 2 Cryptography and Network Security, William Stallings, Pearson Education, 411 i Edition
- 3 Cryptography and Network Security, Atul Kahate, McGrawHill, 2nd Edition

Reference Books:

- 1 Introduction to Network Security, Neal Krawetz, CENGAGE Learning
- 2 Information Security, Principles and Practice, Mark Stamp, Wiley India.

Web Links:

- 1 <https://www.geeksforgeeks.org/computer-networks/network-security/>
- 2 <https://learn.microsoft.com/en-us/azure/security/fundamentals/network-overview>

Introduction to System Design

Course Code: 2501AI37

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain system design fundamentals and analyze system requirements.
- CO2:** Apply core design principles and assess modularity, abstraction, and coupling.
- CO3:** Compare architectural styles and apply design patterns for system development.
- CO4:** Design scalable, high-performance systems with optimized data modeling.
- CO5:** Incorporate security, fault tolerance, and reliability in large-scale system designs.

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	3	2	2	1	-	-	-	-	2	2
CO2	3	3	3	1	2	-	-	-	-	1	2
CO3	3	2	3	1	2	-	-	-	-	1	2
CO4	3	3	3	2	3	-	-	-	-	2	2
CO5	3	3	3	2	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

System Design Basics & Requirements: System design fundamentals, software architecture patterns, scalability and load balancing, functional and non-functional requirements (NFRs), high availability and fault tolerance, data consistency models and caching strategies, microservices architecture, CAP theorem, security in system design, performance analysis and design for failure

Practice:

1. Define functional and non-functional requirements for an e-commerce system
2. Draw a context-level diagram and requirement document

UNIT-II

Design Principles & Patterns: Object-oriented principles, abstraction in software design, modularity and reusability, encapsulation and information hiding, low coupling and high cohesion, SOLID principles, design pattern catalog (GoF) including Singleton, Factory, Observer, and Strategy patterns, threat modeling in design, secure design principles, anti-patterns and code smells, and design policy enforcement tools

Practice:

1. Implement a modular system using abstraction and encapsulation
2. Apply Singleton and Factory design patterns to a basic problem

UNIT-III

Architectural Styles: Client-server model, layered architecture pattern, monolithic and microservices architecture, service decomposition and inter-service communication (REST/gRPC), scalability and performance trade-offs, deployment complexity and fault isolation, API gateway pattern and load balancing strategies, containerization (Docker/Kubernetes), security risks in distributed systems, service discovery mechanisms, and architecture decision records (ADR)

Practice:

1. Compare microservices and monolithic architectures
2. Design a client-server or layered architecture diagram

UNIT-IV

Database Design & Performance: Database normalization forms, indexing strategies (B-Tree, Hash), entity-relationship modeling and query execution plans, SQL query optimization techniques, read/write load balancing and sharding (horizontal/vertical), in-memory caching (Redis/Memcached) and caching invalidation policies, database partitioning and denormalization trade-offs, data consistency and replication, SQL injection prevention, database performance monitoring tools, and CAP theorem in distributed databases

Practice:

1. Design a normalized schema and ER diagram for a system
2. Analyze index and query optimization for given queries

UNIT – V

Security, Reliability & Case Studies: Security hardening techniques and patch management policies, principle of least privilege with threat modeling and risk assessment, backup and recovery strategies, high availability architecture with redundancy and failover systems, disaster recovery planning with RTO and RPO metrics, SIEM and incident response planning, real-world breach case studies, business continuity planning, cloud-based disaster recovery, and compliance and regulatory requirements (e.g., GDPR, ISO 27001).

Practice:

1. Evaluate a system design for potential security flaws
2. Present trade-offs and analysis from a real-world system case study

Text Books:

- 1 A. Xu, System Design Interview – An Insider's Guide, ByteByteGo, 2020.
- 2 M. Kleppmann, Designing Data-Intensive Applications, O'Reilly Media, 2017.
- 3 M. Richards and N. Ford, Fundamentals of Software Architecture, O'Reilly Media, 2020.

Reference Books:

- 1 N. Ford and M. Richards, Software Architecture: The Hard Parts, O'Reilly Media, 2021.
- 2 R. C. Martin, Clean Architecture: A Craftsman's Guide to Software Structure and Design, Pearson, 2017.
- 3 M. L. Abbott and M. T. Fisher, *The Art of Scalability*, Addison-Wesley, 2015.
- 4 C. Richardson, Microservices Patterns, Manning Publications, 2018

Web Links:

- 1 <https://www.geeksforgeeks.org/system-design/system-design-tutorial/>
- 2 <https://www.ibm.com/docs/en/ram/7.5.4?topic=management-system-design>
- 3 <https://nptel.ac.in/courses/107106009>

Introduction to Generative AI

Course Code:2501AI38	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the foundational concepts and types of generative AI models.
- CO2:** Use Python and libraries like TensorFlow/PyTorch for generative model implementation.
- CO3:** Prepare and preprocess datasets for effective generative model training.
- CO4:** Build and evaluate GANs, VAEs, and sequence generation models.
- CO5:** Apply generative AI to real-world problems and analyze model outcomes.

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	-	-	-	-	-	3
CO2	3	2	2	1	3	-	-	-	-	-	2
CO3	2	3	2	2	3	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	2
CO5	2	3	3	3	3	-	-	-	2	1	3

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 to Generative AI: Generative model fundamentals, GAN architecture and training basics, Variational Autoencoders (VAEs), Autoencoders and representation learning, Sequence generation models (LSTM, GRU), Python syntax and data structures, TensorFlow and PyTorch workflows, Secure and ethical coding practices

Practice:

1. Implement a basic image generator using NumPy
2. Use PyTorch to build a simple autoencoder for MNIST

UNIT-II

Data Preprocessing for Generative Tasks: Data preprocessing and cleaning techniques, Data deduplication and normalization, Data augmentation strategies, Bias and noise

mitigation, Privacy-preserving data processing, Tools for dataset preparation, Dependency and environment management, Ethical data governance and compliance

Practice:

1. Preprocess and augment image data for GANs
2. Preprocess and augment image data for GANs

UNIT-III

Implementation of Generative Models: Generator vs Discriminator roles, Adversarial training loop, Loss functions: Binary Cross, Entropy, Wasserstein, Mode collapse and training challenges, VAE architecture and latent space modeling, Reparameterization trick, Autoencoders: denoising, feature extraction- Implementation using TensorFlow and PyTorch

Practice:

1. Implement a VAE to reconstruct and generate digit images
2. Create a denoising autoencoder and evaluate performance

UNIT-IV

Advanced Generative Architectures: Transformer architecture and pretraining principles, Attention mechanisms and prompt engineering, Language generation and protocol tuning, Overfitting and regularization threats, Bias and fairness in language models, Real-world generative use cases: images, text, healthcare

Practice:

1. Train an LSTM model for character-level text generation
2. Evaluate generative models using FID and Inception Score

UNIT – V

Evaluation, Applications & Ethical Considerations: Inception Score (IS) and FID metrics, Output quality evaluation and benchmarking, Deepfake detection and adversarial risks, Regulatory and compliance policies, Generative AI misuse and ethical risks, Content authenticity and governance, Industry applications and real-world relevance

Practice:

1. Use a pre-trained GPT model for text generation and fine-tuning
2. Develop a mini-project applying generative AI in a selected domain

TextBooks:

- 1 Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press
- 2 David Foster, *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play*, O'Reilly
- 3 Francois Chollet, *Deep Learning with Python*, Manning Publications

Reference Books:

- 1 PyTorch and TensorFlow official documentation
- 2 Tutorials from DeepLearning.ai and Coursera on GANs and VAEs
- 3 Research papers on generative models (NIPS, ICLR, CVPR)

Web Links:

- 1 https://www.cloudskillsboost.google/course_templates/536
- 2 <https://www.coursera.org/learn/introduction-to-generative-ai>

Cloud Security Essentials

Course Code:2501AI39

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Describe cloud computing concepts and assess cloud-specific security challenges.
- CO2:** Apply identity and access management strategies including MFA and RBAC.
- CO3:** Implement encryption, key management, and network security controls in cloud platforms.
- CO4:** Monitor cloud security events, perform logging, and handle security incidents.
- CO5:** Evaluate compliance needs and implement governance and cloud security best practices.

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	2	1	1	2	2	-	-	1
CO2	3	3	3	2	2	1	2	2	-	-	1
CO3	3	3	3	2	3	2	1	2	-	-	2
CO4	3	2	3	2	3	2	2	2	-	-	2
CO5	2	2	2	2	2	3	3	3	-	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Cloud Security Fundamentals: Cloud service and deployment models, shared responsibility model, identity and access management, cloud access security brokers, data encryption and protection, misconfiguration and API security risks, cloud-native and workload protection tools, compliance frameworks and incident response

Practice:

1. Create a free-tier cloud account and explore services
2. Identify and document shared responsibility for selected services

UNIT-II

IAM and Access Security: Principle of least privilege, Single sign-on (SSO) and identity

providers (IdPs), Role hierarchy and permission sets, Authentication vs authorization, MFA methods and credential protection, OAuth 2.0 and OpenID Connect, Privileged access management (PAM), IAM policies and enforcement

Practice:

1. Create IAM users, roles, and groups in a cloud platform
2. Enable and test MFA for cloud access

UNIT-III

Encryption, Key and Network Security: Encryption techniques and types (AES, RSA, symmetric, asymmetric), Key Management Services (KMS) and key lifecycle, Envelope encryption and HSM, Virtual Private Cloud (VPC) security, Security Groups and NACLs, Firewall types and configurations, VPN and TLS/SSL protocols, Data Leakage Prevention (DLP)

Practice:

1. Encrypt cloud storage with a customer-managed key
2. Set up a secure VPC with firewall and subnet controls

UNIT-IV

Monitoring, Logging and Incident Response: Security logging practices and retention, Log analysis and SIEM integration, Real-time threat detection and response, Incident response lifecycle and automation, Forensic investigation techniques, Security event normalization, Alert tuning and prioritization, Compliance and audit logging

Practice:

1. Enable logging and monitor events in cloud console
2. Simulate and document a simple incident response scenario

UNIT – V

Compliance and Best Practices:Data classification and protection, Compliance frameworks (GDPR,HIPAA,ISO), Cloud governance models, Cloud Security Posture Management (CSPM), Data residency and sovereignty, Encryption and tokenization, Policy enforcement and automation, Risk management and assessment, Data Loss Prevention (DLP), Security best practices in cloud environments.

Practice:

1. Run a compliance check using built-in cloud tools
2. Create a checklist of cloud security best practices

TextBooks:

- 1 K. Hashizume et al., *An Analysis of Cloud Computing Security Issues*, Springer, 2021
- 2 G. Reese, *Cloud Application Architectures*, O'Reilly Media, 2009.

- 3 T. Krutz and R. Dean, *Cloud Security: A Comprehensive Guide to Secure Cloud Computing*, Wiley, 2010

Reference Books:

- 1 Rittinghouse and J. Ransome, *Cloud Computing: Implementation, Management, and Security*, CRC Press, 2016
- 2 B. Grobauer, T. Walloschek, and E. Stöcker, *Understanding Cloud Computing Vulnerabilities*, IEEE Security & Privacy, 2011
- 3 D. Linthicum, *Cloud Security Basics*, O'Reilly Media, 2022

Web Links:

- 1 <https://www.geeksforgeeks.org/software-engineering/cloud-computing-security/>
- 2 <https://www.ibm.com/think/topics/cloud-security>

Cyber Security Essentials

Course Code:2501AI40

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain core cybersecurity concepts, threat actors, and risk assessment strategies.
- CO2:** Analyze cyber threats and plan incident responses using appropriate tools.
- CO3:** Apply cryptographic techniques and secure protocols to protect data in transit and at rest.
- CO4:** Configure and test technical controls such as firewalls, VPNs, and security infrastructure.
- CO5:** Implement access control models, conduct penetration testing, and ensure compliance with cybersecurity regulations

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	2	1	-	-	-	-	-	1
CO2	3	3	3	3	2	-	-	-	1	1	2
CO3	3	3	3	2	2	-	-	-	-	1	2
CO4	3	3	3	3	3	-	-	-	1	2	2
CO5	3	3	3	3	3	-	-	-	2	2	3

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Foundations of Cybersecurity: CIA Triad and core security principles, Access control and least privilege enforcement, Defense in depth and layered security, Threat actors and malware classification, Social engineering and human factors, Risk assessment and incident response, Security tools and endpoint protection, Cybersecurity frameworks and awareness training

Practice:

1. Research recent cyber attacks and present threat types,
2. Simulate a phishing or fake login page for awareness

UNIT-II

Web Security and Cryptography: OWASP Top 10 vulnerabilities, Injection attacks (SQL, Command), Broken authentication, Sensitive data exposure, HTTPS and TLS

protocols, TLS handshake process, Symmetric encryption (AES), Asymmetric encryption (RSA), Hashing algorithms (SHA-256), Digital signatures and integrity, Public Key Infrastructure (PKI), SSL/TLS certificate validation, Secure key management, Cryptographic attack vectors (brute force, padding oracle), Secure coding best practices

Practice:

1. Perform OWASP web vulnerability testing using Juice Shop or Burp Suite,
2. Capture and analyze HTTPS traffic using Wireshark.

UNIT-III

Access Control and IAM: Discretionary Access Control (DAC), Role-Based Access Control (RBAC), Attribute-Based Access Control (ABAC), Identity and Access Management (IAM), Multi-Factor Authentication (MFA), Single Sign-On (SSO), Authentication vs Authorization, OAuth 2.0 protocol, OpenID Connect, Identity Federation, Credential theft prevention, Privileged Access Management (PAM), Identity lifecycle management, Access control policies, Insider threat mitigation

Practice:

1. Configure MFA and role-based access control in a demo web app,
2. Set up and manage user identities using OpenLDAP

UNIT-IV

Technical Controls and Infrastructure: Network intrusion detection systems (NIDS), Network intrusion prevention systems (NIPS), Virtual Private Networks (VPN) protocols (IPSec, SSL/TLS), Firewall rule configuration, Next-generation firewalls (NGFW), Deep packet inspection (DPI), Traffic monitoring tools (Wireshark, Zeek), Port scanning and enumeration (Nmap), Secure tunneling protocols, Access control lists (ACLs), Bandwidth and anomaly analysis, Zero Trust Network Architecture, Threat intelligence integration, Security logging and alerting, Network segmentation and isolation

Practice:

1. Set up a basic firewall using UFW or pfSense
2. Configure a VPN connection and verify encryption

UNIT – V

Compliance, Ethics, and Auditing: General Data Protection Regulation (GDPR), Health Insurance Portability and Accountability Act (HIPAA), Payment Card Industry Data Security Standard (PCI DSS), Data privacy principles and data minimization, Digital rights and ethical hacking, Security compliance frameworks and continuous compliance monitoring, Risk assessment, mitigation and third-party risk management, Security audit processes, governance and legal implications of cyber threats and breach notification policies, Privacy Impact Assessments (PIA)

Practice:

1. Conduct a mock compliance audit (GDPR, HIPAA, etc.)
2. Draft a simple security policy for a small organization

Text Books:

- 1 W. Stallings, Network Security Essentials: Applications and Standards, Pearson, 2016
- 2 M. Whitman and H. Mattord, Principles of Information Security, Cengage Learning, 2021
- 3 C. P. Pfleeger and S. L. Pfleeger, Security in Computing, Pearson, 2015

Reference Books:

- 1 M. Sikorski and A. Honig, Practical Malware Analysis, No Starch Press, 2012
- 2 S. Malik, Security Operations Center: Building, Operating, and Maintaining Your SOC, Apress, 2020
- 3 T. Holt et al., Cybercrime and Digital Forensics: An Introduction, Routledge, 2018
- 4 R. Bejtlich, The Practice of Network Security Monitoring, No Starch Press, 2013

Web Links:

- 1 <https://www.coursera.org/learn/cyber-security-fundamentals>
- 2 <https://learn.microsoft.com/en-us/training/paths/describe-basic-concepts-of-cybersecurity/>

Fundamentals of Block Chain

Course Code:2501AI41

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Explain the foundational concepts of blockchain and distributed systems
- CO2:** Demonstrate cryptographic techniques and consensus mechanisms used in blockchain
- CO3:** Develop smart contracts and deploy decentralized applications
- CO4:** Identify real-world blockchain use cases and evaluate their feasibility
- CO5:** Analyze blockchain limitations, trends, and regulatory concerns

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

Introduction to Blockchain: Consensus algorithms, Blockchain models, Cryptographic hashing, Block creation and validation, Node synchronization, Smart contracts, Scalability and security in decentralized systems, Blockchain applications and compliance

Practice:

1. Simulate a basic blockchain with chained blocks and hash computation
2. Implement SHA-256 and verify hash changes with block data

UNIT-II

Cryptographic Foundations: Symmetric and asymmetric cryptography, Cryptographic hash functions, Digital signatures and PKI, Key management and trust models, Cryptanalysis and security threats, Consensus protocols (PoW vs PoS), Data confidentiality and integrity, Quantum-safe and regulatory-compliant cryptography

Practice:

1. Demonstrate digital signatures and key pair generation using Python
2. Set up a local Ethereum blockchain using Geth

UNIT-III

Smart Contracts and Platforms: Ethereum architecture and EVM, Solidity programming and contract deployment, Gas optimization and DApp design, Smart contract security and tools (Remix, Truffle), Blockchain oracles and integrations, Hyperledger Fabric and chaincode, Consensus mechanisms and access control (MSP), Enterprise blockchain scalability and interoperability

Practice:

1. Develop and deploy a simple smart contract using Solidity in Remix
2. Connect a smart contract to frontend using Web3.js and MetaMask

UNIT-IV

Blockchain Use Cases: DeFi and cross-border payments, Blockchain in supply chain and logistics, Healthcare privacy and EHR systems, Secure voting and digital identity (SSI), IoT authentication and data integrity, NFT standards, ownership, and provenance, Regulatory compliance and cybersecurity risks, Cross-platform blockchain interoperability

Practice:

1. Explore real-world blockchain use case – land registry or supply chain
2. Deploy an ERC-20 token or NFT (ERC-721) on testnet

UNIT – V

Challenges & Future Trends: Layer 2 scaling solutions, blockchain interoperability, regulatory compliance and legal frameworks, smart contract security, Web3 identity and access control, DeFi risks and vulnerabilities, protocol optimization and composability, tokenomics and governance

Practice:

1. Analyze transaction data and gas fees on Ethereum testnet
2. Present current trends in blockchain (e.g., Web3, Layer 2, DeFi, ZK-rollups)

TextBooks:

- 1 Imran Bashir, *Mastering Blockchain*, Packt Publishing
- 2 Melanie Swan, *Blockchain: Blueprint for a New Economy*, O'Reilly Media
- 3 Andreas M. Antonopoulos, *Mastering Ethereum*, O'Reilly Media

Reference Books:

- 1 Arvind Narayanan et al., *Bitcoin and Cryptocurrency Technologies*, Princeton University Press

- 2 Joseph Bonneau et al., *SoK: Research Perspectives and Challenges for Bitcoin and Cryptocurrencies* (IEEE)
- 3 Hyperledger Fabric documentation – <https://hyperledger-fabric.readthedocs.io/>

Web Links:

- 1 <https://learn.microsoft.com/en-us/shows/beginners-series-to-blockchain/>
- 2 <https://learn.microsoft.com/en-us/archive/msdn-magazine/2018/march/blockchain-blockchain-fundamentals>

AI for Cyber Threat Intelligence

Course Code:2501AI42

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Describe AI concepts and their application to cyber threat intelligence
CO2: Build ML models for threat detection, anomaly detection, and alert classification
CO3: Apply NLP and deep learning for malware and phishing analysis
CO4: Automate CTI tasks such as incident response and SOC operations using AI
CO5: Analyze limitations, adversarial threats, and ethics in AI-driven security 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
CO1	3	2	1	2	-	-	-	-	-	-	2
CO2	3	3	3	2	1	-	-	-	-	1	2
CO3	3	3	3	2	1	-	-	-	-	-	2
CO4	3	2	3	2	-	-	-	-	-	2	2
CO5	2	2	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

Introduction to AI in Cybersecurity: Cyber Threat Intelligence (CTI) lifecycle, threat intelligence types (tactical, operational, strategic), threat actor profiling and TTPs, indicators of compromise (IoCs), threat modeling and risk assessment, AI/ML in threat detection, threat data enrichment and correlation, threat intelligence platforms and protocols (STIX, TAXII), threat hunting and incident response integration, automation and policy-based mitigation

Practice:

1. Explore threat intelligence feeds and IoC extraction

UNIT-II

ML Techniques for Threat Detection: Supervised and unsupervised learning for threat

detection, clustering and classification models (K-Means, DBSCAN, SVM, Random Forest), feature extraction and selection in cybersecurity, DDoS and insider threat detection using ML, time-series analysis for threat detection, reducing false positives and evaluating models (precision, recall, F1), real-time intrusion detection with ML, adversarial machine learning threats, data labeling challenges, and integration of ML models into SIEM and security policy enforcement

Practice:

1. Build a supervised ML model to detect phishing URLs
2. Perform anomaly detection using clustering on network logs

UNIT-III

NLP and Deep Learning in Threat Intelligence: Phishing detection using NLP, Malware behavior analysis via text mining, Log parsing and normalization, Threat intelligence report mining, Named entity recognition in cybersecurity texts, Word embeddings for threat classification, RNNs for sequential log analysis, CNNs for network traffic classification, Transformer models in cybersecurity, Semantic analysis of threat reports, Protocol anomaly detection using deep learning, NLP-based spam and phishing email filtering, Tokenization and feature extraction from logs, Policy compliance through log analysis, Cyber threat hunting using deep neural networks

Practice:

1. Use NLP to extract threats from CTI reports
2. Classify malware samples using CNN models

UNIT-IV

Automated Threat Intelligence and SOC Integration: SIEM architecture and data pipelines, Real-time threat detection and correlation, Alert fatigue and triage optimization, Risk-based case prioritization, Playbook automation for incident response, MITRE ATT&CK integration with SIEM, Threat intelligence enrichment in alerts, Anomaly detection in security events, Reinforcement learning for adaptive defense, Autonomous incident response systems, Policy-driven alert classification, Behavioral analytics for SOC operations, Protocol-aware event normalization, Threat scoring using machine learning, Modern SOAR-SIEM integration

Practice:

1. Automate alert triage using AI on SIEM data
2. Simulate incident response workflow with intelligent decision trees

UNIT – V

Challenges, Ethics, and Adversarial AI: Adversarial example generation techniques, Model poisoning and data integrity threats, Evasion attacks in deployed ML models,

Explainable AI for security decision-making, Differential privacy in model training, Secure federated learning protocols, AI model auditing and risk assessment, Robustness evaluation metrics for ML models, Regulatory frameworks for AI security (e.g., EU AI Act), Privacy-preserving machine learning, Secure multi-party computation in AI, Threat modeling for ML systems, Policy compliance in AI model deployment, Detection and mitigation of AI supply chain attacks, Interpretable ML tools for SOC analysts

Practice:

1. Evaluate model robustness against adversarial attacks
2. Use explainable AI (XAI) to interpret threat model decisions
3. Present a case study on real-world AI threat intelligence system

Text Books:

- 1 Sumeet Dua and Xian Du, *Data Mining and Machine Learning in Cybersecurity*, CRC Press
- 2 Clarence Chio and David Freeman, *Machine Learning and Security*, O'Reilly Media
- 3 Nina Godbole and Sunit Belapure, *Cybersecurity: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley

Reference Books:

- 1 MITRE ATT&CK Framework – <https://attack.mitre.org/>
- 2 IBM X-Force Exchange – <https://exchange.xforce.ibmcloud.com/>
- 3 Research papers on adversarial ML in cybersecurity (IEEE/ACM)

Web Links:

- 1 <https://learn.microsoft.com/en-us/credentials/certifications/cybersecurity-architect-expert/>

Generative Adversarial Networks Fundamentals

Course Code:2501AI43

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain the architecture, components, and purpose of GANs.
- CO2:** Implement various types of GANs using TensorFlow or PyTorch
- CO3:** Apply GANs to tasks like image generation, style transfer, and image translation.
- CO4:** Evaluate advanced GAN techniques and their applications
- CO5:** Identify ethical implications and limitations associated with GANs.

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	2	1	1	-	1	-	-	1
CO2	3	3	3	3	3	1	-	-	-	-	2
CO3	3	3	3	3	3	1	1	-	-	-	2
CO4	3	3	3	3	2	2	1	-	-	-	2
CO5	2	2	2	1	1	3	2	3	1	-	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

Foundations of GANs: Generative Adversarial Networks (GANs), Generator vs Discriminator and adversarial training, GAN loss functions and mode collapse, DCGAN and Conditional GANs (cGAN), CycleGAN and StyleGAN architectures, TensorFlow and PyTorch GAN implementations, Dataset preparation and evaluation metrics (FID, IS), Ethical concerns, security threats and responsible AI guidelines

Practice:

1. Train a Deep Convolutional GAN (DCGAN) to generate new images and check its quality.
2. Generate class-specific images with cGAN and try unpaired image translation using CycleGAN.

UNIT-II

Basic GANs and Conditional GANs: Basic GAN implementation and architecture design, Adversarial loss functions and training stability, Conditional GANs and label conditioning, Dataset labeling and preprocessing techniques, Mode collapse prevention and generalization, GAN training with TensorFlow/PyTorch, Evaluation metrics (FID, IS) and output analysis, Use cases of cGANs (image-to-image, data augmentation), Ethical concerns, deepfake detection, and content regulation policies

Practice:

1. Build a simple GAN to generate images, watch training behavior, and try one fix for mode collapse.

UNIT-III

DCGANs, CycleGANs and PGGANs: DCGAN design and convolutional architecture, Normalization and activation strategies, CycleGAN for unpaired image translation, Generator consistency and domain transfer, Progressive GANs and resolution scaling, Training stability and GAN frameworks, Synthetic data risks and authenticity challenges, Ethical AI use and policy development.

Practice:

1. Build a DCGAN to generate images, learn normalization/activation choices, then try a simple progressive upscaling (PGGAN-lite) to improve resolution

UNIT-IV

Style GANs and Applications: StyleGAN architecture and improvements, Latent space and style manipulation, GANs for data augmentation and imbalance handling, Anomaly detection using GANs, GAN frameworks (PyTorch/TensorFlow), Synthetic data risks and adversarial robustness, Deepfake detection and misuse prevention, Ethical governance and explainability of GAN outputs

Practice:

1. Generate a few images using a pretrained StyleGAN generator, perform a small latent interpolation, and discuss possible applications, risks, and ethics.

UNIT – V

Ethics and Advanced Techniques: Deepfake generation and detection, Privacy and ethical risks of synthetic data, GAN training challenges (convergence issues, mode collapse, evaluation), Advanced GAN architectures (WGAN-GP, SAGAN, BigGAN), AI-generated content regulations, Bias and fairness in GAN outputs, Content authenticity and verification, Governance and responsible AI frameworks

Practice:

1. Learn how deepfakes are detected, why they're risky, and how policy/ethics guide safe work.
2. Implement a small WGAN-GP (or adapt a given tiny implementation), observe training stability and mode collapse, and test for bias in generated outputs. Propose governance / mitigation steps.

Text Books:

- 1 Goodfellow et al., Deep Learning, MIT Press, 2016
- 2 A. Rosebrock, Deep Learning for Computer Vision with Python, PyImageSearch, 2019
- 3 I. Goodfellow, Y. Bengio, and A. Courville, Generative Adversarial Networks, MIT Deep Learning Series, 2020

Reference Books:

- 1 J. Brownlee, Generative Adversarial Networks with Python, Machine Learning Mastery, 2021
- 2 S. Li and L. Wand, Progressive Growing of GANs for Improved Image Synthesis, arXiv preprint, 2018
- 3 A. Brock et al., Large Scale GAN Training for High Fidelity Natural Image Synthesis, ICLR, 2019
- 4 H. Zhang et al., Self-Attention Generative Adversarial Networks, ICML, 2019

Web Links:

- 1 https://developers.google.com/machine-learning/gan/gan_structure
- 2 <https://www.geeksforgeeks.org/deep-learning/generative-adversarial-network-gan/>

AI in Healthcare Security

Course Code:2501AI44

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Explain the role of AI in healthcare security and data protection
- CO2:** Analyze healthcare data security standards and regulatory frameworks.
- CO3:** Apply AI methods like ML, NLP, and generative models to detect and prevent threats
- CO4:** Design privacy-preserving AI systems for healthcare environments
- CO5:** Evaluate healthcare security incidents and propose AI-driven compliance solutions.

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	2	2	2	-	-	-	-	2
CO2	3	3	3	3	3	1	-	-	-	-	3
CO3	3	3	3	2	2	3	-	-	-	1	2
CO4	3	2	2	2	1	3	-	-	-	1	2
CO5	2	2	2	1	1	2	-	-	-	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

Introduction to AI in Healthcare Security: AI-driven threat detection, data privacy and HIPAA compliance, anomaly detection in patient data, encryption and access control protocols, Zero Trust architecture in healthcare, cybersecurity policies and governance, ransomware and phishing threats, privacy-preserving machine learning, real-time monitoring and alerting tools

Practice:

1. Analyze anonymized healthcare datasets and identify data privacy issues

UNIT-II

Healthcare Data Security and Regulatory Frameworks: HIPAA Security Rule, PHI encryption protocols, access control and authentication, data breach threats, compliance

monitoring tools, risk management frameworks, regulatory enforcement and penalties, cloud and mobile security challenges, privacy policies and audit requirements

Practice:

1. Implement HIPAA-compliant data handling procedures in AI workflows

UNIT-III

Core AI Techniques in Healthcare Security: Threat intelligence platforms, anomaly detection algorithms, behavioral analysis, zero-day threat response, data encryption standards (AES, RSA), key management protocols, intrusion detection systems (IDS), cloud data protection, AI-driven threat identification

Practice:

1. Train a supervised ML model for malware detection in healthcare
2. Use NLP to detect phishing or fraud in medical communication logs
3. Perform threat intelligence extraction using ML from threat reports

UNIT-IV

Advanced AI Models and NLP in Healthcare Security: Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), synthetic data generation, anonymization techniques, privacy-preserving AI, differential privacy, deepfake detection, model inversion attacks, supervised learning for fraud detection, insider threat identification using NLP, AI-powered communication monitoring tools

Practice:

1. Build a generative model (GAN) for synthetic medical data
2. Configure access control and network security for a simulated hospital network
3. Evaluate the impact of adversarial attacks on healthcare AI systems

UNIT – V

Cybersecurity Operations and Compliance in Healthcare: Intrusion detection and prevention systems (IDPS), Endpoint Detection and Response (EDR), RBAC/ABAC, multi-factor authentication (MFA), SIEM tools, adversarial ML threats, model robustness, fairness and bias mitigation, forensic analysis, GDPR principles, AI-driven compliance monitoring, automated auditing protocols, post-incident review and modern breach prevention strategies

Practice:

1. Analyze a real-world healthcare breach and propose AI solutions
2. Build a dashboard for compliance monitoring using AI tools

Text Books:

- 1 Pascal Hitzler et al., *Foundations of AI in Healthcare*, Springer
- 2 Sumeet Dua and U. Rajendra Acharya, *Machine Learning in Healthcare Informatics*, Springer
- 3 HIPAA Journal – <https://www.hipaajournal.com/>

Reference Books:

- 1 Arvind Narayanan et al., *Security and Privacy in Machine Learning*, Princeton University Resources
- 2 Research papers from IEEE, Springer, Elsevier on AI in healthcare cybersecurity
- 3 OWASP Healthcare InfoSec resources – <https://owasp.org/>

Web Links:

- 1 <https://www.microsoft.com/en-us/research/project/ai-for-health/>

Advanced Topics in Generative AI

	L	T	P	C
Course Code:2501AI45	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the architectures and working of advanced GenAI models
- CO2:** Implement and fine-tune generative models for practical applications
- CO3:** Analyze and create multimodal generative systems
- CO4:** Evaluate ethical, legal, and societal implications of GenAI technologies
- CO5:** Design solutions using prompt engineering and domain-specific generative 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	PO 11
CO1	3	2	2	2	2	1	2	2	-	-	2
CO2	3	3	3	3	3	2	1	-	-	-	3
CO3	3	3	3	3	3	1	2	-	1	-	2
CO4	2	2	2	2	1	3	3	3	1	-	2
CO5	3	3	3	3	3	1	2	2	1	-	3

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Architectures in Generative AI: Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), Autoregressive models (PixelCNN, WaveNet), Denoising Diffusion Probabilistic Models (DDPM), Latent diffusion models (LDMs), Transformer-based text generation, GPT architecture and applications, T5 for text-to-text tasks, BERT for masked language modeling and generation, Ethical concerns in generative AI, Misuse of synthetic content, Hallucination and bias in AI models, Content authenticity and watermarking, Open-source vs closed-source model policies, Responsible AI development frameworks

Practice:

1. See differences between a VAE and a small DCGAN on MNIST
2. Generate text with a small GPT model and check for hallucinations / bias.

UNIT-II

Training & Fine-tuning GenAI Models: Pretraining vs fine-tuning paradigms, Transfer learning in NLP, Prompt tuning techniques, Prompt injection attacks, Prompt engineering best practices, Reinforcement Learning with Human Feedback (RLHF), Human-in-the-loop training, Model alignment and safety, Low-Rank Adaptation (LoRA), Parameter-Efficient Fine-Tuning (PEFT), Model robustness and adversarial prompts, Ethical considerations in LLM training, Bias and fairness in fine-tuning, Secure deployment of tuned models, Governance policies for generative AI

Practice:

1. See the difference between full fine-tuning and lightweight prompt-based tuning on a small NLP task
2. Understand how prompt injection can make an LLM ignore instructions and learn basic mitigation

UNIT-III

Multimodal Generative AI: Text-to-Image generation (DALL·E, Stable Diffusion), Text-to-Audio synthesis (e.g., Bark, Tortoise TTS), Text-to-Video models (e.g., Sora, Gen-2), Diffusion models in multimodal generation, Latent space conditioning, Image captioning algorithms, Visual Question Answering (VQA) systems, Multimodal Transformers (e.g., Flamingo, GPT-4V), Cross-modal embedding techniques, Ethical concerns in synthetic media, Deepfake detection in multimodal content, Dataset biases in multimodal training, Content moderation policies, Accessibility through multimodal AI, Responsible deployment of generative models

Practice:

1. Generate images from text prompts using a pretrained diffusion model (Stable Diffusion mini / DALL·E API) and then generate captions for them using a pretrained image-captioning model.
2. Ask a pretrained Visual Question Answering (VQA) model questions about an image and check for biases or incorrect answers.

UNIT-IV

Applications and Industry Use Cases: AI-assisted content creation tools (e.g., Canva, Adobe Firefly), Generative design in digital media, AI in code generation (e.g., GitHub Copilot, CodeWhisperer), Game development with generative AI, Personalized learning with AI tutors, AI in medical imaging and diagnostics, Drug discovery using generative models, AI for scientific hypothesis generation, Responsible AI in education and healthcare, Data privacy in GenAI applications, Intellectual property and content ownership, Bias and fairness in AI-generated content, Human-AI

Practice:

1. Use a free AI-assisted tool (like Canva Text-to-Image or Adobe Firefly free plan) to create designs from text prompts and reflect on ownership, bias, and real-world use.
2. Use an AI code assistant (GitHub Copilot, CodeWhisperer, or Hugging Face CodeGen) to generate solutions for small problems, test outputs, and discuss

safety/privacy.

UNIT – V

Ethical Considerations and Governance: Deepfakes and synthetic media threats, Disinformation and misinformation campaigns, AI alignment challenges, Bias in training data and model outputs, Hallucination in generative AI models, Content authenticity verification, Model interpretability and explainability, Copyright issues in AI-generated content, Legal frameworks for AI governance, International AI regulations (EU AI Act, U.S. EO), Ethics in AI development and deployment, Responsible AI and GenAI frameworks (e.g., OECD, NIST), Safety protocols for model deployment, Transparency and accountability in GenAI, Human oversight and control in AI systems

Practice:

1. Explore how deepfakes/synthetic media can be created and detected, and discuss the risks and governance measures.
2. Understand bias in model outputs and the importance of explainability & governance.

Text Books:

- 1 Goodfellow et al., Deep Learning, MIT Press, 2016
- 2 L. Hugging Face Team, The Transformers Book, Hugging Face, 2023
- 3 A. Radford et al., Language Models are Few-Shot Learners, OpenAI, 2020
- 4 P. Isola et al., Image-to-Image Translation with Conditional Adversarial Networks, CVPR, 2017

Reference Books:

- 1 C. Raffel et al., Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer, JMLR, 2020
- 2 OpenAI, GPT-4 Technical Report, arXiv, 2023
- 3 A. Dosovitskiy et al., An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale, ICLR, 2021
- 4 C. O’Neil, Weapons of Math Destruction, Crown Publishing, 2016

Web Links:

- 1 <https://www.coursera.org/courses?query=generative%20ai>
- 2 <https://learn.microsoft.com/en-us/training/modules/fundamentals-generative-ai/>

Ethical AI and Responsible Computing

	L	T	P	C
Course Code:2501AI46	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the ethical foundations and societal impact of AI and computing
- CO2:** Identify algorithmic bias, discrimination, and fairness concerns in AI systems
- CO3:** Apply ethical frameworks and principles to assess AI design and deployment
- CO4:** Design responsible AI solutions adhering to transparency and accountability
- CO5:** Analyze legal, regulatory, and real-world challenges in AI ethics.

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	2	3	2	-	1	-	-	-	-	2	2
CO2	2	2	2	-	1	-	-	-	-	-	1
CO3	2	3	2	-	1	-	-	-	-	2	2
CO4	3	3	1	-	-	-	-	-	-	-	2
CO5	3	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	-	2

UNIT-I

Introduction to Ethical AI: Algorithmic bias, AI transparency and explainability, Ethical hacking and penetration testing, Data privacy and consent, Deepfake and misinformation threats, Responsible AI principles, Digital surveillance ethics, Ethical governance frameworks, AI policy and regulatory compliance

Practice:

1. Analyze ethical dilemmas in emerging AI use cases

UNIT-II

Bias and Fairness in AI: Algorithmic bias detection, Fairness metrics evaluation, Discrimination in automated decisions, Bias mitigation techniques, Ethical AI principles, Fairness-aware machine learning tools, Regulatory and policy frameworks, Inclusive data practices, Real-world case studies of algorithmic bias

Practice:

1. Identify bias in datasets and explore fairness metrics

UNIT-III

Ethical Frameworks and Principles: Ethical decision-making frameworks, AI moral reasoning models, Deontological rule-based systems, Utilitarian outcome optimization, Virtue ethics in AI behavior, Human-centered design principles, Value alignment in AI systems, Ethical risk assessment protocols, Policy guidelines for ethical AI

Practice:

1. Evaluate AI algorithms using ethical impact assessment tools
2. Conduct an ethical risk analysis on a public AI system

UNIT-IV

Responsible AI Design: Explainability techniques in AI, Model interpretability tools, Accountability in automated decisions, Transparency principles in AI systems, Auditing protocols for AI models, Ethical threats of black-box algorithms, Regulatory policies for XAI, Human-in-the-loop frameworks, Trust and reliability in AI outputs

Practice:

1. Design an interpretable AI model and generate explanations using XAI
2. Develop a code of ethics or policy guideline for responsible AI use

UNIT – V

Governance, Policy, and Regulation: EU AI Act provisions, Global AI regulatory frameworks, Data privacy and protection laws, Compliance auditing tools, Risk-based AI classification, Legal and ethical AI principles, Enforcement protocols for AI governance, Cross-border data sharing threats, Challenges in regulatory compliance

Ethical Challenges in Real-world Applications: Biometric data protection, AI surveillance ethics, Deepfake detection technologies, Autonomous decision-making protocols, Privacy threats in facial recognition, Regulatory frameworks for AI surveillance, AI misuse and societal impact, Security vulnerabilities in AV systems, Legal and ethical governance of deepfakes

Practice:

1. Simulate a case study review under AI regulation (e.g., GDPR or EU AI Act)
2. Explore adversarial impacts of unregulated AI systems (e.g., misinformation, surveillance)
3. Debate a controversial AI deployment and propose ethical alternatives

TextBooks:

- 1 Virginia Dignum, *Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible Way*, Springer

- 2 Markus D. Dubber, Frank Pasquale, Sunit Das, *Oxford Handbook of Ethics of AI*, Oxford University Press
- 3 Shannon Vallor, *Technology and the Virtues: A Philosophical Guide to a Future Worth Wanting*, Oxford University Press

Reference Books:

- 1 IEEE Global Initiative on Ethics of Autonomous and Intelligent Systems
- 2 World Economic Forum – AI Governance Frameworks
- 3 AI Now Institute Reports – <https://ainowinstitute.org/>

Web Links:

- 1 <https://www.microsoft.com/en-us/ai/responsible-ai#:~:text=Microsoft's%20responsible%20AI%20principles%20include,inclusiveness%2C%20transparency%2C%20and%20accountability.>

Minor Degree in Artificial Intelligence and Machine Learning (offered to other branches students):

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AI02	Artificial Intelligence	IC	2		1	3	50	50	100	DAP
2501AI05	Machine Learning	IC	2		2	4	50	50	100	DAP
2501AI15	AI Chatbots	IC	2			2	50	50	100	DAP
2501AI17	Federated Machine Learning	AC	2			2	50	50	100	ML
2501AI14	Soft Computing (or)	IC	1		2	3	50	50	100	AI
2501CS34	Fundamentals of Data Science		2		1					
2501AI10	Natural Language Processing (or)	AC	2		1	3	50	50	100	AI (or) FDS
2501AI19	Data Visualization									
2501AI16	Prompt Engineering and GenAI (or)	AC	2		1	3	50	50	100	AI (or) FDS
2501CS41	Social Network Analysis									
TOTAL			14		6	20				

Artificial Intelligence
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501AI02	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Illustrate the historical development of AI, key milestones and contributors.
- CO2:** Apply the basic principles of AI in problem solving
- CO3:** Apply Local Search Algorithms and Optimization Techniques.
- CO4:** Choose the appropriate representation of Knowledge.
- CO5:** Summarise the expert systems and real time 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
CO1	3	-	-	1	-	-	-	1	1	-	1
CO2	3	2	-	2	-	-	-	1	1	-	1
CO3	3	2	1	2	1	-	-	1	1	-	1
CO4	2	-	1	-	-	-	-	1	1	-	-
CO5	2	2	1	1	1	-	-	1	1	-	1

UNIT-I

Introduction: What Is AI? The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art, Agents and Environments, Good Behaviour: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Practice:

1. Introduction to LISP :
 - a. To demonstrate simple recursive functions and list manipulation in LISP
2. Introduction to Prolog :
 - a. Provide a brief introduction to Prolog syntax, including facts, rules, and queries.

UNIT-II

Problem formulation: Problem Definition Production systems, Control strategies, Search strategies. Problem characteristics, ProblemSolving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies

Practice:

1. Implementation of DFS for water jug problem using LISP/PROLOG
2. Implementation of BFS for tictactoe problem using LISP/PROLOG

UNIT-III

Problem solving methods: Problem graphs, Matching, Indexing and Heuristic functions Local Search Algorithms and Optimization Problems, Searching with Nondeterministic Actions, , Constraints satisfaction – Measure of performance and analysis of search algorithms. Game playing.

Practice:

1. Implementation of TSP using heuristic approach using LISP/Prolog
2. Implementation of Hillclimbing to solve 8 Puzzle Problem

UNIT-IV

Knowledge representation: Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logicStructured representation of knowledge Basic plan generation systems – Strips Advanced plan generation systems – K strips Strategic explanations Why, why not and how explanations.

Practice:

1. Design a semantic network to represent knowledge about a specific domain, such as animals or transportation systems. Experiment with different node types, relationships, and attributes to encode information effectively. Implement a Python / LISP code for this program.
2. Create a framebased representation for a simple domain like a restaurant. Define frame templates for entities like menu items, customers, and orders, along with slots for attributes such as price, ingredients, and customer preferences.

UNIT – V

Expert Learning: Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

Practice:

1. Using PYTHON / LISP , develop an expert system to help users plan travel itineraries, including transportation, accommodation, and activities. Utilize knowledge about travel destinations, transportation options, and user preferences to generate personalized travel plans.
2. Using PYTHON / LISP , create an expert system to assist students in selecting courses, majors, or career paths based on their interests, skills, and academic performance. Use knowledge about educational programs, career prospects, and academic requirements to make personalized recommendations.

Text Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig , Pearson, 3rd Edition, ISBN: 978-9332543515
2. Artificial Intelligence: Structures and Strategies for Complex Problem Solving by George F. Luger, 2nd Edition, ISBN: 978-0805347807

Reference Books:

1. Artificial Intelligence, Saroj Kaushik, Cengage Learning India, ISBN: 978-8131510995
2. Artificial Intelligence, Elaine Rich and Kevin Knight, Tata McGraw Hill, ISBN: 978-0-07-052263-3
3. Artificial Intelligence: Foundations for Computational Agents, David Poole and Alan Mackworth, Cambridge University Press, ISBN: 978-1107195394

Web Links:

- 1 <https://nptel.ac.in/courses/106105077>
- 2 <https://nptel.ac.in/courses/106106126>
- 3 <https://aima.cs.berkeley.edu>

Machine Learning
(Common to All, Except CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501AI05	2	0	2	4

Course Outcomes:

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

- CO1:** Outline the Concepts of Machine Learning and Statistical Learning
- CO2:** Build Regression and Classification models for given data.
- CO3:** Apply Instance based Learning techniques and SVM techniques linear and nonlinear data.
- CO4:** Apply clustering techniques on high dimensional data to group the similar entities.
- CO5:** Make use of ensemble learning techniques to improve the performance of a model.

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	2	2	-	-	2	2	-	1	1	-	-
CO2	2	2	3	-	2	2	-	1	1	-	-
CO3	3	2	3	-	2	-	-	1	1	-	2
CO4	3	2	3	-	2	-	-	1	1	-	-
CO5	2	2	2	-	2	-	-	1	1	-	2

UNIT-I

INTRODUCTION: Machine Learning, Types of Machine Learning Systems, Main Challenges of Machine Learning. Statistical Learning: Introduction, Supervised and Unsupervised Learning, The Learning Problem, Feasibility of Learning.

Practice:

1. Installation of Jupitar/Spider notebook and working on basic commands.
2. Loading and apply key preprocessing techniques on the dataset and also analyse the dataset.

UNIT-II

Supervised Learning(Regression/Classification):Basic Methods: Concept Learning: General-to-Specific Hypotheses Ordering, Find-S and Candidate Elimination Algorithm, Version Space, and Inductive Bias.

Bayesian Learning: Probability Overview, MLE and MAP Estimates, Gaussian Naive Bayes Classifier, Bayesian Networks.

Instance-based Learning: k-Nearest Neighbour (kNN) Classifier, Voronoi Diagram and Distance-Weighted kNN, Distance Metrics and Curse of Dimensionality.

Practice:

1. Implement and demonstrate the FIND-S algorithm for finding the most specific

hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Exercises to solve the real-world problems using Binary Classifier
4. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions.

UNIT-III

Linear Models and Regression: Linear Classification, Linear Regression, Non-linear Transformation, Logistic Regression.

Support Vector Machines: Decision Boundary and Support Vector: Optimization and Primal-Dual Problem, Soft Margin and Non-linear Decision Boundary, Kernel Functions and Radial Basis Functions introduction.

Practice:

1. Exercises to solve the real-world problems using Linear Regression
2. Exercises to solve the real-world problems using Logistic Regression
3. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of heart patients.

UNIT-IV

Classifier / Hypothesis Evaluation: Accuracy, Precision, Recall and F-Measures, Scores, Sampling, Bootstrapping and ROC, Hypotheses Testing and Cross-validation.

Unsupervised Learning:

Clustering : Partitional Clustering and Hierarchical Clustering, Cluster Types, Attributes and Salient Features, Hierarchical and Density-based Clustering Algorithms, Inter and Intra Clustering Similarity, Cohesion and Separation. MST and DBSCAN Clustering Algorithms.

Practice:

1. Develop a program for Bias, Variance, Remove duplicates , Cross Validation
2. Write a program to implement One-hot Encoding.
3. Write a program to implement Categorical Encoding.

UNIT – V

Ensemble Learning :

Bagging and Boosting, Adaboost and Random Forest ,

Computational Learning Theory : Error and Noise Formalisms, Training vs. Testing, Theory of Generalization, PAC Learnability and VC Dimensions, Overfitting, Regularization and Validation.

Practice:

1. Write a program to demonstrate the working of Random Forest classifier. Use appropriate dataset for Random Forest Classifier.

2. Use a sentiment analysis dataset from Twitter or other social media platforms, available on platforms like Kaggle and apply bagging and boosting techniques for prediction.

Additional Practice:

1. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
2. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using kMeans algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

Capstone Project

Student Performance Prediction System

Objective: Predict a student's performance (pass/fail or score range) based on input features like study time, attendance, past grades, family background, etc.

Domain: Education

Techniques & Concepts Used:

- Supervised learning (Classification – Logistic Regression, SVM)
- Data preprocessing (handling nulls, encoding categorical variables)
- Evaluation metrics (accuracy, precision, recall)

Text Books:

- 1 Hands On Machine Learning with ScikitLearn, Keras, and TensorFlow, 2nd Edition, O'Reilly Publications, 2019, ISBN: 978-1492032649
- 2 Data Science and Machine Learning Mathematical and Statistical Methods, Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, 2019, ISBN: 978-1138492530

Reference Books:

- 1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, ISBN: 9780262018029
- 2 Machine Learning Tools, Dr Muddafa Maruli Krishna, Dr A Vanathi, Final Thawaksr, Dr Lokesh P. Gangani, publisher: Book Rivers, ISBN: 978-93-5515-730-0

Web Links:

- 1 <https://www.deeplearning.ai/machinelearningyearning/>
- 2 <https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html>
- 3 https://onlinecourses.nptel.ac.in/noc21_cs24/preview

AI Chatbots
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501AI15	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1:** Explore the benefits and challenges of deploying chatbots for business use cases.
- CO2:** Evaluate a fully-functional and interactive chatbot using a commercial platform.
- CO3:** Deploy the finished chatbot for public use and interaction.
- CO4:** Distinguish between the NLP and NLU Tools
- CO5:** Demonstrate Microsoft Bot Framework, RASA and Third Party API's

Mapping of Course Outcomes with Program Outcomes:

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

UNIT I

Introduction: Benefits from Chatbots for a Business, A Customer-Centric Approach in Financial Services, Chatbots in the Insurance Industry, Conversational Chatbot Landscape,

Identifying the Sources of Data: Chatbot Conversations, Training Chatbots for Conversations, Personal Data in Chatbots, Introduction to the General Data Protection Regulation (GDPR)

UNIT II

Chatbot Development Essentials: Customer Service-Centric Chatbots, Chatbot Development Approaches, Rules-Based Approach, AI-Based Approach, Conversational Flow, Key Terms in Chatbots, Utterance, Intent, Entity, Channel, Human Takeover, Use Case: 24x7 Insurance Agent

UNIT III

Building a Chatbot Solution: Business Considerations, Chatbots Vs Apps, Growth of Messenger Applications, Direct Contact Vs Chat, Business Benefits of Chatbots, Success Metrics, Customer Satisfaction Index, Completion Rate, Bounce Rate, Managing Risks in Chatbots Service, Generic Solution Architecture for Private Chatbots

UNIT IV

Natural Language Processing, Understanding, and Generation: Chatbot Architecture, Popular Open Source NLP and NLU Tools, Natural Language Processing, Natural Language Understanding, Natural Language Generation, Applications.

UNIT V

Introduction to Microsoft Bot, RASA, and Google Dialog flow: Microsoft Bot Framework, Introduction to QnA Maker, Introduction to LUIS, Introduction to RASA, RASA Core, RASA NLU, Introduction to Dialog flow

Chatbot Integration Mechanism: Integration with Third-Party APIs, Connecting to an Enterprise Data Store, Integration Module

Text Books:

- 1 Artificial Intelligence Based Chat Bot Design, Nazneen Akhter Shaikh, Khan Samrin Syed Zebanaaz, Saniya Raheen Patel, Lambert Publication, ISBN: 978-6202786713

Reference Books:

- 1 Hands-On Chatbots and Conversational UI Development: Build Chatbots and Voice User Interfaces with Chatfuel, Dialogflow, Microsoft Bot Framework, Twilio, and Alexa Skills, Packt publication, ISBN: 9781788294669

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_ge29/preview
- 2 <https://www.geeksforgeeks.org/nlp-vs-nlu-vs-nlg/>
- 3 <https://dev.botframework.com/>

Soft Computing
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501AI14	L	T	P	C
	1	0	2	3

Course Outcomes:

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

- CO1:** Compare intelligent systems and knowledge based systems
- CO2:** Explain fuzzy sets and fuzzy operations
- CO3:** Discuss neuro systems and neural network applications
- CO4:** Apply genetic algorithm and operators
- CO5:** Compare and contrast Swarm Intelligence based algorithms

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	2	2	2	-	1	-	-	1	1	-	2
CO2	2	2	3	-	2	-	-	2	2	-	2
CO3	2	2	3	-	1	-	-	2	2	-	2
CO4	2	2	3	-	1	-	-	2	2	-	2
CO5	2	2	3	-	1	-	-	2	2	-	2

UNIT – I

Introduction to intelligent systems and soft computing: Intelligent systems, Knowledgebased systems, Knowledge representation and processing, Soft computing techniques.

Practice:

1. Text summarization using a simple sequencetosequence model with LSTM (Long ShortTerm Memory) layers.
2. Apply networkx library to represent and process knowledge

UNIT – II

Fundamentals of fuzzy logic systems: Introduction , Background ,Evolution of fuzzy logic, Popular applications, Stages of development of an intelligent product, Use of fuzzy logic in expert systems, Fuzzy sets , Fuzzy logic operations

Practice:

1. Learn the fundamentals of the fuzzy logic ,experiment the basic operations of fuzzy logic (Virtual Labs)
2. Learn about the Fuzzy inference system (FIS) with an example (Virtual Labs)

UNIT – III

Fundamentals of artificial neural networks Introduction Learning and acquisition of knowledge , Symbolic learning , Numerical learning, Features of artificial neural networks , Neural network topologies, Neural network activation functions, Neural network learning algorithms, Fundamentals of connectionist modeling

Practice:

1. Implement Neural Networks and Perceptron with an example (Virtual Labs)
Virtual Labs
2. Study Multilayer Perceptron apply it for image classification

UNIT – IV

Genetic algorithms and evolutionary programming: Introduction, Genetic algorithms, Procedures of genetic algorithms, working of genetic algorithms, genetic algorithm operators, Issues in GAs.

Practice:

1. Implement a genetic algorithm for finding the maximum value of a function.
2. Implement Crossover and Mutation in genetic algorithms

UNIT – V

Swarm Intelligent systems: Introduction, Swarm Intelligence based algorithms – Ant Algorithms; Bee Algorithms; Particle Swarm Optimization, Background of Ant intelligent system, ant colony systems Importance, development, applications, working of ant colony systems, Artificial Bee Colony (ABC) Optimization Behavior of real bees, ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist

Practice:

1. Implement Particle Swarm Optimization algorithm
2. Implement ABC with GBest Algorithm:And GBestDist Algorithm

Text Books:

- 1 Soft Computing and Intelligent Systems Design Theory, Tools and Applications, Fakhreddine O. Karray and Clarence de Silva, ISBN: 978-8131723241
- 2 Artificial Intelligence and Intelligent Systems, N. P. Padhy, Oxford University press, ISBN: 9780195671544

Reference Books:

- 1 Fuzzy Logic: A Pratical approach, F. Martin, , Mc neill, and Ellen Thro, AP Professional, ISBN: 978-0124859654
- 2 An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, ISBN: 9780262280013

Web Links:

- 1 <https://nptel.ac.in/courses/106105174/>
- 2 <https://www.kdnuggets.com/>
- 3 <https://www.import.io/post/datascientistsvsdataanalystswhythedistinctionmatters/>

Fundamentals of Data Science
(Common to All, Except CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501CS34	2	0	1	3

Course Outcomes:

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

- CO1:** Explain fundamental concepts of Data Science.
- CO2:** Implement Data Collection and Preprocessing Techniques.
- CO3:** Demonstrate Proficiency in Data Loading, Storage, and File Handling
- CO4:** Conduct Exploratory Data Analysis (EDA) using Visualization and Statistical Techniques.
- CO5:** Make use of Neo4j, Cypher tools to manage and analyze graph data.

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	2	3	-	-	-	-	-	-	2	2	-
CO2	2	-	-	-	-	-	-	-	1	2	-
CO3	2	2	2	-	-	-	-	-	2	2	-
CO4	2	2	-	-	2	-	-	-	2	1	-
CO5	3	-	-	-	-	-	-	-	1	1	-

UNIT – I

Introduction To Data Science: Definition and Scope of Data Science, History and Evolution of Data Science, Applications of Data Science, Data Science Lifecycle, Data Types and Structures, Tools and Technologies in Data Science.

Practice:

1. Importing and Exploring Datasets - Loading datasets using libraries and performing basic exploration.
2. Basic Data Structures - Working with data structures such as arrays, lists, data frames, and matrices.

UNIT – II

Data Collection and Preprocessing: Data Collection Methods, Data Cleaning and Handling Missing Values, Data Transformation: Normalization and Standardization, Feature Engineering and Feature Scaling, Data Integration and Aggregation.

Practice:

1. Computing summary statistics like mean, median, mode, and standard deviation for a sample dataset.
2. Handling missing values and outliers in a dataset using techniques like imputation and filtering.

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 Mongo DB.

Practice:

1. Read data from a JSON file into a DataFrame using Pandas (pd.read_json) or R (jsonlite). Parse nested JSON structures and convert them into a flat table format.
2. Perform web scraping on an HTML page using BeautifulSoup in Python or rvest in R. Extract data from HTML tables and convert it into a DataFrame.

UNIT – IV

Exploratory Data Analysis (EDA): Descriptive Statistics, Data Visualization Techniques, Correlation and Covariance Analysis, Univariate, Bivariate, and Multivariate Analysis, Pattern Detection and Anomaly Identification.

Practice:

1. Plotting histograms and box plots to understand the distribution of a single variable.
2. Creating scatter plots and calculating correlation coefficients to study the relationship between two variables.

UNIT – V

Data Science Tools: Neo4j for dealing with graph databases, graph query language Cypher, libraries like nltk and SQLite for handling Text mining and analytics.

Practice:

1. Get hands-on experience with Neo4j to understand how to manage and query graph databases.
2. Practice writing Cypher queries to interact with graph data in Neo4j.

Text Books:

- 1 Python for Data Analysis, Wes McKinney, O'REILLY, 1st edition, ISBN:978-1-449-31979-3
- 2 Doing Data Science, Rachel Schutt & O'neil, O'REILLY, 1st edition, ISBN:978-1-449-35865-5

Reference Books:

- 1 Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly Media, ISBN: 9781492041139.
- 2 Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization, Matt Harrison, O'Reilly, ISBN: 9781787123137

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs133/preview
- 2 https://onlinecourses.nptel.ac.in/noc24_cs68/preview
- 3 <https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/>

Natural Language Processing
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501AI10	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain datasets for NLP tasks and context free grammar.
- CO2:** Explain Text preprocessing and stemming algorithms.
- CO3:** Explain feature engineering on text data
- CO4:** Apply similarity measures and word embedding models
- CO5:** Explain text summarization and semantic analysis.

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
CO1	2	2	1	-	1	-	-	1	1	-	2
CO2	2	2	2	-	2	-	-	1	1	-	2
CO3	2	2	3	-	1	-	-	1	1	-	2
CO4	2	2	3	-	1	-	-	1	1	-	1
CO5	2	2	3	-	1	-	-	1	1	-	1

UNIT – I

Overview of Natural Language Processing, Natural Language Processing and Python: Understanding Natural language Processing and applications, NLTK, Corpus and Dataset, understanding structure of sentence Defining Context free grammar, Morphological Analysis

Practice:

1. Word Analysis Learn about morphological features of a word by analysing it
2. Word Generation generate word forms from root and suffix information.

UNIT – II

Syntactic Analysis, Semantic analysis, Ambiguity resolution, Discourse integration, Preprocessing tokenization, stemming , lemmatization, Word tokenization and lemmatization

Practice:

1. Implement Porter Stemming Algorithm
2. NGrams learn to calculate bigrams from a given corpus and calculate probability of a sentence

UNIT – III

Feature engineering and NLP algorithms parsers, context free grammars, different types of parsers, POS tagging and different types of POS parsers.

Practice:

1. Morphology understanding the morphology of a word by the use of AddDelete table.
2. POS Tagging – calculate emission and transition matrix which will be helpful for tagging Parts of Speech

UNIT – IV

Basic statistical features of NLP: TFIDF, Vectorization Encoders and Decoders, Normalization, Advanced feature engineering and NLP algorithms Basics of Word2Vec

Practice:

1. Apply term frequency(TFIDF) to Measures the importance of a word to a specific document
2. Implement word embedding using word2vec

UNIT – V

Rule Based system for NLP, Machine Learning for NLP problems, Applications of NLP Text Summarization, Sentiment Analysis

Practice:

1. Chunking understand the concept of chunking and get familiar with the basic chunk tag set.
2. Building Chunker the importance of selecting proper features for training a model and size of training corpus in learning how to do chunking.

Text Books:

- 1 Python Natural Language Processing, Thanaki J, Packt Publishing Ltd, ISBN: 9781787121423
- 2 Springer Handbook of Speech Processing, Jacob Benesty, M. M. Sondhi, Yiteng Huang Springer, ISBN: 978-3-540-49127-9

Reference Books:

- 1 Speech & language processing, Jurafsky D, Pearson Education India, ISBN: 978-9332518414
- 2 Foundations of Statistical Natural Language Processing, Christopher, D. Manning and Hinrich Schütze, MIT Press, ISBN: 9780262133609

Web Links:

- 1 <https://www.nltk.org/data.html>
- 2 <https://www.analyticsvidhya.com/blog/2017/01/ultimatguidetounderstandimplem entnaturallanguageprocessingcodesinpython/>
- 3 https://datahack.analyticsvidhya.com/contest/linguipediacodefestnaturallanguagep rocessing1/?utm_source=ultimatguidetounderstandimplementnaturallanguagep rocessingcodesinpython&utm_medium=blog

Data Visualization
(Common to All, Except CSE, IT, AIML & CSE (DS))

	L	T	P	C
Course Code: 2501AI19	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the various types of data and principles of data visualization
- CO2:** Apply visualization techniques to a problem and its associated dataset
- CO3:** Apply structured approach to create effective visualizations
- CO4:** Outline the valuable insights from the massive dataset using visualization.
- CO5:** Build visualization dashboard to support decision making

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	2	2	-	-	1	-	-	1	1	-	2
CO2	2	2	-	-	2	-	-	1	1	-	2
CO3	2	2	3	-	1	-	-	1	1	-	2
CO4	2	2	3	-	1	-	-	1	1	-	1
CO5	2	2	3	-	1	-	-	1	1	-	1

UNIT – I

Introduction to Visualization: Introduction to Data Visualizations and Perception: Introduction to visualization and visual perception, visual representation of data, Gestalt principles, Information overload.

Practice:

1. Introduction to various Data Visualization tools
2. Basic Visualization in Python

UNIT – II

Visual Representations: Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.

Practice:

1. Basic Visualization in R
2. Introduction to Tableau and Installation

UNIT – III

Classification of Visualization Systems: Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multidimensional data, text and text documents.

Practice:

1. Connecting to Data and preparing data for visualization in Tableau
2. Data Aggregation and Statistical functions in Tableau

UNIT – IV

Visualization of Groups: Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization. Various visualization techniques, data structures used in data visualization.

Practice:

1. Data Visualizations in Tableau

UNIT – V

Visualization of Volumetric Data And Evaluation of Visualizations: Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations

Practice:

1. Basic Dashboards in Tableau

Text Books:

- 1 Interactive Data Visualization: Foundations, Techniques, and Applications, Ward, Grinstein, Keim, Natick, A K Peters, Ltd, 2nd edition, ISBN: 978-1482257373

Reference Books:

- 1 Visualization Analysis & Design, Tamara Munzner, AK Peters Visualization Series, 1st edition, ISBN: 978-1466508910
- 2 Interactive Data Visualization for the Web, Scott Murray, 2nd Edition, ISBN: 978-1491921289

Web Links:

- 1 <https://elearn.nptel.ac.in/shop/iitworkshops/completed/datavisualizationwithr/?v=c86ee0d9d7ed>
- 2 <https://www.udemy.com/course/mastering-datavisualization/?couponCode=NVDIN35>

Prompt Engineering & GenAI
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501AI16	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the importance of prompt engineering, distinguish between explicit, implicit, and creative prompts.
- CO2:** Apply prompt engineering to improve NLP tasks, enhance creativity and diversity in AI-generated content.
- CO3:** Evaluate the Finetuning Language Models for Optimal Output Managing Prompt Complexity and Length.
- CO4:** Analyze the data preprocessing Techniques for language models.
- CO5:** Evaluate the ethical considerations and societal impact of generative AI 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
CO1	2	2	-	-	2	-	-	1	1	-	1
CO2	2	2	-	-	2	-	-	1	1	-	2
CO3	3	2	-	-	2	-	-	1	1	-	1
CO4	3	2	1	-	2	-	-	1	1	-	1
CO5	2	1	1	-	2	-	-	1	1	-	2

UNIT – I

Introduction to Prompt Engineering: What is prompt engineering and why it matters, Prompt types: explicit, implicit, and creative prompts, Best Practices for Crafting Effective Prompts

Practice:

1. Write a python program for Prompt Clarity Evaluation.
2. Write a python program for prompt Relevance Assessment
3. Write a Python Program for Prompt Diversity Experiment

UNIT – II

Practical Applications of Prompt Engineering: Improving NLP Tasks with Custom Prompts, Enhancing Creativity and Diversity in AIGenerated Content, Addressing AI Ethics and Bias through Thoughtful Prompt Engineering, Personalization and Adaptability in AIGenerated Content

Practice:

1. Write a python program for Custom Prompt for NLP Task
2. Write a python program for Enhancing Creativity in AIGenerated Content

3. Write a python program for Addressing Bias in AIGenerated Content

UNIT – III

Advanced Prompt Engineering Techniques

Customising Prompts for Specific Use Cases, Finetuning Language Models for Optimal Output Managing Prompt Complexity and Length, Enhancing Control and Diversity in Generated Text

Practice:

1. Write a python program for Customizing Prompts for Specific Use Cases
2. Finetuning Language Models for Optimal Output using python

UNIT – IV

Foundations of Generative AI

Neural Networks and Their Relevance in AI Language Generation, Deep Learning Architectures for Text Generation and its Implications for Prompt Engineering, Data Preprocessing Techniques for Language Models

Practice:

1. Write a python program for Training a Simple Text Generation Model using LSTM
2. Data Preprocessing Techniques for Language Models using python

UNIT – V

Advanced Topics in Generative AI

Adversarial attacks and defences in generative models, Ethical considerations and societal impact of generative AI, LangChain Framework

Practice:

1. Detecting and Mitigating Adversarial Attacks using python

Text Books:

- 1 Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville Version: 1st Edition, ISBN: 978-0262035613
- 2 Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit, Steven Bird, Ewan Klein and Edward Loper Version: 1st Edition, ISBN: 978-0596516499

Reference Books:

- 1 Markov Decision Processes: Discrete Stochastic Dynamic Programming, Puterman, Martin L., Germany: Wiley, ISBN: 978-0471727828
- 2 Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play, Author: David Foster Version: 1st Editon 2019, ISBN: 978-1492041948

- 3 Interpretable Machine Learning: A Guide for Making Black Box Models Explainable
Christoph Molnar Version: 1st Edition 2019, ISBN: 978-1700895466

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc20_cs74/preview

Social Network Analysis
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501CS41	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Explain the fundamental of semantic web.
- CO2:** Illustrate knowledge representation using ontology.
- CO3:** Analyze various communities in social networks
- CO4:** Illustrate the prediction of human behaviour for social networks.
- CO5:** Design visualization of social networks.

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	-	-	-	-	-	-	1	-	-
CO2	2	3	-	-	-	-	-	-	1	-	-
CO3	2	3	2	1	-	-	-	-	-	1	-
CO4	2	2	-	-	-	-	-	-	1	-	-
CO5	3	2	2	-	-	-	-	-	1	1	-

UNIT – I

INTRODUCTION: Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Webbased networks– Applications of Social Network Analysis.

Practice:

1. Learn how to construct a social network object in R

UNIT – II

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION: Ontology and their role in the Semantic Web: Ontologybased knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: Stateofheart in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.

Practice:

1. Perform knowledge representation of semantic web.

UNIT – III

EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS: Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – MultiRelational characterization of dynamic social network communities.

Practice:

1. Learn how to visualize a social network

UNIT – IV

PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES: Understanding and predicting human behavior for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in online social networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and counter measures.

Practice:

1. Learn how to calculate node and network level summary statistics

UNIT – V

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS: Graph theory – Centrality – Clustering – NodeEdge Diagrams – Matrix representation – Visualizing online social networks, visualizing social networks with matrixbased representations – Matrix and NodeLink Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – CoCitation networks.

Practice:

1. Learn how to incorporate network connectivity in a spatial regression model

Text Books:

- 1 Social Networks and the Semantic Web ,Peter Mika, Springer ,First Edition. ISBN: 978-0-387-71000-6
- 2 Handbook of Social Network Technologies and Applications ,Borko Furht, ISBN: 978-1441971418

Reference Books:

- 1 Web Mining and Social Networking Techniques and applications,Guandong Xu ,Yanchun Zhang and Lin Li, First Edition, Springer. ISBN: 978-1441977342

- 2 Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively ,Dion Goh and Schubert Foo, IGI Global Snippet. ISBN: 978-1599045436
- 3 Max Chevalier, Christine Julien and Chantal SouléDupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet. ISBN: 9781605663074
- 4 The Social Semantic Web ,John G. Breslin, Alexander Passant and Stefan Decker, ,Springer. ISBN: 978-3642424328

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc22_cs117/preview
- 2 <https://open.hpi.de/courses/semanticweb>
- 3 <https://crd230.github.io/lab9.html>

Federated Machine Learning
(Common to All, Except CSE, IT, AIML & CSE (DS))

Course Code: 2501AI17	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1:** Outline the Concepts of Federated Machine Learning
- CO2:** Explore the types of Federated machine Learning.
- CO3:** Apply Optimization techniques for Federated heterogeneous networks.
- CO4:** Apply clustering techniques on high dimensional data to group the similar entities.
- CO5:** Make use of ensemble learning techniques to improve the performance of a model.

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

UNIT – I

Introduction to Federated learning: Introduction to Federated learning, Privacy Preserving, Distributed Machine Learning, Threats to Federated Learning, Data Valuation

UNIT – II

Types of the Federated learning: Horizontal Federated learning ,Vertical Federated Learning, Federated Transfer learning

UNIT – III

Federated Optimization for heterogeneous networks: Deep Networks from Decentralized data, Federated Multitask Learning, Personalized Federated Learning

UNIT – IV

Federated Learning Applications: Recommendation in health care and Finance, Mobile keyboard prediction, Learning of out of vocabulary words.

UNIT – V

Adaptive personalized Federated learning : Privacy Preserving Deep Learning, Advances and Open Problems.

Text Books:

- 1 Federated Learning, Qiang Yang, Yang Liu, Yong Cheng, Yan Kang, Tianjian Chen, Han Yu, Morgan & Claypool Publishers, 2019, ISBN: 978-1681736976
- 2 Handbook of Big data Privacy, KimKwang Raymond Choo, Ali Dehghantanha, Springer Nature Switzerland, 2020, ISBN: 978-3030385569

Reference Books:

- 1 Machine Learning Probabilistic Approach, Kevin P. Murphy, MIT Press, ISBN: 9780262018029

Web Links:

- 1 <https://www.deeplearning.ai/machinelearningyearning/>
- 2 https://onlinecourses.nptel.ac.in/noc21_cs24/preview
- 3 <https://www.udemy.com/course/machinelearning/>

Minor Degree in Civil Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE25	Repair & Rehabilitation of Structures	FC	3			3	50	50	100	-
2501CE43	Building Planning & Computer-Aided Drawing	FC			2	2	50	50	100	-
2501CE27	Green Buildings	FC	3			3	50	50	100	-
2501CE40	Fundamentals of Soil Behaviour	FC	2	1		3	50	50	100	-
2501CE54	Railway Engineering (or)	FC	3			3	50	50	100	-
2501CE47	Docks & Harbour Engineering									
2501CE36	Environmental Impact & Risk Management	IC	3			3	50	50	100	-
2501CE37	(or) Environmental Management									
2501CE56	Urban Transportation Planning (or)	IC	3			3	50	50	100	-
2501CE49	Intelligent Transportation Systems.									
TOTAL			17	1	2	20				

Repair and Rehabilitation of Structures

(Common to All, Except CE)

Course Code: 2501CE25

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe the concept of repair and its need.
- CO2:** Classify various causes of deterioration of concrete structure and Distresses monitoring techniques.
- CO3:** Identify the effect of corrosion on structures.
- CO4:** Assessing the techniques for repairing.
- CO5:** Apply the NDT techniques to assess the condition of the structures& explain seismic retrofitting and maintenance of heritage 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
CO1	3	1	3	1	-	2	-	-	-	-	-
CO2	2	-	2	2	-	2	-	-	-	-	-
CO3	2	1	2	2	-	2	-	-	-	-	-
CO4	2	-	2	2	-	2	-	-	-	-	-
CO5	2	-	2	2	-	3	-	-	-	-	-

UNIT – I

Introduction: Maintenance and Repair strategies - Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure.

UNIT – II

Deterioration of Structures: Introduction, Basic terminology – Causes of deterioration, physically induced deterioration, chemically induced deterioration, Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking.

UNIT – III

Corrosion of structures: Corrosion mechanism - Effects of cover thickness and cracking - Methods of corrosion protection – Inhibitors - Coatings - Cathodic protection for reinforcements-design and construction errors - Effects of cover thickness and cracking.

UNIT – IV

Rehabilitation and Retrofitting methods: Repair: Guniting, Shortcreting, Epoxy – Cement mortar injection, Crack ceiling Rehabilitation Methods: Grouting, Imbalance of structural stability, Strengthening & Stabilization techniques, Design consideration – Beam shear capacity strengthening – Shear transfer strengthening – Stress reduction techniques – Column strengthening, Flexural strengthening – Connection stabilization & strengthening.

UNIT – V

Damage Assessment: Repairs to Structures - Repair of structures distressed due to earthquake – Strengthening using FRP Strengthening and stabilization techniques for repair Non – Destructive testing methods – Rebound hammer, Ultrasonic pulse velocity, Rebar locator, Corrosion meter, Penetration resistance & Pullout tests. Seismic Retrofitting and Maintenance of Heritage Structures: Earthquake damages of buildings, their retrofitting and restoration. Effects of earthquakes. Methods of seismic retrofitting, restoration of buildings, Special care in repair and rehabilitation of heritage structures.

Text Books:

1. Maintenance Repair Rehabilitation & Minor works of Buildings- P.C. Varghese, PHI Publications. (ISBN: 978-81-203-4945-2)
2. Repair and Rehabilitation of Concrete Structures – P.I. Modi, C.N. Patel, PHI Publications. (ISBN : 9788120352148).

Reference Books:

1. Rehabilitation of Concrete Structures - B. Vidivelli, Standard Publishers Distributors (ISBN: 8180141101).
2. Rehabilitation of Concrete Structures - B. Vidivelli, Standard Publishers Distributors (ISBN : 9788180141102).
3. Concrete Repair and Maintenance illustrated - Peter H.Emmons (ISBN-13: 978-0876292860).

Web Links:

1. https://www.academia.edu/30633495/Repair_and_Rehabilitation_of_Structures
2. <https://nptel.ac.in/courses/105/106/105106202/>

Building Planning and Computer Aided Drawing

(Common to All, Except CE)

Course Code: 2501CE43	L	T	P	C
	0	0	2	2

Course Outcomes:

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

- CO1:** Discuss about CAD software and basic functions.
- CO2:** Plan different types of buildings as per NBC regulations and building laws
- CO3:** Sketch the various building components
- CO4:** Evaluate plans of Single storied building & multistoried buildings
- CO5:** Develop different sections at different elevations
- CO6:** Detailing of building components like doors, windows and roof trusses etc.

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	-	-	-	3	3	2	2	2	2	2
CO2	3	-	-	-	2	3	2	2	2	2	1
CO3	3	-	-	-	2	2	2	2	2	2	2
CO4	2	-	-	-	3	3	2	2	2	2	2
CO5	2	-	-	-	3	3	2	2	2	2	2
CO6	2	-	-	-	3	3	2	2	2	2	2

Practice:

1. Introduction to various CAD commands with simple examples
2. To understand about Principals of building planning and building bye-laws.
3. To draw the foundation details for the buildings.
4. To draw the stretcher and header bond.
5. To draw the English and Flemish bond.
6. To draw the plan section and elevation of different types of staircases
7. To draw the plan section & elevation of buildings using software a) Single storeyed b) Multi storeyed residential buildings
8. To draw the developed plan, elevation, section and site plan of public buildings (Hospital & or School buildings).
9. Detailing of building components like doors and windows.
10. To draw the elevation of roof structures like king post and queen post truss.

Additional Practice:

1. To draw the plan, elevation, section and site plan of Industrial buildings
2. To draw the plan and elevation of different types staircases.
3. To draw the plan, elevation, and section of two storied building.

Text Books:

1. Building Planning and Drawing, Dr. N. Kumara Swamy, A. Kameswara Rao, Charotar Publishing House Pvt. Ltd. 2019, 9th edition. (ISBN: 13. 978-9385039386).
2. Building Planning and Drawing by S.S. Bhavikatti, Dreamtech Press India Pvt. Ltd, 1 Edition 2019. (ISBN: 13. 978-9389307085)

Reference Books:

1. Building, Planning and Drawing - Tech Knowledge Publications by Nishant A. Upadhye (ISBN: 978-93-89684-17-9)
2. Model Building Bye-laws 2016, Young Global Publications (ISBN-13:978-8188274475)
3. Planning, Designing and scheduling, Girescharan Singh & Jagadish Singh, Published by Standard Publishers Distributors. (ISBN: 13. 978-8180140051)

Web Links:

1. <http://www.bsiet.org/notes/BPD%20Theory.pdf>
2. <https://sites.google.com/a/mitr.iitm.ac.in/iitmcivil/ce2050>
3. <http://www.cadmatesoftware.com/>

Green Buildings
(Common to All, Except CE)

Course Code: 2501CE27

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO 1:** Define sustainability and a green building, along with its features and benefits.
- CO 2:** Describe the methods used to maintain indoor environmental quality.
- CO 3:** Describe the water efficiency methods
- CO 4:** Design sustainable and energy efficient civil engineering projects.
- CO 5:** Select materials for sustainable built environment & adopt waste management 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	PO 11
CO1	1	2	-	-	-	2	-	1	-	-	-
CO2	3	3	-	-	-	2	-	1	-	-	-
CO3	3	3	-	-	-	2	-	1	-	-	-
CO4	2	2	-	-	-	2	-	1	-	-	-
CO5	3	3	-	-	-	2	-	1	-	-	-

UNIT I

Green Building Concept: Overview of green building movement; Concept of Green building and sustainable development; Issues and strategies of Green building and sustainable development; Objectives Principals and Benefits of Green building design; Introduction to High-performance building; integrated design process of high-performance building; Green project requirements and strategies; Overview of various green rating systems worldwide.

UNIT-II:

Green Building Materials and Indoor Environment Quality: Introduction; Low emitting materials; Building and material reuse; Construction waste management; Regional materials; Life cycle cost assessment of building materials and products; Factors affecting indoor environment quality; Ventilation and filtration; Building materials and finishes- Emittance level; Indoor Environment quality best practice.

UNIT-III:

Water: Reduce, Reuse and Recycle: Introduction; Wastewater strategy and water reuse/recycling; Water fixtures and water use reduction strategies.

UNIT-IV:

Energy Efficiency: Environmental impact of building constructions, Concepts of embodied energy, operational energy and life cycle energy.

Methods to reduce operational energy: : Energy efficient building envelopes, Solar Heat Gain Coefficient, U-Values for facade materials, efficient lighting technologies, energy efficient and BEE rated appliances for heating and air-conditioning systems in buildings, zero ozone depleting potential (ODP) materials, wind and solar energy harvesting, energy metering and monitoring, concept of NET ZERO buildings.

UNIT-V:

Building materials: Methods to reduce embodied energy in building materials: (a) Local building materials. (b) Natural and renewable materials like bamboo, timber, rammed earth, stabilized mud blocks. (c) Materials with recycled content such as blended cements, pozzolana cements, fly ash bricks, vitrified tiles, materials from agro and industrial waste. (d) Reuse of waste and salvaged materials.

Waste Management: Handling of construction & demolition waste materials, separation of household waste, handling e-waste, on-site and off-site organic waste management.

Text Books:

1. Alternative Building Materials and Technologies, K.S. Jagadeesh, B.V. Venkata Rama Reddy, and K.S. Nanjunda Rao, New Age International Publishers. (ISBN: 9788122433110)
2. Green Building Fundamentals, Mike Montoya, Pearson in the USA. (ISBN: 9780135066403)

Reference Books:

1. Green Buildings, Peter Gevorkian, published by McGraw-Hill. (ISBN: 9780071473590)
2. Green Building Handbook, Volume 1, Tom Woolley, Sam Kimmins, Paul Harrison, and Rob Harrison, E & FN Spon (an imprint of Thomson Science & Professional). (ISBN: 9780419236900)

Web Links:

1. <https://www.igbc.in/>
2. <http://www.sbtmanual.in/>
3. <https://www.grihaindia.org/>

Fundamentals of Soil Behaviour
(Common to All, Except CE)

Course Code: 2501CE40	L	T	P	C
	2	1	0	3

Course Outcomes:

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

- CO1:** Identify the probable soil formation history
- CO2:** Evaluate the soil fabric by indirect and direct methods
- CO3:** Identify and solve soil water interaction problems
- CO4:** Evaluate the soil compressibility aspects and estimate probable settlements.
- CO5:** Asses the shear strength characteristics by conducting the most appropriate 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
CO1	3	3	2	2	2	1	1	1	1	1	2
CO2	3	3	2	2	2	1	1	1	1	1	2
CO3	3	3	3	2	2	2	2	1	2	2	2
CO4	3	3	2	3	2	2	2	1	2	1	2
CO5	3	3	2	2	3	2	2	1	2	1	2

UNIT – I

Soil Formation and Composition : Origin, nature and distribution of soil, description of individual particle, clay mineralogy, clay-water electrolytes, soil fabric and structure.

UNIT – II

Effective Stress and Soil Permeability: Effective stress principle, steady state flow in soil, effect of flow on effective stress, determination of coefficient of permeability.

UNIT – III

Soil Consolidation: Consolidation in one, two, three and radial direction, variation of effective stress during consolidation, consolidation tests and determination of consolidation parameters.

UNIT – IV

Shear Strength of Soils: Stress path analysis, tri-axial and direct shear tests, shear behaviour of granular soils and Fine-Grained Soils, factors affecting shear behaviour, determination of shear strength parameters, pore pressure parameters, UU, CU, CD tests, total and effective shear strength parameters, factors affecting shear strength- determination of in situ

undrained strength.

UNIT – V

Critical State Model: Introduction models and soil mechanics, use of models in engineering, elasticity, soil elasticity, plasticity and yielding, yielding of metal tubes in combined tension and torsion, elastic-plastic model for soil, elastic volumetric strains, a particular elastic-plastic model.

Text Books:

1. Soil Mechanics and Foundation Engineering ,Arora K.R., Standard publisher, 2020. (ISBN: 13- 978-8180141126).
2. Soil Mechanics and Foundations , Punmia, B.C., Laxmi Publications Pvt. Ltd. New Delhi. (ISBN: 13- 978-8170087915).

Reference Books:

1. Text book in Fundamentals of Soil Behaviour , Mitchell, J. K., , John Wiley & Sons, New York, 2Ed. (ISBN: 13- 978-0471856405).
2. Soil Behaviour and critical State Soil Mechanics , Muir Wood , Cambridge University Press. (ISBN: 13- 978-0521337823).

Web Links:

1. <https://nptel.ac.in/courses/105101084>
2. <https://archive.nptel.ac.in/courses/105/101/105101201/>

Railway Engineering
(Common to All, Except CE)

Course Code: 2501CE54

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain different components of railway track
- CO2:** Design track gradients as per given requirements
- CO3:** Discuss various types of tracks turnouts and crossings
- CO4:** Explain interlocking and signaling systems
- CO5:** Describe purposes and facilities at Railway Stations
- CO6:** Explain track maintenance

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	2	1	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	-	-	-	-	-
CO3	-	2	3	-	-	1	-	-	-	-	-
CO4	-	1	3	-	-	2	-	-	-	-	-
CO5	1	-	-	-	-	2	-	-	-	-	-
CO6	1	-	-	-	-	2	-	-	-	-	-

UNIT – I

Components of Railway Engineering: Permanent way components – Railway Track Gauge - Cross Section of Permanent Way - Functions of various Components like Rails, Sleepers and Ballast –Rail Fastenings – Creep of Rails- Theories related to Creep – Adzing of Sleepers- Sleeper density – Rail joints.

UNIT – II

Geometric Design of Railway Track: Alignment – Engineering Surveys - Gradients- Grade Compensation- Cant and Negative Super elevation- Cant Deficiency – Degree of Curve – safe speed on curves – Transition curve – Compound curves.

UNIT – III

Turnouts & Controllers: Track layouts – Switches – Design of Tongue Rails – Crossings – Turnouts – Layout of Turnout – Double Turnout – Diamond crossing – Scissors crossing – Inspection and maintenance of Points and Crossings.

UNIT – IV

Signalling and Interlocking: Objectives of Signalling - Classification of Signals – Fixed Signals - Stop Signals Signalling Systems – Mechanical Signalling System - Electrical Signalling System - Systems for Controlling Train Movement – Interlocking - Modern Signalling Installations.

UNIT – V

Railway Stations and Yards: Purpose of a Railway Station - Selection of Site for a Railway Station - Facilities Required at Railway Stations – Requirements of a Passenger Station Yard - Classification of Railway Stations - Station Platforms - Types of Yards.

Text Books:

1. Railway Engineering, Satish Chandra and M.M. Agrawal, Oxford University Press, New Delhi, 2020. (ISBN: 9780195687798).
2. Railway Engineering, Rangwala, Charotar Publishing House. (ISBN: 9788177643260).

Reference Books:

1. Roads, Railways, Bridges & Tunnel Engineering, T.D.Ahuja & G.S.Birdie. (ISBN: 9788189401337).

Web Links:

1. <https://nptel.ac.in/courses/105/107/105107123/>
2. <http://www.nptelvideos.in/2012/11/transportation-engineering-ii.html>
3. <https://lecturenotes.in/subject/458>

Docks & Harbour Engineering
(Common to All, Except CE)

Course Code: 2501CE47

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Introduce history and classifications of harbors.
- CO2:** Explain the fundamentals of Harbor planning.
- CO3:** Explain the natural forces affecting ports and general design aspects of marine structures.
- CO4:** Describe various navigational aids and dock & repair facilities.
- CO5:** Describe maintenance and protection of port facilities.

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	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	2	-	-	-	2	-
CO3	1	1	3	-	-	2	-	-	-	-	-
CO4	2	2	-	-	-	-	-	1	-	2	-
CO5	1	1	-	-	-	-	1	2	-	2	-

UNIT – I

Harbor Planning: Types of water transportation, water transportation in India, requirements of ports and harbors, classification of harbors, selection of site and planning of harbors, location of harbor, traffic estimation, master plan, ship characteristics, harbor design, turning basin, harbor entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations.

UNIT – II

Harbor Works: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, navigational aids, requirements of signals, fixed navigation structures, the necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar.

UNIT – III

Docks and Repair Facilities: Harbor docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of the lock, lock gates, types of gates.

UNIT – IV

Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities.

UNIT – V

Dredging, Coastal Protection and Inland navigation: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone, and beach profile. Inland waterways, Inland water transportation in India, classification of waterways, the economics of inland waterways transportation, national waterways

Text Books:

1. Dock and Tunnel Engineering, Srinivasan and S. C. Rangwala, Harbour, Charotar Pub House, Anan. (ISBN: 9788192869261).
2. Docks and Harbour Engineering, Bindra S.P. - Dhanpat Rai & Sons, New Delhi.(ISBN: 9788189928858).

Reference Books:

1. Transportation Engineering, Railways, Airports, Docks & Harbours, Srinivasa Kumar R, University Press, Hyderabad,2020. (ISBN: 9789389211160).
2. Port Design - Guidelines and recommendations, C. A. Thoresen, Tapir Publications,2018. (ISBN: 9788251908399).
3. Highway, Railway, Airport and Harbor Engineering, Subramanian K. P, Scitech Publications (India) Pvt Limited, Chennai. (ISBN:13- 9788195330591).

Web Links:

1. <https://nptel.ac.in/courses/114106025>
2. <https://lecturenotes.in/s/1892-dock-harbour-and-airport-engineering/videos>

Environmental Impact & Risk Management
(Common to All, Except CE)

Course Code: 2501CE36	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Apply basic principles of EIA
- CO2:** Illustrate the necessity to study the impacts
- CO3:** Interpret different risks that will be caused by projects or industries
- CO4:** Identify methods to overcome these impacts
- CO5:** Demonstrate the concepts of the legal requirements of Environmental and Risk Assessment for 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
CO1	3	-	1	-	-	2	-	-	-	1	1
CO2	2	2	2	1	-	2	-	-	-	-	-
CO3	2	2	1	1	-	3	-	-	-	-	-
CO4	2	2	2	1	-	2	-	-	-	-	-
CO5	2	-	3	-	-	3	-	-	-	-	-

UNIT – I

Introduction : Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

UNIT – II

Impact Identification and Prediction: Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

UNIT – III

Social Impact Assessment and Eia Documentation: Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials –

Report preparation.

UNIT – IV

Environmental Management Plan: Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

UNIT – V

Environmental Risk Assessment and Management: Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modelling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans – Design of risk management programs.

Text Books:

1. Environmental Impact Assessment , Canter, L.W., McGraw Hill, New York. (ISBN: 0070097674).
2. Environmental Impact Assessment – Practical solutions to recurrent problems, Lawrence, D.P., Wiley-Interscience, New Jersey. (ISBN: 978-0-471-72202-1).

Reference Books:

1. Environmental Risk and Hazards, Cutter, S.L., Prentice-Hall of India Pvt. Ltd., New Delhi, (ISBN: 0137538561)
2. Risk Assessment and Management Handbook, Kolluru Rao, Bartell Steven, Pitblado R and Stricoff , McGraw Hill Inc., New York. (ISBN: 13978-0070359871)
3. Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control Sam Mannan, Lees, 4th Edition, Butterworth Heineman. (ISBN: 978-0-7506-7555-0).

Web Links:

1. <https://nptel.ac.in/courses/120108004>
2. <https://www.witpress.com/journals>
3. <https://www.researchgate.net/publication/235859306>

Environmental Management
(Common to All, Except CE)

Course Code: 2501CE37	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Understand the physical and chemical treatment processes
- CO2:** Knowledge on various unit operations e.g, sedimentation tank, coagulation and filtration tank.
- CO3:** Knowledge on biological treatment significance
- CO4:** Know the aerobic treatment of wastewater
- CO5:** Understand the anaerobic treatment of wastewater

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	2	2	1	-	2	3	2	-	-	-	2
CO3	3	2	3	-	-	3	-	2	-	-	2
CO4	3	-	-	-	-	3	-	3	-	-	1
CO5	2	-	-	-	-	3	3	1	-	-	2

UNIT – I

Principles of Environmental Management: Definition of Environmental Management - Principles of Environmental Management - Nature, Scope and Components of Environmental Management - Policies and Legal Aspect of Environmental Management.

UNIT – II

Sustainable Environmental solutions: Public Private Participation Model - ISO Certification - Environment Health & Safety (EHS) - Environment & Disaster Management (EDM) - Environmental organizations for planning and implementation of sustainable development.

UNIT – III

Environmental Management Plan: Preventive and reactive strategies for environmental pollution control - Life Cycle Assessment as Environmental Management Tool - Environmental Management Plan (EMP) - Components of EMP - Preparation of EMP - Case Study

UNIT – IV

Environmental Impact Assessment: Environmental Impact Assessment (EIA) - Need and Importance - Steps involved - Methods of EIA - Ad-hoc, checklist, network, matrix etc - Typical case studies of environmental impact assessment - Environmental impact statement and risk assessment

UNIT – V

Environmental Legislations: Environmental Legislation - Air, Water and Environmental acts - Preventive and reactive strategies for environmental pollution control - Environmental Audit.

Text Books:

1. Assessment and analysis of Environmental management, Shukla S. S., Shrivastva P. R, commonwealth publishers New Delhi (ISBN: 8171692192).
2. An introduction to Environmental Management, Dr, Anand Bal, Himalaya Publishing House, (ISBN-13 978-8183183758).

Reference Books:

1. Environmental Impact Assessment, second edition, Larry W. Canter, McGraw-Hill International editions (ISBN-13 978-0070097643).
2. Environmental Management 2013, Vikas Khanna, D. R. & Chopra, A. K. & Matta, Gagan & Bhutiani, R. & Singh (ISBN-13 978-8170358220).

Web Links:

1. <https://enviromicro-journals.onlinelibrary.wiley.com/journal/14622920>.
2. <https://link.springer.com/book/10.1007/978-94-017-9118-2>

Urban Transportation Planning
(Common to All, Except CE)

	L	T	P	C
Course Code: 2501CE56	3	0	0	3

Course Outcomes:

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

- CO1:** Design, conduct and administer surveys to provide the data required for transportation planning.
- CO2:** Explain the process of data collection about travel behavior and analyze the data for use in transport planning
- CO3:** Develop and calibrate modal split, trip generation rates for specific types of land use developments
- CO4:** Apply the mode choice behaviour and mode split models.
- CO5:** Adopt the steps that are necessary to complete a long-term transportation plan.

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	2	1	3	-	-	2	1	-	-	-	-
CO2	2	2	1	1	-	2	1	-	-	-	-
CO3	2	-	3	-	-	2	1	-	-	-	-
CO4	2	-	-	-	-	2	2	-	-	-	-
CO5	2	-	-	-	-	3	1	-	-	-	-

UNIT – I

Introduction: Urbanization, urban class groups, transportation problems and identification, impacts of transportation, urban transport system planning process, modeling techniques in planning. Urban mass transportation systems: urban transit problems, travel demand, types of transit systems

UNIT – II

Data Collection:Types and Sources of Data Trip generation models - Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis - Trip distribution models – Growth factor models.

UNIT – III

Trip Generation: UTPS Approach, Trip Generation Analysis: Zonal Models, Category Analysis, Household Models, Trip Attraction models, Commercial Trip Rates; Trip Distribution by Growth Factor Methods. Problems on above.

UNIT – IV

Trip Distribution: Gravity Models, Opportunity Models, Time Function Iteration Models. Travel demand modeling: gravity model, opportunity models, Desire line diagram. Modal split analysis. Problems on above.

UNIT – V

Traffic Assignment: Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models - Lowry derivative models Diversion Curves; Basic Elements of Transport Networks, Coding, Route Properties, Path Building-Preparation of alternative plans - Evaluation technique.

Text Books:

1. Principles of Urban Transportation System Planning , Hutchinson B.G., McGraw Hill. (ISBN : 13. 978-0070315396).
2. Introduction to Transportation Planning , J. Hutchinson, London. (ISBN: 13: 9780090986200).

Reference Books:

1. Transportation Engineering , Kent Lall, Prentice Hall of India (ISBN-13: 978-9332569706).
2. Transportation Engineering and Planning, C.S. Papacostas and P.D. Prevedouros, Prentice Hall of India Pvt. Ltd (ISBN-13: 978-0130814197)
3. Highway Engineering, S.K. Khanna& C.E.G. Justo, Nemchand & Bros., 10th edition (ISBN-13: 978-8185240930)

Intelligent Transportation Systems

(Common to All, Except CE)

Course Code: 2501CE49
Course Outcomes:

L	T	P	C
3	0	0	3

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

- CO1:** Identify and differentiate ITS user services and their components.
- CO2:** Study the telecommunications in ITS.
- CO3:** Interpret ITS functional areas.
- CO4:** Implement suitable ITS and services for effective transportation.
- CO5:** Applications of Automated Highway 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
CO1	2	2	-	-	1	-	-	-	-	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-
CO3	2	2	1	1	1	-	-	-	-	-	-
CO4	2	2	1	1	1	-	-	-	-	-	-
CO5	2	2	1	1	1	-	-	-	-	-	-

UNIT – I

Introduction: Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT – II

Telecommunications in ITS: Importance of telecommunications in the ITS system, Information Management, Traffic Management Centers (TMC). Vehicle – Roadside communication – Vehicle Positioning System.

UNIT – III

ITS functional areas: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS).

UNIT – IV

ITS User Needs and Services: Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management.

UNIT – V

Automated Highway Systems: Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

Text Books:

1. Fundamentals of Intelligent Transportation Systems Planning, M.A. Chowdhury and A. Sadek, Artech House, First Edition. (ISBN: 9781580534702).
2. Intelligent Transport Systems, Sarkar, Pradip Kumar, and Amit Kumar Jain, PHI Learning, 2018, First Edition. (ISBN: 9788120353001).

Reference Books:

1. Economic Impacts of Intelligent Transportation Systems: Innovations and Case Studies, Bekiaris and Y.J. Nakanishi, Elsevier/JAI. (ISBN: 9780762310320).
2. Intelligent Transport Systems Standards, Bob Williams, Artech House Publishers. (ISBN: 9781607839324)
3. Intelligent Transport Systems: Cases and Policies, Roger Stough, Edward Elgar. (ISBN: 3. 978-1840644470).

Web Links:

1. https://www.civil.iitb.ac.in/tvm/nptel/591_ITS_1/web/web.html
2. https://www.civil.iitb.ac.in/tvm/nptel/592_ITS_2/web/web.html
3. <https://archive.nptel.ac.in/courses/105/101/105101008/>
4. <http://digital-library.theiet.org/content/journals/iet-its>

Minor Degree in Electrical and Electronics Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE55	Operation & Control of Electric machines	FC	2			2	50	50	100	BEEE
2501EE56	Fundamentals of Power Electronics	FC	2			2	50	50	100	BEEE
2501EE13	Electrical Measurements & Instrumentation	FC	2		2	4	50	50	100	ENA-1/BEEE
2501EE53	Electric Power Generation, Transmission & Distribution Systems	IC	3			3	50	50	100	ENA-1/BEEE
2501EE34	Alternative Energy Sources (or)	IC	3			3	50	50	100	EPGDS/ BEEE/ ISM
2501EE27	Utilization of Electrical Energy									
2501EE37	Hybrid Electric Vehicles (or)	AC	3			3	50	50	100	FPE/ OCEM
2501EE35	Special Electric machines									
2501EE43	Electrical Safety (or)	AC	3			3	50	50	100	EPGDS/ PSA
2501EE30	Methods & Algorithms for Intelligent Control									
TOTAL			18		2	20				

Operation & Control of Electric Machines
(Common to All, Except EEE)

Course Code: 2501EE55	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1** Explain the concepts of electromechanical energy conversion & operation of the DC machines.
- CO2** Analyze starting methods & speed control of DC machines.
- CO3** Analyze the performance of DC machines by conducting various tests on DC machines.
- CO4** Analyze the performance of synchronous generator.
- CO5** Analyze the Parallel operation of synchronous generators.

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	-	-	-	-	-	-	1	1	-
CO2	2	3	2	-	-	-	-	-	1	1	-
CO3	3	2	2	-	-	-	-	-	1	1	-
CO4	3	2	-	-	-	-	-	-	1	1	-
CO5	2	3	2	-	-	-	-	-	1	1	-

UNIT – I

Electromechanical Energy Conversion & introduction to DC machines: Principles of Energy Conversion, singly excited & multi excited systems, torque production in rotating machines & general analysis of the electromechanical system.

DC Generator: Construction - the principle of operation - EMF equation – Types – Armature reaction - Characteristics – Applications.

UNIT – II

DC Motors: Principle of operation - Types- Back EMF - Torque equation – Characteristics – Losses - Efficiency – Commutation – Applications - 3 point starter - 4 point starter – Speed control methods.

UNIT – III

Single-phase Transformers: Types - constructional details – principle of operation – EMF equation – operation on no load & on load – lagging, leading & unity power factors loads – phasor diagrams of transformers – equivalent circuit.

UNIT – IV

Synchronous generator: Operation – Construction - type – Types of Armature windings – Distribution– Pitch & winding factors – E.M.F equation - armature reaction – Voltage regulation by synchronous impedance method– MMF method & Potier triangle method - Two reaction theory, Slip test.

UNIT – V

Parallel Operation of Synchronous Generators: Parallel operation with infinite bus & other alternators – Power flow equations - Synchronizing power – Load sharing– Control of real & reactive power.

Text Books:

1. Electrical Machinery by P.S. Bhimbra, R.C. Khanna & Vineet Khanna, 1st edition, 2021 ISBN: 9788174091734.
2. Electrical Machines by R. K. Rajput, Lakshmi publications, 5th edition ISBN: 9788131807460.

Reference Books:

1. Electrical Machines by D. P. Kothari, I. J. Nagarth, McGraw Hill Publications, 5th edition (ISBN: 9780070699670).
2. Electrical Machinery by Abijith Chakrabarthy & Sudhipta Debnath, McGraw Hill, 1st edition (ISBN: 9781259006456).

Web Links:

1. <http://nptel.ac.in/courses/108106071>
2. http://www.ncert.nic.in/html/learning_basket/electricity/electricity/machine/machine_content.htm
3. <https://lecturenotes.in/subject/41/electrical-machine-1>

Fundamentals of Power Electronics
(Common to All, Except EEE)

Course Code: 2501EE56

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1** Explain the different types of power semiconductor devices & their Characteristics.
- CO2** Evaluate the performance of rectifiers.
- CO3** Design DC-DC & AC-AC converter with given characteristics.
- CO4** Explain the operation of Inverters.
- CO5** Explain the operation of three phase Inverters & application of PWM 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
CO1	3	2	1	-	-	-	-	-	1	1	-
CO2	2	3	2	-	-	-	-	-	1	1	-
CO3	3	2	2	-	-	-	-	-	1	1	-
CO4	2	3	2	-	-	-	-	-	1	1	-
CO5	3	2	2	-	-	-	-	-	1	1	-

UNIT – I

Introduction to Power Electronics devices: Concept of power electronics, applications, types of power converters, operation & characteristics of Power IGBT, SCR, TRIAC, static & dynamic characteristics of SCR, protection of SCR, turn on methods of SCR & commutation of SCR, Thyristor Firing Circuits.

UNIT – II

Phase Controlled Converters: Principles of single-phase fully-controlled converter with R, RL, & RLE load, effect of freewheeling diode, Principles of single-phase half-controlled converter with RL & RLE load.

UNIT – III

DC-DC Converters: Introduction, Basic principles of step-down & step-up operation, chopper classification study of Buck, Boost & Buck-Boost regulators.

AC-AC converters: AC Voltage Controllers: Introduction, principle of operation of single-phase voltage controllers for R-L, R-L-E loads.

UNIT – IV

Inverters: Introduction, principle of operation, single phase bridge inverters with R, RL & RLC loads,

UNIT – V

3-phase bridge inverters: 180- & 120-degrees mode of operation, Voltage control of single-phase inverters –single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation.

Text Books:

1. Power Electronics – by P. S. Bhimbra, Khanna Publishers ISBN:9788174092793.
2. Power Electronics: Circuits, Devices & Applications – by M.H Rashid, Prentice Hall of India, 3rd Edition, ISBN: 9788120345317.

Reference Books:

1. Power Electronics: Essentials & Applications by L. Umanand, Wiley, Pvt. Limited, India , ISBN: 9788126519453.
2. Power Electronics, M. D. Singh & K. B. Kanchandhani, Tata McGraw – Hill Publishing Company, 2nd Edition, ISBN: 9780074633694.

Web Links:

1. <https://nptel.ac.in/courses/108/101/108101038/>
2. <https://nptel.ac.in/courses/108/102/108102145/>
3. <https://nptel.ac.in/courses/108/102/108102145/>

Electrical Measurements & Instrumentation
(Common to All, Except EEE)

	L	T	P	C
Course Code: 2501EE13	2	0	2	4

Course Outcomes:

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

- CO1:** Explain different types of instruments for measuring AC & DC quantities.
- CO2:** Explain different types of instruments for measurement of power & power factor.
- CO3:** Identify suitable bridges for measurement of R, L, & C
- CO4:** Analyze the effectiveness of Transducers.
- CO5:** Illustrate the principle of different types of Digital Meters.

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	1	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-

UNIT – I

Analog Ammeter & Voltmeters: Classification – deflecting - control & damping torques – PMMC - Moving Iron type & Electrostatic Instruments - Construction - Torque equation - Range extension - Errors & compensations. Instrument transformers – Current & Potential transformers- Construction-Working.

UNIT – II

Analog Wattmeters & Power Factor Meters:Electrodynamometer type wattmeter (LPF & UPF) - Power factor meters: Dynamometer & M.I type (Single phase & Three phase) - Single phase induction type energy meters- Construction - theory - torque equation - advantages & disadvantages. Measurement of active & reactive power in single phase & in three phase with balanced loads.

Potentiometers: Introduction to DC & AC Potentiometers – Construction-working.

Practice:

1. Calibration & Testing of single phase energy Meter.
2. Calibration of dynamometer wattmeter using phantom loading.
3. Calibration of PMMC ammeter & voltmeter using Crompton D.C. Potentiometer.
4. Measurement of 3 phase reactive power with single phase wattmeter for balanced Loading.
5. Measurement of 3 phase power with single wattmeter & using two C.Ts.

6. Calibration of LPF wattmeter by direct loading.

UNIT – III

Measurements of Electrical parameters: DC Bridges: Wheat stone's bridge - Kelvin's double bridge for measuring low resistance - Loss of charge method for measurement of high resistance - Megger – measurement of earth resistance.

AC Bridges: Measurement of inductance & quality factor: - Maxwell's bridge - Hay's bridge - &erson's bridge. Measurement of capacitance & loss angle - Desauty's bridge - Schering Bridge.

Practice:

1. Measurement of resistance & Determination of Tolerance using Kelvin's double Bridge.
2. Capacitance Measurement using Schering Bridge.
3. Inductance Measurement using &erson Bridge.

UNIT – IV

Transducers:Definition - Classification - Resistive - Inductive & Capacitive Transducer - LVDT - Strain Gauge - Thermistors - Thermocouples - Piezo electric & Photo Diode Transducers - Hall effect sensors.

Practice:

1. Determination of the characteristics of a LVDT.

UNIT – V

Digital meters : Digital Voltmeters – Successive approximation DVM - Ramp type DVM & Integrating type DVM – Digital frequency meter - Digital multimeter - Digital tachometer - Digital Energy Meter. CRO- measurement of phase difference & Frequency using lissajious patterns.

Additional practice:

1. Measurement of resistance using Wheatstone bridge.
2. Dielectric oil testing using H.T test Kit.
3. Measurement of Choke coil parameters & single-phase power using three voltmeter & three ammeter method.

Text Books:

1. Electrical Measurements & measuring Instruments by E.W. Golding & F.C.Widdis - Wheeler Publishing ,5th Edition, ISBN: 9780273402022.
2. Modern Electronic Instrumentation & Measurement Techniques by A.D. Helfrick & W.D. Cooper - PHI ,5th Edition, ISBN: 9788120307520.

Reference Books:

1. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co.Publications, ISBN: 9786009578337.
2. Electrical & Electronic Measurements & instrumentation by R.K.Rajput, ISBN: 9788121929899.

Web Links:

1. Electrical Measurements by Buckingham & Price - Prentice – Hall
2. <https://archive.nptel.ac.in/courses/108/105/108105153/>
3. <https://electricalbaba.com/different-types-of-transducers/>

Electric Power Generation, Transmission & Distribution Systems
(Common to All, Except EEE)

Course Code: 2501EE53	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Identify the different components of various power plants.
- CO2:** Analyze the performance of short, medium and long transmission lines.
- CO3:** Identify various factors related to sag and corona.
- CO4:** Distinguish between AC/ DC distribution systems and also estimate voltage drops of distribution systems.
- CO5:** Analyze the different economic factors of power generation and tariffs.

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	1	-	-	-	2	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-
CO3	2	1	3	-	-	1	-	-	-	-	-
CO4	2	3	1	-	-	1	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-

UNIT – I

Power Stations: Principle of power generation, site selection and layout of Thermal, Nuclear, Hydro power plant, Components of Thermal and Nuclear power plant.

UNIT – II

Performance of Transmission Lines: Classification of Transmission Lines –Short, medium, long and their model representations –End condenser method, Nominal-T–Nominal-Pie, and A, B, C, D Constants, Surge Impedance and SIL of Long Lines.

UNIT – III

Corona and Sag: Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss –Radio Interference. Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor.

UNIT – IV

Distribution Systems: Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations: DC distributors for following cases - radial DC distributor fed at one end and at both ends

(equal / unequal voltages), ring main distributor, stepped distributor and AC distribution, comparison of DC and AC distribution.

UNIT – V

Economic Aspects of Power Generation and Tariff Methods: Types of load, Load curve, load duration and integrated load duration curves, Important terms and factors in Load Curve. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs, Characteristics and types of Tariff..

Text Books:

1. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar and, A. Chakrabarti, Dhanpat Rai AND Co. Pvt. Ltd ISBN:9788177000207.
2. Generation, Distribution and Utilization of Electric Energy by C. L. Wadhawa, Newage International (P) Limited, Publishers ISBN: 9789393159175.

Reference Books:

1. Principles of Power System by V. K. Mehta & Rohit Mehta, S Chand & Company Limited, Publishers (ISBN: 9788121924962).
2. Electrical Power Distribution Systems by V. Kamaraju, Tata McGraw Hill, New Delhi (ISBN: 9780070151413).

Web Links:

1. <https://www.slideshare.net/ntpc-project-korbasuper-themal-power-plant>
2. <https://www.euronuclear.org/1-information/energy-uses.htm>
3. <https://www.slideshare.net/9anku/electrical-distribution-system>

Alternative Energy Sources
(Common to All, Except EEE)

Course Code: 2501EE34	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Describe the environmental aspects of Renewable Energy Resources.
- CO2:** Describe the use of Solar Energy & the various components used in the energy production.
- CO3:** Understand the conversion principles of Wind & Biomass Energy Resources.
- CO4:** Acquire the basic knowledge of Ocean Thermal Energy
- CO5:** Acquire the basic knowledge of energy conversion & Hydrogen Energy.

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

UNIT – I

Introduction: Principles of renewable energy; energy & sustainable development, worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale

UNIT – II

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal & inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Solar Thermal systems: Flat plate collector; Solar distillation; Solar Pond electric power plant. Photovoltaic system for electric power generation.

UNIT – III

Wind Energy: Wind velocity & power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double & multiblade system. Vertical axis- Savonius & darrieus types.

Biomass Energy: Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion.

UNIT – IV

Tidal Power: Tides energy suppliers & their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages & limitations.

Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems as

UNIT – V

Green Energy: Introduction, Fuel cells: Classification of fuel cells – H₂; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy (contemporary cases).

Text Books:

1. Non-Conventional energy resources, Khan B.H, Tata Mc-Graw hill, New Delhi, 3rd Edition, ISBN: 9789352601882.
2. Non-conventional Energy Sources, G.D.Rai, Khanna Publications, New Delhi, 4th Edition, ISBN: 9788174090737.

Reference Books:

1. Renewable energy resources, Twidell, J.W. & Weir, A., BSP Books Pvt.Ltd, UK, 2nd Edition, ISBN: 9780415584388.
2. Renewable Energy Technologies, R.Ramesh, Uday kumar, Narosa Publishing House, New Delhi, 1st Edition, ISBN:9788173190674.

Utilization of Electrical Energy

(Common to All, Except EEE)

Course Code: 2501EE27	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Identify various illumination methods produced by different illuminating sources.
- CO2:** Identify a suitable motor for electric drives & industrial applications
- CO3:** Identify most appropriate heating & welding techniques for suitable applications.
- CO4:** Distinguish various traction systems & determine the tractive effort & specific energy consumption.
- CO5:** Explain the necessity & usage of different energy storage schemes for different applications & comparisons.

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	1	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-

UNIT – I

Illumination fundamentals & Methods: Illumination fundamentals Introduction - terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter Sources of light. Various Illumination Methods Discharge lamps - MV & SV lamps – Comparison between tungsten filament lamps & fluorescent tubes Basic principles of light control– Types & design of lighting & flood lighting–LED lighting - Energy conservation.

UNIT – II

Selection of Motors: Choice of Motor - Type of Electric Drives - Starting & Running Characteristics – Speed Control–Temperature Rise – Applications of Electric Drives– Types of Industrial Loads–Continuous Intermittent & Variable Loads–Load Equalization - Introduction To Energy Efficient Motors.

UNIT – III

Electric Heating & Welding: Advantages & methods of electric heating–Resistance heating induction heating & di electric heating. Electric Welding. Electric welding– Resistance & arc welding–Electric welding equipment–Comparison between AC & DC Welding.

UNIT – IV

Electric Traction: Traction & electrification– Special features of traction motor– Mechanics of train movement, Speed-time curves, tractive effort, Specific energy consumption, acceleration & retardation–Adhesive weight, coefficient of adhesion.

UNIT – V

Introduction to Energy Storage Systems: Need For Energy Storage - Types of Energy Storage-Thermal - Electrical - Magnetic & Chemical Storage Systems - Comparison of Energy Storage Technologies Applications.

Text Books:

1. Utilization of Electric Power – by Er.R.K Rajput – Lakshmi publications Third Edition , 2023, ISBN: 9788131808290.
2. Utilisation of Electric Power : Including Electric Drives & Electric Traction – by Suryanarayana N.V, New Age International (P) Limited - Publishers – Third edition 2024,ISBN: 9788122405460.

Reference Books:

1. Utilization Of Electric Energy: Including Electric Drives & Electric Traction -by Tarlok singh, ISBN: 9789380027845.
2. Utilization of Electric power & Electric Traction -by J.B.Gupta S.K.Kataria & Sons ISBN: 9789350142585.

Web Links:

- 1 <https://nptel.ac.in/courses/108105060>
- 2 https://onlinecourses.nptel.ac.in/noc23_ag06/preview

Hybrid Electric Vehicles
(Common to All, Except EEE)

Course Code: 2501EE37

L T P C
3 0 0 3

Course Outcomes:

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

- CO 1:** Analyze the architectures of HEVs with various components.
- CO 2:** Illustrate the concept of Electric Vehicle & Hybrid Electric Vehicles.
- CO 3:** Explain the Plan concept of Plug-in Electrical Vehicles.
- CO 4:** Analyze the power electronics converters for HEVs.
- CO 5:** Apply various energy storage technologies in Hybrid Vehicles.

Mapping of course outcomes with program outcomes:

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

UNIT-I

Introduction: History of hybrid vehicles, architectures of HEVs, series & parallel HEVs, complex HEVs.

UNIT-II

Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle & propulsion load; Drive cycles & drive terrain; Concept of electric vehicle & hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV & PHEV; Fuel Cell vehicles & its constituents.

UNIT-III

Plug-in Hybrid Electric Vehicle: PHEVs & EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, PHEV battery charging.

UNIT-IV

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, isolated bidirectional DC-DC converter, PWM rectifier in HEVs, EV & PHEV battery chargers.

UNIT-V

Battery & Storage Systems: Energy Storage Parameters; Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource.

Text Books:

1. Advanced Electric Drive Vehicles by Ali Emadi, CRC Press , ISBN: 9781138072855.
2. Electric & Hybrid Vehicles: Design Fundamentals by Iqbal Hussein, CRC Press, ISBN: 9780367693930.

Reference Books:

1. Introduction to Hybrid Vehicle System Modeling & Control by Wei Liu, Wiley ,ISBN: 9788126556205.
2. Electric & Hybrid Vehicles Technologies, Modelling & Control: A Mechatronic Approach by Amir Khajepour, Saber Fallah& Avesta Goodarzi, John Wiley & Sons Ltd , ISBN: 9781118341513.

Web Links:

1. <https://archive.nptel.ac.in/courses/108/103/108103009/>
2. https://ndl.iitkgp.ac.in/he_document/nptel/nptel/

Special Electrical Machines
(Common to All, Except EEE)

Course Code: 2501EE35

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the operation & control of Stepper Motor.
- CO2:** Describe theory of operation & control of Switched Reluctance Motor.
- CO3:** Explain the operation & control of Synchronous Reluctance Motor.
- CO4:** Describe theory of operation & control of Permanent Magnet Brushless D.C. Motors.
- CO5:** Explicate the theory of PMSM & LIM & its 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
CO1	3	2	1	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-

UNIT – I

Stepper Motors: Constructional features – Types of Stepper Motors - permanent magnet (PM) type - Hybrid type Stepper Motor - Variable Reluctance Motor (VRM) - Single stack & multiple stack VRM – Characteristics, Modes of Operation & Applications of Stepper Motor.

UNIT – II

Switched Reluctance Motors: Constructional features, Principle of operation, Torque production, Power Converters & their controllers, Methods of Rotor position sensing, Sensor less operation, Closed loop control of SRM, Characteristics.

UNIT – III

Synchronous Reluctance Motor: Construction, Working, Torque Equation, control, Advantages & Applications Synchronous Reluctance Motor

UNIT – IV

Brushless D.C. Motors: Principle of Operation, Types, EMF & torque equations, Commutation, Motor characteristics & control, Torque/speed characteristics.

UNIT – V

Permanent Magnet Synchronous Motors: Construction, Principle of Operation, EMF Equation of PMSM, Torque Equation, Comparison of Conventional & PM Synchronous Motors, Application of PMSM

Linear Induction Motors: Linear Induction Motors (LIM)- Construction– principle of operation— Development of one-sided LIM with back iron equivalent circuit of LIM- Applications

Text Books:

1. Brushless Permanent magnet & reluctance motor drives, by T.J.E.Miller, Clarendon press, Oxford , ISBN:9780198593690.
2. Special electrical Machines, by K. VenkataRatnam, University press, New Delhi, ISBN: 9781439806463.

Reference Books:

1. Special electrical machines, E.G. Janardhanan, PHI learning private limited, ISBN: 9788120348806.
2. Permanent Magnet & BLDC Motor Drives, by Krishnan R, CRC Press ISBN:9780824753849.

Web Links:

1. <https://nptel.ac.in/courses/108102156>
2. <https://www.monolithicpower.com/stepper-motors-basics-types-uses>
3. <https://epochautomation.com/synchronous-reluctance-motor-working/>

Electrical Safety
(Common to All, Except EEE)

Course Code: 2501EE43

L T P C
3 0 0 3

Course Outcomes:

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

- CO 1:** Describe electrical hazards & safety equipment.
- CO 2:** Analyze & apply various grounding & bonding techniques
- CO 3:** Select appropriate safety method for low, medium equipment's & high voltage equipment.
- CO 4:** Participate in a safety team & Carry out proper maintenance of electrical equipment by understanding various standards.
- CO 5:** Analyze the safety method for high voltage equipment's.

Mapping of course outcomes with program outcomes:

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

UNIT-I

Hazards of Electricity & Electrical Safety Equipment: Primary & secondary hazards- arc, blast, shocks causes & effects-safety equipment flash & thermal protection, head & eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers & signs, safety tags, locking devices- voltage measuring instruments- proximity & contact testers-safety electrical one line diagram- electrician's safety kit.

UNIT-II

Grounding of Electrical Systems & Equipment: General requirements for grounding & bonding- definitions grounding of electrical equipment-bonding of electrically conducting materials & other equipment connection of grounding & bonding equipment- system grounding- purpose of system grounding-grounding electrode system- grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage & high voltage systems.

UNIT-III

Safety Procedures & Methods: The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation & approach distances-calculating the required level of arc protection-safety equipment,

procedure for low, medium & high voltage systems- the one-minute safety audit

UNIT-IV

Safety Management & Organizing Structure: Electrical safety program structure, development- company safety team- safety policy program implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation.

UNIT-V

Electrical Maintenance & Legal Safety Requirements & Standards: Safety related case for electrical maintenance- reliability centred maintenance (RCM) - eight step maintenance program- frequency of maintenance- maintenance requirement for specific equipment & location- regulatory bodies- national electrical safety code standard for electrical safety in work place- occupational safety & health administration standards, Indian Electricity Acts related to Electrical Safety

Text Books:

1. Electrical Safety Handbook by John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, McGraw-Hill Education, 4th Edition , ISBN: 9780071745130.
2. Electric Safety Practice & Standards, Khaled Ismail, CRC Press, Taylor & Francis, ISBN: 9781138073999.

Reference Books

1. Electrical Safety- a guide to the causes & prevention of electric hazards, Maxwell Adams.,J, The Institution of Electric Engineers, IET, ISBN: 9780852968062.
2. 'Electrical Safety in the Workplace', Ray A. Jones, Jane G. Jones, Jones & Bartlett Learning, ISBN: 9780877655800.

Web Links:

1. <http://nptel.ac.in/courses/103106071/5>
2. <https://www.electricalsafetyfirst.org.uk>

Methods & Algorithms for Intelligent Control
(Common to All, Except EEE)

	L	T	P	C
Course Code: 2501EE30	3	0	0	3

Course Outcomes:

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

- CO1:** Design feedback controllers for complex dynamic systems using ANN.
- CO2:** Design fuzzy logic-based controller for dynamic systems.
- CO3:** Construct TS fuzzy models for complex dynamic systems.
- CO4:** Formulate hybrid controllers by combining the concepts of Genetic Algorithm and BioInspired algorithms with ANN.
- CO5:** Formulate hybrid controllers by combining the concepts of Genetic Algorithm and BioInspired algorithms with Fuzzy logic.

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	2	2	3	1	2	-	-	-	-	-	-
CO2	2	2	3	1	2	-	-	-	-	-	-
CO3	2	2	3	1	2	-	-	-	-	-	-
CO4	2	2	3	1	2	-	-	-	-	-	-
CO5	2	2	3	1	2	-	-	-	-	-	-

UNIT – I

Introduction: Introduction to intelligent control, comparison study between conventional and intelligent control, intelligent supervisory control, intelligent adaptive control.

UNIT – II

Neural network based control: Introduction to Neural Network, theory of neural network for classification and function approximation, supervised and unsupervised learning rules, RBF neural network, Support vector machines, intelligent control using Neural Network, Approximation capabilities by feed-forward and recurrent neural network, Neuro-control based on back propagation algorithm, system identification with neural network.

UNIT – III

Fuzzy logic control: Introduction to fuzzy set theory and logic, application of fuzzy logic in control system, fuzzy quantization of knowledge, fuzzy controller design, Fuzzy T-S modelling for dynamic system and stability using Lyapunov theory.

UNIT – IV

Genetic algorithm and control: Basic theory and operations of Genetic algorithm, GA

based control system, optimization problem using GA related to control and other engineering problems.

UNIT – V

Bio-inspired evolutionary algorithms: Bio-inspired evolutionary algorithms – like Particle swarm optimization (PSO), simulated annealing, Fire-fly optimization, bacterial foraging etc – only the concepts and case studies related control problems.

Text Books:

1. Neural Networks, Simon Haykin. Pearson Education Asia, ISBN: 9780023527616.
2. Genetic Algorithm in Search Optimization & Machine Learning, David E. Goldberg, Pearson Education, ISBN: 9780201157673.

Reference Books:

1. Fuzzy logic (intelligence control and information), J. Yen and R. Langari, Pearson, first Edition, ISBN: 9780135258170.
2. Methods and Applications of Intelligent Control, Spyros G. Tzafestas, Kluware academic publisher (ISBN: 9780792346241).

Web Links:

1. <https://archive.nptel.ac.in/courses/108/104/108104049/>
2. <https://archive.nptel.ac.in/courses/106/106/106106126/>

Minor Degree in Mechanical Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME74	Basic Mechanical Engineering	FC	2			2	50	50	100	-
2501ME04	Engineering Thermodynamics	IC	2	1		3	50	50	100	SSP/ MP
2501ME77	Introduction to Automobile Engineering (or)	IC	3			3	50	50	100	SSP/ MP
2501ME78	Mechanics of Solids									
2501ME12	Heat Power Engineering (or)	IC	2	1		3	50	50	100	ETD
2501ME40	Refrigeration & Air Conditioning									
2501ME75	Production Technology	IC	3			3	50	50	100	EWS
2501ME76	Metallurgy & Material Science	IC	3			3	50	50	100	SSP/ MP
2501ME79	Theory of Machines (or)	AC	3			3	50	50	100	SSP/ MP
2501ME80	Advanced Engineering Metrology									
TOTAL			18	2		20				

Basic Mechanical Engineering
(Common to All, Except ME)

Course Code: 2501ME74

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Explain the basic concepts of thermodynamics and fluid mechanics
- CO2:** Explain the engineering design principles and process
- CO3:** Draw the velocity and acceleration diagrams analyzing machines and mechanisms
- CO4:** Explain the different manufacturing techniques
- CO5:** Explain the fundamentals of vibrations in mechanical 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
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Thermodynamics: Basic concepts and definitions (system, surroundings, state, process, cycle) Zeroth, First, and Second Laws of Thermodynamics, Properties of pure substances, Energy analysis of closed systems and Control volumes, Applications

Fluid Mechanics: Properties of fluids, Pressure variation in a static fluid, Manometry, Bernoulli's equation, Continuity equation, Venturi meter, Orifice meter, Pitot tube, Laminar and Turbulent flow, Reynolds number

UNIT – II

Engineering Design: Definition and importance of engineering design, The role of design in engineering, Historical perspectives and case studies, Steps of the engineering design process, Principles of design thinking, Introduction to computer-aided design (CAD)

UNIT – III

Machines & Mechanisms: Machines: Definition and significance of machines and mechanisms, History and evolution of mechanical systems, Applications

Mechanisms: Types of mechanisms (linkages, cams, gears), Kinematic analysis of mechanisms, Velocity and acceleration diagrams, Gears and gear trains and applications.

UNIT – IV

Manufacturing Processes: Introduction to manufacturing techniques, Casting, Forging, Forming, Machining, Welding, Joining, Powder metallurgy, Plastic and Composite manufacturing, Introduction to Computer Numerical Control (CNC) machines, Additive manufacturing. Introduction to Robotics - Joints & Links, Configurations and Applications of Robotics

UNIT – V

Vibrations: Fundamentals of Vibration: Introduction to Free vibration of single-degree-of-freedom systems, Damped vibration, Forced vibration, Vibration isolation and transmissibility.

Vibration Measurement: Vibration measuring instruments, Basic concepts of vibration control.

Text Books:

1. Basic Mechanical Engineering, P.K. Nag, Tata McGraw Hill Education, 3rd Edition, ISBN : 9780070708389.
2. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven Schmid, Pearson Education; 7th Edition, ISBN-13. 978-9332587908.

Reference Books:

1. Theory of Machines, S.S. Ratan, McGraw Hill Education India Private Limited, 4th Edition, ISBN-13. 978-9353166281.
2. Engineering Design - A Project-Based Introduction, CL Dym, John Wiley & Sons Inc, 4th Edition, ISBN-13, 978-1118324585.

Web Links:

1. <https://nptel.ac.in/courses/112105123>
2. <https://archive.nptel.ac.in/courses/112/107/112107145/>

Engineering Thermodynamics
(Common to All, Except ME)

Course Code: 2501ME04

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Apply thermodynamic concepts to analysis of energy system.
- CO2:** Apply the first law of thermodynamics for closed and open systems.
- CO3:** Apply the second law of thermodynamics and principle of entropy for the engineering system.
- CO4:** Analyse the properties of pure substances.
- CO5:** Explain the working of various refrigeration system and psychrometric 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
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility, Forms of energy, pressure, work and heat transfer, temperature and the Zeroth Law of thermodynamics

UNIT – II

First Law of Thermodynamics: Energy analysis of closed and open system, energy analysis of steady flow devices – Nozzle, Diffusers, Turbine, Compressor, and Throttle. Limitation of first law of thermodynamic.

UNIT – III

Second Law of Thermodynamics: Heat engine and reversed heat engine, Statements of second law (Kelvin-Planck and Clausius Statement) and their equivalence, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic Temperature Scale, Thermodynamic scale of Temperature, Entropy, Clausius Inequality, The increase in entropy principles – Energy Equation, Reversibility and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT – IV

Properties of Pure Substances: Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy transfer.

UNIT – V

Introduction to Refrigeration: Properties of the refrigerants Working of Air Refrigeration System, Vapour Compression Refrigeration System, Coefficient of performance (COP), Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

Text Books:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill Publishers, 6th Edition, ISBN: 9789352606429.
2. Thermodynamics: An Engineering Approach, Cengel, Y.A and Boles, M.A, McGraw Hill, 5th Edition, ISBN: 0073107689.

Reference Books:

1. Treatises on Heat Engineering, V.P.Vasandhani & D.S Kumar, Metropolitan Book Depot, 4th Edition, ISBN: 9788120003507.
2. Engineering Thermodynamics, Mayhew and Rogers, Longman Green & Co Ltd., 4th Edition, ISBN: 0582045665.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/106/112106310/>
2. <https://archive.nptel.ac.in/courses/112/104/112104113/>
3. <https://ocw.mit.edu/courses/3-00-thermodynamics-of-materials-fall-2002/download/>

Introduction to Automobile Engineering
(Common to All, Except ME)

Course Code: 2501ME77

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Summarize the Vehicle Chassis Layouts of 4-wheelers
- CO2:** Identify the different constructional features and working principles of Un-Sprung components of the given vehicle
- CO3:** Identify the different constructional features and working principles Sprung components of the given vehicle.
- CO4:** Summarize the functionalities of various Electrical systems of typical Automobile
- CO5:** Explain the different Active and Passive Vehicle Safety 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
CO1	2	-	-	-	-	-	1	2	1	-	1
CO2	3	-	-	3	-	-	1	2	1	1	1
CO3	2	-	-	-	-	-	1	2	1	-	1
CO4	3	1	1	-	-	-	1	2	1	-	1
CO5	3	1	1	-	-	3	1	2	1	-	1

UNIT – I

Introduction: History of Automobile and introduction to Automobile Industry, Chassis Layouts : Components of four wheeler automobile - power transmission modes, Types and Homologation of Vehicles.

UNIT – II

Transmission: Clutches, Gear Box, Rear Axles and its Types, Differential and its applications. **Steering System:** Steering geometry – Types of steering mechanism steering linkages of Independent and Conventional Suspension.

UNIT – III

Suspension System: Objectives of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system, Air Suspension, Rubber Suspension.

Braking System: Mechanical braking system, hydraulic braking system requirement of brake fluid.

UNIT – IV

Wheels and Tyres: Basic Requirements of Wheels and Tyres, Construction of Wheel

Assembly, Tyre Construction, Types, Tyre Sizes and Designation, Aspect Ratio, Tyre Tread Pattern, Selection of Tyre under Different Applications.

UNIT – V

Electrical System: Charging circuit, generator, starting system, lighting, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator.

Safety Systems: Introduction, safety systems - seat belt, air bags, anti-lock brake system (ABS), Electronic Brake force Distribution (EBD), Head restraints, seats with anti-submarine effects and fuel cut off switch.

Text Books:

1. Automobile Engineering, Kirpal Singh, Vol- I, Standard Publisher, New Delhi, 2020, ISBN: 9788180142420.
2. Motor Vehicles, Newton Steeds and Garret, Butterworth, 13th Edition, ISBN: 0750637633.

Reference Books:

1. Modern Vehicle Technology, Heinz Hazler, Butterworth, London, 2nd Edition, ISBN: 0750651318.
2. Automotive Chassis, Heldt P.M., Chilton Co., New York, 2012, ISBN: 1258386380.

Web Links:

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>
2. <https://www.udemy.com/course/automotive-engineering-automobile-fundamentals-and-advanced/?couponCode=LEADERSALE24A>

Mechanics of Solids
(Common to All, Except ME)

Course Code: 2501ME78

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Calculate stress and strain in bodies of varying cross-section and composite bars, principal stresses and strain energy.
- CO2:** Determine the shear force and bending moment diagrams for beams of various loads.
- CO3:** Analyse the variation of bending and shear stresses across a beam.
- CO4:** Compute the slope and deflection for beams of varying loads and support arrangements and torsional rigidity of a solid and hollow shaft.
- CO5:** Analyze the stresses and stability characteristics of thin, thick cylinders and columns.

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	3	2	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-

UNIT – I

Simple Stresses & Strains: Elasticity and plasticity – Types of stresses & strains– Hooke’s law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr’s circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II

Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III

Flexural Stresses: Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections.

Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

UNIT – IV

Deflection of Beams: Bending into a circular arc – slope, deflection and radius of curvature - Differential equation for the elastic line of a beam – Double integration and Macaulay’s methods - Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL. Mohr’s theorem and Moment area method - application to simple cases.

Torsion: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

UNIT – V

Thin and Thick Cylinders: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in diameter, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lamé’s equation – cylinders subjected to inside & outside pressures – compound cylinders.

Columns: Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler’s Formula, Rankine’s Formula

Text Books:

1. Strength of materials, GH Ryder, Palgrave Macmillan publishers India Ltd, ISBN-13978-0333109281.
2. Strength of materials, B.C. Punmia, Lakshmi publications Pvt. Ltd, 10th Edition, New Delhi, ISBN - 978-8131809259.

Reference Books:

1. Mechanics of materials, Gere & Timoshenko, CBS publications, 2nd Edition ,ISBN: 978-8123908946.
2. Strength of Materials, Andrew Pytel and Ferdinand L. Singer, Longman Publications, 4th Edition, ISBN:9780060453138.
3. Mechanics of Solids, Popov, New Pearson Education, 2nd Edition, ISBN:978-9332550216.

Weblinks:

1. <https://www.classcentral.com/course/swayam-strength-of-materials-iitm-184204>
2. <https://www.coursera.org/learn/mechanics-1>

Heat Power Engineering
(Common to All, Except ME)

Course Code: 2501ME12

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Apply the various techniques to improve the performance of Rankine Cycle
- CO2:** Explain the working principle and performance of boiler and draught system
- CO3:** Analyse the performance of Steam nozzles
- CO4:** Analyse the performance of Impulse and Reaction Turbines
- CO5:** Analyse the performance of Steam Condensers and Gas Turbines.

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

UNIT – I

Steam Power Cycles: Steam Power plant - Layout, Rankine cycle - Schematic layout, Thermodynamic analysis - Simple Cycle. Methods to improve cycle performance - Regeneration & Reheating cycle.

UNIT – II

Boiler: Classification, Working principles of low-pressure (LP) & high-pressure (HP) boilers with sketches, Boiler mountings and accessories. Performance of boiler - Equivalent evaporation - Efficiency.

Draught System: Classification – Natural and Artificial draught – Induced, Forced & Balanced draught - height of chimney for given draught and discharge - condition for maximum discharge and chimney efficiency

UNIT – III

Steam Nozzles: Function of a nozzle – applications – types, Flow through nozzles and thermodynamic analysis, assumptions, Velocity coefficient and condition for maximum discharge, Critical pressure ratio, Supersaturated flow and its effects, Degree of super saturation and Degree of undercooling, Wilson line.

UNIT – IV

Steam Turbines: Impulse turbine: Mechanical details - Velocity diagram - Effect of

friction power developed, Axial thrust, Blade or diagram efficiency - condition for maximum efficiency.

Reaction Turbine: Mechanical details, principle of operation, Thermodynamic analysis of a stage, Degree of reaction velocity diagram, Parson's reaction turbine, Condition for maximum efficiency, Calculation of blade height. Compounding – Velocity, Pressure and Velocity Pressure compounding

UNIT – V

Steam Condensers: Classification - working principle, vacuum efficiency and condenser efficiency, air leakage, sources and their effects, air pump, cooling water requirement.

Gas Turbines: Simple gas turbine plant - Ideal cycle - Essential components - Actual cycle. Regeneration, Inter cooling and Reheating cycle, Merits and demerits.

Text Books:

1. Heat Engineering, V.P Vasandani and D.S Kumar, Metropolitan Book Company, 4th Edition, ISBN: 978-8120003507.
2. Thermodynamics and Heat Engines, R. Yadav, Central publishing house, 6th Edition, ISBN:9788185444403.

Reference Books:

1. Thermodynamics: An Engineering Approach, Cengel, Y. A. and Boles, M. A., Tata McGraw-Hill, 7th Edition, ISBN:978-0-07-352932-5.
2. Thermal Engineering, P.L.Ballaney, Khanna publishers, 25th Edition, ISBN:978-81-7409-031-7

Web Links:

1. <https://nptel.ac.in/courses/112/106/112106303/>
2. <https://nptel.ac.in/courses/112103262>.

Refrigeration & Air Conditioning

(Common to All, Except ME)

Course Code: 2501ME40

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain the principle and applications of air refrigeration system.
- CO2:** Describe vapour compression refrigeration system.
- CO3:** Explain different types of vapour absorption refrigeration system.
- CO4:** Describe air-conditioning processes using the principles of Psychrometry.
- CO5:** Calculate loads in air-conditioning system and explain different heat pump circuits.

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	-	-	-	1	-	-	-	-	1
CO2	3	2	-	-	-	1	-	-	-	-	-
CO3	3	2	-	-	-	1	-	-	-	-	-
CO4	2	3	-	-	-	1	-	-	-	-	1
CO5	3	2	-	-	-	1	-	-	-	-	-

UNIT – I

Introduction to Refrigeration: Necessity, application, unit and C.O.P of refrigeration, Reversed Carnot cycle, Bell Coleman cycle with its numerical problem, Air Refrigeration System (ARS), Open & Dense air system, Refrigeration system used in air crafts and its problem. Classification of Refrigerants & its Properties, Nomenclature, Ozone layer Depletion, Global Warming.

UNIT – II

Vapour Compression Refrigeration System (VCRS): Simple Vapour Compression Refrigeration Cycle, Comparison between ARS & VCRS, Representation of cycle on T-S and P-H charts, Effect of sub cooling & super heating, Actual cycle influence of various parameters on system performance, Brief description about Actual VCRS.

UNIT – III

Vapour Absorption Refrigeration System (VARS): Working principal of VARS, Comparison between VCRS & VARS, Description & working of principle of Ammonia-Water VARS, Lithium-Bromide water VARS, Principle & operation of three fluid absorption system. Salient features, working principle and basic components of Steam Jet Refrigeration System, Principle & operation of thermoelectric refrigeration system - Vortex tube.

UNIT – IV

Introduction to Air Conditioning: Psychometric properties & processes, Ventilation, Infiltration, Comfort conditions, Factors Affecting Human Comfort, Factors Affecting Optimum Effective Temperature, Requirements of human comfort and concept of effective temperature, comfort chart. Air Conditioning Systems: Working principle of comfort, industrial, winter, summer, year-round, unitary and central air conditioning system.

UNIT – V

Air-conditioning load calculations: Load concepts of Room Sensible Heat Factor, Grand Sensible Heat Factor and Effective Room Sensible Heat Factor. Classification of equipment used in an air conditioning system, Humidifier, filters, grills, registers, fans, and blowers. Air Handling Units, Heat pump – heat sources, Different types of heat pump circuits.

Text Books:

1. Refrigeration and Air-conditioning, Arora C.P., Tata Mc Graw –Hill, 4th edition, 2021, ISBN : 9789390385843.
2. Refrigeration and Air Conditioning, Khurmi R. S., S Chand, Revised edition, 2019, ISBN : 9788121927819.

Reference Books:

1. Refrigeration and Air Conditioning, Manohar Prasad, New Age International, Pvt Ltd, 3rd edition 2021, ISBN:978-8122436945.
2. A Course in Refrigeration and Air conditioning, S. C. Arora & S. Domkundwar, Dhanpatrai, ISBN: 9788120339156.

Data Book:

1. Refrigerant and Psychrometric Properties - Tables and Charts [SI Units], Mathur, M. L., and Mehta, F. S., Jain Brothers.

Web Links:

1. <https://nptel.ac.in/courses/112105128>.
2. <https://www.udemy.com/course/water-cooler-dispenser-working-and-circuit-diagram/?couponCode=NVDPRODIN35>.
3. <https://bharatskills.gov.in/Home/StudyMaterial?var=06nHBys5P85EmOqtjA1wsA==&Default=YES>.

Production Technology
(Common to All, Except ME)

Course Code: 2501ME75

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Elaborate the fundamental principles of casting process.
- CO2:** Classify the various joining process with applications
- CO3:** Discuss the basic concepts of metal forming techniques
- CO4:** Explain the basic concepts of smithy and forging techniques.
- CO5:** Explain the basic concepts of plastic processing techniques and powder metallurgy

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

UNIT – I

Introduction: Introduction to manufacturing process, Classification and Overview of Manufacturing Processes. Introduction to Metal Casting, Casting design considerations, Sand casting process, Casting Terminology, Types of Patterns, Pattern Materials and Pattern Allowances, Sand casting, Classifications of Moulds, moulding materials and their properties, Core, Gating system and its Design, Riser and its design, Foundry - furnaces, Melting & Pouring, Fluidity, Solidification of pure metals and alloys, Casting defects, Advanced casting processes, advantages and applications.

UNIT – II

Metal Joining: Introduction, Classification of Welding Processes, Gas Welding & Cutting, Arc Welding-Theory of heat generation, Power Source Selection, Arc characteristics, Arc blow, ISI classification of coated electrodes, SMAW,GTAW,GMAW-CO₂, SAW,LBW,EBW,UW, Resistance welding, Solid state welding processes, Hybrid Welding Processes, Brazing, Soldering and their applications, HAZ, characteristics of weldment, Welding Defects and Remedies.

UNIT – III

Sheet Metal Work: Standard Specifications for Sheets, Sheet Metal Operations, Yield criteria, Plastic deformation of metals, Tools and Equipment in SMW, Deep drawing.

Forming : Hot working and Cold working, Rolling, Hubbing, Embossing, Thread rolling,

Tube Piercing, Hot spinning, Press Working, Defects in metal working, Wire Drawing, Tube drawing. High Energy rate Forming (HERF) processes.

UNIT – IV

Smithing And Forging: Forging & Forging dies, Smith Forging operations, Forging Process, Hand Forging, Power Forging, Impression Die Forging, Drop Hammers, Press Forging, Upset forging, Forging Defects and Remedies.

UNIT – V

Plastic Processing: Types of Plastics, Properties, Applications, and their processing methods, Blow molding and Injection molding.

Powder Metallurgy: Powder production methods, compaction, and sintering. Applications of powder metallurgy. Advantage and Disadvantage of Powder Metallurgy in comparison to Conventional Shaping process.

Text Books:

1. Manufacturing Engineering and Technology, Kalpakian S, Schmid S.R., Pearson Education, Delhi, 7th Edition 2018, ISBN 978-9332587908.
2. Fundamentals of Modern Manufacturing, Groover Mikell P, John Wiley and Sons Inc, 7th Edition, 2018, ISBN 978-1119722014.

Reference Books:

1. Manufacturing Science, A. Ghosh & A.K. Mallik, East West Press Pvt. Ltd Publication, 3rd Edition, ISBN 978-8176710633.
2. Manufacturing Processes, H.S. Shan, Cambridge University Publication, 2nd Edition, ISBN 978-1316638583.
3. Process and materials of manufacture, Lindberg, PHI Publications, 4th Edition, ISBN 978-8120306639.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc24_me16/preview
2. https://onlinecourses.nptel.ac.in/noc24_me51/preview
3. <https://archive.nptel.ac.in/courses/113/106/113106098/>

Metallurgy & Material Science
(Common to All, Except ME)

Course Code: 2501ME76

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the concepts of structure of metals and equilibrium diagrams.
- CO2:** Analyse the ferrous and non-ferrous metals and alloys in industrial applications
- CO3:** Analyse the heat treatment on steels.
- CO4:** Explain the methods of making of metal powders and applications of powder metallurgy.
- CO5:** Summarize the properties and applications of ceramic and composite materials.

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

UNIT– I

Structure of Metals and Constitution of alloys: Crystallization of metals, Packing Factor SC, BCC, FCC & HCP-line density, plane density. Grain and grain boundaries, effect of grain boundaries– determination of grain size. Imperfections, Slip and Twinning. Necessity of alloying, types of solid solutions, Hume Rothery’s rules, intermediate alloy phases, and electron compounds.

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe₃C.

UNIT–II

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

UNIT–III

Heat treatment of Steels: Effect of alloying elements on Fe-Fe₃C system, annealing, normalizing, hardening, TTT diagrams, tempering, harden ability, surface - hardening methods, age hardening treatment, Cryogenic treatment.

UNIT–IV

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization- Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

UNIT– V

Ceramic and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nano materials and smart materials.

Text Books:

1. Introduction to Physical Metallurgy, Sidney H Avner, TMH Publications, 2nd Edition
2. Materials Science and Metallurgy, V.D. Kodgire, Everest Publishing House, 39th Edition

Reference Books:

1. Materials Science and Engineering, An Introduction, William D. Callister, Wiley Publications, 9th Edition.
2. Mechanical Metallurgy George Ellwood Dieter, David Bacon. McGraw- Hill Book company.
3. Engineering Materials & Metallurgy, R.K. Rajput, S. Chand Publications, 2nd Edition.

Weblinks:

1. <https://archive.nptel.ac.in/courses/113/106/113106032/>
2. <https://www.coursera.org/learn/fundamentals-of-materials-science>
3. <https://www.coursera.org/learn/material-behavior>.

Theory of Machines
(Common to All, Except ME)

Course Code: 2501ME79

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Apply the knowledge of mechanisms in real time applications
- CO2:** Construct the velocity and acceleration diagrams using relative velocity method and instantaneous centre method.
- CO3:** Calculate the velocity and acceleration of follower motions and construct the cam profile
- CO4:** Calculate the velocities of different components of a compound and epicyclic gear trains
- CO5:** Construct the turning moment diagram of engine and flywheel.

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

UNIT – I

Elements of Kinematics: Classification of Mechanisms-Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain -Limit positions- Mechanical advantage- Description of common mechanisms- Inversions of 4-bar chain: Crank and Slotted Lever mechanism, Quick Return Motion mechanism, Davis and Ackermann Steering gear mechanisms, Hooke's joint.

UNIT – II

Velocity and Acceleration Analysis: Plane motion of a rigid body: Instantaneous centre of rotation, centrode and axode - Relative motion between two bodies – Kennedy's Theorem – Graphical determination of instantaneous centre for Four bar and Single Slider Crank chain mechanisms, Determination of Angular Velocity of points and links. Motion of a Link in Machine - Determination of Displacement, Velocity and Acceleration for a Four Bar Mechanism, Single Slider Crank chain mechanism, Double Slider Crank chain mechanism.

UNIT – III

Cams and followers: Definition and classification of Cams and Followers - Terminology - Types of follower motion: Uniform velocity, Simple harmonic motion and Uniform

Acceleration and Retardation, Cycloidal motion for Knife edge, Flat face and Roller follower and offset follower.

UNIT – IV

Power Transmission: Introduction –Modes of Power Transmission applications. Gears and Gear Trains- Classification, Terminology, Law of Gearing, Path of contact, Arc of contact. Interference, Methods of avoiding interferences. Simple gear train, Compound gear train, reverted gear train, epicyclic gear train and Differential. Table method to find velocity of components of a gear train.

UNIT – V

Turning Moment Diagrams: Static and dynamic force analysis of planar mechanisms, Dynamic force analysis of slider crank mechanism, Inertia Torque, Angular Velocity and Acceleration of connecting rod, Crank Effort and Turning Moment Diagrams – Fluctuation of energy – Fly Wheel design.

Text Books:

1. Theory of machines, S.S.Rattan, Tata Mc Graw Hill, 5th Edition, 2019, ISBN: 9789351343479.
2. Theory of machines, Thomas Bevan, CBS Publishers, 3rd Edition, ISBN: 9788123908748.

Reference Books:

1. Theory of machines: Kinematics and Dynamics , Sadhu Singh, 3rd Edition, Pearson Publisher, 2011, ISBN: 9788131760697.
2. Theory of machines, R.K.Bansal, J.S.Brar, Laxmi Publications, 6th Edition, ISBN: 9788131808054.

Web Links:

1. https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_403_Part_3_KINEMATICS_OF_MACHINERY.pdf
2. <https://archive.nptel.ac.in/courses/112/104/112104121/>

Advanced Engineering Metrology
(Common to All, Except ME)

Course Code: 2501ME80

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify the generalized concept of measurement system.
- CO2:** Summarize the concepts of DC and AC bridges used in measurement systems.
- CO3:** Apply the fundamentals in measurements and calibration of instruments.
- CO4:** Describe the working principles and operation of measuring instruments.
- CO5:** Explain the basic physics of transducers and their operating principles.

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	1	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

UNIT-I

Generalized Configuration of Measuring System: Functional elements of a basic measuring system, different types of measurands, description of functional elements, input-output configuration of a measuring system, linear and angular measurements, comparators, interferometry, form and finish measurement, alignment and testing methods, tolerance analysis in manufacturing and assembly, concepts of coordinate-measuring machine (CMM), mathematical model for generalized configuration of a measurement system.

UNIT-II

Comparative Methods of Measurements: D.C potentiometers, D.C (Wheat stone, and Kelvin bridge) & A.C bridges (Maxwell, Anderson, and Schering bridges), transformer ratio bridges, self-balancing bridges, interference & screening, multiple earth and earth loops, electrostatic and electromagnetic interference, grounding techniques, uncertainty analysis.

UNIT- III

Characteristics of Instruments: Objective of studying the characteristics of the instruments. Static characteristics – accuracy, precision, error, sensitivity, hysteresis, threshold, drift, span, and static stiffness, dynamic characteristics – time domain and frequency domain characteristics terms, concept of mechanical loading.

UNIT-IV

Principles of Instrumentation: Sensor interrogation principles using bridge circuits, signal amplification, signal conditioning (transduction, & linearization), phase measurements, active and passive filters, isolation and shielding, elements of control theory, digital data acquisition.

UNIT- V

Principles of Transduction and Transducers: Description of various types of transduction principles. transducers based on variable resistance, variable inductance, variable capacitance, and piezo-electric effects, displacement transducers - wire wound potentiometers, LVDT, strain gauges, diaphragm type pressure transducers and other pressure measuring techniques, design of accelerometers and their applications, temperature and flow measurement techniques.

Text Books:

1. Instrumentation for Engineering Measurements, James W. Dally, W.F. Riley and K.G. McConnell, John Wiley & Sons Inc, 2nd Edition, ISBN:978-0471551928
2. Mechanical Measurements and Instrumentation & Control, A. K. Sawhney, Dhanpat Rai & Co. (P) Limited, ISBN:978-8177000238.

Reference Books:

1. Engineering Metrology, M. Mahajan, Dhanpat Rai Publishers, 1st Edition, ISBN:978-8177000511.
2. Mechanical and Industrial Measurements, R. K. Jain, Khanna Publishers, 1st Edition ISBN:978-8174091918

Web Links:

1. <https://archive.nptel.ac.in/courses/112/106/112106139/>
2. <https://ocw.mit.edu/courses/20-309-biological-engineering-ii-instrumentation-and-measurement-fall-2006/>

Minor Degree in Electronics and Communication Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EC87	Fundamentals of Communications	FC	2		1	3	50	50	100	-
2501EC88	Fundamentals of Signal Processing	FC	2		1	3	50	50	100	-
2501EC89	Analog & Digital Circuits	IC	2			2	50	50	100	BEEE
2501EC42	Wireless LAN's & PAN's	IC	2	1		3	50	50	100	-
2501EC90	Linear & Digital IC Applications (or)	IC	3			3	50	50	100	ADC
2501EC91	Sensors & Actuators									
2501EC92	Embedded Microcontrollers (or)	IC	2		1	3	50	50	100	ADC, PPSC
2501EC93	Digital System Design									
2501EC67	Introduction to Internet of things (or)	AC	2		1	3	50	50	100	EM, WLAN's & PAN's
2501EC74	Modern Wireless Communications		3			3	50	50	100	FC
TOTAL			15	1	4	20				

Fundamentals of Communication
(Common to All, Except ECE)

Course Code: 2501EC87	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Summarize the functional blocks of a communication system.
- CO2:** Interpret the modulation and demodulation techniques of AM.
- CO3:** Discuss the concepts of Angle modulation and demodulation.
- CO4:** Infer Pulse analog modulation and demodulation Techniques.
- CO5:** Interpret the transmitter and receiver sections.

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	-	1	2	1	-	1
CO2	3	2	2	-	1	-	1	2	1	-	1
CO3	3	2	2	-	1	-	1	2	1	-	1
CO4	3	2	2	-	1	-	1	2	1	-	1
CO5	3	2	2	-	1	-	1	2	1	-	1

UNIT – I

Introduction to Communication system, Elements of Communication system, Modulation, Need for Modulation, Electromagnetic Spectrum, Frequency Division Multiplexing(FDM). Introduction to Amplitude Modulation (AM), Generation and detection of AM, Spectrum of AM Signals, Power and Power Efficiency of AM.

Practice:

1. Generate amplitude modulated signal, determine the percentage modulation and demodulate the modulated signal using envelope detector.

UNIT – II

Double Sideband Suppressed Carrier ((DSB-SC) Modulation, Spectrum of DSB-SC Signals, Coherent Demodulation of DSB-SC signals, Introduction to Single Sideband (SSB) Modulation, Generation, and detection of SSB Modulation, Introduction to VSB modulation.

Practice:

1. Generate AM-DSBSC modulated signal and demodulate the modulated signal.

UNIT – III

Frequency modulation: Frequency Modulation: Narrow Band FM, Wide BandFM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals.

Practice:

1. Generate frequency modulated signal, determine the modulation index and Bandwidth, also demodulate the frequency modulated signal.

UNIT – IV

Digital representation of analog signals: Need for Digitizing Analog information, Time Division Multiplexing, Pulse Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, and Filtering, Introduction to Delta Modulation, Signal Reconstruction in Delta Modulation, Slope Overload Distortion and Granular Noise, Differential Pulse Code Modulation (DPCM).

Practice:

1. Analyse the process of pulse Code modulation.

UNIT – V

Transmitters and Receivers: Classification of Transmitters, AM Transmitters, FM Transmitters Receivers: Radio Receiver - Receiver Types - Tuned radio frequency receiver, Superheterodyne receiver, RF section and Characteristics - Frequency changing and tracking, Intermediate frequency, Image frequency, AGC.

Practice:

1. Verify the characteristics of mixer.
2. Experimentally study the characteristics of a given AGC circuit.

Capstone Project:

1. AM Transmitter and Receiver Design
Design and simulate or build an Amplitude Modulation system.
Tools: Breadboard, signal generator, MATLAB/Scilab, or Python

Text Books:

1. Introduction to Analog and Digital Communications, Simon Haykin, Wiley, 2nd Edition, ISBN: 0471432229.
2. Electronics Communication Systems-Fundamentals through Advanced-Wayne Tomasi, Pearson, 5th Edition, 30 August 2019, ISBN: 978-8131719534.
3. Modern digital and analog communication systems—B.P.Lathi , Zhi Ding,oxford,4th Edition, ISBN: 0195331451.

Reference Books:

1. Principles of Communication Systems - Herbert Taub, Donald L Schilling, Goutam Saha, McGraw-Hill, 4th Edition, ISBN: 1259029859.
2. Analog and Digital Communication – K. Sam Shanmugam, Willey, 2018, ISBN: 9788126536801.

Web Links:

1. <https://archive.nptel.ac.in/courses/117/105/117105143/>
2. https://onlinecourses.nptel.ac.in/noc21_ee74/preview
3. <https://archive.nptel.ac.in/courses/108/102/108102096/>
4. <https://archive.nptel.ac.in/courses/117/101/117101051/>
5. <https://web.stanford.edu/class/ee179/>
6. <https://www.udemy.com/course/analog-communication-e/>

Fundamentals of Signal Processing

(Common to All, Except ECE)

Course Code: 2501EC88

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Analyse the characteristics of CT periodic signals using Fourier series.
- CO2:** Analyse the spectral characteristics of CT aperiodic signals using Fourier Transforms.
- CO3:** Analyse sampling process and reconstruction of signals.
- CO4:** Analyze the response of continuous time LTI system.
- CO5:** Apply Laplace and Z-transform techniques on signals.

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	2	1	1	-	1	-	1	1	1	-	1
CO2	2	1	1	-	1	-	1	1	1	-	1
CO3	2	2	1	-	1	-	1	1	1	-	1
CO4	3	2	1	-	1	-	1	1	1	-	1
CO5	2	2	2	-	1	-	1	1	1	-	1

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, Convergence of Fourier Series: Dirichlet's conditions, properties of Fourier series.

Practice:

1. Generation of various signals such as unit impulse, unit step, ramp, exponential and sinewave.
2. Perform Operations on signals such as Addition, Multiplication, Scaling, Shifting, and Folding.
3. Perform Fourier synthesis of square wave.

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.

Practice:

1. Calculate the Fourier Transform and Inverse Fourier Transform of a for Continuous time signal.
2. Calculate the Fourier Transform and Inverse Fourier Transform for the Standard signals.

UNIT – III

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 undersampling – Aliasing.

Practice:

1. Perform convolution of given continuous time signals.
2. Verify Sampling theorem.

UNIT – IV

Laplace Transform: Bilateral and unilateral Laplace Transforms, Region of convergence and its properties, Constraints on ROC for various classes of continuous time signals, Properties of Laplace Transform, Inverse Laplace Transform.

Z-Transform: Concept of Z- Transform of a Discrete Sequence, Region of convergence in Z-Transform, Properties of Z-Transform, Inverse Z-Transform.

Practice:

1. Obtain Laplace Transform and inverse Laplace Transform of a given continuous time signal.
2. Calculate the Z-Transform and Inverse Z-Transform of a given discrete time signal.

UNIT – V

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, Discrete Fourier transforms.

Practice:

1. Obtain Impulse and step response of given LTI system.

Capstone Project:

Spectral Decomposition and Analysis of Complex Signals

Text Books:

1. Signals and Systems - A.V. Oppenheim, A.S. Willsky, and S.H. Nawab, PHI, 2nd Edition, ISBN: 9332550239.
2. Signals and Systems – A. Anand Kumar, PHI, 4th Edition, ISBN: 8120348400.

Reference Books:

1. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition, ISBN: 0471164747 .
2. Fundamentals of Signals and Systems- Michel J. Robert, MGH International Edition, ISBN: 9780070702219.
3. Digital Signal Processing, P. Ramesh Babu, SciTech Publications, 6th Edition, ISBN: 9395245271.

Web Links:

1. <https://freevideolectures.com/course/3540/signals-and-systems-i> (Signals and Systems by Prof. K.S. Venkatesh IIT Kanpur)
2. <https://nptel.ac.in/courses/108104100> (Principles of Signals and System by Prof. Aditya K. Jagannatham, IIT Kanpur)
3. <https://nptel.ac.in/courses/117/102/117102060/> (Digital Signal Processing - by Prof. S.C. Dutta Roy Department of Electrical Engineering IIT Delhi)

(Common to All, Except ECE)

Course Code: 2501EC89

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Examine the characteristics of special semiconductor diode.
- CO2:** Illustrate the performance of FET and MOSFET.
- CO3:** Realize logic minimization using suitable techniques
- CO4:** Illustrate various combinational logic circuits.
- CO5:** Construct different sequential logic circuits.

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	2	3	2	-	-	-	-	-	-	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-
CO3	2	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	2	2	3	-	-	-	-	-	-	-	-

UNIT – I

Semiconductor Devices: Tunnel Diode, Varactor Diode, LED, Photo Diode, Transistor as a switch, Transistor as an Amplifier.

UNIT – II

Transistor Characteristics-FET& MOSFET: Construction and operation of FET, Characteristic of FET, FET as a switch and an amplifier, MOSFET working and Characteristics (Depletion mode & Enhancement mode).

UNIT – III

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 5 variables.

UNIT – IV

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, Design of decoder, de-multiplexer,encoder, multiplexer,Realization of Boolean functions using decoders & multiplexers, priority encoder,2-bit Magnitude Comparator.

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-flipflop with reset and clear terminals). Ripple counters, Synchronous Counter Johnson counter, ring counter. Registers - shift register, bi-directional shift register, universal shift register.

Text Books:

1. Electronic Devices and Circuits, J. Millman, Christos C. Halkias, Tata Mc-Graw Hill, 4th Edition, ISBN: 9789339219543.
2. Digital Design, Morris Mano, Pearson, 3rd Edition, ISBN: 8178085550.

Reference Books:

1. Electronic Devices and Circuits, R.L. Boylestad and Louis Nashelsky, Pearson Publications, 9th Edition, ISBN: 0131189050.
2. Modern Digital Electronics, RP Jain, Tata Mc Graw Hill, 4th Edition, ISBN: 0070669112.
3. Introduction to Switching Theory and Logic Design, Fredriac J. Hill, Gerald R. Peterson, John Wiley & Sons Inc., 3rd Edition, ISBN: 8126520310.

Web Links:

1. <https://nptel.ac.in/117103063/11>
2. <http://nptel.ac.in/courses/117/106/117106086/>
3. <https://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html>

Wireless LANs & PANs
(Common to All, Except ECE)

Course Code: 2501EC42

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Discuss the concept of Random Access protocols
- CO2:** Understand the Wireless LAN Protocols
- CO3:** Demonstrate the IEEE802.11 Standard for WLAN
- CO4:** Describe the Wireless PAN Protocols
- CO5:** Illustrate the IEEE802.15 Standard for WPAN

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

UNIT – I

Wireless System & Random Access Protocols: Introduction, First and Second Generation Cellular Systems, Cellular Communications from 1G to 3G, Wireless 4G systems, The Wireless Spectrum; Random Access Methods: Pure ALOHA, Slotted ALOHA, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA).

UNIT – II

Wireless LANs: Introduction, importance of Wireless LANs, WLAN Topologies, Transmission Techniques: Wired Networks, Wireless Networks, comparison of wired and Wireless LANs; WLAN Technologies: Infrared technology, UHF narrowband technology, Spread Spectrum technology.

UNIT – III

The IEEE 802.11 Standard for Wireless LANs: Network Architecture, Physical layer, The Medium Access Control Layer; MAC Layer issues: Hidden Terminal Problem, Reliability, Collision avoidance, Congestion avoidance, Congestion control, Security, The IEEE 802.11e MAC protocol.

UNIT – IV

Wireless PANs: Introduction, importance of Wireless PANs, The Bluetooth technology:

history and applications, technical overview, the Bluetooth specifications, piconet synchronization and Bluetooth clocks, Master-Slave Switch; Bluetooth security; Enhancements to Bluetooth: Bluetooth interference issues, Intra and Inter Piconet scheduling, Bridge selection, Traffic Engineering, QoS and Dynamics Slot Assignment, Scatternet formation.

UNIT – V

The IEEE 802.15 working Group for WPANs: The IEEE 802.15.3, The IEEE 802.15.4, ZigBee Technology, ZigBee components and network topologies, The IEEE 802.15.4 LR-WPAN Device architecture: Physical Layer, Data Link Layer, The Network Layer, Applications; IEEE 802.15.3a Ultra wide band.

Text Books:

1. Ad Hoc and Sensor Networks - Carlos de Morais Cordeiro and Dharma Prakash Agrawal, World Scientific, ISBN: 978-9814338882.
2. Wireless Communications and Networking - Vijay K.Garg, Morgan Kaufmann Publishers, ISBN: 9780123735805.

Reference Books:

1. Principles of Wireless Networks - Kaveh Pahlaram, Prashant Krishnamurthy, PHI, ISBN: 8120323807.
2. Guide to Wireless Communication- Marks Ciampor, Jeorge Olenewa, Cengage Learning, ISBN: 1111307318.

Web Links:

1. <https://archive.nptel.ac.in/courses/106/105/106105183/>
2. <https://archive.nptel.ac.in/courses/108/108/108108179/>

Linear & Digital IC Applications
(Common to All, Except ECE)

Course Code: 2501EC90

L	T	P	C
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
CO1	1	1	3	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	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 an Op-Amp, Pin diagram, symbolic representation and features of 741IC, 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 Amplifiers, 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. Different types of ADCs parallel Comparator type ADC, Counter type ADC, Successive Approximation ADC and dual slope ADC. DAC and ADC Specifications.

UNIT – V

Digital Logic Families and Interfacing: Introduction to logic families, Bipolar logic, transistor-transistor logic, TTL families, Emitter coupled logic, CMOS logic, CMOS logic families, state and dynamic electrical behavior.

Text Books:

1. Linear Integrated Circuits–D.RoyChowdhury, New Age International(p)Ltd, 2nd Edition, ISBN: 8122403077.
2. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 4th Edition, ISBN: 8131713660.
3. Op-Amps and Linear Integrated Circuits, Ramakant A. Gayakwad, PHI, Pearson Education, 4th Edition, ISBN: 8131713660.

Reference Books:

1. Design with Operational Amplifiers & Analog Integrated Circuits-Sergio Franco McGrawHill, ISBN: 0071157220.
2. OPAMPS and Linear Integrated Circuits concepts and Applications, James MFiore, Cengage Learning India Ltd, ISBN: 9788131512340.
3. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, Zvonko Vranesic, McGrawHill, 3rd Edition, ISBN: 1259025977.

Web Links:

1. <http://nptel.ac.in/courses/117108038/Prof.GunashekarM.K/IIScBangalore>
2. <https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-01sc-introduction-toelectrical-engineering-and-computerscience-i-spring-2011/unit-3-circuits/op-amps>

Sensors & Actuators
(Common to All, Except ECE)

Course Code: 2501EC91

L	T	P	C
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:** Analyse various approaches, procedures and results related to Thermal sensors.
- CO3:** Examine the radiation sensors based on their characteristics.
- CO4:** Apply Smart Sensors in the field of Communication, Automation and Manufacturing
- CO5:** Classify various Actuators based on their 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
CO1	3	1	-	-	-	-	-	-	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-
CO3	2	3	2	-	-	-	-	-	-	-	-
CO4	2	3	2	-	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-

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.

UNIT-III

Radiation Sensors: Introduction – Basic Characteristics – Types of Photo sensistors /Photo detectors– X-ray and Nuclear ,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 – Pressure 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. Sensors and Transducers, D. Patranabis, PHI Learning Private Limited, ISBN: 9788120321984.
2. Mechatronics, W. Bolton, Pearson Education Limited, ISBN: 1292250976.

Reference Books:

1. Sensors and Actuators, D. Patranabis, PHI, 2nd Edition, ISBN: 9788120321984..
2. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, ISBN: 978-0123821966.

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>

Embedded Microcontrollers
(Common to All, Except ECE)

Course Code: 2501EC92

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain the microprocessor internal architecture and programming.
- CO2:** Discuss Microcontroller internal architecture and its assembly language programming.
- CO3:** Describe the Hardware interfaces with Microcontroller in Assembly Language and C programming.
- CO4:** Describe PIC Microcontroller internal architecture and its assembly language programming.
- CO5:** Illustrate the usage of ATMEGA 328P in their project designs.

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	1	3	-	-	3	-	1	1	1	-	-
CO2	1	3	-	-	3	-	1	1	1	-	-
CO3	2	-	3	-	3	-	1	1	1	-	-
CO4	2	3	-	-	3	-	1	1	1	-	-
CO5	2	-	3	-	3	-	1	1	1	-	-

UNIT – I

Microprocessor: Basics of Microprocessor, 8086 Hardware architecture ,8086 registers and its functions, Min mode and Max mode system configuration ,Instruction set of 8086 and simple Programs,Interrupts, DMA.

Practice:

1. Write an Assembly language program to perform Arithmetic operations on 8 bit data.
2. Write an Assembly language program to perform Multi byte addition and subtraction.

UNIT – II

8051 Microcontroller: Comparisons between Microprocessors and microcontroller, 8051 architecture, Pin functions, Memory organization, Special Function Registers, addressing modes, Instruction set. C Programming- I/O programming, Timer programming, 8051 interrupts Programming.

Practice:

1. Introduction to KEIL Software.

2. Write an ALP to find Number of 1's and number of 0's in a given 8-bit.
3. Write an ALP to generate square wave using Timer control.

UNIT – III

External Peripheral Interface: LCD interfacing, Keyboard interfacing, Interfacing with external ROM, ADC interfacing, DAC interfacing, Stepper motor interfacing, DC motor interfacing.

Practice:

1. Interface Keypad to 8051 using proteus software.
2. Interface LCD to 8051 using proteus software.

UNIT – IV

PIC Microcontrollers: Introduction, characteristics of PIC microcontroller, memory organization, parallel and serial input and output, timers, Interrupts, PIC 16F877 architecture, instruction set of the PIC 16F877.

Practice:

1. Introduction to MPLAB XIDE software.
2. Write a C Program for LED Blinking using PIC16F877.

UNIT – V

Atmega328 Microcontroller: ATMEGA 328P architecture, register file, memory, addressing mode, instruction sets, I/O ports, Case studies: interfacing with LCD, Temperature Sensor DHT11, High-Voltage Device and Relay, Bluetooth Module (HC-05), GSM Module (SIM900A), Using I2C Protocol, Using Zigbee to interface wireless sensors.

Practice:

1. Study of Arduino software.
2. Interfacing of analog sensors with Arduino.
3. Interfacing of DC Motor with Arduino.

Capstone Project:

Password Based Door lock System with 8051 using Proteus Software.

Description: Enter a 4-digit password using keypad; correct code opens lock (simulated with LED or motor).

Text Books:

1. Advanced Microprocessors and Peripherals with ARM and an introduction to Microcontrollers and Interfacing, K. M. Bhurchandi and A. K. Ray, Tata McGraw Hill, 3rd Edition, ISBN: 1259006131.
2. Micro Controller theory and Application ,Ajay .V. Deshmukh, TATA McGraw –Hill, 1st Edition, ISBN: 0070585954.
3. Programming and Interfacing with Arduino, Dr. Yogesh Misra, Taylor and Francis, ISBN: 1032059850.

Reference Books:

1. The 8051 Microcontrollers and Embedded systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay; Pearson 2nd Edition, ISBN: 8131758990.
2. Microprocessors and Interfacing, D. V. Hall, 3rd Edition (SIE), ISBN: 9781259006159.
3. The 8051 Micro Controller Architecture, Programming and Applications, Kenneth J Ayala, Thomson Publishers, 3rd Edition, ISBN: 9788131502006.

Web Links:

1. <https://archive.nptel.ac.in/courses/108/103/108103157/> microprocessor and microcontrollers by IIT Gowhati.
2. <https://nptel.ac.in/courses/108108147S> sensors and Actuators, IISc Bangalore Prof. Hardik Jeetendra Pandya.

Digital System Design
(Common to All, Except ECE)

Course Code: 2501EC93

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain the design process of HDL based digital systems.
- CO2:** Illustrate language constructs in Verilog HDL
- CO3:** Develop Verilog Program for Combinational Logic Circuits using gate primitives.
- CO4:** Develop dataflow modeling Verilog Program for Logic Circuits.
- CO5:** Construct sequential circuits using behavioral Modeling.

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

UNIT – I

INTRODUCTION TO VERILOG: Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools.

Practice:

1. Introduction to Xilinx Software

UNIT – II

LANGUAGE CONSTRUCTS AND CONVENTIONS: Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators.

Practice:

1. Write a verilog code with the use of data types as scalars and vectors

UNIT – III

GATE LEVEL MODELING: Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples: Adders, Subtractor and Multiplexers. Additional Examples: Design of Flip-flops with Gate Primitives, Delays, Net Types.

Practice:

1. Write a Verilog code for logic gates using gate Primitives
2. Write a Verilog code for FullAdder and subtractor using gate Primitives.
3. Write a Verilog code for Multiplexer using gate Primitives.

UNIT – IV

MODELING AT DATA FLOW LEVEL: Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators, Design Examples- Encoder, Decoder and Comparator

Practice:

1. Write a Verilog code for encoder in dataflow model
2. Write a Verilog code for decoder in dataflow model.
3. Write a Verilog code for Comparator in dataflow model.

UNIT – V

BEHAVIORAL MODELING: Introduction, Operations and Assignments, Initial Construct, Always Construct, The case statement, *if* and *if-else* constructs, repeat construct, for loop Examples, Assignments with Delays, Design Examples-Flip-flops, Registers and Counters.

Practice:

1. Write a Verilog HDL code for the RS and JK flip-Flops using case statement.
2. Write a Verilog HDL code for the 4 bit register using *if-else* statement.
3. Write a Verilog HDL code for the 4 bit register using behavioral Modeling.

Capstone Project:

4-bit ALU Design

- Functions: Addition, Subtraction, AND, OR, NOT
- Input: Two 4-bit operands and a 2-bit opcode.
- Output: 4-bit result and carry/overflow flags

Text Books:

1. Fundamentals of Digital Logic with Verilog Design- Stephen Brown, Zvonko Vranesic, McGrawHill, 3rd Edition, ISBN: 1259025977.
2. Advanced digital design with the Verilog HDL, Michael D. Ciletti, Eastern economy edition, PHI, ISBN: 0136019285.

Reference Books:

1. A Verilog HDL primer by J.Bhaskar, Star galaxy publishing, 3rd Edition, 2018, ISBN: 0965039161.
2. Design through Verilog HDL by T. R. Padmanabhan, B. Bala Tripura Sundari, A JOHN WILEY & SONS, INC., Publication, ISBN: 0471441481.

Web Links:

1. <http://nptel.ac.in/courses/117105080/> by Prof.D. Roy chaudhry, IIT kharagpur
2. <http://nptel.ac.in/courses/117106086/1> by Prof.S.Srinivasan, IIT Madras
3. https://onlinecourses-archive.nptel.ac.in/noc17_cs21/ course by Prof. Indranil Sen Gupta, IIT kharagpur

Introduction to Internet of Things
(Common to All, Except ECE)

Course Code: 2501EC67	L	T	P	C
	2	0	1	3

Course Outcomes:

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

- CO1:** Describe M2M and IOT Technologies.
- CO2:** Identify the layers and protocols in IOT.
- CO3:** Describe various communication technologies used in IOT.
- CO4:** Demonstrate various hardware components required for IOT applications
- CO5:** Identify the cloud technologies Explain the applications of IoT

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	1	-	-	-	-	-	1	1	-	-
CO2	2	2	-	-	-	-	-	1	1	-	-
CO3	2	2	-	-	-	-	-	1	1	-	-
CO4	3	2	-	-	-	-	-	1	1	-	-
CO5	2	2	-	-	-	-	-	1	1	-	-

UNIT – I

Introduction from M2M to IoT - An Architectural Overview, building architecture, Main design principles and needed capabilities, An IoT architecture outline, M2M and IoT Technology Fundamentals - Devices and gateways.

Practice:

1. Interfacing of analog sensors with Arduino.
2. Interfacing of Digital sensors with Arduino.

UNIT – II

Functionality of Layers in IoT: Study of protocols - Wireless HART, Z-Wave, 6LoWPAN, RPL, CoAP, MQTT.

Practice:

1. Interfacing of actuators with Arduino/Node-MCU.
2. Control an actuator based on sensor input with Arduino/Node-MCU.

UNIT – III

Communication Technologies in IoT : IoT Connectivity-IEEE 802.15.4, Wi-Fi, Bluetooth, Zigbee, LPWAN, 5G Era.

Practice:

1. Develop an Application to Interface Bluetooth module with Arduino.
2. Develop an Application to Interface Wi-Fi module.

UNIT – IV

System Hardware : Sensors, Actuators, Radio Frequency Identification, Introduction to Embedded Devices for IoT - RASPBERRY PI.

Practice:

1. Interfacing of analog sensors with Raspberry pi.
2. Interfacing of digital sensors with Raspberry pi/Node-MCU.

UNIT – V

Cloud Computing: Data Collection, Storage and Computing Using a Cloud Platform for IoT Applications/ Services. Use Cases - Smart and Connected Cities, Agriculture, and Healthcare.

Practice:

1. Deploy sensor data on a cloud platform.
2. Develop IoT model using soil moisture sensor for Agriculture application.

Capstone Project:

Develop IoT model to design Weather Monitoring System which Measures temperature, humidity, and pressure and Sends data to ThingSpeak or Blynk.

Text Books:

1. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, Academic Press,. 1st Edition, ISBN: 012407684X.
2. Internet of Things (A Hands-on- Approach), Vijay Madisetti and Arshdeep Bahga, 1st Edition, VPT, ISBN: 8173719543.
3. Internet of Things - By Raj Kamal, McGraw-Hill Education. Copyright, ISBN: 9352605225.

Reference Books:

1. Internet of Things—From Research and Innovation to Market Deployment, Peter Friess, River Publishers, ISBN: 8793102941.
2. From Internet of Things to Smart Cities: Enabling Technologies - edited by Hongjian Sun, Chao Wang, Bashar I. Ahmad, CRC Press -2018, ISBN: 9781498773782.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015, Editors Ovidiu Vermesan, ISBN: 1783553537.

Web Links:

1. [NPTEL :: Computer Science and Engineering - NOC:Introduction to internet of things](#)
BY IIT Kharagpur.
2. <https://nptel.ac.in/courses/108108147> Sensors and Actuators, IISc Bangalore
Prof. Hardik Jeetendra Pandya.

Modern Wireless Communications
(Common to All, Except ECE)

Course Code: 2501EC74	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1: Summarize the functioning of basic cellular mobile radio systems
- CO2: Identify the general problems of cellular mobile networks
- CO3: Summarize various mobile propagation models
- CO4: Make use of managerial techniques for efficient use of cellular frequency bands.
- CO5: Compare basic digital cellular networks

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	1	1	-	-	-	-	-	-	-	-
CO2	3	1	2	-	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-

UNIT – I

Cellular Mobile Radio Systems: Introduction to Cellular Mobile Systems, Generations-1G, 2G, 3G 4G, Performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells, Analog and Digital Cellular systems.

Elements of Cellular Radio System Design: General description of the problem, concept of frequency channels, Co-channel Interference Reduction Factor, desired C/I from a normal case in a Omni directional Antenna system, consideration of the components of Cellularsystem.

UNIT – II

Interference: Introduction to Co-Channel Interference, real time Co-Channel interference, Co-Channel measurement, diversity receiver, non-co channel interference-different types.

UNIT – III

Cell Coverage for Signal and Traffic: Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation antenna height gain, form of a point to point model.

UNIT – IV

Frequency Management and Channel Assignment: Numbering and grouping, setup access and paging channels channel assignments to cell sites and mobile units, channel sharing and borrowing, Sectorization, overlaid cells, non-fixed channel assignment.

Handoff: Handoff, dropped calls and cell splitting, types of handoff, handoff invitation, delaying handoff, forced handoff, mobile assigned handoff. Intersystem handoff, cell splitting, micro cells, vehicle locating methods, dropped call rates and their evaluation.

UNIT – V

Digital Cellular Networks: GSM architecture, GSM channels, GSM call flow, CDMA(IS-95), Forward and Reverse CDMA Channels, DECT, PACS.

Text Books:

1. Mobile Cellular Tele Communications, W.C.Y. Lee, Tata McGraw Hill, 2nd Edition, ISBN: 978-0070635999.
2. Principles of Mobile Communications, Gordon L. Stuber, Springer International, 2nd Edition, ISBN: 9780792379980.

Reference Books:

1. Wireless Communications, Theodore. S. Rapport, Pearson education, 2nd Edition, ISBN: 978-8131731864.
2. Wireless Communication and Networking, Jon W. Mark and WeihuaZhqung, PHI, 1st Edition, ISBN: 978-0130409058.
3. Wireless Communication Technology, R. Blake, Thompson Asia Pvt. Ltd., 1st Edition, ISBN: 978-8131518403.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_ee61/preview?msclkid=f61e217ec14311ecb1ce5ecbd56ce03d
2. <https://www.electronics-notes.com/articles/connectivity/cellular-mobile-phone/what-is-cellular-communications.php>

Minor Degree in Petroleum Technology

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT27	Introduction to Petroleum Engineering	FC	3			3	50	50	100	-
2501PT35	Unit Operations in Petroleum Industry	FC	3			3	50	50	100	-
2501PT47	Fundamentals of Geology & Reservoir Engineering	IC	3			3	50	50	100	-
2501PT48	Fundamentals of Drilling & Production Engineering (or)	IC	2			2	50	50	100	-
2501PT16	Unconventional Hydrocarbon Resources		2			2				
2501PT49	Natural Gas Hydrates (or)	AC	2			2	50	50	100	-
2501PT05	Fundamentals of Liquefied Natural Gas		2			2				
2501PT50	Artificial Lift Techniques (or)	AC	3			3	50	50	100	-
2501PT03	Enhanced Oil Recovery		2	1						
2501PT12	Petroleum Refinery Engineering	AC	2		2	4	50	50	100	-
TOTAL			17	1	2	20				

Introduction to Petroleum Engineering
(Common to All, Except PT)

Course Code: 2501PT27

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO 1:** Identify the various streams in the petroleum industry.
- CO 2:** Outline the onshore and offshore reservoirs.
- CO 3:** List out the various artificial lift techniques.
- CO 4:** Illustrate various attributes in mid-stream processing and storage.
- CO 5:** Describe the crude oil products and their specifications.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT-I

What is Petroleum Engineering & Significance? Introduction Petroleum Industry- Upstream Sector- Midstream Processing-Downstream Processing-Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT- II

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. Exploration and Drilling Rigs- Rig Components- Drill and drill bits- Drilling fluids.

UNIT- III

Well Completions Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.
Artificial Lift: Principles and operation of Rod Pumps Down Hole Pumps - Gas Lift - Plunger Lift- Electrical submersible pumps.

UNIT- IV

Separation of Reservoir Fluids- Manifolds and Gathering - Production Separators - Gas

Treatment and Compression - Oil & Gas Storage.

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

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. Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, ABB ATPA Oil and Gas. eISBN: 978-1329783454
2. John R. Fanchi and Christiansen, R.L. Introduction to Petroleum Engineering, John Wiley & Sons. eISBN:9781119193463

Reference Books:

1. Production and transport of oil and gas (part B: gathering and transport); Szilas A.P; Elsevier publications, 2nd Edition. eISBN: 0-444-99564-1
2. Subsea Engineering Handbook; Yong Bai., QiangBai; Gulf Professional Publishing; Elsevier eISBN: 978-1-85617-689-7

Web Links:

1. <https://www.studentenergy.org>
2. https://petrowiki.org/Hydrate_problems_in_production
3. https://en.wikipedia.org/wiki/Pipeline_transport
4. https://petrowiki.org/Production_system

Unit Operations in Petroleum Industry

(Common to All, Except PT)

Course Code: 2501PT35

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Understand the Heat and Mass Transfer Principles
- CO2:** Prioritize Proficiency in Conduction Mechanisms
- CO3:** Explain Mastery of Convective Heat Transfer
- CO4:** Apply Knowledge of Heat Exchange Equipment and Evaporation
- CO5:** Distinguish Mass Transfer and Distillation 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
CO1	3	-	-	-	-	-	-	-	-	2	1
CO2	3	-	-	-	-	-	-	-	-	2	1
CO3	3	-	-	-	-	-	-	-	-	2	1
CO4	3	-	-	-	-	-	-	-	-	2	1
CO5	3	-	-	-	-	-	-	-	-	2	1

UNIT – I

Introduction: Objective, scope and outcome of the course.

Conduction: Introduction to unit operation and its application in petroleum engineering. Heat Transfer and its application, Modes of heat transfer one dimensional and two-dimensional, heat rate equations, Theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylinder and sphere.

UNIT – II

Convection: Convective heat transfer, natural and forced convection, co/counter/cross current contacting for heat transfer, individual and overall heat transfer coefficient, Fouling factor, Heat transfer with and without phase change conditions.

UNIT – III

Heat Exchange equipment: Introduction to double pipe, shell and tube exchangers, condensers, extended surface equipment.

Evaporation- Type of evaporators and their applications single and multiple effect evaporators, operation of forward– backward and mixed feed operations.

UNIT – IV

Mass transfer and its application: Analogies in transfer process, basic concept of diffusion

and interphase mass transfer. Mass transfer theory film theory Penetration and surface renewal theory.

UNIT – V

Distillation: Rectification, reflux ratio, calculation of numbers of plates by McCabe Thiele method, optimum reflux ratio

Basic introduction to absorption, liquid extraction, leaching

Drying: Equilibrium mechanism theory of drying, drying rate curve

Text Books:

1. Heat and Mass Transfer: Fundamentals and Applications by Yunus A. Çengel and Afshin J. Ghajar. eISBN: 978-9339223199
2. Introduction to Chemical Engineering Thermodynamics" by J.M. Smith, H.C. Van Ness, and M.M. Abbott. eISBN: 978-0070145870

Reference Books:

1. Transport Processes and Separation Process Principles" by Christie John Geankoplis. eISBN: 9789332549432
2. Process Heat Transfer" by Donald Q. Kern. eISBN: 978-0074632178

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc22_me139/preview
2. https://www.engineeringtoolbox.com/convective-heat-transfer-d_430.html
3. <https://www.thomasnet.com/articles/process-equipment/double-pipe-heat-exchangers/>
4. <https://pages.mtu.edu/~fmorriso/cm3120/lectures/2020%20CM3120%20First%20Diffusion%20Lecture%209.pdf>
5. <http://www.dempt.co.za/mso2015/handout4.pdf>

Fundamentals of Geology & Reservoir Engineering
(Common to All, Except PT)

Course Code: 2501PT47

L T P C
3 0 0 3

Course Outcomes:

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

CO 1: Explain the general facts of the earth.

CO 2: Compare and classify various kinds of rocks.

CO 3: Explain how basins are formed.

CO 4: Understand the basic concepts in petroleum reservoir engineering.

CO5: Acquire the knowledge on drive mechanisms and how to apply the material balance to oil reservoirs.

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	1
CO2	3	-	-	-	-	-	-	-	-	2	1
CO3	3	-	-	-	-	-	-	-	-	2	1
CO4	3	-	-	-	-	-	-	-	-	2	1
CO5	3	-	-	-	-	-	-	-	-	2	1

UNIT-I

Origin and Evolution of Earth: Dimensions, origin, internal structure of the earth -- crust, mantle, core. Internal dynamic process- Plate tectonics, Continental drift, Earthquake and Volcanoes. External dynamic process – weathering-erosion-deposition. Principles of stratigraphy.

UNIT-II

Petrology: Origin of igneous, sedimentary and metamorphic rocks. Sedimentology - Sedimentary structures-petrographic characters of conglomerate, sandstone, shale, and limestone.

UNIT-III

Sedimentary Basins: Introduction to sedimentary basins and deltaic systems; Topographic maps, Thematic maps, and their profiles

UNIT-IV

Some 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- Hydrocarbon phase behaviour, Basic concepts in PVT analysis.

UNIT-V

Material balance applied to oil reservoirs: General form -The material balance expressed as a linear equation- Reservoir drive mechanism- Solution gas drive- Gas cap drive- Natural water drive- compaction drive under related pore compressibility phenomena.

Darcy's law and applications: Darcy's law and field potential- Sign convention

Textbooks:

1. Engineering Geology, Bell, F.G., 2nd Edition, Butter worth Heimann. eISBN: 978-0750680776
2. Fundamentals of Reservoir Engineering, L.P. Dake, Elsevier Science eISBN: 978-0444418302

Reference Books:

1. Text book of Geology, Mukherjee, P.K., The World Press Pvt. Ltd., eISBN: 9786039657736.
2. Principles of Engineering Geology, Bangar, K.M., 2nd Edition, Standard Publishers eISBN: 9788180141157.
3. Reservoir Engineering Handbook, Tarek Ahmed, 3rd Edition, Gulf Professional Publishing eISBN: 9780080480688.

Web Links:

1. web.crc.losrios.edu/~jacks0h/classes/earthscience/Chapter1.pdf
2. <https://ocw.mit.edu/courses/earth-atmospheric-and-astro/12...sedimentary.../ch11.pdf>
3. www.ucmp.berkeley.edu/fosrec/ONeill.html
4. <https://wiki.seg.org/wiki/Volumetrics>
5. https://petrowiki.spe.org/Material_balance_in_oil_reservoirs

Fundamentals of Drilling & Production Engineering
(Common to All, Except PT)

Course Code: 2501PT48

L T P C
2 0 0 2

Course Outcomes:

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

- CO1:** Explain the Overview of GTO
- CO2:** Design of the drill string, drilling hydraulics.
- CO3:** Determine the well head pressure, down-hole pressure and operating oil/ gas flow rates of the reservoir.
- CO4:** Illustrate the concepts of artificial lift methods
- CO5:** Determination of stimulation methods in production 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
CO1	3	-	-	-	-	-	-	-	-	2	1
CO2	3	-	-	-	-	-	-	-	-	2	1
CO3	3	-	-	-	-	-	-	-	-	2	1
CO4	3	-	-	-	-	-	-	-	-	2	1
CO5	3	-	-	-	-	-	-	-	-	2	1

UNIT-I

Overview of drilling: Drilling plan - GTO -Types of drilling, Hydrostatic pressure, Pore pressure, Causes of abnormal pore pressure, abnormal pore pressure evaluation - Measurement while drilling & logging while drilling data -Direct measurements of pore pressure – Drilling fluid properties - Drilling fluid hydraulics calculations - Bit Hydraulics Formation integrity tests – Fracture gradient determination – Theory of wellbore – FIT procedural Guidelines – Predicting fracture gradient.

UNIT-II

Wellbore stability – e in-situ stress - Determination of rock properties, Failure criteria – Stress distribution around a wellbore - safe mud weights to prevent hole collapse, Kick tolerance Use of kick tolerance to calculate wellbore pressures. Casing: Functions of casing – Types of casing – Casing properties and specifications – Casing connections – Factors influencing casing design – Combination strings – Tension criterion - Compression loads – Biaxial effects – Triaxial analysis. Cementation: Introduction to cement slurries - Cementing nomenclature - Cement additives.

UNIT-III

Petroleum production system over all view, Production from various types of reservoirs based on drive mechanisms, field development method, Safety control system. Properties of oil and natural gas: Solution Gas-oil ratio, density of oil and gas, viscosity of oil and gas,

formation volume factor of oil and gas, oil and gas compressibility, specific gravity of gas and gas pseudo critical pressure and temperature.

UNIT-IV

Basic concepts on artificial lift methods: Sucker rod pumping system, electrical submersible pumps, hydraulic piston pumping, progressive cavity pumping, plunger lift, hydraulic jet pumping, and Gas lift system.

UNIT-V

Production Stimulation: Well problem identification, Matrix acidizing, Fundamentals of Hydraulic fracturing.

Text Books:

- 1 Petroleum Engineering: Drilling and Well Completion, Carl Gatlin, Prentice-Hall, Inc. eISBN: 978-0136621553
- 2 Petroleum Production Engineering: A Computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elsevier Science & Technology Books. eISBN: 9780080479958

Reference Books:

- 1 Oil Well Drilling Engineering: Principles and Practice, H. Rabia, Graham & Trotman eISBN: 978-0860107149
- 2 Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University

Web Links:

- 1 <https://www.slb.com/resource-library/oilfield-review/defining-series/defining-drilling>
- 2 <https://www.slb.com/resource-library/oilfield-review/defining-series/defining-drilling>
- 3 <https://onepetro.org/JPT/article/36/06/889/73274/Wellbore-Stability>
- 4 https://petrowiki.spe.org/Production_system
- 5 https://wiki.aapg.org/Artificial_lift
- 6 1. <https://www.petrosync.com/blog/what-is-well-stimulation/>

Unconventional Hydrocarbon Resources
(Common to All, Except PT)

Course Code: 2501PT16	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1:** Explain the present global energy scenario
- CO2:** Determine the Characteristics of a Tight Reservoir and Oil
- CO3:** Illustrate the origin and characterize shale gas
- CO4:** Demonstrate the Characteristics of Coal Bed Methane and Gas Hydrates
- CO5:** Explain the heavy oil reservoirs and their challenges

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	2	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction

Introduction to Unconventional Hydrocarbon resources, Coal Bed Methane: Geological controls in CBM plays, Resource estimation, Drilling, completion and production performance of a CBM well, Indian Scenario

UNIT – II

Tight Gas and Oil

Characteristics of a Tight Reservoir; What makes them Tight; The Permeability Jail; Where to find Tight Reservoirs; Drilling practices for Tight reservoirs; Formation Evaluation; Hydraulic Fracturing, Post Fracture Reservoir evaluation; New Technologies

UNIT – III

Shale Gas/ Oil

Introduction, geology, important occurrences, petrophysical properties, hydro fracturing, horizontal wells, production profiles.

UNIT – IV

Coal Bed Methane and Gas Hydrates

Characteristics of Coal Bed Methane Gas; Drilling practices for Coal Beds; Workflow for Coal Bed Formation Evaluation, Cleat, Gas Content; Hydraulic Fracturing, Depressuring and Dewatering issues Success and Lessons learnt so far; Gas Hydrates: Minerology,

Chemistry and physical properties, stability, challenges and pitfalls

UNIT – V

Non-Conventional Oil

Introduction to Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales; origin and occurrence worldwide, resources, reservoir characteristics, new production technologies

Textbooks:

- 1 Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Islam M.R., Gulf Professional Publishing, 2014 eISBN: 978-0128017682.
- 2 Coal Bed Methane: From Prospects to Pipeline, Thakur P., Aminian K., Schatzel S., Elsevier Science Publishing, 2015. eISBN: 978-0128002138

Reference Books:

- 1 Geophysical Characterization of Gas Hydrates: 14 (Geophysical Developments), Michael Riedel, Satinder Chopra, Society of Exploration Geophysicists; 1st edition, 2010 eISBN: 978-1560802454
- 2 Shale Gas: Exploration and Environmental and Economic, Anurodh Mohan Dayal, Devleena Mani, Elsevier Science Publishing, 2017. eISBN: 978-0128041519.

Web Links:

- 1 <https://link.springer.com/article/10.1007/s13202-021-01404-x>
- 2 https://spgindia.org/10_biennial_form/P260.pdf
- 3 <https://www.iogp.org/wp-content/uploads/2016/10/An-introduction-to-shale-oil-and-gas-Jul2015-1.pdf>https://link.springer.com/chapter/10.1007/978-3-030-21414-2_1
- 4 https://link.springer.com/chapter/10.1007/978-3-030-21414-2_1
- 5 <https://www.open.edu/openlearn/science-maths-technology/living-without-oil/content-section-1>.

Natural Gas Hydrates
(Common to All, Except PT)

Course Code: 2501PT49

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO 1:** Explain the necessity of natural gas hydrates, different hydrate types and formers.
- CO 2:** Apply different hand calculation methods and computer methods for rapid estimation of hydrate formation conditions.
- CO 3:** Outline the design information for battling hydrates using chemicals and the reasons responsible for dehydration of gas.
- CO 4:** Identify the regions of pressure and temperature for combating hydrate formation and the importance of physical properties of design processes.
- CO 5:** Examine the relationship between fluid phase equilibria and hydrate formation and water content of natural gas.

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

UNIT-I

Introduction: Overview of Natural Gas Hydrates; Natural Gas; The Water Molecule; Hydrates; Water and Natural Gas; Heavy Water.

Hydrate Types and Formers: Type I Hydrates; Type II Hydrates; Type H Hydrates; Size of the Guest Molecule; N-Butane; Other Hydrocarbons; Cyclopropane; 2-Butane; Hydrogen and Helium; Chemical Properties of potential Guests; Liquid Hydrate Formers; Hydrate Forming Conditions; L_A+L_N+H Correlations; Quadruple Points; Other Hydrate Formers; Hydrate Formation at 0C ; Mixtures.

UNIT-II

Hand Calculation Methods: Gas Gravity Method; K-Factor Method; Baillie-Wichert Method; Other Correlations; Comments on all of these methods; Local Models.

Computer Methods: Phase Equilibrium; Van der Waals and Platteeuw; Parrish and Prausnitz; NG and Robinson Methods; Calculations; Dehydration.

UNIT-III

Inhibiting Hydrate Formation with Chemicals: Freezing Point Depression; Hammer-

Schmidt Equation; Nielsen-Bucklin Equation; New method; Brine Solutions; Comment on the Simple Methods; Advanced Calculation Methods; Inhibitor Vaporization; Comment on the Injection Rates; Safety Considerations; Low Dosage Hydrate Inhibitors.

Dehydration of Natural Gas: Water Content Specification; Glycol Dehydration; Mole Sieves; Refrigeration.

UNIT-IV

Combating Hydrates using Heat and Pressure: Plugs; Use of heat; Depressurization; Melting a Plug with Heat; Hydrate Plug Location.

Physical Properties of Hydrates: Molar Mass; Density; Enthalpy of Fusion; Heat Capacity; Thermal conductivity; Mechanical Properties; Volume of Gas in Hydrate.

UNIT-V

Phase Diagrams: Phase Rule; Comments about Phases; Single Component Systems; Binary Systems; Phase behavior below 0°C; Multi component Systems.

Water Content of Natural Gas: Dew Point; Equilibrium with Liquid Water; Equilibrium with Solids.

Text Books:

1. Natural Gas Hydrates: A Guide for Engineers, John Carroll, Elsevier Publications, 3rd Edition, 2014. eISBN: 9780128000748
2. Clathrate Hydrates of Natural Gas, E Dendy Sloan, Jr., C Koh, CRC Publications, 3rd Edition, 2007. eISBN: 978-0849390784

Reference Books:

1. Natural Gas Hydrates in Flow Assurance, E Dendy Sloan, Jr., C Koh, Amadeu K Sum, Elsevier Publications, 2011. eISBN: 9781856179454
2. Exploration of Gas Hydrates; Geophysical Techniques, Naresh Kumar Thakur, Sanjeev Rajput, Springer Publications, 2011. eISBN: 978-3662519578

Web Links:

1. https://www.researchgate.net/publication/300953314_Hydrate_Types_and_Formers
2. https://petrowiki.org/Hydrate_problems_in_production
3. https://en.wikipedia.org/wiki/Glycol_dehydration
4. <https://www.hindawi.com/journals/jther/2010/271291/>
5. <https://www.ogj.com/articles/print/volume-91/issue-13/in-this-issue/gas-processing/chart-estimates-water-content-of-sour-natural-gas.html>

Fundamentals of Liquefied Natural Gas
(Common to All, Except PT)

	L	T	P	C
Course Code: 2501PT05	2	0	0	2

Course Outcomes:

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

- CO1:** Explain the LNG value chain
- CO2:** Classify the different liquefaction technologies of LNG
- CO3:** Explain the components of LNG receiving terminals
- CO4:** Summarize LNG storage and transportation facilities
- CO5:** Identify major equipment and safety aspects of LNG 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	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	2
CO2	3	2	-	-	-	-	-	-	-	-	2
CO3	3	2	-	-	-	-	-	-	-	-	2
CO4	3	2	-	-	-	-	-	-	-	-	2
CO5	3	2	-	-	-	-	-	-	-	-	2

UNIT – I

Introduction: Overview of LNG industry -History of LNG industry – Base load LNG – Development of an LNG Project – World and Indian Scenario– Properties of LNG.

UNIT – II

Propane precooled mixed refrigerant process – Description of Air products C3MR LNG process–. Description of Conoco Phillips optimized cascade (COPOC) process – Liquefaction– LNG flash and storage.

Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and sub cooling- Trends in LNG train capacity –strategy for grassroots plant- offshore LNG production.

UNIT – III

Gas pre-treatment: Slug catcher– NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit Receiving terminals in India – Main components and description of marine facilities – LNG tanks– Process descriptions. –Mercury and sulphur removal unit–NGL recovery–Nitrogen rejection–Helium recovery.

UNIT – IV

LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane –

prismatic; Cargo measurement and calculations, Cryogenic heat exchangers: Spiral–Wound heat exchangers – Plate & fin heat exchangers – Cold boxes; Centrifugal compressors –Axial compressors – Reciprocating compressors; LNG pumps and liquid expanders –Loading Arms and gas turbines, Description of Regasification.

UNIT – V

Submerged combustion vaporizers- Open rack vaporizers–Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues– Risk-based analysis of an LNG plant.

Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.

Textbooks:

- 1 LNG: Basics of Liquefied Natural Gas, Stanley Huang, Hwa Chiu and Doug Elliot, 1st Edition, PETEX. eISBN: 978-0886982171
- 2 Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press. eISBN: 9780608024646

Reference Books:

- 1 Natural Gas by Sea: The Development of a new technology, Roger Rooks, Wither by Publishers eISBN: 9780856140549
- 2 Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre. eISBN:

Web Links:

- 1 <http://folk.ntnu.no/skoge/prost/proceedings/aiche2008/data/papers/P139095.pdf>
- 2 https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/html/index.Htm
- 3 [http://petrowiki.org/Liquified_natural_gas_\(LNG\)](http://petrowiki.org/Liquified_natural_gas_(LNG))
- 4 <http://www.chebeague.org/fairwinds/risks.htm>
- 5 http://www.beg.utexas.edu/energyecon/LNG_Safety_and_Security_Update_2012.pdf

Artificial Lift Techniques
(Common to All, Except PT)

Course Code: 2501PT50

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the fundamental concepts of artificial lift techniques such as reservoir pressure, well productivity and reservoir fluids
- CO2:** Apply sucker rod lift system, polished rod motion, FRP sucker rods, criteria for rod string design with advantages and limitations.
- CO3:** Apply gas lift, gas compression requirements sonic flow, subsonic flow, volumetric efficiency advantages and limitations.
- CO4:** Explain electrical submersible pumps, principle hydraulic piston pumping advantages and limitations.
- CO5:** Explain hydraulic jet pumping advantages and disadvantages.

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	2	1	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	2	1	-	-	-	-	-	-	-	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-

UNIT-I

Introduction of artificial lift: 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, Progressive cavity pumping: Electrical submersible Pumps (ESP)-principle-hydraulic piston pumping-ESP design-ESP advantages and limitations.
Progressive cavity pumping: Plunger lift-working principle-design-plunger lift models-progressive cavity pumping (PCP) 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 pumpassisted 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. eISBN: 978-0123838469
2. Petroleum Engineering Handbook-Production Operations Engineering, volume 4 by Joe Dunn Clegg and Larry W. Lake, SPE. eISBN: 978-1555631147

Reference Books:

1. Petroleum production systems, M.J. Economides, A. Daniel Hill & C. E. Economides, Prentice-Hall, N.J-07488. eISBN: 978-0136586832
2. The Technology of Artificial Lift Method, Brown, K.E, Volume 1-4, Penn WellBooks, Tulsa, Oklahoma. ceISBN: 978-0878141545

Web Links:

1. http://petrowiki.org/Sucker-rod_lift
2. http://petrowiki.org/Gas_lift
3. http://petrowiki.org/Electrical_submersible_pumps
4. http://petrowiki.org/Hydraulic_pumping
5. https://en.wikipedia.org/wiki/Progressive_cavity_pump.

Enhanced Oil Recovery

(Common to All, Except PT)

Course Code: 2501PT03

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain the basic features and technical foundations of the most common EOR methods
- CO2:** Explain the basic geological factors for flooding of reservoirs
- CO3:** Apply screening criteria to a given reservoir to select a displacement method both technically and economically
- CO4:** Make Use of rock, fluid, and reservoir data for the Displacement of fluids in the reservoir
- CO5:** Apply screening criteria to a given reservoir to select a chemical method for flooding

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

UNIT – I

Principles of enhanced oil and gas recovery methods. IOR, EOR& EGR. Screening criteria for EOR methods.

UNIT – II

Geological Factors in Enhanced Oil Recovery

Reservoir heterogeneities, Examples of geological factors in enhanced recovery projects

Natural fractures,

Determination of Residual Oil Saturation based on

Geophysical Well logging techniques, Determination of residual saturation, Well-log-derived oil saturation determination in open hole, Residual oil saturation determination in cased wellbore

UNIT – III

Immiscible displacement: Injection well location, production well completion, surface installation. Miscible drive: Miscible slug flooding, thermodynamic miscibility, ternary diagrams, methods of miscible drive. Benham's correlations, physical and mathematical modelling.

UNIT – IV

Displacement of fluids in reservoir: capillary force; viscous force; phase trapping; mobilization of trapped phases, and alteration of viscous/capillary force ratio.

UNIT – V

Design aspects of chemical flooding. Case studies of surfactant, alkali, polymer, ASP flooding. WAG process, SWAG process, and Chemical augmented WAG process. Foam flooding.

Textbooks:

- 1 Enhanced Oil Recovery: Mechanisms, Technology, and Feasibility" by Ajay Mandal and Keka Oja. eISBN: 978-0128200810.
- 2 Applied Enhanced Oil Recovery, Aural Carcoane, Prentice Hall eISBN: 9780130442727

Reference Books:

- 1 Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, eISBN: 9781851666171
- 2 Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier eISBN: 978-3-319-31421-1
- 3 Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, eISBN: 9780132816014

Web Links:

- 1 <https://www.ogj.com/oil-drilling-and-production/production-operations/ior-eor.html>
- 2 http://www.ccop.or.th/ppm/document/INWS4/INWS4DOC03c_Norway_GUNNA_R.pdf
- 3 https://petrowiki.org/Polymer_waterflooding
- 4 https://www.glossary.oilfield.slb.com/en/Terms/a/alkaline_flooding.aspx
- 5 https://petrowiki.org/Conformance_improvement

Petroleum Refinery Engineering

(Common to All, Except PT)

Course Code: 2501PT12
Course Outcomes:

L	T	P	C
2	0	2	4

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

- CO1:** Identify the types of petroleum feed stocks and products by their properties
- CO2:** Make use of process knowledge to solve operational problems and increase the efficiency
- CO3:** Apply the knowledge of crucial processes to meet the end product demands
- CO4:** Prioritize the demand of various petrochemicals to optimize the processes
- CO5:** Classify various petrochemical products and their uses

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	2	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-

UNIT – I

Basic of Petroleum:

Role of Crude oil in global economy, Present Scenario of Crude Oil Refinery, Importance, Occurrence, Origin(formation), Exploration, Composition, Classification and Evaluation of Crude oil, Crude Assay Analysis, Distillation Characteristics such as True Boiling (TBP), American Society for Testing Materials (ASTM).

UNIT – II

Properties of Crude and Petroleum Products:

Various types of Average Boiling Points of Crude Oil & Petroleum Fractions.

Types of Gases & their Composition, Types of Gasoline & it's Important Properties and tests such as ASTM Distillation, RVP, Octane Number, Oxidation Stability, Sulphur Content etc,

Various Types of Naphtha and their Important Properties & Applications.

Important Tests & Properties of Kerosene such as Flash& Fire Point, Smoke Point, Aniline Point etc.,

Types of Diesel & its Important Properties & Tests such as Pour Point, Diesel Index, Cetane Number etc.

Heavy Fractions like Lube Oil, Bitumen, Asphalt etc & their Important Properties such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point etc.

UNIT

–

III

Processing of Petroleum:

Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude,

Distillation of Petroleum & Types of Reflux, ADU & VDU.

UNIT – IV

Thermal & Catalytic Cracking:

Thermal cracking – Processes, operating parameters, feed stock selection and product yields, Advantages –Types and functions of secondary processing – Visbreaking – Processes, operating parameters and advantages–Coking –Operating parameters and advantages. Fluid catalytic cracking – processes, operating parameters, feed stock selection and product yields –Advantages.

UNIT – V

Treatment Techniques:

Physical Impurities found in Crude& their Removal, Sweetening Techniques, Production and Treatment of LPG & their Methods, Dehydration and Sweetening of Gases, Gasoline Treatment such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Treatment of kerosene.

Textbooks:

- 1 Petroleum Refining: Technology and Economics ,J.H.Gary and G.E.Handwerk, 5th Edition, Marcel Dekkar, Inc. eISBN: 9780203907924
- 2 Elements of Petroleum Processing, D S Jones, Wiley–Blackwell. eISBN: 9780471964896

Reference Books:

- 1 Petroleum Refining Engineering, WL Nelson, 4th Edition, McGraw Hill Company eISBN: 9780070462687
- 2 Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers eISBN: 9780846404385
- 3 Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company eISBN: 9782710810650

Web Links:

- 1 <https://www.scribd.com/doc/.../Surface-Production-Operations-Volume-1-Oil-System>
- 2 www.academia.edu/.../Ken_Arnold-Surface_Production_Operations_Volume_1_3rdE
- 3 <https://byjus.com/chemistry/petroleum/>
- 4 <https://www.slideshare.net/.../surface-production-operations-volume-iv-pumps-compr...>
- 5 https://www.researchgate.net/publication/359449933_Petroleum_sludge_treatment_and_disposal_techniques_a_review

Minor Degree in Mining Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN03	Development of Mineral Deposits	FC	3			3	50	50	100	-
2501MN41	Green Mining	FC	3			3	50	50	100	-
2501MN06	Surface Mining	IC	3			3	50	50	100	DMD
2501MN24	Drilling & Blasting	IC	3			3			100	DMD
2501MN07	Underground Coal Mining Technology (or) Underground Metal Mining Technology	IC	3			3	50	50	100	DMD
2501MN08										
2501MN14	Mine Legislation & General Safety (or) Environmental Pollution & Control	AC	3			3	50	50	100	UCMT / UMMT
2501MN28										
2501MN45	Industrial Safety Practices (or) Ground Control	AC	2			2	50	50	100	-
2501MN46										
TOTAL			2			20				

Development of Mineral Deposits
(Common to All, Except Min.E)

Course Code: 2501MN03

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Summarize different stages in the life of a mine
- CO2:** Choose a suitable location for opening to a deposit.
- CO3:** Explain Exploratory and Production Drilling
- CO4:** Categorize the use of explosives and blasting.
- CO5:** Summarize material handling and transportation 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
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction to mining: Mining terminologies, Stages in the life of the mines- Prospecting, Exploration, Development, Exploitation, Reclamation, Brief overview of Surface & Underground Mining Methods.

UNIT – II

Access to mineral Deposits: Adits, shafts, incline - location, shape and size; Drilling, blasting and removal of debris. Methods of shaft sinking –conventional, mechanized and special methods; opening up of surface deposits.

UNIT – III

Exploratory and Production Drilling: Principles of drilling, Types of drill, Drill rods and drill bits – types and applications, Exploratory drilling - Drilling fluid; Production drilling – Rotary, Percussive, Rotary- percussive, pneumatic; Drill patterns.

UNIT – IV

Explosives and Blasting: Types of explosives, Properties of explosives, Detonators. Detonating cords, and detonating fuse and nonel detonator. Storage and transport of explosives, Mechanics of blasting, Primary and secondary blasting, Blast geometry and design, electrical and non electrical methods, delay blasting techniques, handling misfires.

UNIT – V

Material Handling and Transportation in Mines: LHD, SDL, shuttle car, AFC and belt conveyors; Raises, winzes, ore passes, ore chutes; shovels, dumpers, silo, bin, CHP, tippler.

Text Books:

1. Elements of Mining Technology, D.J.Deshmukh, Denett& Co., Nagpur Vol. I, ISBN: 978-8189904333.
2. Surface Mining, Dr T.N.Singh, Lovely Prakashan, Dhanbad , 2nd Edition, ISBN: 978-8179561294.

Reference Books:

1. Indian Bureau of Mines, Minerals Year Book & other publications, Latest Edition.
2. Explosives and blasting techniques, G.K Pradhan, Latest edition. ISBN: 978-0470512275.
3. Rock Blasting and Overbreak Control, Dr. Calvin Konya; Precision Blasting Services, Montville, Ohio 2nd Edition, ISBN: 9780318198965.

Web Links:

1. <http://www.miningglobal.com/operations/gifs-5-stages-mining-life-cycle>
2. <https://www.minecationstandards.org/fileadmin/MAS/documents/nmas-national>
3. stabdards/afghanistan/AMAS_07.04_Storage_Transportation_Handling_of_Explosives.Pdf

Green Mining
(Common to All, Except Min.E)

Course Code: 2501MN41

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the importance of green mining.
- CO2:** Plan and scheduling of activities related to mine waste management.
- CO3:** Analyze the impact of water pollution due to mining.
- CO4:** Distinguish progressive and final mine closure planning
- CO5:** Explain the usage of renewable energy in mines.

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	1	-	-	-	-	-	-	-	-
CO2	-	-	1	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-
CO5	-	3	1	-	-	-	-	-	-	-	-

UNIT – I

Footprint Reduction: Importance of green mining, Sustainable project management, Corporate social responsibility for industrial sustainability, Environment Friendly Mining Equipment's, Clean development mechanism (CDM), CCUS technology, Application of Bio Fuels.

UNIT – II

Mine Waste Management: Types of mine waste Overburden, Tailings and other wastes. Characterization, disposal, management of different types of mining waste.

UNIT – III

Mine Water: Sources of pollution, Effect of mining on water bodies, Treatment of mine water, Water conservation initiatives in mines, zero waste water discharge.

UNIT – IV

Mine Closure Planning: Progressive and final mine closure planning, structure of mine closure report, Legislative provisions on mine closure planning.

UNIT – V

Renewable Energy: Usage of renewable energy in mines solar power, wind power; associated problems.

Text Books:

1. Green Mining: The Way Forward, Anil Jha, Das Gupta Co Pvt Ltd Publication, 2019, ISBN: 978-8194161424.
2. Sustainable Mining Practices, A.K. Gorai and D. Nimaje, Narosa Publishing House, ISBN: 9788184876048.

Reference Books:

1. Mining and Environmental Sustainability, G. S. Roonwal, ASTRAL Publication, ISBN: 9789351247591.
2. Advances in Productive, Safe, and Responsible Coal Mining, Joseph Hirschi, Elsevier Ltd, 2019, ISBN: 9780128156263.

Web Links:

1. <https://www.mdpi.com/books/pdfview/book/3216>
2. <https://web.mit.edu/12.000/www/m2016/finalwebsite/solutions/greenmining.html>
3. <https://www.sciencedirect.com/science/article/pii/S187661021200077X>
4. [Oxford scientists show how green mining could pave the way to net zero and provide the metals we need for a sustainable future | University of Oxford](#)
5. Green Mining (mdpi.com)

Surface Mining
(Common to All, Except Min.E)

Course Code: 2501MN06

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Analyze different surface mining methods
- CO2:** Design the layout of a large opencast mine
- CO3:** Design drilling and blasting for Surface mining
- CO4:** Choose the better excavation and loading equipments
- CO5:** Organize the transportation 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
CO1	3	1	-	2	-	-	-	-	-	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction: Status and scope of surface mining- Applicability, Limitations and, advantages and disadvantages. Methods of opening box cut, selection of site for box cut. Surface Mining Methods: Open pit Mining, Open cast Mining, Quarrying, High-wall Mining Modern Methods. Placer Mining.

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, Bench Design/Geometry, Design and stability slopes.

UNIT – III

Blast Design in Surface Mines: Drillability, mechanics of drilling, major types of drilling machines. Blasting: Basics of mechanics of blasting, principles of fragmentation. Blast design, Adverse impacts of blasting in surface mines. Controlled blasting techniques. Novel methods of blasting.

UNIT – IV

Excavation and Loading: Shovels, Dragline, Front-end loader. Non-Cyclic Surface Mining: Bucket Wheel Excavators and Continuous surface miners. Auxiliary Equipment: Stackers, Graders, Dozers, Ripper.

UNIT – V

Transport Equipment: Selection of mode of transport. Dumpers, Aerial ropeways-monocable and bicable types and their constructional details. Conveyor systems, ICC system, Slurry Transportation.

Text Books:

1. Surface Mining Technology, S. K. Das, Lovely Prakashan, Dhanbad.
2. Surface Mining, G. B. Mishra, Dhanbad Publishers.

Reference Books:

1. Opencast Mining unit operations, V.V.Rzhevsky, Mir Publisher's, Moscow, ISBN: 978-0873351087.
Open Pit Mine Planing and Design Crawford, T.john, American Institute of
2. Mining, Metallurgical and Petroleum Engineers, ISBN: 978-0873351027.

Web Links:

1. <http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf>
2. http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/safework/documents/normativeinstrument/wcms_107828.pdf
3. <https://www.iitbhu.ac.in/faculty/min/rajesh-rai/NMEICT/Slope/Pdf/03%20Types%20of%20slope%20failure.pdf>

Drilling & Blasting (Common to All, Except Min.E)

Course Code: 2501MN24

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Differentiate between types of drilling machines.
CO2: Identify and classify explosives
CO3: Analyze problems associated with open cast blasting and mitigation.
CO4: Analyze problems associated with underground blasting and mitigation.
CO5: Assess blasting in metal mines.

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	1	3	2	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	1	3	-	-	-	-	-	-	-	-	-
CO4	1	3	-	-	-	-	-	-	-	-	-
CO5	1	3	-	-	-	-	-	-	-	-	-

UNIT – I

Drilling: Drillability, mechanics of drilling, major types of drilling machines, Principles of drilling, Types of drill, Drill rods and drill bits -Types and applications, Exploratory and Production Drilling.

UNIT – II

Explosives and Blasting Accessories: Mechanism of blasting, Explosives- types and properties. Selection of explosives, Handling, and storage of explosives. Types of initiating systems – Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders. Blast Design in Surface and Underground Mines.

UNIT – III

Drilling and Blasting in Surface Mines: Factors affecting blasting, Blast design - estimation of burden and spacing, estimation of charge requirement; Initiation patterns; secondary blasting – pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure.

UNIT – IV

Drilling and Blasting in Underground Coal Mines: Blast hole patterns and their applicability, blasting-off-solid, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns.

UNIT – V

Drilling and Blasting in Underground Metal mines: Blast hole patterns and their applicability, blast design for horizontal drivage, long hole blasting, vertical crater retreat blasting.

Text Books:

1. Principle of rock drilling, B. Misra, U.M. Rao Karanam, Taylor & Francis, CRC Press, ISBN: 9781138033646.
2. Drilling & Blasting Minetech, Pradhan G.K., Ghose A.K., Bhubaneswar, India: Mintech, ISBN: 9789383183039.

Reference Books:

1. Elements of Mining Technology, DJ Deshmukh, Denet, First Edition, Vol. 1, ISBN: 978-81-89940-02-7.
2. Surface mining, GB Mishra, Dhanbad, Vol.1, ISBN: 978-0873351027.

Web Links:

1. <https://archive.nptel.ac.in/courses/123/105/123105003/>
2. <https://www.rpmdrilling.co.za/blast-hole-drilling-process/>
3. www.railsystem.net/drill-and-blast-method/

Underground Coal Mining Technology
(Common to All, Except Min.E)

Course Code: 2501MN07

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of underground coal mining.
- CO2:** Explain the various mine development methods.
- CO3:** Explain the long wall mining method.
- CO4:** Analyze the various thick and deep seam mining methods.
- CO5:** Categorize the various modern mining 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	PO 11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	2	-	3	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-

UNIT – I

Introduction: Formation of coal deposits, structures associated with coal deposits, rank and grade of coal. Different coal mining methods: factors influencing choice of coal mining methods. Status of coal mining industry in India and global scenario.

UNIT – II

Bord and Pillar Mining: Applicability, limitations, advantages and disadvantages of Bord and pillar mining method. Development-Design of pillars and panel, supports. Depillaring-methods and sequence of operations, splitting and slicing of pillars, supports. Partial extraction techniques. Extraction of multi seams. Stowing Techniques. Mechanization-SDL, LHD, Continuous miners, belt conveyors, UDM etc., Case studies.

UNIT – III

Longwall Mining: Applicability, limitations, merits and demerits, Longwall mining Methods- Advancing and Retreating, Thin and Thick seam. Longwall Development- Gate roads, longwall face. Face Mechanization, Shearer, Plough, AFC, Powered Supports. Sequence of operations- Cutting and conveying of coal from face. Case studies.

UNIT – IV

Thick Seam Mining: Applicability, limitations, and problems associated with thick seam mining, selection of mining method, caving and stowing methods. Different slicing methods-inclined Slicing, Horizontal Slicing, Diagonal Slicing, Transversely Inclined

Slicing, Caving methods- Sublevel Caving Working Steep and Moderately Thick Seams- Blasting Gallery method, Room and Pillar method, Descending Shield method of Mining. Design of Supports, Case studies.

UNIT – V

Modern Coal Mining Methods: Horizon Mining, Hydraulic Mining, Underground Coal Gasification. Case studies.

Text Books:

1. Principles and Practices of Modern Coal Mining, R. D. Singh, New Age International, ISBN: 978-8122429705.
2. Modern Coal Mining Technology, S. K. Das, Lovely Prakashan Publishers, 2nd Edition, ISBN: 978-81-7850-043-6.

Reference Books:

1. Underground Coal Mining Methods, J. G. Singh, BrajKalpa Publishers, Varnasi, ISBN: 81-7525-204-9.
2. Coal Mining, I.C.F. Statham, The Caxton Publishing Company Ltd. Inc, Vol. I, II, III and Vol. III, ISBN: 978-81-7850-043-9.
3. Winning and working coal, R. T. Deshmukh, D.J Deshmukh Vol 1 & 2, ISBN: 97-88-189904333.

Web Links:

1. <https://osme.co.in/wp-content/uploads/2023/01/UCMR-BAL-1.pdf>
2. https://www.digitalxplore.org/up_proc/pdf/340-151522605452-56.pdf

Underground Metal Mining Technology (Common to All, Except Min.E)

Course Code: 2501MN08

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of metal mining
- CO2:** Analyze the various mine development methods.
- CO3:** Analyze the basics of stoping
- CO4:** Compare the various stoping methods.
- CO5:** Categorize the various special stoping 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	PO 11
CO1	3	-	-	-	-	3	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction to Metal Mining: Terminologies in metal mining. Special Characteristics of Metalliferous deposit. Scope and limitations of underground metal mining. Access to deposits, Status of metal mining in India and World.

UNIT – II

Mine Developments: Factors affecting choice of level interval, Cross cuts, drive, shape and size of drive, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks. Unit Operations in Metal Mining.

UNIT – III

Basics of Stopping: Stopping methods- applicability, limitations, merits and demerits. Selection of stopping methods. Stope design and production planning in various methods of stoping. Support design.

UNIT – IV

Stoping Methods: Supported and un-supported Stopping Methods, Caving methods. Description, application and design of stoping methods. Mechanisation of stopes.

UNIT – V

Novel Techniques: In-situ leaching, bio-mineral engineering, hydraulic mining, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.

Text Books:

1. Introductory Mining Engineering, H L Hartman, John Wiley and sons. ISBN: 978-0471811778.
2. Elements of Mining Technology, D.J.Deshmukh. Vol III. ISBN: 978-8184890700.

Reference Books:

1. Deep Mining, Jack Spalding, Mining Publications, ISBN: 978-0-903078-36-8
2. Mineral Engineers Handbook, Peele, Vol. I & II, ISBN: 978-0873352205 & 978-0873352212.
3. U/G Mining Method, Hustrulid, Society for Mining, Metallurgy & Exploration, ISBN: 978-0873352643.

Web Links:

1. <https://www.911metallurgist.com/methods-mining-metals/>
2. <https://www.greatmining.com/metals.html>

Mine Legislation & General Safety
(Common to All, Except Min.E)

Course Code: 2501MN14

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Illustrate the general principle of mining laws and regulations
CO2: Compare the rules and regulation framed under CMR& MMR.
CO3: Explain the various mining rules and Indian electricity rules
CO4: Explain the Mineral concession rules and mine act
CO5: Explain the training rules and DGMS circular

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	1	3	-	-	-	2	-	-	-	-	-
CO2	1	3	-	-	-	-	-	-	-	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	-	-	-	-	-	-

UNIT – I

General principles of mining laws, The Mines Act 1952, The mines & Minerals (Regulation & Development) Act 2015, Industrial dispute Act 1947.

UNIT – II

The Coal Mines Regulations 2017 and The Metalliferous Mines Regulations 2019.

UNIT – III

The Mines Rules 1955, Mine rescue rule 1985, Indian Electricity rule 1956.

UNIT – IV

The Mineral Concession Rules 2017, The Mineral Concession and Development Rules 2017.

UNIT – V

Introduction to Environmental Legislation in mines, Land Acquisition & Revenue: Concepts: Related laws and regulations. Forest Conservation Act 1980.

Text Books:

1. Mines act, Mine Rules, CMR, MMR, MVTC, Mine Rescue Rules, DGMS
2. Legislation in Indian Mines: A critical appraisal, Rakesh and S. D. Prasad, Mrs Asha Lata Varnasi, 5th Edition.

Reference Books:

1. Proceeding of the National Seminar on Policies, A. K. Ghosh, S. K. Ray and A. K. Patra, Statutes & Legislation in Mines, CIMFR, Dhanbad.
2. Mineral Concession Rules 1960, V. K. Malhotra, Malhotra Bros., Patna, Supplementary Edition.

Web Links:

1. <https://mines.gov.in/writereaddata/UploadFile/MMDR%20Act,1957.pdf>
2. <https://dgms.gov.in>.

Environmental Pollution & Control
(Common to All, Except Min.E)

Course Code: 2501MN28

L T P C
3 0 0 3

Course Outcomes:

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

CO1: Illustrate the fundamentals of environmental issues in mining

CO2: Examine the various causes of water pollution.

CO3: Analyze the various causes of air pollution.

CO4: Analyze the methods for mine reclamation

CO5: Assess environmental impact due to 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
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

UNIT – I

Air Pollution: Atmospheric science; Sources of air pollution in mines; Effect of air pollution and preventive measures; Ozone layer and greenhouse effect; Dispersion model.

UNIT – II

Water Pollution: Sources of water pollution; Effect and preventive measures of water pollution; Ground water and its contamination; Water pollution modeling - biological oxygen demand and chemical oxygen demand; Acid mine drainage; Waste water treatment.

UNIT – III

Noise Pollution: Terminologies associated with noise; Sources and effects of noise; Measurement of noise; Noise standard and guidelines; Noise control strategies.

UNIT – IV

Land Reclamation and Rehabilitation: Causes of land degradation; Land reclamation method- Rehabilitation, Reclamation, Restoration; Factor affecting the land restoration; Land reclamation planning.

UNIT – V

Socio-Economic Impact Assessment: Socio-economic impact of mining, Quality of life index.

Text Books:

1. Environmental Pollution and Control, Peirce J. Jeffrey, Elsevier Science & Technology, Fourth Edition, 2018, ISBN: 978-0128125428.
2. Principle and practices of modern coal mining, R.D. Singh, New Age International, ISBN: 978-8122416464.

Reference Books:

1. Ground Control, Peng, S.S. Wiley Publications, New York, ISBN: 978-0471775410.
2. Open pit mine planning and Design, W. Hustrulid and M. Kuchta, A. A. Balkema Rotterdam, 1st edition, Vol – I, ISBN: 978-9056990736.
3. Surface Mining, G. B. Mishra, Lovely Prakashan Dhanbad, 1st Edition, ISBN: 978-81-85500-42-6.

Web Links:

1. <https://miningandblasting.wordpress.com/2011/08/30/mine-planning-and-scheduling-smart-practice>
2. https://onlinecourses.nptel.ac.in/noc22_ce22/preview

Industrial Safety Practices
(Common to All, Except Min.E)

Course Code: 2501MN45

L T P C
2 0 0 2

Course Outcomes:

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

- CO1:** Describe Occupational Health Hazards
- CO2:** Analyze the concept of Ergonomics and its importance in Industrial safety
- CO3:** Describe Importance of Industrial safety.
- CO4:** Analyze and apply effects of radiation on human body
- CO5:** Analyze different accident prevention 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
CO1	2	3	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction to industrial safety: Safety scenario in national and international arena, identification of safety issues in different industries and their remedial measures, general safety practices.

UNIT – II

Ergonomics: Ergonomics – Importance, Ergonomics Hazards – Musculoskeletal Disorders and Cumulative Trauma Disorders, ergonomics studies.

UNIT – III

Industrial Health and Hygiene: Occupational health hazard & classification of health hazards, Occupational health and hygiene surveillance, legislative measures and prevention of health hazards.

UNIT – IV

Personal Protective Equipment: Types of personal protective equipment and their usages.

UNIT – V

Accident Prevention Techniques:Types of accidents, causes of accidents- unsafe acts and conditions, accident investigation and prevention.

Text Books:

1. The Factories Act with amendments, Govt. of India Publications DGFASLI, Mumbai, ISBN: 978-9352471010.
2. Frank P Lees – Loss of prevention in Process Industries, Butterworth- Heinemann Ltd., London, Vol. 1 and 2, ISBN: 978-0750633016 & 978-0750633023.

Reference Books:

1. Accident Prevention Manual, NSC, Chicago, ISBN: 978-1118240295.
2. Occupational safety Manual, BHEL, Trichy, ISBN: 978-81-73190163.
3. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, ISBN: 978-8173190162.

Web Links:

1. <https://www.osha.gov/>
2. <https://www.healthandsafetyatwork.com/>
3. <http://ohsonline.com/>

Ground Control
(Common to All, Except Min.E)

Course Code: 2501MN46

L T P C
2 0 0 2

Course Outcomes:

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

- CO1:** Describe about concept of ground control in mines.
- CO2:** Analyze strata pressure and management.
- CO3:** Illustrate types of Roof support.
- CO4:** Analyze the design of structure in rock.
- CO5:** Explain about the Subsidence 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
CO1	2	3	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-
CO5	2	3	-	-	-	-	-	-	-	-	-

UNIT – I

Introduction: Definition and concept of ground control in mines, Ground control practice in mines, constraints on ground control design.

UNIT – II

Strata pressure and management: The modern concept of strata pressure redistribution. Manifestation of strata pressure, convergence, load on the prop, creep, heave, roof fall, and fracture systems due to mining. In-situ stress measurement, instrumentation.

UNIT – III

Roof support: Timber and steel supports, friction and hydraulic prop, arches, shotcrete, roof truss, roof bolts and cable bolts powered supports stowing caving strip packing pump packing rock reinforcement.

UNIT – IV

Design of structures in rock: Design of underground openings. Design of pillars, design of open pit slopes, waste dumps, and embankments, design of stopes.

UNIT – V

Subsidence: Theories of subsidence, factors affecting subsidence, prediction, and measurement of subsidence. Damage and prevention of damage due to subsidence, Bumps and rock bursts-causes, occurrence, and control.

Text Books:

1. Rock Mechanics and Design of structures in rock, Obert & Duvall, ISBN: 978-0471192994.
2. Coal Mining Ground Control, Peng S.S., ISBN: 978-0470512277.

Reference Books:

1. Fundamental of Rock Mechanics, Jaeger and Cook, ISBN: 978-0470015393.
2. Rock Mechanics and Ground Control, V. Singh & B.P. Khare, ISBN: 978-8187739557.

Web Links:

1. <https://www.sciencedirect.com/science/article/pii/S1877705812045055>
2. <https://core.ac.uk/download/pdf/237427482.pdf>
3. <https://raiseandlevel.com/how-to-prevent-ground-subsidence-in-residential-areas/>

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AE82	Fundamentals of Renewable Energy Sources	FC	3			3	50	50	100	
2501AE83	Post-harvest Engineering of Cereal Crops	FC	3			3	50	50	100	
2501AE84	Ground Water Hydrology	FC	3			3	50	50	100	
2501AE85	Micro Irrigation Systems	IC	2			2	50	50	100	
2501AE86	Surface Water Hydrology (or) Land & Water Management Engineering	IC	3			3	50	50	100	GWH
2501AE87										
2501AE88	Agricultural Process Engineering & Food Quality (or) Post-harvest Engineering for Horticultural Produce	AC	3			3	50	50	100	PHECC
2501AE89										
2501AE90	Agricultural Machinery & Equipment (or) Design of Bio-energy systems	AC	3			3	50	50	100	FRES
2501AE91										
TOTAL			20			20				

Fundamentals of Renewable Energy Sources
(Common to All, Except AE)

Course Code: 2501AE82

L T P C
3 0 0 3

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

- CO1:** Explain the fundamental concepts of renewable energy.
- CO2:** Analyze the principles of solar energy and explore its various applications.
- CO3:** Describe wind energy conversion systems, including wind generators, and evaluate their power generation capabilities.
- CO4:** Analyze the processes involved in biogas production from biomass.
Explain the basic principles and operations of tidal energy, fuel cells, and geothermal energy systems.
- CO5:** Explain the basic principles and operations of tidal energy, fuel cells, and geothermal energy

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	3	2	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-
CO3	3	-	3	-	2	-	-	-	-	-	1
CO4	3	-	3	2	-	1	-	-	-	-	-
CO5	3	-	3	2	-	1	-	-	-	-	-

UNIT – I

Renewable energy sources: Different sources of renewable energy- concepts and limitations of different renewable energy sources (RES) as solar, wind, geothermal, biomass, ocean energy sources. Criteria for assessing the potential of RES. Comparison of renewable energy sources with non-renewable sources.

UNIT – II

Solar energy: Solar energy- energy available from sun, solar radiation data, solar energy conversion into heat through flat plate and concentrating collectors, different solar thermal devices, principle of natural and forced convection solar drying system. Solar photo voltaics- basics and applications, p-n junctions. Solar cells, PV systems, stand alone, grid connected solar power station. Calculation of energy through photovoltaic power generation and cost economics.

UNIT – III

Wind Energy: Wind energy- energy availability, general formula, lift and drag. Basics of wind energy conversion, effect of density, frequency variances, angle of attack, wind speed, types of windmill rotors, determination of torque coefficient, induction type generators. Working principle of wind power plant. Wind farms, aero-generators, wind power

generation system.

UNIT – IV

Energy from Biomass: Biogas- basics of anaerobic digestion, types and constructional details of biogas plants, biogas generation and its properties, factors affecting biogas generation and usages, design considerations, advantages and disadvantages of biogas spent slurry. Generation of power from biogas. Design & use of different commercial biogas plants.

UNIT – V

Other source of energy: Power generation from urban, municipal and industrial waste. Ocean thermal and electric power generation, wave and tidal power. Power generation from biomass (gasification & Dendro- thermal). Mini and micro hydel plants. Fuel cells and its associated parameters

Text Books:

1. Rai G D. Non-Conventional Energy Sources. Khanna Publishers, New Delhi. (ISBN:978-81-7409-073-8)
2. Basu P. Biomass Gasification and Pyrolysis Practical Design and Theory. Academic Press. (ISBN: 10-0123749883)

Reference Books:

1. Patel M R. Wind and Solar Power Systems. CRC Press, Bota Racon. (ISBN: 978-0849315701)
2. DeubleinD and SteinhauserA. Biogas from Waste and Renewable Resources. WILEY- VCH Verlag GmbH & Co. KGaA, Weinheim. (ISBN:9783527621705)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2. https://www.vssut.ac.in/lecture_notes/lecture1428910296.pdf

Post-harvest Engineering of Cereal Crops (Common to All, Except AE)

Course Code: 2501AE83

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the importance of different unit operations and working of size reduction equipments.
- CO2:** Identify various methods for determining moisture content, EMC and drying.
- CO3:** Compare separator equipments based on physical characteristics of grains and explain material handling devices.
- CO4:** Explain the importance, design and working of milling equipments for cereals.
- CO5:** Explain the importance, design and working of milling equipments for rice.

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	3	2	-	1	1	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-
CO3	3	2	2	2	2	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-

UNIT – I

Unit operations in grain processing: General unit operations in agricultural process engineering and importance of these unit operations in grain processing; Structure and composition of cereals. Cleaning and grading: Principles of cleaning, scalping, sorting and grading; Size reduction: Principle; Bond’s law, Kick’s law, Rittinger’s law; Sieve analysis; Different classifications of size reduction machines; description of jaw crusher, hammer mill, attrition mill, and ball mill.

UNIT – II

Drying: Moisture content and water activity, free moisture, bound moisture and equilibrium moisture content, isotherm, hysteresis effect, EMC determination; Psychrometric chart and its use in drying; Drying principles and theory, thin layer and deep bed drying analysis, falling rate and constant rate drying periods, maximum and decreasing drying rate periods, drying equations, mass and energy balance, Shedd’s equation; Drying methods (conduction, convection, radiation, batch, continuous); Different types of cereal grain dryers (bin, flat bed, LSU, columnar, RPEC, fluidized, rotary and tray), tempering during drying; dryer performance.

UNIT – III

Separation and Material Handling: Screens, different types of screen separators, fixed and variable aperture screens, capacity and effectiveness of screens, sieve analysis; various types

of separators as specific gravity, magnetic, disc, spiral, pneumatic, inclined belt draper, velvet roll separator, colour sorter, cyclone separator.

Basic parts of different types of conveyors and elevators, viz. belt, roller, chain, screw, and bucket elevator, cranes & hoists, pneumatic conveying, power requirement for conveying and elevating.

UNIT – IV

Milling of wheat, corn, pulses and oil seeds: Milling of wheat: unit operations and equipment; Milling of corn: unit operations and equipment in dry and wet milling methods; Milling of pulses: pre-conditioning, dry milling and wet milling methods, CFTRI and Pantnagar methods.

UNIT – V

Milling of Rice: Merits and demerits, changes during parboiling of rice, parboiling methods, viz. traditional methods, CFTRI method, Jadavpur method, pressure parboiling; different unit operations and equipment involved in traditional and modern rice milling methods; Preparation of rice products as rice flakes and puffed rice.

Text Books:

1. Unit Operations of Agricultural Processing, Sahay KM and Singh KK, Vikas Publishing House Pvt. Ltd., New Delhi. (ISBN-13. 978-8125911425)
2. Post-Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A, Oxford and IBH Publishing. Ltd., Calcutta.(ISBN-10. 9788120409699)

Reference Books:

1. Transport Processes and separation Process Principle, Geankoplis C J Prentice-HallInc., New Jersey.(ISBN-13. 9788120409699)
2. Unit Operations of Chemical Engineering, McCabe WL, Smith JC and Harriott P McGraw-Hill Book Co., Boston.(ISBN-13. 978-8184959635)

Web Links:

1. <http://www.cigr.org/documents/CIGRHandbookVol4.pdf>
2. <http://ecoursesonline.iasri.res.in/course/view.php?id=22>

Ground Water Hydrology (Common to All, Except AE)

Course Code: 2501AE84

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain properties of various water bearing formations and movement of ground water.
- CO2:** Determine the aquifer properties under unsteady state and steady state subsurface flow conditions.
- CO3:** Explain design, development and construction of wells.
- CO4:** Analyze various water quality parameters and explain the occurrence of saline water intrusion.
- CO5:** Select appropriate method for exploration and replenishment of ground water.

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	1	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	-	3	-	1	-	-	-	-
CO3	-	-	3	2	-	-	-	-	-	-	-
CO4	1	-	2	-	-	-	-	-	-	-	-
CO5	1	1	-	-	-	-	-	-	-	-	-

UNIT-I

Occurrence and Movement of Ground water: Introduction- Global water scenario; Water resources status in India; Origin and age of ground water; groundwater column, zones of aeration and saturation, Aquifer and its types; Aquifer characteristics.

Ground water movement: Darcy's law; Determination of Hydraulic conductivity; Ground water flow rates and directions; Ground water tracers, General flow equations through porous media.

UNIT-II

Well Hydraulics: Determination of aquifer parameters under steady/ unsteady, uniform/ radial flow to a well in a confined/ unconfined /leaky aquifer by different methods- Dupit Theim, Theis, Jacob and Chow's; Characteristic well losses; Specific capacity.

UNIT-III

Water Wells: Classification of wells; Methods of drilling of wells; Design and assembly of gravel packing; Installation of well screens; Common well drilling difficulties; Completion and development of well; Well Rehabilitation.

UNIT-IV

Ground water quality: Sources of salinity; Measures of water quality; Chemical, Physical and Biological analysis of ground water; Ground water samples; Water quality criteria; Occurrence of saline water intrusion- Ghyben-Herzberg relation between fresh and saline waters.

UNIT-V

Ground Water Investigations: Geological /geophysical exploration/ remote sensing / electric resistivity /seismic refraction-based methods for surface investigation of ground water, sub-surface ground water investigation through geophysical / resistivity; Methods of artificial recharge of ground water.

Text Books:

- 1 Groundwater, H.M. Raghunath, New Age International, 3rd Edition. (ISBN: 978-8122419047)
- 2 Groundwater Hydrology, D.K. Todd, John Wiley and Son, New York, 2nd Edition. (ISBN: 9788126508365)

Reference Books:

- 1 Land and Water Management Engineering, V.V.N Murty and M.K. Jha, Kalyani Publishers, 6th Edition. (ISBN: 978-9327214659)
- 2 Groundwater and tube wells, Garg S.P, Oxford and IBH publishing company limited, New Delhi. (ISBN: 8120408268)

Web Links:

- 1 <http://nptel.ac.in/courses/105105042/>
- 2 <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124667/>

Micro Irrigation Systems
(Common to All, Except AE)

Course Code: 2501AE85	L	T	P	C
	2	0	0	2

Course Outcomes:

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

- CO1:** Assess the adaptability, problems, and prospects of different types of sprinkler irrigation systems.
- CO2:** Plan and design the layout of sprinkler irrigation systems, including the hydraulic design of lateral, sub-main, and main pipelines, and select appropriate pumps and power units.
- CO3:** Evaluate the performance of sprinkler irrigation systems by analyzing water distribution patterns, overlapping of sprinklers and laterals, uniformity coefficient, and pattern efficiency.
- CO4:** Explain the types, components, and advantages and disadvantages of micro irrigation systems (drip, spray, and bubbler), and design effective drip irrigation systems considering wetting patterns and irrigation requirements.
- CO5:** Perform proper operation and maintenance of micro irrigation systems, addressing issues like clogging, filter cleaning, flushing, and chemical treatment, and apply fertigation techniques, understanding their benefits, limitations, and best practices.

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

UNIT – I

Introduction to Sprinkler Irrigation Systems: Sprinkler irrigation: adaptability, problems and prospects, types of sprinkler irrigation systems.

UNIT – II

Design and Components of Sprinkler Irrigation Systems: Design of sprinkler irrigation system: layout selection, hydraulic design of lateral, sub-main and main pipe line, design steps; Selection of pump and power unit for sprinkler irrigation system.

UNIT – III

Performance Evaluation and Micro Irrigation Systems: Performance evaluation of sprinkler irrigation system: water distribution pattern and overlapping of sprinklers and laterals, uniformity coefficient and pattern efficiency; Micro Irrigation systems: types- drip, spray, & bubbler systems, merits and demerits, different components.

UNIT – IV

Design and Operation of Drip Irrigation Systems: Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection; Hydraulics of drip irrigation system, design steps; Necessary steps for proper operation of a drip irrigation system, maintenance of micro irrigation system: clogging problems, filter cleaning, flushing and chemical treatment.

UNIT – V

Fertigation in Micro Irrigation Systems: Fertigation: advantages and limitations of fertigation, fertigation frequency, duration and injection rate, methods of fertigation.

Text Books:

1. Principles of Sprinkler Irrigation system, Mane M S and Ayare B L.Jain Brothers, New Delhi.(ISBN : 9788183601504)
2. Irrigation: Theory and Practice, Michael A M. ,Vikas Publishing, New Delhi. (ISBN:978-8125918677)

Reference Books:

1. Micro Irrigation - Theory and Practices, Suresh R, Standard Publishers Distributors, Delhi. (ISBN:9788180141508)
2. Sprinkler Irrigation, Sivanappan R K.,Oxford & IBH Publishing House, New Delhi. (ISBN:978-8120402324)

Web Links:

1. http://agritech.tnau.ac.in/agricultural_engineering/agriengg_swc_microirri_ferti.html
2. Course: Micro Irrigation Systems Design 3(2+1) (iasri.res.in)

Surface Water Hydrology
(Common to All, Except AE)

Course Code: 2501AE86

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Calculate the mean areal precipitation using various methods.
CO2: Explain rainfall characteristics and measuring devices in India.
CO3: Explain runoff and stream flow measurement methods.
CO4: Estimate the discharge volume of runoff using hydrographs and unit hydrographs.
CO5: Plan a reservoir using flood routing techniques for management of natural resources.

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	2	-	-	-	-	-	-	-	-	-	-
CO2	2	1	-	-	2	-	-	-	-	-	-
CO3	2	1	-	-	2	-	-	-	-	-	-
CO4	2	-	-	2	3	-	-	-	-	-	-
CO5	1	2	-		3	-	-	-	-	-	-

UNIT-I

Precipitation: Hydrology-definition, hydrological cycle and its components. Forms of Precipitation, Characteristics of rainfall in India (types of monsoon). Measurement of Rainfall – Recording and Non-Recording Rain gauges- Rain gauge network density for different topographic conditions – Point rainfall analysis - Presentation of Rainfall data – Mass Curve and hyetograph, Mean Precipitation over an area –

Arithmetic Mean, Thiessen Polygon, Isohyetal methods, DAD Relationships and curves. Probability Analysis of Rainfall – Return Period, Plotting position by Weibull's method – Rainfall events at different probability levels (20%, 40%, 60%, and 80 %).

UNIT-II

Runoff: definition-components of runoff-direct runoff and base flow, overload flow and interflows, pictorial representation of different routes of runoff. Runoff characteristics of streams – perennial, intermittent and ephemeral streams. Definition and Estimation of peak runoff using rational method.

Stream flow measurement: Measurement of stream flows. Measurement of stage and velocities, staff gauge, wire gauge, automatic stage recorders, current meters (horizontal and vertical axis meters), calibration ($V = a N_s + b$). Rainfall-Runoff relations ($R = a P + b$), curve fitting and determination of 'a' and 'b' and (correlation coefficient). Intensity-Duration-Frequency-Relationship ($i = ((KT_x) / (D+A) n)$). Determination of net effective rainfall-infiltration indices- Phi index.

UNIT-III

Hydrographs: definition and components, factors affecting flood hydrographs, hydrograph separation for simple and complex storms – Method I, II and III. Unit Hydrograph-concept and the three implications of the definitions and the two basic assumptions. Effects of the characteristics of storms (duration of rain, time-intensity pattern, areal distribution of runoff and amount of runoff) on the shape of the resulting hydrographs. Derivation of Unit hydrographs for simple and complex storms. Derivation of an average unit hydrographs from several storms of the same duration (proper procedure of computing average peak flow and time to peak).

UNIT-IV

Unit Hydrographs: The methods for conversion of unit hydrograph of different durations, (1) method of superposition and (2) S-curve. Concept of S-curve method, explanation application and determination of lower duration graph from the given higher duration graph and vice-versa. Concepts of Synthetic unit hydrograph, Snyder' synthetic unit hydrograph and formulas relating to hydrograph features (basin lag, Peak flow and time base of the unit hydrograph). Concept and application of Instantaneous unit hydrograph and SCS Triangular Hydrograph.

UNIT-V

Flood Routing: Flood Routing-introduction, two broad categories of flood routing and channel routing, hydrologic routing and hydraulic routing, basic equations. Hydrologic storage routing, Schematic representation of storage routing, modified Pul's method (semi-graphical method). Explanation of the features of the modified Pul's method. Flood routing through a reservoir by modified Pul's method. Applications of Hydrology in land and water management, watershed management, Flood mitigation, Floodplain mapping, Retards, Flood control and Regulation.

Text Books:

1. Engineering Hydrology, Raghunath H.M., Willey Eastern Limited, New Delhi, 3rd Edition. (ISBN: 978-9393159045)
2. Watershed Hydrology, Suresh R., Standard Publisher and Distributors, New Delhi. (ISBN: 978-8186308233)

Reference Books:

1. Engineering Hydrology, Subramanyam K., Tata Mc. Graw – Hill Publishing Co., Limited, New Delhi.(ISBN: 978-1259029974)
2. Hydrology for Engineers, Linsley R.K. Kholer A. & Paul Hus J.L.H., Mc-Graw Hill Book Co. New Delhi. (ISBN-13. 978-0070379565)
3. Watershed Management, Dhruvanarayana, VV., ICAR Publication, New Delhi. (ISBN: 978-8120346765)

Web Links:

1. <http://www.nptelvideos.in/2012/11/advanced-hydrology.html>
2. <https://www.slideshare.net/MohammedSalahat1/chapter-3-surface-water-hydrolo>
3. <https://theconstructor.org/water-resources/types-of-rain-gauges/12801/>
4. <http://nptel.ac.in/downloads/105101002/>

Land & Water Management Engineering
(Common to All, Except AE)

Course Code: 2501AE87	L	T	P	C
	3	0	0	3

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

- CO1:** Apply methods for assessing and mitigating soil erosion to enhance soil conservation and sustainable land management.
- CO2:** Design, implement, and evaluate various water erosion control measures, incorporating both agronomical and engineering approaches to enhance soil conservation and land sustainability.
- CO3:** Apply energy and momentum principles in open channels, design soil erosion control structures, and implementing permanent gully control structures, ensuring hydrologic, hydraulic, and structural integrity.
- CO4:** Demonstrate wind erosion control measures, land use capability classification and sedimentation of reservoirs.
- CO5:** Classify water harvesting techniques, design and construct various structures such as farm ponds and percolation ponds, and apply design considerations for nala bunds.

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	-	-	2	3	-	2	1	2
CO2	2	3	3	-	-	2	3	-	2	1	2
CO3	2	3	3	-	-	2	3	-	2	1	2
CO4	2	2	-	-	-	-	2	-	-	-	-
CO5	2	2	2	-	-	-	2	-	-	1	-

UNIT – I

Soil Erosion: Causes, Types, Mechanisms, and Measurement

Soil erosion: introduction, causes and types - geological and accelerated erosion, agents, factors affecting and effects of erosion; Water erosion: mechanics and forms- splash, sheet, rill, gully, ravine and stream bank erosion; Gullies: classification, stages of development; Soil loss estimation– Universal soil loss equation (USLE) and modified USLE. Rainfall erosivity- estimation by KE>25 and EI30 methods; Soil erodibility- topography, crop management and conservation practice factors; Measurement of soil erosion- Runoff plots, soil samples.

UNIT – II

Water Erosion Control Measures and Techniques

Water erosion control measures- agronomical measures, contour farming, strip cropping, conservation tillage and mulching; Engineering measures- bunds and terraces, bunds: contour and graded bunds- design and surplussing arrangements; terraces: level and graded broad base terraces, bench terraces - planning, design and layout procedure, contour stone wall and trenching; Gully and ravine reclamation- principles of gully control, vegetative measures, temporary structures and diversion drains. Grassed waterways and design.

UNIT – III

Hydraulic Principles and Soil Erosion Control Structures

Energy and momentum principles in open channels; specific energy and specific force, hydraulic jump and its application, types of hydraulic jump, energy dissipation due to the jump; Soil erosion control structures- introduction, classification and functional requirements. 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

Wind Erosion and Sedimentation Control in Agriculture

Wind erosion- factors affecting, mechanics, soil loss estimation and control measures - vegetative, mechanical measures, wind breaks and shelter belts and stabilization of sand dunes; Land capability classification, dryland farming; Rate of sedimentation, silt monitoring and storage loss in tanks, control of sedimentation in reservoirs.

UNIT – V

Water Harvesting Techniques and Structures for Agricultural Use

Water harvesting techniques- classification based on source, storage and use, runoff harvesting- short- term and long-term techniques; 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.

Text Books:

- 1 Open-Channel Hydraulics, Chow V T, McGraw- Hill Book Company, Inc.(ISBN: 9780070107762)
- 2 Manual of Soil and Water Conservation Practices, Singh. G., Venkataraman C, Sastry G and Joshi B P., Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.(ISBN: 978-8120405523)

Reference Books:

- 1 Land and Water Management Engineering, Murthy V V N., Kalyani Publishers, New Delhi,4th Edition, (ISBN: 978-9327214659)
- 2 Principles of Agricultural Engineering, Michael A M and Ojha T.P, Volume II. Jain Brothers, New Delhi, 4th Edition. (ISBN: 978-8183601849)

Web Links:

- 1 Course: Soil & Water Conservation Engg. 3(2+1) (iasri.res.in)
- 2 [Soil-and-Water-Conservation-Engineering.pdf](#) (agrimoon.com)

Agricultural Process Engineering & Food Quality
(Common to All, Except AE)

Course Code: 2501AE88

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the functions of various unit operations and working of size reduction equipments for processing of fibrous and dry size reduction in processing of agriculture produce.
- CO2:** Explain the design and working of mixing equipments for powder, high and low viscosity liquids.
- CO3:** Classify separator equipment based on physical characteristics of grains.
- CO4:** Identify various methods for determining moisture content, EMC and drying process.
- CO5:** Explain the importance, design and working of milling and material handling devices, food quality control, food laws, food standards and HACCP.

Mapping of course outcomes with program outcomes:

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

UNIT-I

Unit operation in agricultural Processing: Scope and importance crop processing – principles and methods of food processing, cleaning, grading, screening, scalping, sorting, size reduction, mixing, separation, drying, storage, milling, material handling, packaging, baking.

Size reduction: Size reduction –principle of comminution/size reduction, particle shape, average particle size, crushing efficiency. Determination and designation of the fineness of ground material, screen analysis, Empirical relationships (Rittinger’s, Kick’s and Bond’s equations) and related problems. Size reduction equipment – Crushers (Jaw crusher, Gyratory crusher, Crushing rolls), Grinders (Attrition mill, Hammer mill, Ball mill), Fine grinders (Rietz mill or disintegrator, Dispersion and colloid mills) and Cutting machines (Rotary knife cutter).

UNIT-II

Mixing: Mixing –Introduction, theory of solids mixing, Mixing of low and moderate viscosity liquids (paddle mixer, turbine mixer, propeller mixer) its applications. Mixing of high viscosity liquids, pastes and plastic solids (pan mixer, kneaders) its applications. Mixers for dry powders and particulate solids (Horizontal screw and ribbon mixer,

Vertical screw mixer, Tumbling mixer) and its applications, mixing index,

Separator units: Theory of separation, types of separators, separator based on length, width, shape of the grains, specific gravity, density, cyclone separators, Pneumatic separator. Air- screen grain cleaner principle and types, Design considerations of air-screen grain cleaners, Sieve analysis- particle size determination, Ideal screen and actual screen– effectiveness of separation and related problems

UNIT-III

Drying: Moisture content and its representation (wet basis, dry basis), methods for determination moisture content (direct and indirect methods) and related problems, Importance of EMC and methods of determination (static-dynamic methods), EMC models, hysteresis effect, bound, unbound and free moisture. Principles of drying, theory of diffusion, mechanism of drying, falling rate, constant rate period, thin layer, deep bed drying methods, Effect of different factors on the drying process, types of dryers.

UNIT-IV

Milling and Material handling devices: Rice milling, principles and equipments, paddy parboiling methods and milling equipment, milling of pulses and oilseeds. Scope and importance of material handling devices, Belt Conveyor– idlers, idler spacing, belt tension, Bucket elevator– classification, operation, capacity, drive mechanism, advantages and disadvantages.

Screw conveyor – Principle of operation, capacity, and power requirement. Pneumatic conveying system- types, limitations of pneumatic conveying system

UNIT-V

Food Quality: Concept, objectives and importance. Sensory evaluation or organoleptic evaluation of food quality, Food laws and regulations in India. Food grade and standards –BIS, AGMARK, PFA, FPO. Hazard analysis and critical control point (HACCP) – objectives, principles, Steps involved in implementation of HACCP

Text Books:

- 1 Unit Operations of Agricultural Processing, Sahay KM and Singh KK, Vikas Publishing House Pvt. Ltd., New Delhi. (ISBN: 978-8125911425)
- 2 Post-Harvest Technology of Cereals, Pulses and oil seeds, Chakraverty A, Oxford and IBH Publishing. Ltd., Calcutta. (ISBN: 978-8120409699)
- 3 Unit operations in Food processing, Earle R L, Pergamon Press, New York. (ISBN: 978-0080255361)

Reference Books:

- 1 Transport Processes and separation Process Principle, Geankopolis C J Prentice-Hall Inc., New Jersey. (ISBN:978-0134181028)
- 2 Unit Operations of Chemical Engineering, McCabe WL, Smith JC and Harriott PMcGraw-Hill Book Co., Boston.(ISBN: 978-0072848236)

Web Links:

- 1 <http://www.cigr.org/documents/CIGRHandbookVol4.pdf>
- 2 <http://www.rpaulsingh.com/Learning and teaching resources>
- 3 <http://ecoursesonline.iasri.res.in/course/view.php?id=22>
- 4 https://moodle.ufsc.br/pluginfile.php/772348/mod_resource/content/0/UnitOperations_in_Food_Engineering_-_A._Ibarz_G._BarbosaCanovas_CRC_2003_WW.pdf
- 5 <http://www.nzifst.org.nz/unitoperations/matlenerg2.htm>

Post-harvest Engineering for Horticultural Produce
(Common to All, Except AE)

Course Code: 2501AE89

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain about various properties and factors affecting quality of fruits and vegetables.
- CO2:** Classify various post harvest operations involved in horticulture processing.
- CO3:** Identify various preservation techniques for processed foods.
- CO4:** Apply the advanced packaging technology in food preservation.
- CO5:** Categorize different beverages based on method of preparation and explain the procedure for extraction of oleoresins and essential oils.

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
CO1	3	2	2	2	-	-	-	-	-	-	-
CO2	3	1	1	1	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-
CO5	3	1	1	1	-	-	-	-	-	-	-

UNIT-I

Properties of Fruits and Vegetables: Engineering properties of fruits and vegetables - physical, aerodynamic, rheological and thermal properties. Electrical properties- Near Infrared reflectance (NIR), radiation, dielectric properties and optical properties: Light transmittance, Light reflectance, machine vision. Quality parameters of fruits and vegetable for processing: sensory, biochemical and nutritional characteristics. Factors affecting fruits and vegetables quality: Pre-harvest factors, environmental factors, cultural factors and post-harvest factors. Harvesting indices of different horticultural produce, modern techniques for determination of harvesting indices. Handling and transportation of fruits and vegetables. Determination of quality parameters for fruits and vegetables: aroma, fruit ripening, leaf changes, firmness, juice content, sugar content, skin color, total soluble solids, pH and acidity.

UNIT-II

Post-Harvest Operations: Cleaning of fruits & vegetables: soaking, rinsing, sanitizing, washing methods: agitating, spraying water, wet and dry brushing, chemical washing. Peeling of fruits and vegetables: hand peeling, mechanical peeling, peeling by heat treatment and lye peeling. Grading of fruits & vegetables, factors affecting grading, types of graders: screen grader, roller grader, rope and cable type grader and weight grader. Canning of fruits & vegetables: grading, washing, peeling, cutting, blanching, cooling, filling, syruping/brining, exhausting, sealing, retorting, cooling, storage, labeling. Cans making, causes of spoilage of canned foods.

UNIT-III

Principles of Preservation of Fruits & Vegetables: Asepsis, preservation by high temperature: pasteurization, flash pasteurization, sterilization. Chemical preservation with sulphur dioxide and benzoic acid, advantages, disadvantages. Drying and dehydration of fruits & vegetables (flow chart), types of dryers: cabinet dryer, tray dryers, tunnel dryer, freeze drying. Rehydration, ratio of rehydration coefficient. Freezing: Definition and methods - slow freezing, quick freezing and IQF, advantages and disadvantages. Types of freezing - direct immersion, indirect contact with refrigerant, air blast, cryogenic and dehydro freezing. Cooling methods - pre-cooling, room cooling, hydro cooling, refrigerated trucks.

UNIT-IV

Packaging of Horticultural crops: Controlled atmospheric storage (CAS), factors effecting on CAS, additional benefits, limitations, maintaining CAS, modified atmosphere storage/packaging (MAS/MAP), maintenance of MAP, active modification, passive modification, requirements of fresh fruits package under CAS or MAS. Packaging of fruits and vegetables, advantages and disadvantages. Packaging materials: cellophane, poly vinyl chloride, polyethylene, ethyl vinyl alcohol. Packaging of horticultural crops.

UNIT-V

Preparation and Preservation of Beverages: Preservation of unfermented fruit beverages: apple juice, grape juice, pineapple juice, citrus juice, mango juice with all flow sheets. Fermented beverages: wine, grape wine with all flow charts. Preparation of vinegar - alcoholic fermentation and acetic acid fermentation.

Oleoresin and Essential Oil Extraction: Turmeric oleoresin and chilli oleoresin. Solvents used for oleoresin extraction, advantages and disadvantages. Extraction of essential oil from spices by steam distillation.

Text Books:

1. Food Science by Potter N. and Hotchkiss J. H, An Aspen Publication, 5th Edition. (ISBN:978-8123904726)
2. Fruits and Vegetable Preservation: Principles and Practices, Srivastava, R.P. & Kumar, S. CBS Publishing, 3rd Edition. (ISBN: 978-8123924373)
3. The Complete Technology Book on Processing, Dehydration, Canning, Preservation of Fruits & Vegetables by NIIR Project Consultancy Services, 3rd Edition. (ISBN: 978-9381039694)

Reference Books:

1. Fruits: Tropical and subtropical, Bose T. K & Mitre, S. K. Naya Prakash, 3rd Edition. (ISBN: 978-8185971810)
2. Fruits and Vegetable processing, Bhatti, S. and Varma U., CBS Publishers, 1st Edition. (ISBN: 978-8123904047)
3. Food Processing and Preservation, Sivasenkar, B., CBS Publications. (ISBN:

978-8120320864)

Web Links:

1. http://www.rpaulsingh.com/animations/animaitons_master3.html
2. <http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1098>
3. https://onlinecourses.nptel.ac.in/noc18_ar08/preview

Agricultural Machinery & Equipment

(Common to All, Except AE)

Course Code: 2501AE90

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the process of selection, cost estimation and methods of ploughing of farm mechanization.
- CO2:** Calculate the forces acting on tillage implements.
- CO3:** Explain inter-culture equipments and understand the sowing, planting and transplanting operation with various implements used for these operations.
- CO4:** Explain the harvesting and threshing operation with various implements used for these operations.
- CO5:** Explain the operation of grain combines harvesting mechanism.

Mapping of course outcomes with program outcomes:

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

UNIT-I

Introduction to farm mechanization: Classification of farm machines. Introduction to materials used in construction of farm machines. Heat treatment processes and their requirement in farm machines. Selection of farm machinery and cost estimation. Hitching systems and controls of farm machinery. Introduction to seed-bed preparation. Familiarization with land reclamation and earth moving equipment. Methods of Ploughing.

UNIT-II

Tillage Practices: Definition, primary tillage, secondary tillage, rotary tillage, deep tillage, minimum tillage and conservation tillage. Draft measurement of tillage equipment, Identification and major functional components of mould-board plough, disc plough, chisel plough, sub-soiler, harrows, cultivators, levelling, Forces acting on tillage implements. Cost of operation of farm machinery.

UNIT-III

Introduction to inter-culture equipments: Weeder – manual and powered, main components and their functional requirement.

Introduction to sowing, planting & transplanting equipment: Study of working of seed drills, no-till drills, happy seeder and strip-till drills. Brief description and working of planters. Study of types of furrow openers and metering systems in drills and

planters. Calibration of seed-drills/ planters. Adjustments during operation. Introduction to plant protection equipment – sprayers and dusters.

Classification of sprayers. Types of nozzles. Calculations for calibration of sprayers and chemical application rates.

UNIT-IV

Study of harvesting operation – methods and terminology. Study of Reapers, Mowers and windrowers – types, working and adjustments. Introduction to threshing systems – manual and mechanical systems. Types of threshing drums and their applications. Types of threshers- tangential and axial, factors affecting thresher performance. Chaff cutters and capacity calculations.

UNIT-V

Study of grain combines (Wheat and Paddy) - Combine terminology, Computation of combine losses, study of combine troubleshooting. Study of Root crop diggers –potato and groundnut. Cotton harvesting mechanisms, study of cotton pickers and strippers. Introduction to vegetables and fruit harvesting equipment and tools.

Reference Books:

1. Agricultural Machines, Theory and Construction (Vol. 1 & 2). Kanafoshi, C.Z. and Karwawshi T. (ISBN: 9388399838)

Text Books:

1. Principles of Agricultural Engineering (Vol. II). A. M. Michael and T.P. Ojha, Jain brothers, New Delhi. (ISBN: 8183601849)
2. Principals of Farm Machinery, R.A. Kepner, Bainer Roy, and E.C. Barges, Publishers and Distributors, Delhi-17. (ISBN: 8123909772)
3. Theory, Construction and Calculation of Agricultural Machines (Vol. 1 and 2), Bosoi, E.S., Oxonion Press Pvt. Ltd., New Delhi. (ISBN: 9383692378)

2. Agricultural Machines, Kelnin, N.I., Popov, I.F., and Sakun, V.A Amerind Publishers, New Delhi. (ISBN: 978-9061914488)

Web Links:

1. <https://nptel.ac.in/courses/126/105/126105009/>
2. <http://www.hillagric.ac.in/edu/coa/agengg/lecture/243/agriengg-243.htm>

Design of Bio-energy systems
(Common to All, Except AE)

Course Code: 2501AE91	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Comprehend Biomass Sources and Fermentation Processes
- CO2:** Explore Biomass Production and Preparation
- CO3:** Analyze Biomass Conversion Technologies
- CO4:** Evaluate Biofuel Production Processes and Applications
- CO5:** Assess Environmental and Economic Aspects of Bio-Energy

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	2	-	-	-	-	2	3	-	-	-	-
CO2	3	2	-	1	-	2	-	-	-	-	-
CO3	2	1	-	-	-	2	3	-	-	-	-
CO4	2	1	-	-	-	3	1	-	-	-	-
CO5	2	1	-	-	-	3	1	-	-	-	-

UNIT – I

Biomass sources and characteristics. Fermentation processes and its general requirements. Aerobic and anaerobic fermentation processes and their industrial applications. Heat transfer processes in anaerobic digestion systems.

UNIT – II

Biomass production- wastelands, classification and their use through energy plantation. Selection of species, methods of field preparation and transplanting. Harvesting of biomass and coppicing characteristics. Biomass preparation techniques for harnessing (size reduction, densification and drying).

UNIT – III

Bio-energy : Properties of biomass and conversion technologies, pyrolysis of biomass to produce solid, liquid and gaseous fuels. Biomass gasification, types of gasifiers, various types of biomass cook stoves for rural energy needs.

UNIT – IV

Thermo-chemical degradation: History of small gas producer engine system. Chemistry of gasification. Producer gas- type, operating principle. Gasifier fuels, properties, preparation, conditioning of producer gas. Applications, shaft power

generation, thermal application and economics.

UNIT – V

Trans-esterification for biodiesel production and application in CI engines. production process, properties and application of ethanol. Bio-hydrogen production routes. Environmental aspect of bio-energy. Assessment of greenhouse gas mitigation potential. Cost economics of bio-energy systems.

Text Books:

1. Biomass Gasification, Pyrolysis and Torrefaction, Basu P, Academic Press, 2018. (ISBN: 10-10128129921)
2. Renewable Energy Academy Training wood energy professionals, Butler S. (ISBN: 13-978-0128129920)

Reference Books:

1. The Biodiesel Handbook, Knothe G, Gerpen J V, Krahl J. (Eds.), AOCS Press. (ISBN: 9781893997622)
2. Non-Conventional Energy Sources, Rai G D, Khanna Publishers, New Delhi. (ISBN: 978-8174090737)

Web links:

1. <https://elearning.icar.gov.in/>
2. https://saveetha.ac.in/images/sec/2021/Syllabus/Agriculture/19AG423-_BIO-ENERGY_SYSTEM_DESIGN_AND_APPLICATIONS.pdf

Minor Degree in Entrepreneurship Development & Incubation

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MB07	New Product Development	FC	3			3	50	50	100	-
2501MB08	Entrepreneurship & Small Business Management	IC	2			2	50	50	100	-
2501MB09	Insurance & Risk Management	IC	3			3	50	50	100	-
2501MB10	Change & Innovations Management	IC	3			3	50	50	100	-
2501MB11	Personal Financial Planning (or)	IC	3			3	50	50	100	-
2501MB12	E-Business management									
2501MB13	Business Policy & Strategic Management (or)	AC	3			3	50	50	100	-
2501MB14	Green Marketing									
2501MB15	Startup Management (or)	AC	3			3	50	50	100	-
2501MB16	Venture Management									
TOTAL			20			20				

New Product Development
(Common to All)

Course Code: 2501MB07	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** To learn how to develop and implement a new product or service to an existing and potential target market.
- CO2:** Understand the importance of new product development to firm performance
- CO3:** To help the student to prepare a Business Plan for a new product or service.
- CO4:** Learn methods of generating, evaluating and testing product ideas.
- CO5:** Understanding the impact of intellectual property and patents on new product development and 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
CO1	-	-	-	-	-	-	1	-	-	-	-
CO2	-	-	-	-	-	-	-	1	1	-	-
CO3	-	-	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	3	-	-	-	-
CO5	-	-	-	-	-	-	2	-	-	-	-

UNIT – I

Introduction- Types of products – Product development - Factors contributing to New Product Development - New product development process – product life cycle in theory and practice - Invention Vs Innovation.

UNIT – II

Strategic Planning for New Product- Sources of new product ideas- Generation of ideas - Criteria for screening – understanding customer needs – need assessment based on secondary and primary research - Concept generation

UNIT – III

Business Analysis – Purpose, Stages of Business analysis- Market potential and Demand - Estimating first time sales - Replacement Sales - Repeat Sales - Estimating costs, Sales and Profit – Business plan preparation

UNIT – IV

Product testing - Test Marketing, its advantages and disadvantages - Test marketing strategies - Launch cycle - Managing Growth and Maturity - Commercialization

UNIT – V

Defining Intellectual Property and Patents–Patent application–ownership and transfer of patent – infringements - The future of New Product management – Contemporary issues

Text Books:

1. Product Management in India, Ramanuj Manjumdar, Prentice Hall Publication, 3rd Edition, ISBN: 9788120312524.
2. Business plan template and example: How to write a Business Plan, Alex Genadinik, ISBN: 9781519741783.

Reference Books:

1. Production design and Development, Karl T Ulrich, Steven D. Eppinger and Amita Goyal, Tata Mc GrawHill, 5th Edition, ISBN: 9781260566437.
2. New Products Management, Crawford, Merle and Di Benedetto, Anthony, McGraw-Hill/Irwin, 10th Edition, ISBN: 9781260575088.

Web Links:

1. <https://www.youtube.com/watch?v=QxQfAw1049M>
2. https://ocw.mit.edu/courses/15-783j-product-design-and-development-spring-2006/resources/clas7_cncpt_genr/

Entrepreneurship & Small Business Management
(Common to All)

	L	T	P	C
Course Code: 2501MB08	2	0	0	2

Course Outcomes:

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

- CO1:** Explain the nature of entrepreneurship and how it relates to small business.
- CO2:** Develop and demonstrate competence in basic business and marketing planning
- CO3:** Explain factors related to readiness for entrepreneurship and getting started in entrepreneurship career.
- CO4:** Identify the factors affecting choice of a business location and explain how layout of physical facility and equipment could lead to efficiency
- CO5:** Explore techniques for improving quality and productivity.

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

UNIT – I

Fundamentals of Business: Forms of business organization, Small-scale industrial undertakings with particular reference to India, and Government incentives for entrepreneurial ventures.

UNIT – II

Business Model and Business Plan: Business plan, Business description, Business environment analysis, SWOT analysis, Competitor analysis, Market analysis, and Marketing, Operations and Financial plan.

UNIT – III

Funding new ventures: Fixed and working capital needs, Capital structure, Public and private sources of capital, Equity and debt financing, Terms loans, Private placements, Project finance, Miscellaneous sources, Special institutional schemes, Venture capital.

UNIT – IV

Launch of a Startup: Location, Facility planning, Resource acquisition, Business operations, Costing and pricing of product/service, and Marketing strategy.

UNIT – V

Managing and Growing the Enterprise: Transition to managerial approach and Functions of Management; Operations, quality and productivity management; Market segmentation, Product positioning.

Text Books:

1. Entrepreneurship and Small Business Management, Dr.P.T.Vijayshree & Dr. M.Alagammai, Margham Publication, 2021
2. Essentials of Entrepreneurship and Small Business Management, M. Scarborough , Jeffrey R. Cornwell, Pearson Education, ISBN: 9780134741086.

Reference Books:

1. Entrepreneurship And Small Business, Dr. B. K. Mehta, Prof. R. C. Agarwal, SBPD Publishing House 1st Edition, ISBN: 9789350470688.
2. Entrepreneurship And Small Scale Business, Sanjeet Sharma, VK Global Publications Pvt Ltd, 1 January 2020, ISBN: 9780000861917.

Web Links:

1. <http://digimat.in/nptel/courses/video/110106141/L06.html>
2. <https://www.coursera.org/learn/fundamentals-of-management>

Insurance & Risk Management
(Common to All)

Course Code: 2501MB09

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify and assess various types of risks, and develop strategies to mitigate or manage them.
- CO2:** Explain the principles of insurance, including types of insurance, policy terms, and claims processing.
- CO3:** Conduct risk assessments and analyses to determine potential losses and develop strategies to minimize them.
- CO4:** Develop and implement risk management strategies, including risk avoidance, transfer, mitigation, and acceptance.
- CO5:** Understand the differences between personal and commercial insurance, including types of policies and coverage.

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

UNIT – I

Insurance: Concept, Nature of Insurance, Functions of Insurance, Importance of Insurance, Principles of Insurance Contract; Features of Life and Non-life Insurance.

UNIT – II

Insurance and IRDA: IRDA Act 1999, Provisions, Duties, Powers and Functions of IRDA.

UNIT – III

Risk and risk management process - Concept of risk, risk vs. Uncertainty, types of risks, risk identification and evaluation.

UNIT – IV

Risk management objectives-selecting and implementing risk management techniques. Commercial risk management applications.

UNIT – V

property, liability, commercial property insurance, different policies and contracts–

business liability and risk management.

Text Books:

1. Life and Health Insurance, Black K. Jr., Skipper. H. D. Jr, Pearson Education, ISBN: 9780138912505.
2. Insurance in India, Response Books, Palande P.S., Shah R.S. and Lunawat M.L., Sage Publications Ltd, ISBN: 9780761997481.

Reference Books:

1. Insurance and Risk Management, Gupta, P.K., Himalaya Publishing House, New Delhi, ISBN: 978-9350246726.
2. Business Policy And Strategic Management, Vipin Gupta, Kamala Gollakota, R. Srinivasan, Phi Learning Pvt. Ltd, ISBN: 9788120328624.

Web Links:

1. <https://archive.nptel.ac.in/courses/110/105/110105160/>
2. https://ocw.mit.edu/courses/15-997-practice-of-finance-advanced-corporate-risk-management-spring-2009/resources/mit15_997s09_lec01_3/

Change & Innovations Management

(Common to All)

Course Code: 2501MB10

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Understand innovation, innovative models and implementing those Models in organization.
- CO2:** Understand Intervention techniques and implement it effectively at the workplace.
- CO3:** Appreciate resistance-to-change, and strategies to overcome those resistances.
- CO4:** Enable learners with in-depth understanding of individual, team, work-group or organizational interventions to work successfully.
- CO5:** Develop and Enhance Competencies to use the Innovative and Change Management techniques effectively at workplace.

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	-	-	-	-	-	-	-	2	-	1	-
CO2	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	-	-	-	-	-	2		-	-
CO4	-	-	-	-	-	-	1	-	-	-	-
CO5	-	-	-	-	-	2	-	-	-	-	-

UNIT – I

Defining innovation, understanding the role of innovation, Understanding innovation, innovation and organizational performance, Understanding how to use innovation as strategy, Defining exploration vs. exploitation in innovation, and Defining disruptive, destructive, and displacement innovation.

UNIT – II

Frameworks for Creating Innovation & The Product Development Process: Identifying and understanding the sources of innovation, Defining and discussing a standard PDP phase gate methods vs. spontaneous methods for managing innovation and product development, Leading practices designed to foster creativity, open innovation vs. closed innovation, Understanding internal barriers to innovation and how to best address resistance, and Assessing the strategic and financial impact of innovation.

UNIT – III

Leading Innovation & Change: How to form innovation teams, Understanding team behavior & dynamics, How to manage innovation teams for high-performance results, How to best measure team performance, Discussion various tips & traps for leading innovation, Factors and considerations in selecting team members and managing innovation teams.

UNIT – IV

Implementation consideration in using incubators and accelerators, Understanding how and when to use DARPA, “Skunk Works,” and Accelerators for innovation, How to identify, assess and address organizational, legal, and cultural impediments to innovation, Assessing environmental factors and how they affect innovation.

UNIT – V

Social Implications of Innovation: Understanding how innovation and society interact, Examining ethical issues of innovation, Determining the role of social entrepreneurship and innovation Creating social innovation.

Text Books:

1. Managing change, bernard burnes, seventh edition, pearson education, 30 june 2020, ISBN: 9780273033769.
2. Change Management for Beginners, Steffen Lobinger, Tim Ongpublisher,2021, ISBN: 9781687022622.

Reference Books:

1. Innovation Management: Strategies, Concepts and Tools for Growth and Profit, Shlomo Maital , D V R Seshadri , SAGE Publications Pvt. Ltd, ISBN-13: 9788132107224.
2. Managing Innovation and Change, David Mayle, SAGE Publications, ISBN: 9781412922500.

Web Links:

1. <https://hits.digimat.in/nptel/courses/video/110107094/L31.html>
2. https://ocw.mit.edu/courses/15-351-managing-innovation-and-entrepreneurship-spring-2008/resources/01_intro/

Personal Financial Planning
(Common to All)

	L	T	P	C
Course Code: 2501MB11	3	0	0	3

Course Outcomes:

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

- CO1:** To provide basic principles for managing personal finance.
- CO2:** To help individual learn investment decisions
- CO3:** Identify and describe various types of risk associated with investments, such as market risk, credit risk, liquidity risk, and operational risk.
- CO4:** Calculate interest, dividend, and capital gains on personal investments, including bonds, stocks, and mutual funds.
- CO5:** To mitigate old age financial planning.

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	-	-	-	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	-	2	-	-	-	-
CO3	-	-	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	3	-	-	-	-
CO5	-	-	-	-	-	1	1	-	-	-	-

UNIT – I

Basics of Personal Financial Management: Basics of Personal Financial Management: Budget, The Personal Financial Planning Process, Preparation of Personal Budget, Personal Financial Statements, Personal Income Tax Planning. Case studies on personal financial planning of individuals.

UNIT – II

Personal Savings & Investment: Investment Criteria- liquidity, safety and profitability. Savings instruments of Post Office and Banks. Chit Funds. Investment in Shares, Debentures, Corporate and Government Bonds, Mutual Fund. Investment in Physical Assets – Real Estate, Gold and Silver, Gold certificates.

UNIT – III

Risk and Return associated with these investments: Case studies on risk and return perception of retail investors on various investments.

UNIT – IV

Computation of Return and Risk of Personal Investment: Present Value and Future Value of a Single Amount and an Annuity. Computation of interest, dividend and capital gains on personal investments. Impact of leverage on return. Personal tax planning.

UNIT – V

Retirement Savings Plans: Retirement Savings Plans: Gratuity plans from the government. Life Insurance types. Health insurance. Pension Plans- Defined Contribution Plan and Defined Benefit Plan. Provident Fund, Gratuity. Life Insurance Plans. General Insurance Plans. Reverse Mortgage Plans.

Text Books:

1. Personal Financial Planning, CS Monika Saini, Dr. Neerza, Scholar Tech Press, 1 January 2024.
2. Personal Financial Planning, Dr Shalu Garg, Sultan Chand & Sons, 1 January 2024, ISBN: 9780357987872.

Reference Books:

1. 5 W's of Financial Planning: Master the Art of Personal Finance Strategy, Dr Vimal Krishna Rajput, Sultan Chand & Sons 5 November 2021, ISBN: 9781685388850.
2. Personal Financial Planning, Dr kamal Garg, Sultan Chand & Sons, 1 January 2020.

Web Links:

1. <https://archive.nptel.ac.in/courses/122/106/122106031/>
2. <https://www.coursera.org/learn/fundamentals-of-management>

E-Business Management (Common to All)

Course Code: 2501MB12	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Explain the concept and significance of e-business.
- CO2:** Evaluate and select appropriate hardware and software components for e-business.
- CO3:** Apply e-business technologies to enhance marketing strategies.
- CO4:** Design hybrid distribution networks that optimize cost and customer experience.
- CO5:** Understand the role of smart cards in payment 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
CO1	-	-	-	-	-	-	-	1	-	-	1
CO2	-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	2	-	-	-	-

UNIT – I

Introduction Concept of e-business: Nature, scope, and impact of e-business; Difference between e-business and ecommerce; History and development of e-business; Advantages of e-business; Business models for e-products and e-services

UNIT – II

Technologies in e-business Introduction: e-business technologies - hardware, e-business software applications, internet and World Wide Web; Database management system; e-business security; Online payment technology

UNIT – III

Digital Marketing Concept: Effects of e-business technologies on marketing strategy, customer retention and e-CRM; Measuring the extent of digital marketing activity; Market analysis; Digital marketing tools

UNIT – IV

Online Distribution Components of a distribution system: Characterization of online distribution; hybrid distribution networks; Model for electronic software distribution.

UNIT – V

E-Payment System Characteristics of payment system; Classification of payment systems -

E-cash, E-check, overview of smart card; Applications of IPsec.

Text Books:

1. E- Business & E- Commerce, Dr. P. Rizwan Ahmed, Margham Publication, ISBN: 978-9383242320.
2. E-Business and E-Commerce Management, Chaffey Dave, Pearson Education India,2020, ISBN: 978-0273707523.

Reference Books:

1. E-Business 2.0: Roadmap for Success, Kalakota, Pearson, 2nd Edition.
2. Entrepreneurship And Small Business, Dr. B. K. Mehta, Prof. R. C. Agarwal, SBPD Publishing House 1 Edition.

Web Links:

1. <https://archive.nptel.ac.in/courses/110/105/110105083/>
2. <https://srmuniv.digimat.in/nptel/courses/video/110105083/L57.html>

Business Policy & Strategic Management
(Common to All)

Course Code: 2501MB13	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** Apply the concepts in strategy and their application under various management functions.
- CO2:** Understand the importance of analyzing external factors that impact an organization.
- CO3:** Understand how organizations maintain their current position by focusing on existing products and markets.
- CO4:** Learn how to turn strategic plans into executable steps, ensuring alignment with organizational goals and objectives.
- CO5:** Explore the opportunities and threats posed by digital disruption.

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	-	-	-	-	-	-	-	-	-	-	2
CO2	-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	2	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	-

UNIT – I

Strategic Management: Meaning, Historical Development, Nature, Scope and Significance; Strategic Decision Making; Enterprise Strategists; Strategic Management Model; Strategic Intent- Vision, Mission and Objectives.

UNIT – II

External Environmental Appraisal: Meaning, Significance and Forces. Environmental Scanning: Process and Techniques; Corporate Appraisal- Meaning; Process; Significance & Techniques; Porter’s Generic Strategies

UNIT – III

Strategy Alternatives, Variation and Choices: Stability, Growth, Retrenchment and Combination Strategies, Strategic Alliances, Mergers, Acquisitions, Diversification, Integration, Liquidation; Corporate Portfolio Analysis; Strategic Choices Models- BCG Matrix.

UNIT – IV

Strategic Implementation: Strategy Implementation Process, Issues in Strategy Implementation: Behavioral, Functional, Operational and Functional Implementation

UNIT – V

Strategy, Evaluation and Control : Process and Methods. Strategic Management in internet era.

Text Books:

1. Business Policy and Strategic Management, Dr. Sangeeta & Dr. Neeraj, Rigi Publication, 7th Edition, ISBN : 978-9391041656.
2. Business Policy (Strategic Management), by Shiva Manoj Bimal Jaiswal, New Royal Book Company, 1 January 2021, ISBN: 978-8195175215

Reference Books:

1. Business Policy And Strategic Management, Vipin Gupta, Kamala Gollakota, R. Srinivasan, Phi Learning Pvt. Ltd, ISBN:978-8120332447.
2. Business Strategies in Times of Crisis, Dr. Charles O. Usigbe, New Royal Book Company, ISBN : 978-1514431771.

Web Links:

1. <https://archive.nptel.ac.in/courses/110/105/110105161/>
2. <https://ocw.mit.edu/courses/15-904-strategic-management-ii-fall-2005/resources/strag/>

Green Marketing
(Common to All)

Course Code: 2501MB14	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- CO1:** To impart knowledge on this area of environmental marketing
- CO2:** To analyse the Environmental Ethics
- CO3:** To gain the knowledge in the area of environmental marketing.
- CO4:** Understand how CDM credits can be used by industrialized countries to meet their emission reduction targets.
- CO5:** Identify marketing opportunities in different countries and regions.

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
CO1	-	-	-	-	-	-	-	1	-	-	-
CO2	-	-	-	-	-	-	-	-	-	1	-
CO3	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	-	1	-	-	-
CO5	-	-	-	-	-	-	2	-	-	-	-

UNIT – I

Environment-Pollution, cause, and remedy, Biodiversity, Environmentalism- Definition, concepts, its impact and relationship to businesses, need to study environment in the modern era, environment- an interdisciplinary approach.

UNIT – II

Environment and its relevance to marketing- ethical products, creating awareness about Green Products, Green Labeling of products, Standards- environmental audit- Global environmental challenges. Environment conscious customer and consumer segment.

UNIT – III

Environment- Developed and developing countries- Influence of Green Marketing on corporate social responsibility, marketing ethical products- challenges and opportunities, promoting green products- advertising on the green platform, Environmental marketing strategies.

UNIT – IV

Building Green Brands, transforming non-green organizations to green organizations- greening the organization structure- building green business- challenges, international organizations, standards, Clean Development Mechanism (CDM), guides for the use of environmental marketing claims.

UNIT – V

The influence of global environmental issues on international business, international marketing opportunities, Project- mini- project- Business process reengineering with the introduction of green technologies, developed and developing markets, environmental marketing of services.

Text Books:

1. Environmental marketing- strategies, Practice, Theory and Research by Michael J. Polansky, and Alma T. Mintu. Wimsatt, Kogan Page Publishers, ISBN: 9781136590337.
2. Environmental Marketing – positive strategies for reaching the green consumer by Walter Codrington Peter Florain, McGraw Hill Professional, 2020, ISBN: 9780070115996

Reference Books:

1. Green Marketing and management- A global perspective by John. F. Wasik , Blackwell publisher, 2022, ISBN: 9781557866349.
2. Marketing, Morality, and the natural environment by Andrew Crane Routledge publishers, ISBN: 9780415439619.

Web Links:

1. <https://www.youtube.com/watch?v=LxxpEKyu134>
2. <https://www.teachmint.com/tfile/studymaterial/b-com/management/unit-7lecture-14greenmarketingpdf/b3248a3e-01af-4f2a-bb41-695c71975ec1>

Startup Management
(Common to All)

Course Code: 2501MB15

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Develop a start-up Enterprise with Big Idea Generation.
- CO2:** Analyze start-up capital requirement by analyzing legal factors.
- CO3:** Interpret feasibility Analysis towards funding issues.
- CO4:** Access growth stages in new venture and reasons for scaling ventures.
- CO5:** Evaluate financial stability and decide on expansion possibilities.

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	-	-	-	-	-	-	1	-	1	1	1
CO2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	-

UNIT – I

Start-up opportunities: The New Industrial Revolution – The Big Idea- Generate Ideas with Brainstorming- Business Start-up - Ideation- Venture Choices - The Rise of The start up Economy - The Six Forces of Change- The Start-up Equation – The Entrepreneuria Ecosystem – Entrepreneurship in India. Government Initiatives.

UNIT – II

Startup Capital Requirements and Legal Environment: Identifying Startup capita Resource requirements - estimating Startup cash requirements - Develop financia assumptions- Constructing a Process Map - Positioning the venture in the value chain Launch strategy to reduce risks- Startup financing.

UNIT – III

Starting up Financial Issues: Feasibility Analysis - The cost and process of raising capital - Unique funding issues of a high-tech ventures - Funding with Equity – Financing with Debt Funding startups with bootstrapping- crowd funding- strategic alliances.

UNIT – IV

Start-up Survival and Growth: Stages of growth in a new venture- Growing with the market - Growing within the industry- Venture life patterns- Reasons for new venture failures- Scaling Ventures – preparing for change - Leadership succession. Support for growth and sustainability of the venture.

UNIT – V

Planning for Harvest and Exit: Dealing with Failure: Bankruptcy, Exit Strategies- Selling the business - Cashing out but staying in-being acquired- Going Public (IPO) – Liquidation.

Text Books:

1. Launching New Ventures, An Entrepreneurial Approach, Kathleen R Allen, Cengage Learning, ISBN: 9780357039175.
2. Managing New Ventures Concepts and Cases, Anjan Raichaudhuri, Prentice Hall International, ISBN: 978-8120341562.

Reference Books:

1. Entrepreneurship, S. R. Bhowmik & M. Bhowmik, New Age International, ISBN: 9788122419061.
2. The Startup Equation -A Visual Guidebook for Building Your Startup, Indian Edition, Steven Fisher, Ja-nae' Duane, Mc Graw Hill Education India Pvt. Ltd, ISBN: 9780071832366.

Web Links:

1. <http://tjsec.digimat.in/nptel/courses/video/110106141/L57.html>
2. <https://archive.nptel.ac.in/courses/127/105/127105007/>

Venture Management (Common to All)

Course Code: 2501MB16

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe the role of venture managers in promoting entrepreneurship.
- CO2:** Learn how to secure and manage IP assets within a venture.
- CO3:** Analyse and assess risks associated with ventures.
- CO4:** Evaluate and choose appropriate exit strategies based on venture goals and market conditions.
- CO5:** Develop a comprehensive plan for scaling and entering global markets.

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

UNIT – I

Introduction to Venture Management: Understanding the concept of venture management, Role of entrepreneurship and innovation in creating ventures,

Market Research and Opportunity Identification: Techniques for market research and identifying business opportunities, Analyzing customer needs, market trends, and competitive landscape.

UNIT – II

Legal and Regulatory Aspects: Legal structures for ventures (sole proprietorship, partnership, corporation, etc.). Intellectual property rights, contracts, and compliance.

Financial Management for Ventures: Budgeting, financial forecasting, and managing startup costs, Sources of funding (bootstrapping, angel investors, venture capital).

UNIT – III

Risk Management and Decision Making: Assessing and mitigating risks associated with ventures. Making informed decisions under uncertainty.

UNIT – IV

Exit Strategies and Succession Planning: Options for exiting the venture (selling, merging, going public), Planning for the long-term sustainability of the venture.

UNIT – V

Venture Scaling and Internationalization: Learn strategies for scaling ventures beyond their initial markets, Understand the challenges and opportunities of international expansion.

Text Books:

1. New Venture Creation: A Framework for Entrepreneurial Start-ups, Paul Burns, MacMillan publication, Latest Edition, ISBN: 9781350321793.
2. Entrepreneurship: New Venture Creation, David H. Holt, Pearson publication, Latest Edition, ISBN: 9780132826747.

Reference Books:

1. Entrepreneurship and new Venture Creation, Excel publication, Latest edition, A Sahay, V Sharma, ISBN: 978-9332568730.
2. Entrepreneurship: Successfully Launching New Ventures, Bruce R. Barringer, R. Duane Ireland, Pearson publication, Latest Edition, ISBN:978-935306649.

Web Links:

1. <https://hits.digimat.in/nptel/courses/video/109105098/L17.html>
2. <https://ocw.mit.edu/courses/15-351-managing-the-innovation-process-fall-2002/resources/lecture2021/>
3. <https://ocw.mit.edu/courses/15-351-managing-the-innovation-process-fall-2002/resources/lecture2324/>

Minor Degree in Quantum Technologies

S.No.	Course Code	Course Name	L	T	P	C	Semester
Mandatory Courses							
1	251EC097	Survey of Quantum technologies and Application	3	0	0	3	IV
2	251EC098	Foundations of Quantum Technologies	3	0	0	3	V
3	251EC099	Basic Programming Lab (or)	1	0	2	3	V
	251EC100	Basic Laboratory Course for Quantum Technologies					
4	251EC101	Quantum Algorithms and Cryptography	12 week 3 Credit - NPTEL MOOC			3	VII/VIII
Any One course from the below							
5	251EC102	Introduction to Quantum Computation	3	0	0	3	VI
6	251EC103	Introduction to Quantum Communication	3	0	0	3	VI
7	251EC104	Introduction to Quantum Sensing	3	0	0	3	VI
8	251EC105	Introduction to Quantum Materials	3	0	0	3	VI
Any One course from the below							
9	251EC106	Engineering Foundations of Quantum Technologies	3	0	0	3	VII
10	251EC107	Solid State Physics for Quantum Technologies	3	0	0	3	VII
11	251EC108	Quantum Optics	3	0	0	3	VII
12	251EC109	Quantum Cybersecurity	3	0	0	3	VII
13	251EC110	Quantum Machine Learning	3	0	0	3	VII
Total			18	0	0	18	

Survey of Quantum Technologies and Applications

Course Code: 251EC097

L T P
3 0 0

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

- CO1** Explain the core quantum mechanical principles relevant to qubits and quantum technologies.
- CO2** Analyze and compare major qubit hardware platforms used in quantum computation.
- CO3** Describe the principles and operating mechanisms of quantum sensing techniques.
- CO4** Evaluate practical applications of quantum sensing in measurement and metrology.
- CO5** Explain and assess quantum communication protocols over fibre-based and free-space channels.

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
CO2	3	3		2	2						2
CO3	2	2		2	2						2
CO4	2	2		3	2	2					2
CO5	3	3		2	3	2	1				2

UNIT – 1: Quantum Technologies – four verticals: Motivation for Quantum Technologies
A qualitative overview of salient aspects of quantum physics: Quantum States, Wavefunctions, Probabilistic interpretation, Physical observables, Hermitian operators, expectation values, Heisenberg uncertainty principle, Schrodinger equation, Time evolution; distinction from classical physics; Heuristic description of Superposition, Tunnelling and entanglement; No cloning theorem; Simulating classical systems – Feynman’s idea of a quantum simulator and the birth of the field.

UNIT-II: Quantum Computation: Basics of qubits -- what is a qubit?, How is it different from a classical bit? – Review of classical logic gates; Di Vincenzo criteria for realising qubits; Basics of qubit gates and quantum circuits; Physical implementation of qubits (very qualitative description); Solid State Qubits: Semiconducting Qubits – quantum dots, spins, Superconducting Qubits – charge, flux and phase, Topological Qubits – proposals and advantages; Atoms and Ions: Trapped ions, Rydberg atoms, Neutral atoms; Photonic Qubits: Conventional linear optical setups, Integrated Photonics; NMR qubits: Conventional NMR qubits, NV centres Overview of applications and recent achievements: RSA and Shor’s algorithm, Quantum Advantage; Long term goals and strategies being followed :

Error correction

UNIT-III: Quantum Sensing: Basics of quantum sensing, Basics of Photon (single and entangled) generation and detection, Gravimetry, Atomic clock, Magnetometry, State of the art in Quantum Sensing

UNIT-IV: Quantum Communications: Basics of digital communication, Quantifying classical information – Shannon entropy, Basic ideas of quantum communication, security, eavesdropping, Overview of quantum communication achievements : Terrestrial – fibre-based, Free space, Satellite-based

UNIT-V: Introduction to Quantum Materials: What are quantum materials, Why are they important, Applications (quantum computing, spintronics, etc.)

Overview of Key Classes of Quantum Materials: Topological Insulators, Superconductors, Mott Insulators, 2D Materials and Quantum Spin Liquids.

Course References:

1. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
2. Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10th Anniversary edition, Cambridge University Press (2010)
3. Elements of Quantum Computation and Quantum Communication, A. Pathak, Boca Raton, CRC Press (2015)
4. An Introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, and Michele Mosca, Oxford University Press (2006)
5. Quantum computing explained, David McMahon, Wiley (2008)

Foundations of Quantum Technologies

Course Code: 251EC098

L T P C
3 0 0 3

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

- CO1** Apply mathematical tools to model and analyze classical and quantum physical systems.
- CO2** Explain and apply the postulates of quantum mechanics to solve elementary quantum system problems.
- CO3** Analyze statistical physics concepts and differentiate classical and quantum statistical distributions.
- CO4** Explain and interpret information-theoretic concepts in classical and quantum information systems.
- CO5** Analyze and compare classical and quantum computational complexity classes with reference to post-quantum cryptography.

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			1						2
CO2	3	3		2	1						2
CO3	3	2		2							2
CO4	2	2			2						2
CO5	2	3			1	1	1				2

UNIT-I: Brief overview of classical physics (This segment is meant for the student to understand what a Hamiltonian is, which will feature later in quantum mechanics) : Hamiltonian function and Hamilton's equations, Phase-space description of a system, Connection and Equivalence with Newton's laws for simple systems – free particle, particle moving in a conservative potential, examples of Harmonic oscillator, hydrogen atom. Historical evolution of quantum mechanics: Planck's quantum hypothesis, Photo electric effect, Atomic spectra, Bohr's quantisation principle, De Broglie's Wave particle duality

UNIT-II Postulates of Quantum Mechanics: State vectors and Hilbert Space, Dirac Bra-Ket notation, Measurables and Hermitian Operators, Unitary Transformations, Schrodinger. Equation and Time evolution of quantum states, Measurement Postulate, Schrodinger, Heisenberg and Interaction pictures, Eigen values, Expectation values and Matrix elements, Heisenberg's Uncertainty principle

UNIT-III:

Density operator formalism of quantum mechanics – pure and mixed states; Superposition and Entanglement in quantum mechanics; No cloning theorem; Applications of postulates – Particle in a box, Hydrogen atom, Harmonic Oscillator. Number states, ladder operators and Coherent states of a harmonic oscillator; Spin and Angular momentum – spin half particles; Rabi problem of a spin-half particle in a rotating magnetic field; Bosons and Fermions

UNIT-IV:

Statistical Physics: Quick review of first and second laws of thermodynamics, Thermal Equilibrium and Gibbs principle, Applying Gibbs principle to Classical and Quantum harmonic oscillators, Bosons and Fermions and Quantum statistics – Fermi-Dirac and Bose- Einstein distributions

UNIT - V: Information Science: Digital communication and information: Quantifying information in terms of Shannon entropy; Basic ideas of quantum information; Decoherence and noise; Introductory ideas of Kraus operators Brief overview of Computational Complexity: Qualitative ideas of a Turing machine: Types of Turing machines; Time and Space complexity – P vs NP, PSPACE; Quantum complexity classes – Q, EQP, BQP, BPP, QMA; Post Quantum Cryptography (PQC)

Course References:

1. Introduction to Quantum Mechanics, Griffiths D. J., 3rd Edition, Cambridge University Press (2024)
2. Introduction to Electrodynamics, Griffiths D. J., 4th edition, Cambridge University Press (2020)
3. Principles of Quantum Mechanics, Shankar, R., 2nd edition, Springer (2014)
4. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
5. Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10th Anniversary edition, Cambridge University Press (2010)
6. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015)
7. Information Theory, Robert B. Ash, Dover Publications (2003)
8. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage India Pvt. Ltd. (2014) Statistical Mechanics, Pathria R. K., Paul D. Beale, 4th edition, Academic Press, (2021)

Basic Programming Lab

Course Code: 251EC099

L	T	P	C
1	0	2	3

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

- CO1** Apply basic programming concepts and object-oriented principles to develop scientific programs.
- CO2** Implement and analyze simple algorithms and evaluate their computational performance.
- CO3** Apply numerical methods to solve differential equations and linear algebra problems.
- CO4** Analyze probabilistic and statistical data using numerical and simulation techniques.
- CO5** Develop computational models for quantum mechanics and electromagnetism 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
CO1	3	2			2						2
CO2	3	3			2						2
CO3	3	2		2	2						2
CO4	2	3		2	2						2
CO5	3	3	2	3	2	1		1			2

Course Content and syllabus:

- Basics of programming
 - Data structures, classes, Object-oriented programming
 - Data storage and retrieval, Memory allocation
 - Scientific plotting, documentation of codes
- Simple algorithms and benchmarking run time
 - Sorting
 - Searching
 - Arithmetic algorithms like GCD, Prime factorisation
- Numerical Integration and differential equations
 - Linear 2nd Order ODEs with constant coefficients
 - Linear 2nd order ODEs with variable coefficients
 - Boundary value problems
 - Poisson equation
 - Laplace equation
 - Wave equation
 - Diffusion Equation

- Numerical techniques in linear algebra
 - Matrix inverse
 - Eigenvalue problem
 - Diagonalisation of matrices
 - Singular value decomposition
- Numerical techniques in Probability and Statistics
 - (Pseudo) Random number generation
 - Computing statistical moments for data samples
 - Least Squares fitting
 - Error Analysis
 - Hypothesis Testing
 - Monte Carlo sampling
- Applications to Quantum Mechanics (can be done using openly available modules in languages like Python, Julia etc.)
 - Eigen energies of coupled two level systems
 - Eigen energies of two-level system coupled to oscillator (Jaynes-Cummings Model)
 - Driven two-level system – Rabi Problem
 - Driven damped oscillator — coherent states
- Applications to EM theory (e.g. magnetic field simulation)
 - Electrostatic charge distributions
 - Magnetostatic current distributions
 - Finite Element techniques for electromagnetic simulations

Course References:

Computational Physics, Nicholas Giordano, Hisao Nakanishi, 2nd edition, Pearson-Addison Wesley (2005)

Basic Laboratory Course for Quantum Technologies

Course Code: 251EC100

L	T	P	C
1	0	2	3

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

- CO1** Apply optical experimental techniques to measure wavelength, diffraction, polarization, and imaging parameters.
- CO2** Analyze and characterize RLC circuits and resonators to determine quality factor and losses.
- CO3** Implement and verify basic digital circuits using standard ICs and laboratory instruments.
- CO4** Operate RF and microwave instruments to measure transmission, reflection, noise, and network parameters.
- CO5** Acquire, process, and interpret experimental data using computer interfacing and quantum simulation tools.

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	2						2
CO2	3	3		2	2						2
CO3	3	2	2		2		1				2
CO4	3	3		2	2	1					2
CO5	3	3	2	2	2	1	1				2

Course Content and syllabus:

- Optics
 - Interferometry – wavelength measurements, intensity measurements
 - Diffraction – single slit, grating
 - Microscopy – magnification, aberration
 - Polarization optics – PBS, HWP, QWP
- RLC circuits
 - Series and parallel RLC circuits – Verifying the quality factor formulae
 - Extracting intrinsic losses
- Digital circuits
 - Adder, Multiplier
 - Encoder, Decoder
 - D flipflop, shift registers
 - How to use common Integrated Circuit chips
- Radio Frequency Technology:
 - Using Oscilloscope

- Ring-up and ring-down time measurements of RLC circuits
- Measurements of different pulse-shapes generated by a function generator
 - Using Vector Network Analyser
- Transmission and reflection measurements of coaxial cable in open, short and matched termination
- Voltage standing wave ratio measurement
- Amplitude and Phase quadrature, In-phase and Out-of-phase quadrature plots and Quality factor measurement of RLC circuits
- Characterising S-parameters, ABCD and Z matrices of common 2 port networks – coaxial cable, attenuator, low pass high pass bandpass filters etc.
- Characterising 3 port networks – directional couplers, circulators, isolators
 - Using a spectrum analyser
- Noise from a resistor at different temperatures
- Interfacing instruments with a computer
- Data acquisition
 - Signal demodulation – heterodyne vs Homodyne, Mixing of signals
 - Sampling, digitisation using ADCs – under-sampling and aliasing, oversampling and noise
 - Averaging and interpolation techniques
- Quantum Simulators
 - Running quantum protocols in a quantum simulator
 - Implementing simple quantum algorithms on cloud-based quantum computers (depending on availability of time on such machines)
- Running simple algorithms on cloud-based quantum processors (optional)

Course References:

1. Optics, Eugene Hecht, A. R. Ganesan, 5th edition, Pearson (2019)
2. Art of Electronics, Paul Horowitz and Winfield Hill, 3rd edition, Cambridge University Press (2015)
3. Digital Design, Morris Mano, Michael D. Cilletti, 6th edition, Pearson Education (2018)
4. Microwave Engineering, David Pozar, 4th edition, Wiley (2013)
5. Discrete-time signal processing, Alan V. Oppenheim and Ronald W. Shaffer, 4th edition, Pearson (2009)
6. Optical quantum information and quantum communication, A. Pathak and A. Banerjee, SPIE Spotlight Series, SPIE Press (2016)

Introduction to Quantum Computation

Course Code: 251EC102

L	T	P	C
3	0	0	3

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

- CO1** Explain the principles of qubits and compare their physical realizations with classical bits.
- CO2** Analyze quantum correlations, entanglement, and Bell-type inequalities in quantum systems.
- CO3** Apply universal quantum gates and circuits to construct basic quantum computational models.
- CO4** Analyze and explain the working of fundamental quantum algorithms such as Grover's and Shor's algorithms.
- CO5** Explain quantum computational complexity, error correction techniques, and the limitations of NISQ-era processors.

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
CO2	3	3		2							2
CO3	3	2			2						2
CO4	3	3		2	2						2
CO5	2	3		2	2	2	1		1		2

Course Content and syllabus:

- Qubits versus classical bits
 - Spin-half systems and photon polarizations
 - Trapped atoms and ions
 - Artificial atoms using circuits
 - Semiconducting quantum dots
 - Single and Two qubit gates – Solovay - Kitaev Theorem
- Quantum correlations
 - Entanglement and Bell's theorems
- Review of Turing machines and classical computational complexity
 - Time and space complexity (P, NP, PSPACE)
- Reversible computation
- Universal quantum logic gates and circuits
- Quantum algorithms
 - Deutsch algorithm
 - Deutsch Josza algorithm
 - Bernstein - Vazirani algorithm
 - Simon's algorithm
- Database search

- Grover's algorithm
- Quantum Fourier Transform and prime factorization
 - Shor's Algorithm.
- Quantum complexity classes – Q, EQP, BQP, BPP, QMA
- Additional Topics in Quantum Algorithms
 - Variational Quantum Eigensolver (VQE)
 - HHL
 - QAOA
- Introduction to Error correction
 - Fault-tolerance
 - Simple error correcting codes
- Survey of current status
 - NISQ era processors
 - Quantum advantage claims
 - Roadmap for future

Course References:

1. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
2. Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10th Anniversary edition, Cambridge University Press (2010)
3. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015)
4. Quantum error correction and Fault tolerant computing, Frank Gaitan, 1st edition, CRC Press (2008)
5. Quantum computing explained, David McMahon, Wiley (2008)
6. Introduction to Quantum Computing: From a lay person to a programmer in 30 steps, Hui Yung Wong, 1st edition, Springer-Nature Switzerland AG (2022)

Introduction to Quantum Communication

Course Code: 251EC103

L	T	P	C
3	0	0	3

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

- CO1** Explain the principles of polarization optics and photodetection relevant to quantum communication systems.
- CO2** Analyze classical and quantum information concepts including entropy, noise, and channel capacity.
- CO3** Explain and analyze quantum correlations, Bell measurements, and fundamental quantum communication protocols.
- CO4** Analyze the working of quantum communication protocols such as teleportation, dense coding, and quantum key distribution.
- CO5** Evaluate quantum communication architectures, hardware implementations, and the concept of quantum networks and internet.

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
CO2	3	3			2						2
CO3	3	3		2							2
CO4	3	3		2	2		1		2		2
CO5	2	2		2	3	2	1		2		2

Course Content and syllabus:

- Basics of Polarization optics
 - Quarter and half-wave plates
 - Polarizing beam splitters
- Basics of linear and square-law detectors
 - Quadrature amplitude modulation
 - Heterodyne and Homodyne demodulation and linear detectors
 - Intensity measurements and square law detectors
 - Photomultipliers, Avalanche Photo diodes
- Digital communication – information theory (basics)
 - Information entropy
 - Noiseless channel encoding
 - Noisy channel encoding
- No cloning theorem
- Quantum Memories
- Quantum repeaters
- Entanglement and Bell Theorems
- Bell Measurements and Tests
- Quantum Teleportation protocol

- Quantum Dense coding
- Quantum Key Distribution protocols
 - BB84
 - E91
 - BBM92.
 - B92
 - COW
 - DPS
- Quantum Networks and Quantum Internet
- Survey of Hardware implementations
 - Free space communications
 - Satellite based communications
 - Fibre optics-based communications

Course References:

1. Quantum computation and quantum information – Nielsen and Chuang
Cambridge University Press, Cambridge (2010)
2. A Pathak, Elements of Quantum Computation and Quantum
Communication, Boca Raton, CRC Press (2015)

Introduction to Quantum Sensing

Course Code: 251EC104

L T P C
3 0 0 3

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

- CO1** Explain the principles of classical sensing, noise mechanisms, and measurement sensitivity limits.
- CO2** Analyze quantum measurement processes including projective, weak, and non-demolition measurements.
- CO3** Apply information-theoretic bounds to quantify and optimize quantum sensing performance.
- CO4** Analyze quantum states of light and photodetection techniques used in precision measurements.
- CO5** Evaluate photon-, entanglement-, atomic-, and spin-based quantum sensing 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
CO1	3	2									2
CO2	3	3		2							2
CO3	3	3		2	2						2
CO4	3	3		2	2				2		2
CO5	2	3		3	2	2			2		2

Course Content and syllabus:

- Classical sensing
 - photo detection
- Classical Noise
 - Johnson Noise, Telegraph noise, flicker or 1/f noise
- Sensitivity of classical measurements
 - Classical Fisher information
 - Cramer - Rao bounds (information theory basics may be required here).
- Quantum measurements
 - projective/orthogonal measurements
 - Approximate/non-orthogonal measurements
 - Weak continuous measurements
 - Error-disturbance relations
 - Standard quantum limits
 - Quantum non-demolition measurements
- States of light
 - fock states
 - Coherent states

- Squeezed states
- Tomography
- Wigner quasi-probability distribution
- P-distribution
- Husimi Q function
- Quantum photo detection
 - Square-law detectors, Intensity measurements and Photo-detection
 - Linear Detectors and Quadrature Measurements
- Quantum Cramer-Rao bounds
- Single photon-based sensing applications
- Entanglement based sensing applications
- Atomic state-based sensing, solid-state spin-based sensing applications (gravimetry, magnetometry)

Course References:

1. Quantum Measurement and Control , Howard Wiseman and David Milburn, Cambridge University Press (2014)
2. Quantum Measurement , Vladimir Braginsky and Farid Ya Khalili, Cambridge University Press (1995)
3. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)

Introduction to Quantum Materials

Course Code: 251EC105

L T P C
3 0 0 3

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

- CO1** Explain the fundamental concepts of band theory and electronic structure in solids.
- CO2** Analyze correlated systems and magnetic phenomena using basic experimental and theoretical principles.
- CO3** Explain the principles of superconductivity and the operation of superconducting devices.
- CO4** Analyze the electronic and optical properties of two-dimensional materials such as graphene and TMDCs.
- CO5** Explain topological phases of matter and assess material growth techniques relevant to quantum 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
CO1	3	2									2
CO2	3	3		2							2
CO3	3	2		2							2
CO4	3	3		2	2				2		2
CO5	2	2		2	2	2			2		2

Course Content and syllabus:

- Band theory basics
 - Metals, Semiconductors and Insulators
 - Band structure of solids
 - Survey of semiconducting devices for quantum technologies
(electronic, quantum optical devices and principle of operation)
- Correlated systems
- Magnetism
 - Para, ferro magnetism basics
 - Magnetic measurements, hall effect, magnetoresistance
 - Faraday and Kerr effects
- Superconductivity
 - BCS theory
 - Ginzburg Landau
 - Josephson Effect – AC and DC Josephson effects
 - Survey of superconducting devices for quantum technologies
- 2D materials

- Graphene and its properties – single and few layers
- Transition Metal Dichalcogenides – Electronic and Optical Properties
- Topological Phases of matter
 - Basics of Topology
 - Geometric phases - Berry Phase
 - Aharonov Bohm effect
 - Topological phases of matter
- Survey of material growth techniques
 - Molecular beam epitaxy
 - Chemical vapor deposition, MOVPE
 - Pulsed laser deposition, etc.
 - Crystal growth techniques

Course References:

1. Condensed Matter Physics , M P Marder, 2nd Edition, John Wiley and Sons, 2010
2. Introduction to Superconductivity, Michael Tinkham, standard ed., Medtech (2017)

Engineering Foundations of Quantum Technologies

Course Code: 251EC106

L	T	P	C
3	0	0	3

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

- CO1** Apply principles of electrical networks and transmission lines to analyze resonant circuits and signal propagation.
- CO2** Explain abstract models of computation and analyze algorithmic complexity using classical computation theory.
- CO3** Analyze analog and digital communication techniques with respect to modulation, noise, and information capacity.
- CO4** Apply noise analysis and signal conditioning principles to evaluate system performance and quantum noise limits.
- CO5** Explain cryptographic principles and analyze classical and post-quantum cryptographic protocols.

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		2						2
CO2	3	3									2
CO3	3	3		2	2			2			2
CO4	3	3		2	2						2
CO5	2	3			2	2		2			2

Course Content and syllabus:

- Electrical Networks (4 hours)
 - Analog RLC circuits – resonances, impedances, quality factors
 - Transmission line basics (2 hours)
 - Telegrapher equations, wave impedance, impedance matching, transmission line resonators
- Computer Science (15 hours)
 - Basics of computer architecture (1 hour)
 - Arithmetic Logic Unit
 - Memory
 - Abstract models of computation (12 hours)
 - Finite State Machine
 - Turing Machines
 - Overview of Hierarchy of languages – Regular, Context-Free, Turing Decidable and Turing Recognisable
 - Complexity Theory (2 hours)
 - Time and Space complexity

- P vs NP, NP-completeness
- Electrical Communications (1 hour)
 - Analog Communications (1 hour)
 - Quadrature amplitude modulation
 - Heterodyne and Homodyne demodulation
- Noise and Signals (6 hours)
 - Characterising Noise
 - Types of Noise
 - Shot Noise
 - Johnson-Nyquist Noise
 - Telegraphic noise or flicker or 1/f noise
 - Signal conditioning and noise mitigation
 - Amplification and Added Noise
 - Linear Amplifier theory
 - Signal-Noise Ratio, Added Noise, Noise Figure of amplification
 - Dynamic Range
 - Noise temperature
 - Quantum limits on noise in linear amplifiers
- Digital Communications (4 hours)
 - Information entropy
 - Noiseless channel encoding
 - Noisy channel encoding
- Basics of cryptography (6 hours)
 - Basics of Number Theory
 - Random Number Generation
 - One time pad, Private key, public key, symmetric and asymmetric cryptography protocols
 - RSA and DH
 - Post Quantum Cryptography (PQC)

Course References:

1. Art of Electronics, Paul Horowitz and Winfield Hill, 3rd edition, Cambridge University Press (2015)
2. Digital Design, Morris Mano, Michael D. Ciletti, 6th edition, Pearson Education (2018)
3. Microwave Engineering, David Pozar, 4th edition, Wiley (2013)
4. Information Theory, Robert B. Ash, Dover Publications (2003)
5. Introduction to the Theory of Computation, Michael Sipser, 3rd edition, Cengage India Pvt. Ltd. (2014)
6. Protecting Information – From Classical error correction to quantum cryptography, Susan Loepf and William K. Wootters, Cambridge University Press (2006)

Solid State Physics for Quantum Technologies

Course Code: 251EC107

L	T	P	C
3	0	0	3

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

- CO1** Explain crystal structures, symmetry, diffraction principles, and bonding mechanisms in solids.
- CO2** Analyze electronic properties of solids using free-electron, band theory, and tight-binding models.
- CO3** Analyze lattice vibrations and phonon dynamics to explain vibrational and thermal properties of solids.
- CO4** Explain and analyze magnetic phenomena in solids using classical and quantum models.
- CO5** Explain superconducting phenomena and analyze superconducting materials and devices relevant to quantum 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
CO1	3	2									2
CO2	3	3		2							2
CO3	3	3		2							2
CO4	3	2		2							2
CO5	3	3		2	2	2					2

Course Content and syllabus:

- Structure of solids –
 - Symmetry, Bravais lattices
 - Laue equations and Bragg’s law,
 - Brillouin Zones
 - Atomic scattering and structure factors.
- Characterisation of crystal structures – XRD etc.
- Bonding in solids –
 - van der Waals and Repulsive interactions,
 - Lennard Jones potential,
 - Madelung constant
- The Drude theory of metals –
 - DC & AC electrical conductivity of a metal;
 - Hall effect & magnetoresistance,
 - Density of states, Fermi-Dirac distribution, Specific heat of degenerate electron gases
 - Free electron model

- Beyond the Free electron model
 - Kronig-Penney Model
 - Periodic potential – Bloch Theorem
 - Band theory
 - Tight binding model
- Phonons in Solids
 - One dimensional monoatomic and diatomic chains
 - Normal modes and Phonons
 - Phonon spectrum
 - Long wavelength acoustic phonons and elastic constants
 - Vibrational Properties- normal modes, acoustic and optical phonons.
- Magnetism
 - Dia-, Para-, and Ferromagnetism
 - Langevin's theory of paramagnetism
 - Weiss Molecular theory
- Superconductivity:
 - Phenomenological description – Zero resistance, Meissner effect
 - London Theory
 - BCS theory
 - Ginzburg-Landau Theory
 - Type-I and type-II superconductors
 - Flux quantization
 - Josephson effect.
 - High T_c superconductivity

Course References:

1. Introduction to Solid State Physics, Charles Kittel, Wiley India Edition (2019)
2. Condensed Matter Physics, M P Marder, 2nd Edition, John Wiley and Sons (2010)
3. Introduction to Superconductivity, Michael Tinkham, standard edition, Medtech (2017)

Quantum Optics

Course Code: 251EC108

L	T	P	C
3	0	0	3

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

- CO1** Explain the quantization of the electromagnetic field and the properties of non-classical states of light.
- CO2** Analyze optical coherence phenomena and interferometric techniques using quantum optical principles.
- CO3** Analyze phase-space representations of quantum states of light to identify non-classical features.
- CO4** Analyze classical, semi-classical, and quantum models of light–matter interaction in atomic systems.
- CO5** Apply open quantum system models to describe decoherence and dissipation in quantum optical 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
CO1	3	2									2
CO2	3	3		2					1		2
CO3	3	3		2					1		2
CO4	3	3		2	2				1		2
CO5	3	3		2	2				1		2

Course Content and syllabus:

- Quantization of the electromagnetic field
 - Number states, coherent states, squeezed states
 - Hanbury-Brown and Twiss experiments – Photon bunching, Photon anti bunching
 - Hong-Ou-Mandel interference
- Theory of Optical coherence
 - Young’s double slit experiment and first order coherence
 - Coherence functions of arbitrary order
 - Normal ordering, symmetric ordering and anti-normal ordering of operators
 - Interferometry
- Phase-space representations of states of light
 - Wigner distribution
 - P-function and the notion of non-classicality with some examples of nonclassical states like squeezed states and their applications
 - Husimi Q function

- Light-matter interaction
 - Classical model of light-matter interaction
 - Semi-classical model of light-matter interaction-
 - Quantum light-matter interaction
 - Rabi Model
 - Jayne's-cummings model
- Open quantum systems
 - Fermi golden rule
 - Born-Markov Lindblad Master Equation

Course References:

1. Introductory Quantum Optics, Christopher Gerry and Peter Knight, Cambridge University Press (2004)
2. Quantum Optics, D. F. Walls, Gerard J. Milburn, 2nd Edition, Springer (2008)
3. Quantum Optics: An introduction, Mark Fox, Oxford University Publishers (2006)
4. Quantum Optics for Beginners, Z. Ficek and M. R. Wahiddin, 1st edition, Jenny Stanford Publishing (2014)