

B. TECH. PROGRAM CURRICULUM - 2025

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

Version 2.0

CIVIL ENGINEERING

Version 1.0–Approved in the BoS meeting on 17-05-2025 & Academic Council meeting on 14-06-2025

Version 2.0–Approved in the BoS meeting on 07-02-2026 & Academic Council meeting on 28-02-2026



Aditya Nagar, ADB Road, Surampalem - 533 437



ADITYA UNIVERSITY

Department of Civil Engineering

Vision

To emerge as a premier center of excellence in Civil Engineering by promoting holistic education, innovative thinking, and lifelong learning for a sustainable future.

Mission

M1: Deliver quality education through an industry-aligned curriculum and experiential learning

M2: Foster interdisciplinary research and technological advancement to address global challenges.

M3: Promote sustainable practices that contribute to societal development.



ADITYA UNIVERSITY

Department of Civil Engineering

PEOs and PSOs of the Undergraduate Program

Program Educational Objectives (PEOs)

Graduates of the Program will

PEO1: Apply technical knowledge and leadership qualities to excel in the industry and higher education.

PEO2: Design sustainable infrastructure that addresses environmental and social needs.

PEO3: Apply research and innovative thinking to solve complex civil engineering problems.

Program Specific Outcomes (PSOs)

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

PSO1: Demonstrate the capability to plan, design and construct sustainable structures based on functional requirements.

PSO2: Apply technical and analytical skills to create efficient, safe, and sustainable infrastructure solutions.

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 Civil Engineering

B.Tech (CE) Program Curriculum – 2025

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

UG Programs Offered

- B. Tech in (Civil Engineering)
- B. Tech in (Civil Engineering) with
 - Minor degree in Electrical and Electronics Engineering
 - Minor degree in Mechanical Engineering
 - Minor degree in Electronics and Communication Engineering
 - Minor degree in Computer Science and Engineering
 - Minor degree in Data Science
 - Minor degree in Artificial Intelligence and Machine Learning
 - 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

Minor Streams offered in B.Tech (Civil Engineering)

- Minor Stream in Structural Engineering
- Minor Stream in Environmental Geotechnics
- Minor Stream in Transportation Engineering
- Minor Stream in Integrated Design for Industrial Facilities Industry
Integrated Program- L & T

Credit Division Category-wise

S.No	Broad Category of Course	UGC	Credits
1	Major Core Courses (MCC)	80	81
2	Minor Stream Courses (MSC) (or) Minor Stream Courses (Min 20 credits) and University Open Elective Courses (UEC) (upto 12 credits)	32	32
3	Multidisciplinary Courses (MDC)	9	10
4	Ability Enhancement Courses (AEC)	8	9
5	Skill Enhancement Courses (SEC)	9	9
6	Value Added Courses (VAC)	6-8	3
7	Summer Internships (SI)	2-4	4
8	Full Semester Internship (PROJ)	12	12
9	Mandatory Courses(MC)	0	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	-
2501MA03	Integral Transforms & Applications of Partial Differential Equations	IC	2	1		3	50	50	100	LAC
2501MA04	Numerical Methods & Statistical Techniques	IC	2	1		3	50	50	100	ITAPDE
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501IT01 / 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	FC			2	2	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100		100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME02	Engineering Mechanics	FC	2	1	1	4	50	50	100	-
2501CE01	Construction Materials & Concrete Technology	IC	2		2	4	50	50	100	-
2501CE02	Fluid Mechanics	IC	1	1	1	3	50	50	100	-
2501CE03	Strength of Materials – I	IC	2		2	4	50	50	100	EM
2501CE04	Engineering Geology	IC	2		1	3	50	50	100	-
2501CE05	Geomatics Engineering	FC	1	1	2	4	50	50	100	-

2501CE06	Hydraulics & Hydraulic Machinery	IC	1	1	1	3	50	50	100	FM
2501CE07	Geotechnical Engineering – I	IC	2		2	4	50	50	100	-
2501CE08	Strength of Materials – II	IC	2	1		3	50	50	100	SOM-1
2501CE09	Structural Analysis	IC	2	1		3	50	50	100	SOM-1
2501CE10	Geotechnical Engineering – II	IC	2	1		3	50	50	100	GE-1
2501CE11	Environmental Engineering	IC	2		2	4	50	50	100	-
2501CE12	Transportation Engineering	IC	1	1	1	3	50	50	100	-
2501CE13	Estimating and Costing	IC	3			3	50	50	100	BP&CAD
2501CE14	Design of Reinforced Concrete Elements	AC	2	1		3	50	50	100	SOM
2501CE24	Design of Steel Structures	AC	2	1		3	50	50	100	SOM
2501CE15	Hydrology & Irrigation with ML Techniques	AC	2	1		3	50	50	100	HHM
Total			44	15	22	81				

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS01/ 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	FC	2		2	4	50	50	100	-
2501EE01	Basic Electrical & Electronics Engineering	FC	2		2	4	50	50	100	-
2501MB01	Engineering Economics & Management	FC	2			2	50	50	100	-
	Total		6		4	10				

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 (or) Proficiency in Foreign Language (Japanese/German/ Spanish/ French)	FC			1	1	100	-	100	CEE
2501UC05										
2501UC04										
2501UC06										
2501UC03										
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	-
2501CE79	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
2501CE43	Building Planning & Computer Aided Drawing	FC			2	2	50	50	100	-
2501CE17	3D Modelling of Building	FC			2	2	50	50	100	EG
2501CE18	Geospatial AI	IC			1	1	100	-	100	-
2501CE19	GeoStudio for Geotechnical Applications	AC			2	2	50	50	100	GT-1, GT-2
2501CE20	Computer-Aided Structural Analysis & Design	AC			2	2	50	50	100	SA
Total					9	9				

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
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
2501CS02	Data Analysis using Python	IC			2	2	50	50	100	PPSC
Total					17	3				

Summer Internships (SI)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE21	Summer Internship - I	IC			2	2	100	-	100	-
2501CE22	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
2501CE23	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: Structural Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE57	Construction & Project Management	FC	2			2	50	50	100	--
2501CE25	Repair & Rehabilitation of Structures	FC	3			3	50	50	100	-
2501CE26	Fire & Safety Engineering	FC	3			3	50	50	100	-
2501CE27	Green Buildings	FC	3			3	50	50	100	-
2501CE29	Construction Equipment & Machinery	FC	3			3	50	50	100	CM&CT
2501CE28	Finite Element Methods	IC	2	1		3	50	50	100	SA
2501CE31	Construction Contract Management	IC	3			3	50	50	100	-
2501CE30	Pre-stressed Concrete Structures	IC	3			3	50	50	100	-
2501CE32	Design of Ocean Structures & Foundation	IC	2	1		3	50	50	100	-
2501CE33	Analysis & Design of Masonry Structures	IC	2	1		3	50	50	100	-
2501CE34	Design of Tall Buildings	AC	2	1		3	50	50	100	-
Total			28	4		32				

Minor Stream: Environmental Geotechnics

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE41	Geoenvironmental Engineering	FC	2			2	50	50	100	ES
2501CE40	Fundamentals of Soil Behaviour	FC	2	1		3	50	50	100	-
2501CE39	Flow & Transport in Porous Media	FC	3			3	50	50	100	-
2501CE44	Land fill Engineering & Remediation Technology	FC	3			3	50	50	100	-
2501CE36	Environmental Impact & Risk Management	FC	3			3	50	50	100	-
2501CE35	Climate Change and Environmental Issues	IC	3			3	50	50	100	-
2501CE42	Ground Improvement Techniques	IC	3			3	50	50	100	GTE-2
2501CE38	Expansive Soils	IC	3			3	50	50	100	GTE-1&2
2501CE37	Environmental Management	IC	3			3	50	50	100	-
2501CE45	Marine Foundations	AC	3			3	50	50	100	GTE-2
2501CE73	Water Resource Management	AC	3			3	50	50	100	-
Total			31	1		32				

Minor Stream: Transportation Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE53	Pavement Materials & Characterization	FC	2			2	50	50	100	-
2501CE47	Docks & Harbour Engineering	FC	3			3	50	50	100	-
2501CE54	Railway Engineering	FC	3			3	50	50	100	-
2501CE55	Road Safety Analysis	FC	3			3	50	50	100	-
2501CE48	Highway Construction & Practices	FC	3			3	50	50	100	-
2501CE52	Pavement Management Systems	FC	3			3	50	50	100	-
2501CE51	Pavement Drainage Systems	FC	3			3	50	50	100	-
2501CE46	Airport Planning & Design	IC	3			3	50	50	100	-
2501CE56	Urban Transportation Planning	IC	3			3	50	50	100	-
2501CE49	Intelligent Transportation Systems	AC	3			3	50	50	100	-
2501CE50	Pavement Design & Evaluation	AC	3			3	50	50	100	-
Total			32			32				

**Minor Stream: Integrated Design for Industrial Facilities Industry Integrated
Program- L & T[#]**

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE69	Building Information Modelling in Construction	FC			3	3	50	50	100	-
2501CE67	Sustainability Practices in Design of Buildings	IC			3	3	50	50	100	-
2501CE70	Formwork Engineering Practices	IC			2	2	50	50	100	-
2501CE72	Design & Execution of Pile Foundations	IC			3	3	50	50	100	-
2501CE61	Metro Rail Transportation Systems & Construction	IC			3	3	50	50	100	-
2501CE71	Deep Excavations, Foundations & Tunnels	AC			3	3	50	50	100	-
2501CE68	Bridge Engineering Design Practices	AC			3	3	50	50	100	-
2501CE16	Geospatial Techniques in Practice	AC			3	3	50	50	100	-
2501CE63	Pre Engineered Buildings	AC			3	3	50	50	100	-
2501CE64	Precast Members & Construction	AC			3	3	50	50	100	-
2501CE60	Hydropower Structures	AC			3	3	50	50	100	-
Total					32	32				

Note:

The syllabus for the industry partnered courses will be released in the department as and when required

UNIVERSITY OPEN ELECTIVE COURSES (UEC)

Branch	Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Offered to	Pre-requisite
CE	2501CE66	Natural Disaster Management & Mitigation		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE81	Wastewater Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE82	Integrated Solid Waste Management for a Smart City		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE83	Watershed Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE53	Electric Power Generation, Transmission & Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	

ME	2501ME36	Sustainable Energy Systems	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ECE	2501EC97	Biomedical Electronics	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC98	Fundamentals of Wireless Communications	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA3	Introduction to Quantum Computing	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/2601DS02	Data Structures* / Data Structures using C++#	FC	2		2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2		2	4	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS

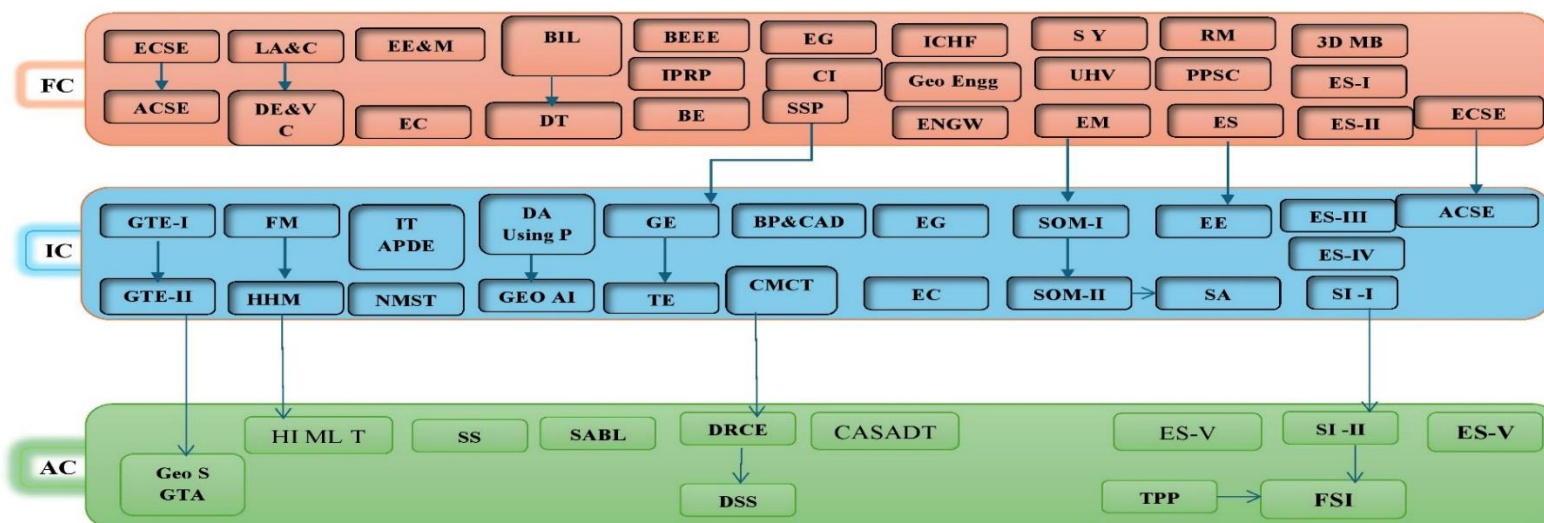
IT	2501CS07	Computer Networks	AC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2		1	3	50	50	CE, EEE, ECE, PT, Min.E	-
AI&ML	2501AI05	Machine Learning	AC	2		2	4	50	50	CE, ECE, PT, Min.E	DAUP
DS	2501CS34	Fundamental of Data Science	FC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	PPSC / CP&DS

Note: *Courses are applicable only to students admitted in the year 2025.

#Courses are applicable to the students admitted from the year 2026 onwards.

All the other courses are applicable to students admitted from the year 2025 onwards.

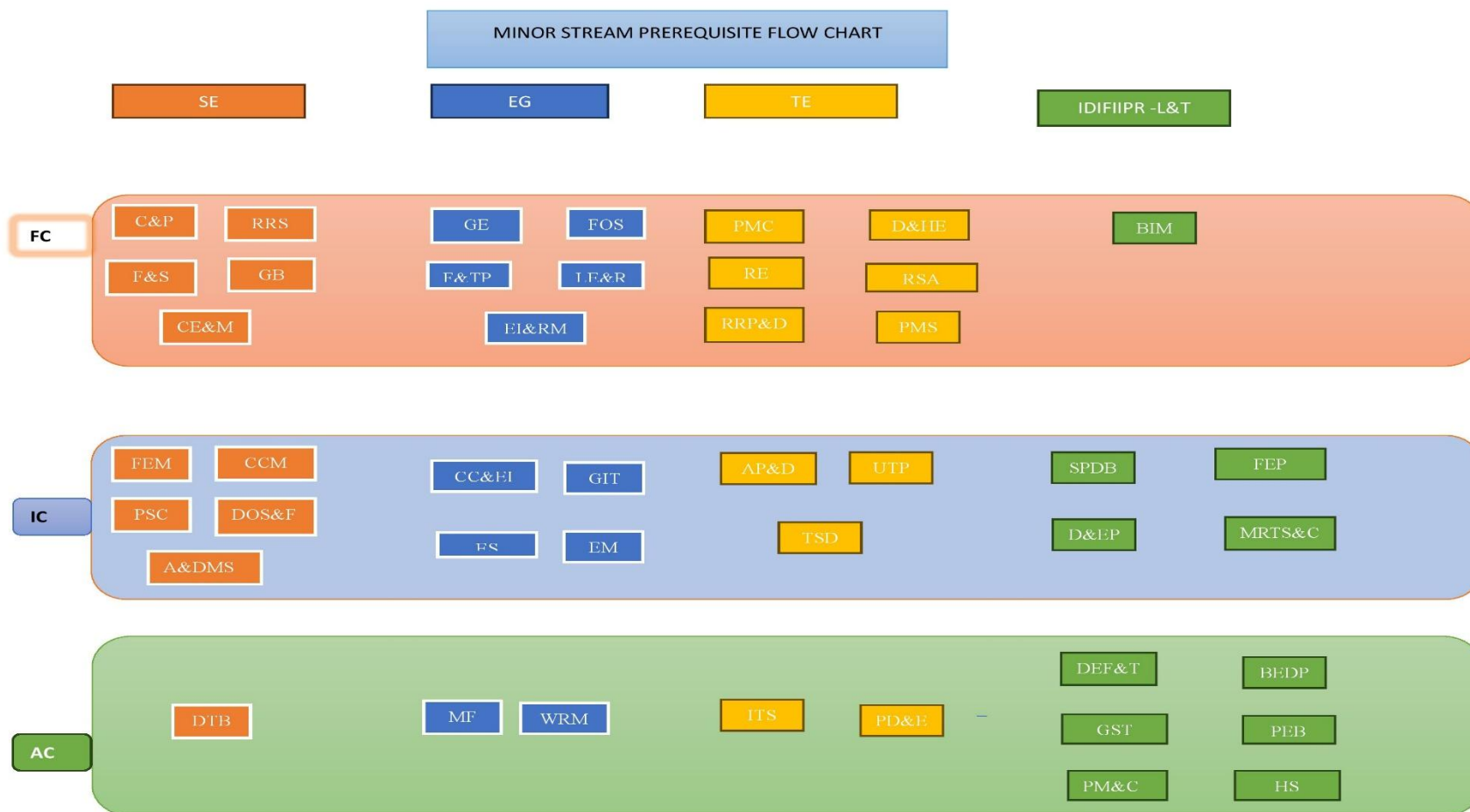
**2025 B. TECH CE CURRICULUM
PREREQUISITE FLOW CHART**



FOUNDATION COURSES
INTERMEDIATE-LEVEL COURSES
ADVANCED COURSES

LAC	Linear Algebra & Calculus	ITAPDE	Integral Transforms & Applications of Partial Differential Equations	DRCS	Design of Reinforced Concrete Elements
DEVC-	Differential Equations & Vector Calculus	NMST	Numerical Methods & Statistical Techniques	DSS	Design of Steel Structures
EC	Engineering Chemistry	FM	Fluid Mechanics	HI ML	Hydrology & Irrigation with ML Techniques
SSP	Solid State Physics	SOM-1	Strength of Materials -1	TPW	Technical Paper Writing
EG	Engineering Graphics	EG	Engineering Geology	GEO	Geostudio for Geotechnical Applications
EM	Engineering Mechanics	CMCT	Construction Materials & Concrete Technology	CASAD	Computer Aided Structural Analysis & Design
GE	Geomatic Engineering	BPCAD	Building Planning & Computer Aided Drawing	CASA& D	Computer Aided Structural Analysis & Design
PPS Using C	Programming for Problem Solving Using C	H&HM	Hydraulics & Hydraulic Machinery	SI	Summer Internship -II
BEEE	Basic Electrical & Electronics Engineering	GTE	Geotechnical Engineering -I	Proj	Full Semester Internship
ECSE-1	Essential Cognitive Skills for Engineers	SOM-II	Strength of Materials -II	ES-V	Employability Skills -V
ACEE	Advanced Cognitive Skills for Engineers	SA	Structural Analysis		
UHV	Universal Human Value	GTE	Geotechnical Engineering-II		
DT	Design Thinking using AI	EE	Environmental Engineering		
IT AI	Business Intelligence Lab	TE	Transportation Engineering		
ENGW	Engineering Workshop	ESC	Estimating and Costing		

ES	Environmental Science	ACSE-1	Advanced Cognitive Skills for Engineers
CI	Constitution of India	DAP	Data Analysis Using Python
IKS	Indian Knowledge Systems	GEO AI	Geospatial AI
RM	Research Methodology	SI	Summer Internship
IPRP	Intellectual Property Rights & Patents	ES-III	Employability Skills -III
BE	Biology for Engineers	ES-IV	Employability Skills -IV
EEM	Engineering Economics & Management		
ES-I	Employability Skills -I		
ES-II	Employability Skills -II		



Minor Stream	FOUNDATION COURSES		INTERMEDIATE-LEVEL COURSES		ADVANCED COURSES	
SE	CPM	Construction & Project Management	FEM	Finite Element Methods	FOS	Foundation of Offshore Structures
	RRS	Repair & Rehabilitation of Structures	OSM	Construction Contract Management		
	FSE	Fire & Safety Engineering	PSC	Prestressed Concrete Structures		
	IOE	Green Buildings	DOS&F	Design of Ocean Structures and Foundations	DTB	Design of Tall Buildings
	CE&M	Construction Equipment & Machinery	A&DMS	Analysis & Design of Masonry Structures		
EG	GE	Geoenvironmental Engineering	BTC	Climate Change & Environmental Issues	MF	Marine Foundations
	FSB	Fundamentals of Soil Behaviour	GIT	Ground Improvement Techniques		
	ES		ES	Expansive Soil		
	FTPM	Flow & Transport in Porous Media			EBT	Water Resource Management
	LERT	Land fill Engineering & Remediation Technology	EM	Environmental Management		
TE	EIRM	Environmental Impact & Risk Management				
	PMC	Pavement Materials & Characteristics	APD	Airport Planning & Design	ITS	Intelligent Transportation Systems
			UTP	Urban Transportation Planning	PDE	Pavement Design & Evaluation
	DHE	Docks & Harbour Engineering				
	RE	Railway Engineering				
IDIFII L&T	RSA	Road Safety Analysis				
	HCP	Highway Construction & Practices				
	PMS	Pavement Management Systems				
	PDS	Pavement Drainage System				
			SPDB	Sustainability Practice in Design of Buildings	DEFT	Deep Excavations, Foundations & Tunnels
			FEP	Formwork Engineering Practices		
			DEPF	Design & Execution of Pile Foundations	PEB	Pre-engineered Buildings
	BIMC	Building Information Modelling in Construction			BEDP	Bridge Engineering Design Practices
					PMC	Precast Members & Construction
					HPS	Hydropower Systems
					GTP	Geospatial Techniques in Practices
			MRTS&C	Metro Rail Transportation System & Construction		

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
2501PH01	Solid State Physics	MCC	FC	2	—	1	3	4
2501ME01	Engineering Graphics	MCC	FC	1	—	2	3	5
2501IT01 / 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	MCC	FC	—	—	2	2	4
2501EN01	Essential Cognitive Skills for Engineers	AEC	FC	—	—	1	1	2
2501ME03	Engineering Workshop	MCC	FC	—	—	1	1	2
2501UC07	Design Thinking using AI	AEC	FC	—	—	1	1	2
2501CE05	Geomatics Engineering	MCC	FC	1	1	2	4	6
2501MB01	Engineering Economics & Management	MDC	FC	2	—	—	2	2
Total				8	2	11	20	30

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
2501CH01	Engineering Chemistry	MCC	FC	2	—	1	3	4
2501EE01	Basic Electrical & Electronics Engineering	MDC	FC	2	—	2	4	6
2501ME02	Engineering Mechanics	MCC	FC	2	1	1	4	5
2501CS01/ 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	MDC	FC	2	—	2	4	6
2501EN02	Advanced Cognitive Skills for Engineers	AEC	FC	—	—	1	1	2
2501UC08	Universal Human Values	AEC	FC	2	—	—	2	2
2501UC11	Employability Skills-I	VAC	FC	—	—	3	—	3
2501AC01	Environmental Science	MC	FC	2	—	—	—	2
Total				14	2	10	21	33

III SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA03	Integral Transforms & Applications of Partial Differential Equations	MCC	IC	2	1	—	3	3
2501CE03	Strength of Materials – I	MCC	IC	2	—	2	4	6
2501CE04	Engineering Geology	MCC	IC	2		1	3	4
2501CE02	Fluid Mechanics	MCC	IC	1	1	1	3	4
2501CE01	Construction Materials & Concrete Technology	MCC	IC	2	—	2	4	6
2501CE43	Building Planning & Computer Aided Drawing	SEC	IC	—	—	2	2	4
2501UC13	Employability Skills-II	VAC	FC	—	—	3	0	3
2501AC02	Constitution of India	MC	FC	2	—	—	0	2
	Total			11	2	11	19	32

IV SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA04	Numerical Methods & Statistical Techniques	MCC	IC	2	1	—	3	3
2501CE06	Hydraulics & Hydraulic Machinery	MCC	IC	1	1	1	3	4
2501CE08	Strength of Materials – II	MCC	IC	2	1	—	3	3
2501CE07	Geotechnical Engineering – I	MCC	IC	2	—	2	4	6
2501CE09	Structural Analysis	MCC	IC	2	1		3	3
	Minor Stream Course-1 (or) University Open Elective Course – 1	MSC/UEC	FC/IC	2	—	—	2	2
2501CE17	3D-Modeling of Buildings	SEC	FC	—	—	2	2	4
2501CS02	Data Analysis Using Python	VAC	IC	—	—	2	2	4
2501UC14	Employability Skills-III	VAC	IC	—	—	3	0	3
2501AC03	Research Methodology	MC	FC	2	—	—	0	2
	Total			13	4	10	22	34

V SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501CE14	Design of Reinforced Concrete Elements	MCC	AC	2	1	—	3	3
2501CE10	Geotechnical Engineering – II	MCC	IC	2	1	—	3	3
2501CE12	Transportation Engineering	MCC	IC	1	1	1	3	4
	Minor Stream Course-2 (or) University Open Elective Course -2	MSC/UEC	FC/IC	3	—	—	3	3
	Minor Stream Course-3 (or) University Open Elective Course -3	MSC/UEC	IC/AC	3	—	—	3	3
	Minor Stream Course-4 (or) University Open Elective Course -4	MSC/UEC	IC/AC	3	—	—	3	3
2501CE20	Computer-Aided Structural Analysis & Design	SEC	AC	—	—	2	2	4
2501UC15	Employability Skills-IV	VAC	IC	—	—	3	0	3*
2501CE21	Summer Internship- 1	SI	IC	—	—	2	2	4
2501AC04	Intellectual Property Rights & Patents	MC	FC	2	—	—	0	2
	Total			16	3	9	22	32

VI SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501CE24	Design of Steel Structures	MCC	AC	2	1	—	3	3
2501CE15	Hydrology & Irrigation with ML Techniques	MCC	AC	2	1	—	3	3
2501CE11	Environmental Engineering	MCC	IC	2		2	4	6
	Minor Stream Course-5 (or) University Open Elective Course -5	MSC/UEC	IC/AC	3	—	—	3	3
	Minor Stream Course -6 (or) University Open Elective Course -6	MSC/UEC	IC/AC	3	—	—	3	3
	Minor Stream Course -7 (or) University Open Elective Course -7	MSC/UEC	IC/AC	3	—	—	3	3
2501CE18	Geospatial AI	SEC	IC	—	—	1	1	2
2501AC05	Indian Knowledge Systems	MC	FC	2	—	—	0	2
	Total			17	2	3	20	25

VII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501CE13	Estimating & Costing	MCC	IC	3	—	—	3	3
	Minor Stream Course -8 (or) University Open Elective Course -8	MSC/UEC	AC	3	—	—	3	3
	Minor Stream Course -9(or) University Open Elective Course -9	MSC/UEC	AC	3	—	—	3	3
	Minor Stream Course -10 (or) University Open Elective Course -10	MSC/UEC	AC	3	—	—	3	3
	Minor Stream Course -11(or) University Open Elective Course -11	MSC/UEC	AC	3	—	—	3	3
2501CE19	GeoStudio for Geotechnical Applications	SEC	AC	—	—	2	2	4
2501CE22	Summer Internship-II	SI	AC	—	—	2	2	2
	Total			15		4	19	21

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	AC			3	1	3*
2501CE23	Full Semester Internship	PROJ	AC			12	12	24
2501CE79	Student Activity Based Learning	AEC	AC				2	
	Total					17	17	33

Total Credit:160

Note: *Courses are applicable only to students admitted in the year 2025.

#Courses are applicable to the students admitted from the year 2026 onwards.

All the other courses are applicable to students admitted from the year 2025 onwards.

Minor Degree in Civil Engineering (offered to other branches students):

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 (or)	IC	3	—	—	3	50	50	100	-
2501CE37	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 and Distribution Systems	IC	3	—	—	3	50	50	100	ENA-1/BEEE
2501EE34	Alternative Energy Sources (or)	IC	3	—	—	3	50	50	100	EPGD S / BEEE/ISM
2501EE27	Utilization of Electrical Energy									
2501EE37	Hybrid Electric Vehicles (or)	AC	3	—	—	3	50	50	100	FPE/OCER
2501EE35	Special Electric machines									
2501EE43	Electrical Safety (or)	AC	3	—	—	3	50	50	100	EPGD S/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 Conditioning									
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	—	3	50	50	100	-
2501EC90	Linear & Digital IC Applications (or) Sensors & Actuators	IC	3	—	—	3	50	50	100	ADC
2501EC91										
2501EC92	Embedded Microcontrollers (or) Digital System Design	IC	2	—	1	3	50	50	100	ADC, PPSC
2501EC93										
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 Computer Science and Engineering

Course Code	Course Title	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS13	Operating Systems	IC	2	—	1	3	50	50	100	-
2501CS07	Computer Networks	IC	2	—	1	3	50	50	100	-
2501IT07	Agile Software Engineering	IC	2	—	1	3	50	50	100	PPSC
2501AI03	Data Mining	IC	2	—	1	3	50	50	100	-
2501CS08	Object Oriented Programming through C++	IC	2	—	2	4	50	50	100	PPSC
2501IT06	(or) Java Programming									
2501CS16	Introduction to MERN Stack Development (or)	IC	—	—	2	2	50	50	100	JP
2501CS30	Information Security Analysis & Audit	IC	2	—		2	50	50	100	-
2501CS18	Advanced MERN Stack Development	AC	—	—	2	2	50	50	100	IMSD
2501IT12	(or) Flutter Fundamentals	AC	—	—	2	2	50	50	100	-
Total			12		10	20				

Minor Degree in Data Science

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501IT07	Agile Software Engineering	IC	2	—	1	3	50	50	100	PPSC
2501CS34	Fundamentals of Data Science	IC	2	—	1	3	50	50	100	PPSC
2501CS12	NoSQL Databases	IC	2	—		2	50	50	100	-
2501AI03	Data Mining	IC	2	—	1	3	50	50	100	-
2501CS37	Health Care Data Analytics (or)	IC	2	—	1	3	50	50	100	PPSC
2501CS36	Business Intelligence & Analytics									
2501AI04	Big Data Analytics (or)	AC	2	—	1	3	50	50	100	DM
2501AI19	Data Visualization									DAP
2501CS41	Social Network Analysis (or)	AC	2	—	1	3	50	50	100	-
2501CS40	Social Networks & Semantic Web									
	Total		14		6	20				

Minor Degree in Artificial Intelligence and Machine Learning

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
2501AI14	Soft Computing (or)	IC	2	—	1	3	50	50	100	AI
2501CS34	Fundamentals of Data Science		2	—	1	3	50	50	100	PPSC
2501AI47	Natural Language Processing and Text Analytics (or)	AC								
2501AI48	Data Visualization Techniques		2	—	1	3	50	50	100	DAP
2501AI16	Prompt Engineering and GenAI (or)	AC								
2501CS41	Social Network Analysis		2	—	1	3	50	50	100	ML
2501AI17	Federated Machine Learning	AC	2	—	—	2	50	50	100	ML
TOTAL			14		6	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	—	3				
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	50	50	100	DMD
2501MN07	Underground Coal Mining Technology	IC	3	—	—	3	50	50	100	DMD
2501MN08	(or) Underground Metal Mining Technology									
2501MN14	Mine Legislation & General Safety	AC	3	—	—	3	50	50	100	UCMT / UMMT
2501MN28	(or) Environmental Pollution & Control									
2501MN45	Industrial Safety Practices	AC	2	—	—	2	50	50	100	-
2501MN46	(or) Ground Control									
Total			20			20				

Minor Degree in Agricultural Engineering

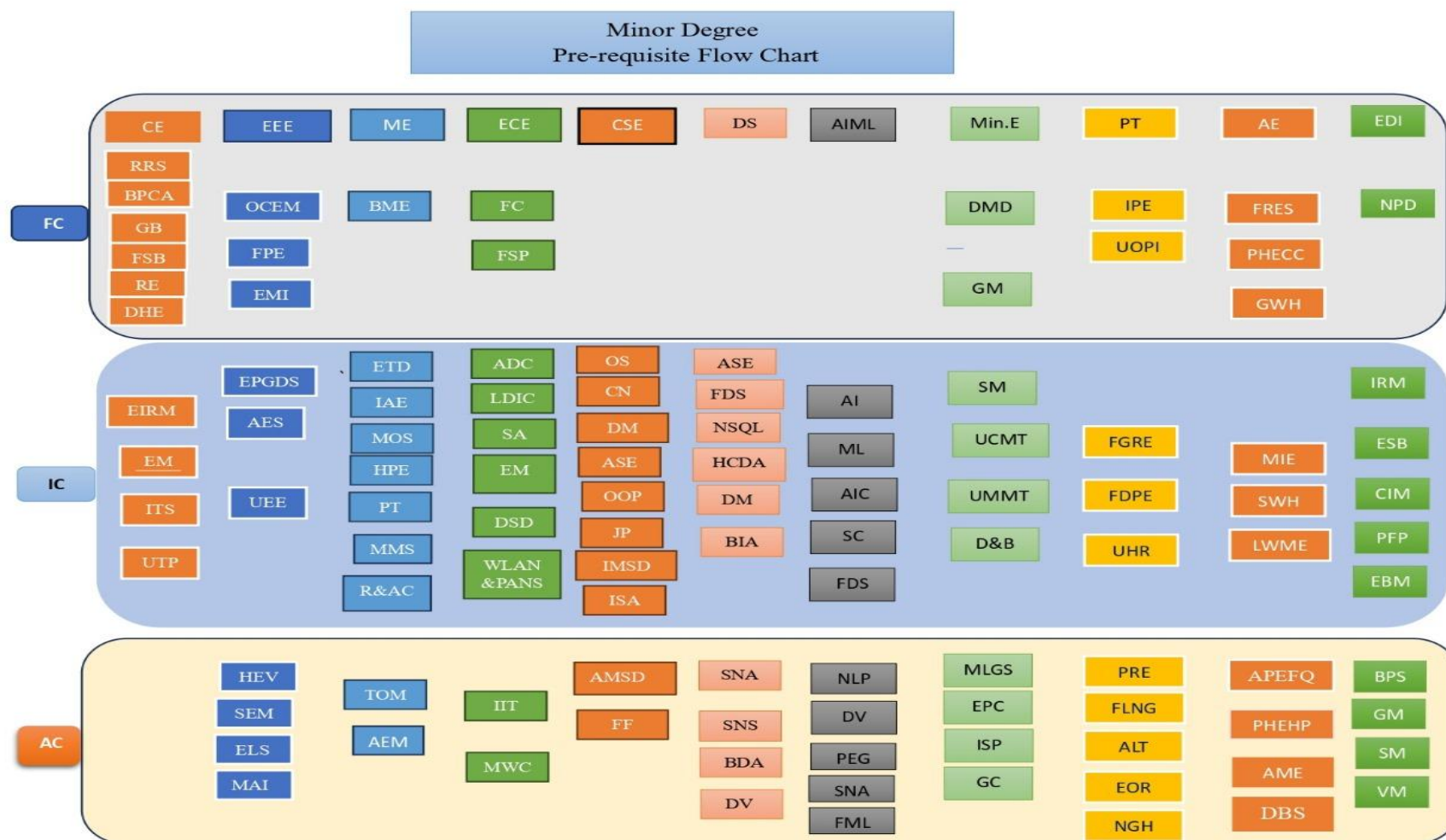
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AE82	Fundamentals of Renewable Energy Sources	FC	3	—	—	3	50	50	100	-
2501AE83	Post-harvest Engineering of Cereal Crops	FC	3	—	—	3	50	50	100	-
2501AE84	Ground Water Hydrology	FC	3	—	—	3	50	50	100	-
2501AE85	Micro Irrigation Systems	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 Prod									
2501AE90	Agricultural &Machinery Equipment (or)	AC	3	0	0	3	50	50	100	FRES
2501AE91	Design of Bio-energy systems									
	Total		20			20				

Minor Degree in Entrepreneurship Development and 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	IC	3	—	—	3	50	50	100	-
2501MB12	(or) E-Business management									
2501MB13	Business Policy & Strategic Management	AC	3	—	—	3	50	50	100	-
2501MB14	(or) Green Marketing									
2501MB15	Startup Management	AC	3	—	—	3	50	50	100	-
2501MB16	(or) Venture Management									
Total			20			20				

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
	BME	Basic Mechanical Engineering	ETD	Engineering Thermodynamics	ELS	Electrical Safety
ME			IAE	Introduction to Automobile Engineering	TOM	Theory of Machines
			MOS	Mechanics of Solids	AEM	Advanced Engineering Metrology
			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			SE	Software Engineering	AMS	Advanced MERN Stack Development
			OOP	Object Oriented Programming through C++	D	
			OS	Operating Systems	FF	Flutter Fundamentals
			CN	Computer Networks		
			JP	Java Programming		
			IMSD	Introduction to MERN Stack Development		
			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
			SE	Software Engineering	BDA	Big Data Analytics
			NSQL	NoSQL Databases	SNS	Social Networks and
					W	Semantic Web
AIML			BIA	Business Intelligence & Analytics		
			HCDA	Health Care Data Analysis		
			ML	Machine Learning	DV	Data Visualization
			AI	Artificial Intelligence	PEG	Prompt Engineering and GenAI
			AI C	AI Chatbot	SNA	Social Network Analysis
Min.E			FDS	Fundamentals of Data Science	FML	Federated Machine Learning
			SC	Soft Computing	NLP	Natural Language Processing
	DMD	Development of Mineral Deposits	SM	Surface Mining	MLG	Mine Legislation and General Safety
	GM	Green Mining	UCMT	Underground Coal Mining Technology	EPC	Environmental Pollution & Control
			UMM	Underground Metal Mining Technology	ISP	Industrial Safety Practices
PT			DB	Drilling & Blasting	GC	Ground Control
	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	FLN	Fundamentals of Liquefied Natural Gas
			UHR	Unconventional Hydrocarbon Resources	NGH	Natural Gas Hydrates
	GWH	Ground Water Hydrology	LWM	Land and Water Management	ALT	Artificial Lift Techniques
Ag.E	PHEC	Post-harvest Engineering of Cereal Crops	SWH	Surface Water Hydrology	EOR	Enhanced Oil Recovery
			MIE	Micro Irrigation Systems	DBS	Design of Bio-Energy Systems
	FRES	Fundamentals of Renewable Energy Sources			PHE	Post-Harvest Engineering for Horticultural Produce
					HP	
	NPD	New Product Development	ESB	Entrepreneurship and Small Business Management	AME	Agricultural Machinery and Equipment
EDC			CIM	Change & Innovations Management	APE	Agriculture Process Engineering and Food Quality
			PFP	Personal Financial Planning	FQ	
			EBM	E-Business Management	BPS	Business Policy & Strategic Management
					GM	Green Marketing
					SM	Startup Management
					VM	Venture 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	-
2501MA03	Integral Transforms & Applications of Partial Differential Equations	IC	2	1		3	50	50	100	LAC
2501MA04	Numerical Methods & Statistical Techniques	IC	2	1		3	50	50	100	ITAPDE
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	FC			2	2	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100		100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME02	Engineering Mechanics	FC	2	1	1	4	50	50	100	-
2501CE01	Construction Materials & Concrete Technology	FC	2		2	4	50	50	100	-
2501CE02	Fluid Mechanics	IC	1	1	1	3	50	50	100	-
2501CE03	Strength of Materials – I	IC	2		2	4	50	50	100	EM
2501CE04	Engineering Geology	IC	2		1	3	50	50	100	-
2501CE05	Geomatics Engineering	IC	1	1	2	4	50	50	100	-
2501CE06	Hydraulics & Hydraulic Machinery	IC	1	1	1	3	50	50	100	FM

2501CE07	Geotechnical Engineering – I	IC	2		2	4	50	50	100	-
2501CE08	Strength of Materials – II	IC	2	1		3	50	50	100	SOM-1
2501CE09	Structural Analysis	IC	2	1		3	50	50	100	SOM-1
2501CE10	Geotechnical Engineering – II	IC	2	1		3	50	50	100	GE-1
2501CE11	Environmental Engineering	IC	2		2	4	50	50	100	-
2501CE12	Transportation Engineering	IC	1	1	1	3	50	50	100	-
2501CE13	Estimating and Costing	IC	3			3	50	50	100	BP&CAD
2501CE14	Design of Reinforced Concrete Elements	AC	2	1		3	50	50	100	SOM
2501CE24	Design of Steel Structures	AC	2	1		3	50	50	100	SOM
2501CE15	Hydrology & Irrigation with ML Techniques	AC	2	1		3	50	50	100	HHM
Total			44	15	22	81				

Linear Algebra and Calculus

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

	L	T	P	C
Course Code: 2501MA01	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)

- Variables, arithmetic operations, elementary mathematical functions.
- Defining row vector, column vector, Arithmetic operations on matrices
- finding transpose of a matrix, inverse of a matrix, determinant of a matrix
- 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):

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):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): 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):Plotting the region of Integration

Students are advised to use any computational / AI Tool like Wolfram 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.)

Course Code:2501MA02	L	T	P	C
	2	1	0	3

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): 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, Legendre's Linear Equations. Study of oscillations arising in LCR circuit (free oscillations and forced oscillations).

Practice(Using any computational tool): 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): 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 Wolfram Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

- 1 Advanced Engineering Mathematics, E. Kreyszig, John Wiley & 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/>

Integral Transforms & Applications of Partial Differential Equations (Common to CE,ME)

Course Code: 2501MA03

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Compute Laplace transform of a function.
- CO2:** Apply Laplace transform to solve initial value problems
- CO3:** Compute the Fourier series of a function
- CO4:** Compute the Fourier transform of a function
- CO5:** Apply method of separation of variables for solving Heat and Wave equations.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Laplace Transforms: Laplace transforms of standard functions, Properties of Laplace Transformations, Laplace transform of Unit step function, Dirac delta function, Periodic function (without proof), Evaluating improper integrals of the type $\int_0^{\infty} f(t) dt$ using Laplace Transform.

Practice(Using any computational tool): Find Laplace transform of elementary functions.

UNIT – II

Inverse Laplace Transforms: Inverse Laplace transforms of functions, First shifting theorem, Convolution theorem (without proof), Second shifting theorem. Solving initial value problems and integro-differential equations using Laplace transforms.

UNIT – III

Fourier Series: Fourier series of periodic functions, Half-range series, Change of interval and Fourier series in complex form, Parseval's formula and R.M.S Value.

Practice(Using any computational tool): Generating Fourier Series of functions.

UNIT – IV

Fourier Transforms: Fourier integral theorem (without proof), Fourier sine and cosine integral, Fourier Transform, Properties, Fourier sine and cosine transforms and Finite Fourier transforms.

UNIT – V

Applications of PDE : Classification of second order P.D.E - Method of separation of Variables- Solution of One dimensional Wave equation, Heat equation and two-dimensional Laplace equation.

Students are advised to use any computational / AI Tool like Wolfram 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 Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021).ISBN 978-9383214204

Reference Books:

- 1 Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907
- 2 Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons,10th Ed., 2018.ISBN 978-0470458365

Web Links:

- 1 <https://nptel.ac.in/courses/111105123/>
- 2 <https://nptel.ac.in/courses/111105093/>
- 3 <https://www.khanacademy.org>

Numerical Methods & Statistical Techniques

(Common to CE & ME)

Course Code:2501MA04

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Apply numerical methods to solve the equations and interpolate the polynomials.
- CO2:** Apply numerical methods to solve problems involving differentiation, integration and initial value problems.
- CO3:** Apply various Probability distributions for both discrete and continuous random variables.
- CO4:** Compute mean and variance of sample means with replacement and without replacement and estimating maximum errors
- CO5:** Apply various tests to test the hypothesis concerning mean, Proportion, variance.

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

Solution of Algebraic and Transcendental Equations and Interpolation:

Solution of Algebraic and Transcendental Equations: Errors in Numerical Computation, Bisection method, Method of false position, Secant method and Newton - Raphson method.

Interpolation: Unequal Intervals- Lagrange's interpolation, Newton's divided difference formulae, Equal Intervals-Newton's Forward and Backward difference formulae, Central difference, Relation between operators.

Practice(Using any computational tool):Find solution of equations and Newton's forward interpolation.

UNIT – II

Numerical Differentiation, Integration and Solutions of Ordinary Differential Equations:

Numerical Differentiation: Numerical differentiation using Newton's Forward, Backward and Newton's divided difference formula.

Numerical Integration: Simpson's 1/3rd and 3/8th rule.

Numerical solution of ordinary differential equations: Taylor's series method, Euler's method and Runge-Kutta method (second and fourth order).

Practice(Using any computational tool): Solving problems on above methods.

UNIT – III

Random variables and Distributions:

Random variables – Discrete and Continuous random variables – Distribution functions – Probability mass function, Probability density function and Cumulative distribution functions – Mathematical Expectation and Variance – Binomial, Poisson and Normal distributions.

Practice(Using any computational tool): Fitting Binomial and Poisson distributions

UNIT – IV

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): Plotting of confidence intervals

UNIT – V

Tests of Hypothesis:

Hypothesis – Null and Alternative Hypothesis – Type I and Type II errors – Level of significance – One tail and two-tail tests – tests for large samples (Z - test for single mean, difference of means, single proportion, difference of proportions) – tests for small samples (t-test for single mean and difference of means) – F-test for comparison of variances – Chi Square test for attributes.

Practice(Using any computational tool): F- test and t- test.

Students are advised to use any computational / AI Tool like Wolfram 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 · ISBN978-8184875607
- 2 Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020. ISBN 978-9353945237

Reference Books:

- 1 Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN 978-9351611738.
- 2 Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907

Web Links:

- 1 https://swayam.gov.in/nd1_noc19_ma21/preview
- 2 https://onlinecourses.nptel.ac.in/noc20_ge20/preview
- 3 https://onlinecourses.nptel.ac.in/noc21_ma74/preview
- 4 <http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html>
- 5 <https://www.khanacademy.org/math/statistics-probability>

Solid State Physics
Common to CE, ME, Min.E, PT

Course Code:2501PH01

L	T	P	C
2	0	1	3

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

- CO1** **Extend basic concepts of Elastic properties and bending of beams.**
- CO2** **Understand the basics of crystals and their structures**
- CO3** **Explain the basic concepts of Semiconductors and identify the type semiconductors using Hall effect.**
- CO4** **Classify the magnetic materials based on behavior of substances**
- CO5** **Summarize various types of electrical polarizations of dielectrics.**

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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

Elasticity of Materials:

Stress – strain - Hooke’s law – stress - strain curve – generalized Hooke’s law with and without thermal strains for isotropic materials – different types of moduli and their relations – bending of beams – Bending moment of a beam – Depression of cantilever.

Practice:

1. Determination of rigidity modulus of a material by using Torsional Pendulum.
2. Determination of Young's Modulus of the material by method of single cantilever beam.
3. Determination of Moment of Inertia of a Fly Wheel.
4. Determination of Acceleration due to Gravity by using Compound Pendulum.

Unit-II

Crystal Structure and X-ray diffraction

Crystal Structure:

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

X-ray Diffraction:

Bragg’s law-Bragg’s x-ray spectrometer – crystal structure determination by Laue’s and powder method- Applications.

Practice:

1. Determine the crystal structure of the sample using data.

Unit–III**Semi-conductor Physics:**

Origin of resistivity - Formation of energy bands in crystalline solids - classification of crystalline solids - Intrinsic semiconductors - Fermi level – extrinsic semiconductors - P-type and N-type -Dependence of Fermi energy on carrier concentration and temperature - Hall effect - Hall coefficient -Applications of Hall effect –Drift and Diffusion currents– Einstein’s equation. – P-N junction diode -Zener Diode - Applications

Practice:

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

Unit–IV**Magnetic materials:**

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

Practice:

1. Study the variation of magnetic field along the axis of a circular coil carrying current by using Stewart and Gee’s apparatus.

Unit – V**Dielectric Materials:**

Introduction – Dielectric polarization–Dielectric polarizability, Susceptibility, Dielectric constant - Relation between D, E, P- Types of polarizations –Electronic (Quantitative), Ionic(Quantitative) and Orientation polarizations (Qualitative) – Ferro electric materials - Frequency dependence of polarization - Applications.

Practice:

1. Determine dielectric constant of dielectric material using charge-discharge method.

Text Books:

1. A Text book of Engineering Physics, M N Avadhanulu, P G Kshirsagar & T.V.S.Arun Murthy S Chand & Company Ltd, 11th edition. **ISBN:** 81-219-0817-5
2. Engineering Physics, R K Gaur and S L Gupta, Dhanpat Rai Publications, **ISBN:** 978-8189928223
3. Physics for Engineers, T. Vijaya Krishna, Cengage publications, **ISBN:** 978-93-5350-755-8

Reference Books:

1. Engineering Physics, M.R.Srinivasan, New Age international publishers .
ISBN: 978-1848290501
2. Text book of Engineering Physics, S. O. Pillai, New Age international publishers.
ISBN: 9788122420753
3. Introduction to Solid State Physics, Charles Kittel, Wiley publications 8th edition)
ISBN: 978-1-119-45416-8

Web Links:

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

Engineering Chemistry
Common to CE, ME, Min.E, PT

Course Code:2501CH01

L	T	P	C
2	0	1	3

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

- CO 1** Apply the knowledge of water treatment and specifications of potable water
- CO 2** Exemplify the principles of electrochemical cells and apply this knowledge to control corrosion
- CO 3** Summarize the essence of polymers and fuels – for sustainable energy solutions
- CO 4** Infer the preliminaries of engineering materials for industrial applications
- CO 5** Explore the fundamentals of Nano materials and integrate Green Chemistry for promoting sustainability

Mapping of Course Outcomes with Program Outcomes

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

UNIT - I

Water Technology:

Soft and hard water, Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment method (Zeolite and Ion-Exchange Process) – Internal treatment of water: Carbonate conditioning, Phosphate conditioning, Colloidal conditioning, Calgon conditioning.

Specifications of water for domestic use (ICMR and WHO); Domestic water purification – Candle filtration- activated carbon filtration; Disinfection methods- Ultra filtration, UV treatment, Ozonolysis, desalination of brackish water, reverse osmosis(RO)and electro dialysis.

Practice:

1. Determination of Hardness of a ground water sample
2. Determination of Chloride content in given water sample
3. Estimation of dissolved oxygen in given water sample

UNIT - II

Electrochemistry and Corrosion:

Electrodes– electrochemical cell, Nernst equation, cell potential calculations. Primary cells – Zinc-air battery, Secondary cells: Nickel-Cadmium (Ni-Cad), and lithium-ion batteries- Working principle of the batteries including cell reactions; Fuel Cells: Principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, Dry corrosion (Pilling Bed worth rule) electro chemical theory of corrosion (Mechanism), differential aeration cell corrosion, galvanic corrosion, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Practice

1. Conductometric titration of strong acid vs weak base
2. Potentiometric titration of red-ox
3. P^H -metric titration of Acid-Base

UNIT - III

Polymers and Fuel Chemistry:

Introduction to polymers, functionality of monomers, Thermo plastics and Thermo setting plastics-: Preparation, properties, and applications of PVC, and Bakelite.

Compounding of plastics: Injection molding, and Extrusion molding.

Biodegradable polymers: Introduction and their requirements.

Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels: Refining of petroleum, Octane and Cetane number, Alternative fuels: CNG, Ethanol and biodiesel.

Practice

1. Calorific value determination by Bomb Calorimeter.
2. Preparation of a Polymer (Bakelite)

UNIT - IV

Engineering Materials:

Composites-Definition, Constituents, Fiber reinforced composites, properties, and Engineering applications.

Refractories-Classification, Properties, Failures of Refractories and Applications.

Lubricants-Classification, Functions of lubricants, Properties of lubricating oils (Definition): Viscosity, Viscosity Index, Flash point& Fire point, Cloud point &Pour point and Applications of lubricants.

Building materials- Portland cement, constituents, Setting and Hardening of cement.

Practice

1. Determination of total acid number by potentiometric titration
2. Estimation of Calcium in port land Cement
3. Estimation of Saponification value of Fats/Oils

UNIT - V

Nano materials and Green Chemistry:

Nano Materials: Introduction to Nano materials, chemical synthesis of Nano materials: Sol-gel method, characterization of Nano materials by SEM and TEM (includes basic principle of SEM and TEM), Applications of Nano materials (waste water treatment, lubricants and engines).

Green Chemistry: Principles of Green Chemistry and applications of green chemistry. Various green chemical approaches – Microwave synthesis, Bio catalyzed reaction (only explanation with examples).

Practice

1. Preparation of Nano particle by Green Synthesis method.

Text Books:

1. Prasanta Rath, S. Aruna Kumari Engineering Chemistry, CENGAGE Learning, 2024. (ISBN 978-93-5350-651-3)(ISBN 93-5350-651-4).
2. Shikha Agarwal , Engineering Chemistry Fundamentals and Applications, Cambridge 2nd Edition (ISBN 978-1-108-72444-9).

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, Thomas Telford Publications, 2nd edition. (978-072-772-5929).
2. Dr S.S. Dara, Dr S.S. Umare, A Textbook of Engineering Chemistry, S. Chand Publication, 2022. (978-935-2-836-068).

Web Links:

1. <https://nptel.ac.in/courses/105107207>
2. <https://nptel.ac.in/courses/113104082>
3. <https://nptel.ac.in/courses/113108051>
4. <https://archive.nptel.ac.in/courses/104/105/104105039/>
5. <https://nptel.ac.in/courses/118102003>

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 Modeling in Power BI

- a. Understanding relationships between tables
- b. Creating calculated columns and measures using DAX

8.Data Modeling 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 drill-down 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 drill-through

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>

Business Intelligence and AI Tools Lab
(Common to CE, EEE, ME, ECE, CSE, AIML, CSE(DS), PT & Min.E)
(Revised Syllabus for batches admitted from the year 2026 onwards)

Course Code: 2601AI01	L	T	P	C
	0	0	2	2

Course Outcomes

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

- CO1** Use Excel for data entry, formulas and built-in functions to perform basic data analysis.
- CO2** Apply data-analysis and visualization techniques in Excel (PivotTables, charts) to extract meaningful insights from datasets.
- CO3** Build data models and interactive dashboards in Power BI to support reporting and decision-making.
- CO4** Use generative AI tools (ChatGPT, Claude, Gemini, Perplexity) through well-structured prompts to solve everyday academic and analytical tasks.
- CO5** Apply AI tools responsibly to research, verify, summarize and create content and presentations.
- CO6** Integrate AI assistance with Excel and Power BI to accelerate data analysis and reporting.

MODULE A — Spreadsheet Analytics with Microsoft Excel

1. Excel Fundamentals

- a. Navigating the Excel interface; entering and formatting data; cell referencing (relative, absolute, mixed).
- b. Core functions and formulas: SUM, AVERAGE, COUNT, IF, VLOOKUP.
- c. Importing data into Excel from CSV and text files.

2. Data Analysis in Excel

- a. Data manipulation: sorting, filtering and grouping data.
- b. Advanced functions: INDEX/MATCH, SUMIFS, COUNTIFS, nested IF.
- c. Creating charts and graphs to visualize data.

3. PivotTables and Summarization

- a. Building PivotTables and PivotCharts for data summarization.
- b. Using slicers and timelines to interact with summaries.
- c. Calculated fields and grouping within PivotTables.

4. Advanced Excel Features

- a. Excel tables and structured references; named and dynamic ranges.
- b. Data-validation techniques (drop-down lists, input rules).
- c. What-if analysis: Goal Seek and Data Tables.

MODULE B — Business Intelligence with Microsoft Power BI

5. Getting Started with Power BI

- a. Overview of Power BI and its advantages over Excel for large datasets.
- b. Installing Power BI Desktop; understanding the interface (ribbons, panes, views).
- c. Importing data from multiple sources (Excel, CSV, web).

6. Data Preparation with Power Query

- a. Cleaning, shaping and filtering data in the Power Query Editor.
- b. Combining data from different sources (append and merge).
- c. Loading the prepared data into the Power BI model.

7. Data Modeling and DAX

- a. Creating relationships between tables; star-schema basics.
- b. Calculated columns and measures using DAX.
- c. Key DAX functions: CALCULATE, FILTER, RELATED, and date/time functions.

8. Visualizations and Interactive Dashboards

- a. Basic and advanced visuals: bar, line, pie, TreeMap, KPI cards.
- b. Slicers, filters and drill-down for interactivity.
- c. Designing an interactive dashboard with bookmarks and drill-through.

MODULE C — Working with AI Tools

9. Exploring the AI Tool Landscape

- a. Introduction to popular AI assistants: ChatGPT, Claude, Gemini, Perplexity.
- b. Comparing tools across tasks — summarizing, simple coding, and reasoning.
- c. Building a comparison matrix and choosing the right tool for a task.

10. Prompt Engineering Essentials

- a. Anatomy of a good prompt; clarity, context and constraints.
- b. Prompt patterns: persona, few-shot, chain-of-thought, and structured (JSON) output.
- c. Iterating and refining prompts for better results.

11. AI for Research and Verification

- a. Using AI for topic research, explanations and quick literature scans.
- b. Three-step verification chain: cross-check claims against primary sources.
- c. Recognizing hallucinations, bias and link-rot; the limits of AI.

12. Responsible and Ethical Use of AI

- a. Academic integrity, plagiarism and proper acknowledgement of AI use.
- b. Privacy, data safety and never sharing sensitive information.
- c. Drafting a simple personal/class “AI use policy”.

13. AI for Content and Presentations

- Summarizing documents and Q&A over your own notes (e.g., NotebookLM).
- Generating outlines, write-ups and email drafts with AI assistance.
- Auto-creating slide decks from a brief (e.g., Gamma) and refining them.

14. AI-Assisted Data Analysis (Capstone)

- Using AI to write/explain Excel formulas and draft DAX measures.
- Cleaning and interpreting a dataset and explaining charts with AI help.
- Mini-project: clean a dataset in Excel, build a Power BI dashboard, and use AI to generate insights and a short summary report.

Cornerstone projects :

S. No	Project Title	Project Description	Dataset URL
1	Indian General Election Analytics Dashboard	Develop an interactive dashboard to analyze election results across all Indian states and union territories. The project includes Spreadsheet Analytics using Microsoft Excel, Business Intelligence using Microsoft Power BI, and AI insights to visualize ruling parties, constituencies won, vote share, voter turnout, alliance performance, and state-wise electoral trends through interactive reports and maps.	https://results.eci.gov.in/
2	Global Renewable Energy Analytics Dashboard	Design a Business Intelligence dashboard to analyze renewable energy production across countries. The project focuses on energy generation by source, installed capacity, consumption patterns, and sustainability trends using Excel, Power BI dashboards, and AI-driven insights for comparative analysis.	https://ourworldindata.org/energy
3	Air Quality Index (AQI) Analytics Dashboard	Build an interactive dashboard to monitor air pollution levels across cities and regions. Analyze AQI values, pollutant concentrations (PM2.5, PM10, NO ₂ , SO ₂), seasonal trends, and pollution hotspots using Excel, Power BI visualizations, and AI-powered insights.	https://www.kaggle.com/datasets/rohanrao/air-quality-data-in-india

4	FIFA World Cup Analytics Dashboard	Create a comprehensive dashboard to analyze FIFA World Cup tournaments by exploring team performance, match results, goals scored, player statistics, venues, and championship history. The project utilizes Excel, Power BI, and AI insights to identify historical trends and performance patterns.	https://www.kaggle.com/datasets/abecklas/fifa-world-cup
5	Global Earthquake Analytics Dashboard	Develop a dashboard that visualizes earthquake occurrences worldwide by analyzing magnitude, depth, geographic location, frequency, and affected regions. Excel is used for data preparation, while Power BI and AI insights help identify seismic trends and risk-prone areas.	https://earthquake.usgs.gov/earthquakes/feed/v1.0/csv.php
6	Flight Delay Analytics Dashboard	Design an interactive airline performance dashboard to evaluate flight delays, cancellations, airline efficiency, airport performance, and seasonal travel trends. The project combines Excel, Power BI, and AI insights to support operational analysis and decision-making.	https://www.kaggle.com/datasets/usdot/flight-delays
7	Global CO₂ Emissions Analytics Dashboard	Analyze global carbon dioxide emissions by country, region, and industry using Power BI. The dashboard presents emission trends, sector-wise contributions, historical comparisons, and sustainability indicators through Excel, interactive visualizations, and AI-generated insights.	https://ourworldindata.org/co2-and-greenhouse-gas-emissions
8	Olympics Performance Analytics Dashboard	Create a Power BI dashboard to evaluate Olympic Games performance by analyzing medal counts, athlete achievements, country rankings, sports categories, and historical participation. Excel and AI-powered visualizations are used to generate meaningful sports analytics and comparative insights.	https://www.kaggle.com/datasets/the-guardian/olympic-games

9	Netflix Content Analytics Dashboard	Develop an interactive dashboard to analyze Netflix's content library by genre, country, release year, ratings, duration, and content trends. Excel is used for preprocessing, while Power BI and AI insights help identify viewing patterns and content distribution across regions.	https://www.kaggle.com/datasets/shivamb/netflix-shows
10	Global Education Statistics Dashboard	Build a Business Intelligence dashboard to analyze global education indicators such as literacy rates, school enrollment, graduation rates, education expenditure, and gender parity. Using Excel, Power BI, and AI insights, the dashboard supports comparative analysis of educational development across countries.	https://data.worldbank.org/topic/education
11	Global Food Production Analytics Dashboard	Develop an interactive dashboard to analyze global food production, crop yields, agricultural output, and production trends across countries. The project incorporates Spreadsheet Analytics using Microsoft Excel, Business Intelligence using Microsoft Power BI, and AI-powered insights to identify production patterns, top-producing countries, and long-term agricultural trends through interactive visualizations.	https://ourworldindata.org/food-supply
12	Road Traffic Fatalities Analytics Dashboard	Design a Business Intelligence dashboard to analyze road traffic accidents and fatalities across countries. The dashboard visualizes accident rates, fatalities by road users, regional comparisons, and yearly trends using Microsoft Excel, Power BI, and AI insights to support road safety analysis and policy evaluation.	https://www.kaggle.com/datasets/data125661/india-road-accident-dataset
13	Global Population Demographics Dashboard	Build a comprehensive dashboard to analyze population growth, age distribution, urbanization, life expectancy, fertility rates, and demographic changes across countries. The project uses Excel for data	https://ourworldindata.org/population

		preparation, Power BI for visualization, and AI insights to identify demographic trends and support population-based decision-making.	
14	International Tourism Analytics Dashboard	Create an interactive dashboard to evaluate global tourism trends by analyzing international tourist arrivals, tourism receipts, popular destinations, and regional tourism growth. Using Microsoft Excel, Power BI, and AI-driven insights, the dashboard enables comparative analysis of tourism performance across countries and years.	https://data.worldbank.org/indicator/ST.INT.ARVL

15	Global Internet Usage & Digital Connectivity Dashboard	Develop a Business Intelligence dashboard that analyzes internet penetration, broadband subscriptions, mobile connectivity, and digital adoption across countries. The project combines Spreadsheet Analytics in Microsoft Excel, interactive Power BI dashboards, and AI-generated insights to explore global digital transformation and connectivity trends.	https://data.worldbank.org/indicator/IT.NET.USER.ZS
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Text Books

- 1 Learn Power BI – Second Edition: A comprehensive, step-by-step guide for beginners to learn real-world business intelligence, ISBN: 9781801811958.
- 2 Power BI Beginner: Zero to Hero in Power BI Desktop, Philip Seamark, ISBN: 1691641227.
- 3 Excel 2021 / Microsoft 365 – The Step-by-Step Guide to Mastering Excel, (latest edition).

Reference Books

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

3 Co-Intelligence: Living and Working with AI, Ethan Mollick (for responsible AI use).

Web Links / e-Resources

- 1 <https://learn.microsoft.com/en-us/power-bi/>
- 2 <https://support.microsoft.com/en-us/excel>
- 3 <https://aistudio.google.com/>
- 4 <https://notebooklm.google.com/>
- 5 <https://www.perplexity.ai/>

Note:

- The cornerstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The evaluation of the Cornerstone Project shall be based on the project implementation, oral presentation, 10-minute video presentation, report and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.
- Finally, the Source code of the cornerstone Project has to be pushed into the Students GitHub repository (if applicable).

Engineering Workshop
(Common to CE,EEE, ME, ECE, PT&Min.E)

Course Code: 2501ME03

L	T	P	C
0	0	1	1

Course Outcomes:

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

- CO1:** Prepare various wooden joints.
- CO2:** Demonstrate various sheet metal models.
- CO3:** Develop the basic knowledge of house wiring.
- CO4:** Develop the basic knowledge of plumbing.
- CO5:** Practice various welded joints.

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

Practice:

1. To make a T-Lap joint from the given wooden workpieces.
2. To make a dovetail lap joint from the given wooden workpieces.
3. To make a taper tray using the given sheet metal.
4. To make a funnel using the given sheet metal.
5. To make a square tin using the given sheet metal.
6. To connect three bulbs by using series and parallel connections.
7. To give connection to a bulb by using staircase wiring.
8. To prepare wiring for a tube light with switch control.
9. To prepare a PVC pipe joint by using the given circuit1.
10. To prepare a PVC pipe joint by using the given circuit2.
11. To make a butt joint using the given M.S pieces by arc welding.
12. To make a lap joint using given M.S pieces by arc welding

Additional Practice:

1. To make a cross lap joint from the given wooden workpieces.
2. To make an open scoop using the given sheet metal.
3. To make a T-joint using given M.S pieces by arc welding.

Text Books:

1. Work shop Manual ,P.Kannaiah & K.L.Narayana/ SciTech Publishers, 2nd edition, ISBN: 978-8183711302.
2. Elements of Workshop Technology ,Vol I by S.K. Hajra Choudhury, S.K. Hajra Choudhury & Nirjhar Roy, Media Promoters and Publishers Pvt. Limited, 14th edition. ISBN: 8185099146.

Reference Books:

1. Workshop Technology, Part 1, W.A.J. Chapman, 5th edition, ISBN 9780415503020.
2. Engineering Practices Lab Manual, T. Jeyapoovan& M. Saravanapandian, Vikas Publishing House Pvt. Limited, 4th edition, ISBN: 8125929037.
3. Engineering Practices Laboratory Manual, Ramesh Babu.V., VRB Publishers Private Limited, Chennai, Revised edition, 2019-20, ISBN: 978-81-935993-8.

Web Links:

1. <https://bharatskills.gov.in>
2. <https://www.gopracticals.com/basic-engineering/workshop/>

Engineering Graphics

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

Course Code: 2501ME01

L	T	P	C
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

Introduction to AutoCAD, Dimensioning, elements of dimensioning, system of dimensioning, and Conventions in Drawing.

2. Construction of Cycloids and Involutives

- 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. Projection of planes

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

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
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 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: 9788122515452.

Reference Books:

- 1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2021, ISBN: 978-9385983177.
- 2. Computer Aided Engineering Graphics, T. Jeyapoovan, 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>

Engineering Mechanics

Common to CE, ME & Min.E

Course Code: 2501ME02

L	T	P	C
2	1	1	4

Course Outcomes:

- CO1:** Solve the resultant of force system using fundamental principles of force-couple system
- CO2:** Solve the efficiency of equilibrium force system involving friction using free-body diagrams
- CO3:** Solve the Centre of gravity and Moment of inertia of rigid bodies using Parallel axis theorem, Perpendicular axis theorem and Pappus theorems
- CO4:** Apply principle of Virtual work and analyze the trusses by Method of sections & Method of joints
- CO5:** Apply D'Alembert's principle, Work-energy and Impulse-momentum principles to solve Rectilinear and Curvilinear motion problems
- CO6:** Analyze the plane motion of a rigid body in translation and rotation

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

UNIT – I

Force systems:

Classification of Forces- Vectors and Tensors- Coplanar Concurrent Forces–Resultant– Moment of Force and its Application –Couple-Varignon's theorem- Resultant of Force Systems-Free-body diagrams and equilibrium- Components in Space(vector notation)

Practice:

1. Verification of Triangle Law, Parallelogram Law and Polygon's law
2. Verification of Law of moments by Rotation Disc
3. Verification of Law of moments by Bell Crank Lever
4. Finding the support reactions using Simply supported beam

UNIT – II

Friction :

Coefficient of friction-Angle of friction- Cone of friction- Coulomb's laws – Applications of Rolling friction, Belt-pulley, Brakes, Clutches, Screw jack, Wedge- Centroid and Center of Gravity :

Concept of Centroid and Centre of Gravity- Regular and Composite areas-Pappus theorems

Practice:

1. Finding Coefficient of friction on inclined plane
2. Find the efficiency of screw jack
3. Finding the Centre of gravity of plane areas
4. Finding the efficiency of pulley system

UNIT – III

Moment of Inertia:

Concept of Moment of Inertia - Parallel axis theorem- Perpendicular axis theorem- Rectangular and Polar Moment of inertia of composite areas- Radius of Gyration- Product of Inertia- Mass Moment of Inertia -Analysis of trusses by Method of Joints and Method of Sections- Principle of Virtual work

Practice:

1. Finding the Moment of inertia of Compound pendulum

UNIT – IV

Rectilinear and Curvilinear motion:

Introduction to Rectilinear motion- Curvilinear motion-Tangential and Normal components-Radial and Transverse Components- D'Alembert's principle -Principle of Work-Energy

UNIT – V

Impulse-Momentum:

Principle of Impulse and momentum - Lagrange's equation

Plane motion of rigid body:

Introduction to plane motion of a rigid body-Translation and rotation

Text Books:

1. Engineering Mechanics-Statics and dynamics, A.K.Tayal, Umesh publications, 14th Edition, ISBN: 9789380117386
2. A textbook of Engineering mechanics, R.K.Bansal. 4th Edition, Laxmi Publications, 2016, ISBN :978-8131800782.

Reference Books:

1. Engineering Mechanics-Statics and Dynamics , R.C.Hibbeler, 15th Edition, 2022, ISBN :9780137514724
2. Vector Mechanics for Engineers - Volume I ,Beer F.P. and Johnston E.R., Statics, Volume II -Dynamics, McGraw Hill, New York, ISBN 9789353166595

Web Links:

1. https://onlinecourses.nptel.ac.in/noc23_me74/unit?unit=17&lesson=18
2. <https://ocw.mit.edu/courses/1-050-engineering-mechanics-i-fall-2007/>

Construction Materials & Concrete Technology

Course Code:2501CE01

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Explain the sources, properties, and applications of bricks and stones.
- CO2:** Demonstrate the properties of binding materials in construction.
- CO3:** Demonstrate various materials and admixtures required for concrete.
- CO4:** Analyse the basic properties of concrete and develop suitable mix-designs.
- CO5:** Demonstrate the properties of various special concrete.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Stones and Bricks :

Properties of building stones – Classification of stones – Stone quarrying – Precautions in blasting, Dressing of stone, Aggregates - Classification of aggregate- Tests conducted on aggregate. Composition of good brick earth, Various methods of manufacturing of bricks. Tests for good bricks as per IS code, including field tests, Special forms of Bricks and their uses.

Practice:

- 1.To determine the grading and fineness modulus of Coarse aggregate by sieve analysis.
- 2.To determine the specific gravity of coarse aggregate.
- 3.To find the grading and fineness modulus of fine aggregate (sand) by sieve analysis.

UNIT – II**Lime, Cement and Masonry:**

Lime: Various ingredients of lime – Constituents of lime stone – Classification of lime – Various methods of manufacture of lime.

Cement: Portland cement- Chemical Composition – Hydration, Setting and fineness of cement. Various types of cement and their properties. Various field and laboratory tests for Cement, Bogue compounds - Manufacturing process of cement - Grades of cement - Uses of cement.

Types of masonry, English and Flemish bonds, Rubble and Ashlar Masonry. Cavity and partition walls.

Practice:

- 1.To find the normal Consistency and fineness of cement.
- 2.To determine the initial setting time and final setting time of cement.
- 3.To find the specific gravity and soundness of cement.
- 4.To determine the compressive strength of cement.

UNIT – III**Concrete Ingredients and Admixtures:**

Cement - Fine aggregates and coarse aggregates. Overview –Chemical and mineral admixtures – additive – Plasticizers – Definition – Situation need high workability– Effects of plasticizer and Super plasticizers in fresh and hardened concrete- Accelerators – Accelerating Plasticizer-Retarders proofers–use–materials-Water-Fly ash -GGBS Metakaolin.

Practice:

- 1.Workability tests on concrete: Slump Cone test, Compaction factor test and Consistency test (VB Consistometer)
- 2.Mechanical properties of concrete: Casting of concrete cube, cylinder specimens, curing and testing.

UNIT – IV**Concrete Properties and Mix Design:**

Fresh concrete – Workability –Workability tests-Segregation –Bleeding. Test on Hardened concrete. Density. Compressive strength – Affecting factors – Test procedure-Flexural strength – Central point load – Two-point load tests. Splitting tensile test-Stress-strain curve for concrete, Modulus of elasticity of concrete. Principle of mix design – Information required for mix design-Indian standard method of mix design- step by step mix design procedure-Mix design examples.

UNIT – V

Special Concretes:

SCC Materials-Workability requirement-Mix design-Test methods. Fibre reinforced concrete - Types of FRC- Application of FRC-Polymer impregnated concrete-Partially impregnated surface coated polymer concrete-Properties -Advantages – Applications- Blended cement concrete - Slurry infiltrated fibrous reinforced concrete (SIFCON) - Composition - Process - Application Bacterial concrete-Geopolymer concrete-Roller compacted concrete-Smart concrete-Recycled aggregate concrete-Reactive powder concrete- Engineered Cementitious Composites.

Additional Practice:

1. Water absorption test on bricks
2. Non-destructive test on concrete
3. Self compacting tests – L box, V Box, J ring.

The following titles are proposed for the Cornerstone Project,

1. Practical assessment of testing the good quality bricks
2. Practical assessment of testing the good quality building stones.
3. Field experiments to test and classify lime.
4. Field experiments of testing the quality of cement.
5. Experimental analysis of testing the efficiency of natural accelerators in concrete
6. Experimental analysis of testing the efficiency of natural retarders in concrete
7. Evaluation of modulus of elasticity of fiber reinforced concrete.
8. Experimental analysis of stress-strain behaviour of engineered cementitious composites.
9. Design of suitable SCC mix with chemical admixtures and testing its properties.

Descriptive:

The objective of these mini projects is to provide practical exposure to the evaluation of construction materials and concrete properties through both field and laboratory methods. This includes assessing the quality of bricks, stones, lime, and cement using simple field tests, studying the influence of natural accelerators and retarders on concrete behavior, determining the modulus of elasticity of special concretes, and designing self-compacting concrete (SCC) mixes with chemical admixtures. The outcome is that students will develop a comprehensive understanding of material properties, mix design, and performance characteristics, enabling them to make informed decisions in material selection and apply appropriate techniques to enhance the strength, durability, and workability of concrete in real-world engineering

applications.

Students are not limited to the above titles and may choose their own project topics based on the recommendations and approval of the course coordinator.

CIE: 50 Marks: Internal Exam 1 (8), Internal Exam 2 (12), Learning Activity (5)

Day-to-Day Activity: Cornerstone Project: Review1-(5), Review2-(5) Lab Test (15)

SEE: 50 Marks: Theory Exam (50)

Note:

- The cornerstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The evaluation of the Cornerstone Project shall be based on the project implementation, oral presentation, 10-minute video presentation, report and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.
- Finally, the Source code of the cornerstone Project has to be pushed into the Students GitHub repository (if applicable).

Text Books:

1. Building Materials, S.K. Duggal, New Age International Publishers, 5th Edition. (ISBN: 978-9387788398)
2. Concrete Technology, Theory and Practice, Shetty, M.S, S. Chand & Company, New Delhi. (ISBN: 9789352533800)

Reference Books:

1. Building Materials, S.S.Bhavikatti, Vices publications House private ltd, 2nd edition. (ISBN: 9789325960442)
2. Properties of Concrete, Neville, A.M, Fifth Edition, Pearson. (ISBN: 978-8131791073)

Web Links:

1. <http://nptel.ac.in/courses/105102088/>
2. <https://nptel.ac.in/courses/105102012>
3. NPTEL Course: Concrete Technology: <https://nptel.ac.in/courses/105102012/>

Fluid Mechanics

Course Code:2501CE02

L	T	P	C
1	1	1	3

Course Outcomes:

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

- CO1:** Apply physical properties of fluid in fluid related problem.
- CO2:** Apply principles of hydrostatic under fluid at rest.
- CO3:** Apply principles of fluid kinematics under fluid motion.
- CO4:** Apply principles of fluid dynamics to determine the measurement of flow.
- CO5:** Apply principles of fluid flow in a closed conduct to determine its head losses and other parameters and buoyancy phenomenon in fluid related problems.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Physical Properties of Fluids & Pressure Measurement:

Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility & Bulk modulus, Surface Tension and Capillarity, Vapour Pressure and Cavitation. Pascal's law, Variation of static pressure, Atmospheric, gauge and vacuum pressures, Simple manometers, Differential manometers.

UNIT – II

Hydrostatics:

Hydrostatic forces on submerged plane, horizontal, vertical, inclined, and curved surfaces – Center of pressure.

UNIT – III**Fundamentals of Fluid Flow:**

Methods of describing fluid motion, Types of fluid flow, Description of the flow pattern, Continuity Equation (Cartesian Coordinates), Acceleration of a fluid Particle, Velocity potential, Stream Function, Streamlines, Equipotential lines and Flow Net, Use of the Flow Net, Limitations of Flow Net.

UNIT – IV**Dynamics of Fluid Flow:**

Eulers Equation of Motion, Bernoulli's Equation from Euler's Equation, Practical Applications of Bernoulli's Equation: Venturi meter, Orifice Meter, Pitot tube, Momentum Equation, Moment of Momentum Equation.

Practice:

1. Verification of Bernoulli's Equation,
2. Determination of Coefficient of Discharge for Venturi Meter
3. Determination of Coefficient of Discharge for Orifice Meter,
4. Determination of Coefficient of velocity for Pitot tube

UNIT – V**Flow Through Pipes:**

Reynolds Experiment, Laws of Fluid Friction - Darcy Weisbach Equation, Other Energy losses in Pipes, Pipes in Series, Equivalent Pipe, Pipes in Parallel.

Buoyancy:

Buoyancy, Centre of Buoyancy, Meta-Centre, Meta-centric Height, Analytical Method for Meta-Centre Height, Conditions of Equilibrium of a Floating and submerged bodies, Experimental Method of Determination of Meta-centric Height.

Practice:

1. Determination of flow by Reynolds Experiment
2. Determination of friction losses in Pipe flow
3. Determination of Minor losses in Pipe flow
4. Determination of Meta-centric Height

Text Books:

1. Fluid Mechanics and Machinery, C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, Oxford Higher Education. (ISBN: 13-978-0195699630)
2. Hydraulics and Fluid Mechanics Including Hydraulics Machines Dr. P.N. Modi & S.M. Seth, Rajsons Publications Pvt. Ltd, 22nd Edition, 2022. (ISBN:13-9788189401269)

Reference Books:

1. Introduction to Fluid Mechanics, Edward J. Shaughnessy, Jr, Ira M. Katz, James P. Schaffer, SI Edition, Oxford Higher Education. (ISBN: 978-0195677836)
2. Fluid Mechanics and Hydraulic Machines, Er. R K Rajput, S. Chand Publishers. (ISBN:13-978-9385401374)

Web Links:

1. <http://nptel.ac.in/courses/105103095/>
2. <http://www.britannica.com>

Strength of Materials-I

Course Code:2501CE03

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Demonstrate the relationships between loads, member forces and deformations and material stresses and strains in structural members.
- CO2:** Build the shear force and bending moment diagram of beams under varying load and support conditions.
- CO3:** Determine the flexural and shear stresses in beams subjected to bending moment.
- CO4:** Analyze the deflections in beams under various loading and support Conditions.
- CO5:** Analyze the stresses in thick and thin cylinder.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Simple Stresses and Strains:

Elasticity and plasticity, Types of stresses and strains, Hooke's law, stress-strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic constants and the relationship between them, Bars of varying section, composite bars, Temperature stresses, Principle of superposition.

Strain Energy:

Resilience, Gradual, sudden, impact loadings and simple applications.

Practice:

1. To estimate the mechanical properties of Mild Steel specimen under Tensile load by Direct Tension.
2. To estimate of Young's modulus of different beams of simply supported beams.
3. To estimate Young's modulus of cantilever beam.
4. To determine the Rigidity modulus of mild steel specimen by performing torsion test.
5. To determine the Brinell & Rock well hardness number of the given Specimen.
6. To find the impact strength of mild steel specimen by performing IZOD and Charpy Impact test.

UNIT – II

Shear Force and Bending Moment:

Definition of beam, Types of beams, Concept of shear force and bending moment, shear force and bending moment 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 contraflexure, Relation between S.F, B.M and rate of loading at a section of a beam.

UNIT – III

Bending and Shear Stress:

Bending Stress -Theory of simple bending, Assumptions, Derivation of bending equation, Neutral axis, Determination of bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections, Design of simple beam sections.

Shear Stress - Derivation of formulae, Shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections and built up beams.

Practice:

1. To determine the ultimate shear strength of mild steel specimen test.
2. To find the strain of given sample by using electrical resistance strain gauge.

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, uniformly distributed load, uniformly varying load, Mohr's theorems, Moment area method, application to simple cases.

Practice:

- 1.To determine the spring properties (stiffness and rigidity modulus) under tensile and compressive loads.
- 2.To determine Young's modulus of different continuous beams.

UNIT – V

Thin Cylinders, Thick Cylinders and Spherical Shells:

Thin Cylinder - Thin seamless cylindrical shells, Derivation of formulae for longitudinal and circumferential stresses, hoop, longitudinal and volumetric strains, changes in diameter, and volume of thin cylinders, Thin spherical shells.

Thick Cylinder -Introduction of Lamé's theory for thick cylinders, Derivation of Lamé's formulae, distribution of hoop and radial stresses across thickness, design of thick cylinders, compound cylinders, Necessary difference of radii for shrinkage, thick spherical shells.

Additional Practice:

- 1.To verify maxwell's reciprocal theorem on beams.
- 2.To perform shear test on given specimen.
- 3.To compare compressive strength of clay brick and reinforced cement concrete cube.

Text Books:

1. Mechanics of Materials, Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, McGraw Hill, 8th Edition, 2020. (ISBN: 13-978-9390219421)
2. Strength of Materials, R.K.Rajput, S.Chand Publications, 6th edition.(ISBN: 13-978-9385401367)

Reference Books:

1. Strength of Materials, R.K.Bansal, Lakshmi Publications. (ISBN: 13-978-8131800003)
2. Strength of Materials, S.Ramamrutham, Dhanpatrai publishing company. (ISBN:9788187433545)

Web Links:

1. <http://nptel.ac.in/courses/105105108/2>
2. <https://archive.nptel.ac.in/courses/105/105/105105108/>
3. <https://accessengineeringlibrary.com/maps/strength-of-materials>

Engineering Geology

Course Code:2501CE04

Course Outcomes:

L	T	P	C
2	0	1	3

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

- CO1:** Sight the geo-morphological processes and formation of landscapes .
- CO2:** Perform megascopic identification of physical properties of rocks and minerals.
- CO3:** Familiarize on impacts of tectonic deformations in lithospheric zone.
- CO4:** Explain the concepts of groundwater hydrology and natural disasters caused by geological process.
- CO5:** Apply geological principles in selection of sites for construction of dams, reservoirs and tunnels.

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

Physical Geology and Geomorphological Process:

Introduction: Branches of Geology, Importance of Geology in Civil Engineering with case studies. Earth surface features and its internal structure. Geological Agents and their work in weathering and erosion with different rocks and landscapes on earth surface. River development process.

UNIT – II

Mineralogy:

Definitions of mineral, Different methods of study of minerals. The Megascopic identification of physical properties of minerals.

Practice 1 :**Megascopic Identification of Physical Properties of Minerals:**

Common rock forming minerals are Feldspar, Quartz Group, Olivine, Augite, Hornblende, Mica Group, Asbestos, Talc, Chlorite, Kyanite, Garnet, Calcite and other ore forming minerals are Pyrite, Hematite, Magnetite, Chlorite, Galena, Pyrolusite, Graphite, Chromite, Magnetite and Bauxite.

Petrology:

Defenition of Rock & Rock cycle, origin and classification, structures, textures and forms of Igneous rocks, Sedimentary rocks and metamorphic rocks

Practice 2 :

Megascopic identification of physical properties of rocks , Granite varieties, (pink, gray, green Etc.,). Pegmatite, Dolerite, Basalt etc., Shale, varieties of Sand Stone, Lime Stone, Laterite, Quartzite, Gneiss, Schist, Marble, Khondalite and Slate

UNIT – III**Structural Geology:**

Structural Geology: Strike, Dip and Outcrop. Study of common geological structures associating with the rocks such as Folds, Faults, Joints and Unconformities- parts, types, mechanism and their importance in Civil Engineering.

Practice 3 : Simple strike & dip problems and marking formations in map.

UNIT – IV**Ground Water Hydrology:**

Ground Water: Water table, Cone of depression, Geological controls of Ground Water Movement and types of aquifers, Ground Water Exploration Techniques Landslides.

Landslides: Classification of Landslides, Causes and Effects, measures to betaken to prevent their occurrence at Landslides.

Earthquakes: Terminology, Classification, causes and effects, Shield areas andSeismic bells, Richter scale intensity, Precautions of building constructions in seismic areas.

Practice 4 : Drawing of cross sections of the formations from geological maps.

UNIT – V**Geophysical Exploration Methods:**

Geophysics: Importance, Classification, Principles of Geophysical study by Gravity method, Magnetic method, Electrical methods, Seismic methods, radiometric method Etc.,

Geology of Dams, Reservoirs and Tunnels:

Types and purpose of Dams, Geological considerations in the selection of a Dam site and Life of Reservoirs. Purpose of Tunneling, effects, Lining of Tunnels. Influence of Geology for successful Tunneling-case studies.

Practice 5:

1. Demonstration of Electrical Resistivity method and well logging.
2. Field work – To explore, identify and study on Mineral & Rock deposits, Geomorphology & Structural Geology of an area and preparation of field trip report.

Text Books:

1. Engineering Geology, N. Chennakesavulu, Trinity Press (Laxmi Publications), 2nd Edition. (ISBN: 978-9380856278)
2. Engineering Geology, D. Venkat Reddy, Vikas Publishing House pvt Ltd, 1st Edition. (ISBN: 978-9325992351)

Reference Books:

1. Engineering Geology, Subinoy Gangopadhyay, Oxford University Press Edition. (ISBN: 978-0198086352)
2. Engineering Geology, F G Bell, Butterworth-Heinemann Ltd; 2nd edition. (ISBN: 978-0750680776)

Web Links:

1. <https://structuralgeology.stanford.edu/fundamentals-structural-geology>
2. http://www.minsocam.org/MSA/collectors_corner/id/mineral_id_key1.htm
3. <https://www.rockptx.com/>

Geomatics Engineering

Course Code:2501CE05

L	T	P	C
1	1	2	4

Course Outcomes:

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

- CO1:** Determine linear and angular distances using chain, compass instruments.
- CO2:** Apply appropriate techniques to measure the level of existing ground.
- CO3:** Calculate height and distances using Theodolite and Tachometry.
- CO4:** Apply advanced surveying techniques and curve design in field projects
- CO5:** Determine regular, irregular areas and volumes of given field.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction To Surveying:

Surveying objectives, plane surveying principles and classification, Errors and Mistakes, Types of tapes and chains, offsets, Errors and Corrections.

Compass Surveying: Measurement of directions and angles, types of compass, meridians and bearings, local attraction, traversing.

Practice:

1. To find the area by chain survey (closed circuit).
2. Survey of an area by using compass survey (closed traverse).

UNIT – II

Plane Table Survey & Leveling:

Purpose-principle, accessories, orientation, methods of plane tabling, errors.

Leveling and Contouring: Concept and Terminology, Leveling Instruments and their temporary and permanent adjustments, method of leveling, Characteristics and Uses of contours.

Practice:

1. To find the area of given boundary by method of radiation (plane table survey).
2. To find the level difference by height of instrument method or rise and fall method. (Differential leveling).
3. To find the level difference along the length of the road (longitudinal section) and draw given road profile (fly leveling).

UNIT – III

Theodolite & Tachometric Surveying:

Theodolite, description, principles, uses and adjustments, temporary and permanent, measurement of horizontal and vertical angles, Trigonometric leveling.

Tachometric Surveying: Stadia and tangential methods of Tachometry, Distance and Elevation formulae for Staff vertical position.

Practice:

1. To determine the horizontal and vertical angles by method of repetition (Theodolite survey).
2. To find the height and distance problem by Trigonometric leveling (When base is accessible).

UNIT – IV

Curves & Advanced Surveying:

Curves: Types of curves, design and setting out simple circular curves by linear and angular methods, introduction to compound curves.

Advanced Surveying: Total station- Advantages and applications, Principle and types of EDM Instruments, Global positioning system, Introduction to Drone survey and LiDAR Survey (Light Detection and Ranging).

Practice:

1. Determination of area and perimeter by using total station.
2. To find the area of a given boundary by using drone survey.

UNIT – V

Computation of Areas and Volumes:

Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section- determination of the capacity of reservoir, volume of barrow pits.

Additional Practice:

1. To find the area of given boundary by method of intersection (plane table survey).
 2. To determine the horizontal angles by method of reiteration (Theodolite survey).
- To find the distance between two inaccessible points by compass survey

Text Books:

1. Surveying (Vol.No.1,2&3), B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) ltd. (ISBN : 13-978-8170088530)
2. Advance Surveying, Satish Gopi, R.SathiKumar and N.Madhu,Pearson Publications. (ISBN: 13-978-9352860722)

Reference Books:

1. Elements of Plane Surveying, Arthur R Benton and Philip J Taety, McGrawHill. (ISBN: 13-978-0070048843)
2. SurveyingVoll,(2&3), Arora KR, Standard Book House, Delhi.(ISBN:13-9788189401238)
3. PlaneSurveying, Chandra AM, New Age International Pvt.Ltd.,NewDelhi. (ISBN:13- 978-8122519023)

Web Links:

1. nptel.ac.in/courses/105104101/
2. <http://www.nptelvideos.in/2012/11/surveying.html>
3. <http://nptel.ac.in/courses/105107158/17>
4. nptel.ac.in/courses/105107122

Hydraulics & Hydraulic Machinery

Course Code:2501CE06

L	T	P	C
1	1	1	3

Course Outcomes:

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

- CO1:** Analyze uniform flow in open channels to compute most economical sectional properties.
- CO2:** Analyze surface profiles in non-uniform flow by basic dynamic equation for gradually varied flow.
- CO3:** Apply hydraulic similitude for model test.
- CO4:** Apply the principle of impact of jet on different vane.
- CO5:** Analyze working behavior and efficiencies of different hydraulic turbines and performance of centrifugal pump.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Flow In Open Channels :

Types of Flow in Channels, Geometrical Properties of Channels, Velocity Distribution, Most economical section, Specific Energy and Critical Depth, Momentum in Open channel Flow, Critical flow and its Computations.

UNIT – II

Non-Uniform Flow In Channels :

Dynamic Equation of Gradually Varied Flow, Relation between S_w and S_o ,

Classification of Channel Bottom Slopes, Classification of Surface Profiles, Characteristics of Surface Profiles, Hydraulic Jump

Practice:

1. Determination of Hydraulic jump

UNIT – III

Hydraulic Similitude and Dimensional Analysis :

Dimensions, Dimensional Homogeneity, Method of Dimensional Analysis, Model Investigation, Similitude, Force Ratio, Similarity Laws.

UNIT – IV

Impact of Free Jets:

Force Exerted by Fluid Jet on (Stationary Flat Plate, Moving Flat Plate, Stationary Curved Vane, Moving Curved Vane), Torque Exerted on a Wheel with Radial Curved Vanes.

Practice:

1. Determination of coefficient of Impact on various vanes

UNIT – V

Hydraulic Turbines:

Elements of Hydroelectric Power Plants, Head and Efficiencies of Hydraulic Turbines, Classification of Turbines, Pelton Turbine and Francis Turbine (Work Done, Efficiencies, working proportions, Design), Radial Flow Impulse Turbine, Kaplan Turbine (Working Proportions), Working and components of both centrifugal pump & Reciprocating pump

Practice:

1. Determine the efficiency of Pelton wheel,
2. Determine the efficiency of Kaplan turbine
3. Determine the efficiency of Francis turbine,
4. Determine the efficiency of Centrifugal pump
5. Determine the efficiency of Reciprocating pump

Text Books:

1. Fluid Mechanics and Machinery, C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, Oxford Higher Education. (ISBN: 13-978-0195699630).
2. Hydraulics and Fluid Mechanics including machines, Dr.P.N.Modi and Dr.S.M.Seth, Rajsons Publications Pvt. Ltd. (ISBN:13-9788189401269)

Reference Books:

1. Fluid Mechanics including Hydraulic machines, Dr. A.K.Jain, Khanna publishers.
(ISBN: 13-978-8174091949).
2. Mechanics of Fluids, Merle C. Potter, David C. Wiggert and Bassem H. Ramadan.
(ISBN:13-978-0495667735)

Web Links:

1. <http://nptel.ac.in/courses/105106114>
2. <https://nptel.ac.in/courses/105107059>

Geotechnical Engineering - I

Course Code:2501CE07

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Identify different types of soils based on index properties
- CO2:** Determine the permeability of different types of soils
- CO3:** Utilize the elastic solutions to evaluate the distribution of stresses within the soil mass
- CO4:** Evaluate the compaction and consolidation characteristics of soil
- CO5:** Determine the shear strength parameters of soils under different drainage conditions

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		3							
CO3	3	3		2							
CO4	3	3	1	3							
CO5	3	3	1	3							

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction :

Soil formation - soil structure and clay mineralogy - Adsorbed water - Multi phase soil system - Phase relationships - Index and physical properties - Classification for engineering purposes -UCS and IS Classification system.

Practice:

- 1.Determination of Specific Gravity using a Density Bottle and Pycnometer.
- 2.Determination of Consistency Limits – (i) Liquid Limit (ii) Plastic Limit and (iii) Shrinkage Limit.
- 3.Determination of Grain Size Distribution using Dry Sieve Analysis and Hydrometer.

UNIT – II

Soil Water and Permeability :

Soil water - Capillarity - Permeability – Darcy's Law - factors affecting permeability - measurement in the laboratory and field. Seepage, - Introduction to flow nets – piping - uplift pressure. Simple problems.

Practice:

1.Determination of Permeability using (i) Constant Head Method and (ii) Falling Head Method.

UNIT – III

Stress Distribution In Soils :

Effective stress concepts in soils - Stress distribution in soil media - Bousinessq's analysis for Point, Circular and Rectangular loads - Westergaard's analysis for point and circular loads – Isobars - Newmark's Chart – 2:1 stress distribution method.

UNIT – IV

Compaction and Consolidation:

Soil compaction – Mechanism of compaction – factors affecting – effects of compaction on soil properties - compaction control – laboratory (light and heavy compaction) and field compaction methods –CBR .

Compressibility – Compressibility constants - Consolidation - Components of settlement Immediate and consolidation settlement - Terzaghi's one-dimensional consolidation theory – Laboratory method - Methods to determine co-efficient of consolidation.

Practice:

1.Determination of Field Unit Weight using Core Cutter and Sand Replacement Method
2.Determination of maximum dry density and optimum moisture content using the Standard Proctor Compaction test.

UNIT – V

Shear Strength:

Shear strength of cohesive and cohesionless soils - Mohr-Coulomb failure theory - saturated soil mass - Measurement of shear strength, direct shear - Triaxial compression, unconfined compression test and Vane shear test - Pore pressure parameters – various drainage conditions.

Practice:

1.Determination of shear strength parameters using the Direct Shear test.
2.Determination of shear strength parameters using Unconfined Compression test.
3.Determination of shear strength parameters using the Vane Shear test.
4.Determination of shear strength parameters using Triaxial test.

Additional Practice:

1. Determination of suitability of subgrade using California Bearing Ratio.
2. Determination of Consolidation Co-efficient using Oedometer

The following titles are proposed for the Cornerstone Project,

1. Classification of Local Soil Based on Index Properties and IS Classification System
2. Determination of Permeability of Different Soils and Evaluation of Seepage Characteristics
3. Analysis of Stress Distribution in Soil Mass under Different Loading Conditions
4. Evaluation of Field Compaction Percentage of a Construction Site Using Standard Proctor Test
5. Experimental Study on Improvement of Shear Strength of Soil Using Additives

Descriptive:

These projects aim to develop a clear understanding of the fundamental properties and behavior of soils through a combination of laboratory testing, field evaluation, and basic analytical methods in Geotechnical Engineering. The work includes classification of local soils based on index properties and IS classification system, determination of permeability characteristics, and analysis of stress distribution in soil under different loading conditions. Students will also evaluate field compaction characteristics by correlating laboratory results from the Standard Proctor test with field density measurements. In addition, an experimental study on improving the shear strength of soils using suitable additives such as lime or cement will be carried out to understand soil stabilization techniques. Through these activities, students will gain practical knowledge of soil behavior, permeability, stress response, compaction control, and strength improvement methods, which are essential for effective geotechnical engineering practice and further advanced studies.

Students are not limited to the above titles and may choose their own project topics based on the recommendations and approval of the course coordinator.

CIE: 50 Marks: Internal Exam 1 (8), Internal Exam 2 (12), Learning Activity (5)

Day-to-Day Activity: Cornerstone Project: Review1-(5), Review2-(5) Lab Test (15)

SEE: 50 Marks: Theory Exam (50)

Note:

- The cornerstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The evaluation of the Cornerstone Project shall be based on the project implementation, oral presentation, 10-minute video presentation, report and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.
- Finally, the Source code of the cornerstone Project has to be pushed into the Students GitHub repository (if applicable).

Text Books:

1. Soil Mechanics and Foundation Engineering Geotechnical Engineering Series Murthy,V.N.S , CBS. (ISBN: 13-978-8123913971)
2. Basic and applied soil mechanics , Gopal Ranjan, and A. S. R. Rao, New Age International, 3rd edition. (ISBN: 13-978-8122440393)

Reference Books:

- Fundamentals of geotechnical engineering , Braja M. Das and Nagaratnam
1. Sivakugan, Cengage India Private Limited, 5th edition. (ISBN: 13-978-9386858139)
 2. Soil Mechanics and Foundation Engineering , Arora K.R., Standard publisher, 2020. (ISBN: 13-978-8180141126)
 3. Soil Mechanics and Foundations , Punmia, B.C., Laxmi Publications Pvt. Ltd. New Delhi. (ISBN: 13-978-8170087915)

Web Links:

1. <https://nptel.ac.in/courses/105103097/>
2. <https://nptel.ac.in/courses/105106142/>

Strength of Materials-II

Course Code:2501CE08

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Calculate the complex stresses in engineering components.
- CO2:** Determine the effect of torsion on springs and shafts.
- CO3:** Determine the load carrying capacity of columns.
- CO4:** Determine the combined effect of direct and bending stresses on engineering Structures.
- CO5:** Analyze the stresses in unsymmetrical bending structure.

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

Complex Stresses and Theories of Failures:

Complex Stress - Introduction, stresses on an inclined plane under axial loading, compound stresses, normal and tangential stresses on an inclined plane for biaxial stresses, two perpendicular normal stresses accompanied by a state of simple shear, principal stresses and strains, mohr's circle of stresses, analytical and graphical solutions.

Theories of Failures:

Introduction, various theories of failures like maximum principal stress theory, maximum principal strain theory, maximum shear stress theory, maximum strain energy theory, maximum shear strain energy theory.

UNIT – II**Torsion of Circular Shafts And Springs:**

Torsion of Circular Shaft - Theory of pure torsion, derivation of torsion equations: $T/J = q/r = N\phi/L$, assumptions made in the theory of pure torsion, torsional moment of resistance, polar section modulus, power transmitted by shafts, combined bending and torsion and end thrust, design of shafts according to theories of failures.

Springs - Introduction, types of springs, deflection of close and open coiled helical springs, springs in series and parallel, leaf or laminated springs.

UNIT – III**Columns:**

Introduction, types of columns, axially loaded compression members, crushing load, Euler's theorem for long columns, assumptions, derivation of Euler's critical load formulae for various end conditions, Equivalent length of a column, slenderness ratio, Euler's critical stress, limitations of Euler's theory, Rankine - Gordon formula, long columns subjected to eccentric loading, secant formula, empirical formulae, straight line formula, Prof. Perry's formula.

UNIT – IV**Combined Stresses:**

Stresses under the combined action of direct loading and bending moment, core of a section, determination of stresses in the case of chimneys, retaining walls and dams, conditions for stability.

UNIT – V**Unsymmetrical Bending and Shear Centre:**

Unsymmetrical Bending - Introduction, centroidal principal axes of section, graphical method for locating principal axes, Moments of inertia referred to any set of rectangular axes, stresses in beams subjected to unsymmetrical bending, principal axes, Deflection of beams under unsymmetrical bending.

Shear Centre - Introduction, shear centre for symmetrical and unsymmetrical (Channel, I, T and L) sections.

Text Books:

1. Mechanics of Materials, Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek, Sanjeev Sanghi, McGraw Hill, 8th Edition, 2020. (ISBN: 13-978-9390219421)
2. A Text book of Strength of materials, R.K. Bansal, Laxmi Publications (P) Ltd, 2018. (ISBN: 10-9788131808146)

Reference Books:

1. Strength of Materials, U C Jindal, Pearson Publications. (ISBN:9789332501232)
2. Mechanics of Materials, B.C. Punmia, Laxmi Publications (P) Ltd. (ISBN:13-978-8170082156)

Web Links:

1. <http://nptel.ac.in/courses/105105108/2>
2. <https://archive.nptel.ac.in/courses/105/105/105105108/>
3. http://www.nptelvideos.com/mechanical/strength_of_materials.php

Structural Analysis

Course Code:2501CE09

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Analyze propped cantilever beams and apply the slope deflection method to determine SFD and BMD.
- CO2:** Apply the moment distribution methods and Clapeyron's theorem of three moments to analyse the beams and frames.
- CO3:** Draw the influence lines for reactions, shears and bending moments in beams due to moving loads.
- CO4:** Analyse two-hinged and three-hinged arches for different loading conditions.
- CO5:** Apply the flexibility and stiffness matrix methods to analyse the beams.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Propped Cantilevers and Slope Deflection Method:

Propped Cantilever - Analysis of propped cantilever beams- Shear force and bending moment diagrams, Deflection of propped cantilevers.

Slope Deflection Method - Kinematic indeterminacy - Derivation of slope-deflection equation, application to continuous beams and analysis of single bayportal frames without sway.

UNIT – II

Moment Distribution Method and Clapeyron's Theorem of Three Moments:

Moment Distribution Method - Stiffness and carry-over factors – Distribution factors - Analysis of continuous beams – Analysis of single bayportal frames without sway.

Clapeyron's Theorem of Three Moments -Analysis of continuous beams with and without supports settlement, shear force and bending moment diagrams.

UNIT – III

Influence Lines :

ILD for shear, moment and reactions for cantilever and simply supported beams.

Moving Loads :

Moving loads on simply supported beams –single and several points' loads – maximum bending moment and maximum shear force – equivalent UDL - absolute maximum bending moment.

UNIT – IV

Two-Hinged Arches:

Introduction – Types of Arches – Analysis of two hinged Arches. Linear Arch. Eddy's theorem.

Three-Hinged Arches:

Analysis of Three hinged arches. Geometrical properties of parabolic and Semi circular arch. Absolute maximum bending moment diagram for a three hinged arch.

UNIT – V

Flexibility Matrix Method :

Introduction - application to continuous beams (maximum of two unknowns) including Support settlements.

Stiffness Matrix Method:

Introduction - application to continuous beams (maximum of two unknowns) including support settlements. (MATLAB Demo).

Text Books:

1. Structural Analysis 1, Bhavikatti S. S, Vikas Publishing House, Noida.(ISBN: 978-8125942696)
2. Theory of Structures, Punmia, B.C, Ashok kumar Jain & Arun Kumar Jain, Laxmi Publications, India. (ISBN: 9788170086185)

Reference Books:

1. Theory of structures, Dhanpat Rai publications. (ISBN: 978-9384378103)
2. Structural Analysis, Hibbeler, R.C, Pearson India. (ISBN: 978-9332586147)

Web Links:

1. <http://nptel.ac.in/courses/105101085/>
2. <https://lecturenotes.in/subject/154/structural-analysis-1>
3. <https://www.vidyarthiplus.com/vp/thread-35607.html#.Wsx43ohuZPY>

Geotechnical Engineering - II

Course Code:2501CE10

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Prepare the soil investigation report based on the suitable soil exploration method
- CO2:** Determine the allowable bearing capacity for various types of shallow foundation
- CO3:** Determine the allowable bearing pressure and settlement for various types of shallow foundation
- CO4:** Calculate the load-carrying capacity of piles and well foundations
- CO5:** Analyze various types of stability failures in earth-retaining 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	3	1	3							
CO2	3	3	2	1							
CO3	3	3	2	2							
CO4	3	3	3	2							
CO5	3	3	3	2							

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Soil Exploration:

Need – Methods and depth of soil exploration – Factors affecting the depth and location of foundation - Boring and Sampling methods – Field tests – Penetration tests – Pressure meter – Planning of program and preparation of soil investigation report.

UNIT – II

Shallow Foundations – Bearing Capacity Criteria:

Types of foundations and factors to be considered in their location – Bearing capacity – Types of bearing capacity of shallow foundation - factors influencing bearing capacity – analytical methods to determine bearing capacity – Terzaghi's theory – IS Methods.

UNIT – III

Shallow Foundations – Settlement Criteria:

Safe bearing pressure based on N-value – Allowable bearing pressure – Safe bearing capacity and settlement from plate load test – Types of foundation settlements and their determination – Allowable settlements of structures – Raft foundation in sand and clay.

UNIT – IV

Pile Foundations and Well Foundations :

Types of piles – Load carrying capacity of piles based on static pile formulae – Dynamic pile formulae – Pile capacity based on empirical relations – Pile load tests – Load carrying capacity of pile groups in sands and clays – Settlement of pile groups. Types – Different shapes of well – Components of well – Functions – Forces acting on well foundations – Construction and sinking of wells – Tilt and shift.

UNIT – V

Earth Retaining Structures and Slope Stability:

Types of retaining walls - Rankine's and Coulomb's theory of Earth pressure – Culmann's graphical method for active earth pressure. Infinite and finite earth slopes in purely cohesionless and cohesive soil – Types and causes of slope failures – Factor of safety – Stability analysis by method of slices – Friction circle method – Taylor's method.

Text Books:

1. Basic and Applied Soil Mechanics, Gopal Ranjan and A.S.R.Rao, New Age International Publishers. (ISBN: 13-978-8122440393)
2. A Textbook of Soil Mechanics and Foundation Engineering by K.R.Arora, Standard Publishers & Distributors, 2020. (ISBN: 13- 978-8180141126)

Reference Books:

1. A Textbook of Soil Mechanics and Foundations B.C.Punmia, Laxmi Publications. (ISBN: 13-978-8170087915)
2. Foundation Analysis & Design, Bowles & J.E, McGraw-Hill. (ISBN: 13-978-0071188449)

Web Links:

1. <https://nptel.ac.in/courses/105/105/105105176/>
2. <https://nptel.ac.in/courses/105/101/105101083/>
3. <https://nptel.ac.in/courses/105/108/105108069/>

Environmental Engineering

Course Code:2501CE11

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Apply basic principles of protected water supply system for a town or city.
- CO2:** Illustrate multiple treatment methods based on characteristics of raw water and distribution of treated water.
- CO3:** Interpret different treatment technologies of wastewater based on characteristics of sewage.
- CO4:** Identify an appropriate secondary and tertiary treatment method of Sewage.
- CO5:** Demonstrate the concepts of sludge management, disposal methods and recycling treated 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	3	-	1	-	-	2	2	-	-	1	1
CO2	2	2	2	1	-	2	2	-	-	-	-
CO3	2	2	1	1	-	2	3	-	-	-	-
CO4	2	2	2	1	-	2	2	-	-	-	-
CO5	2	-	3	-	-	2	3	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction To Protected Water Supply System:

Importance and Necessity of Protected Water Supply systems, Water borne diseases, Flow chart of public water supply system, Estimation of water demand for a town or city, Per capita Demand and factors influencing it - Types of water demands and its variations factors affecting water demand, Design Period, population forecast, Sources of water, Intakes, conveyance of raw water.

UNIT – II

Raw Water Treatment and Distribution:

Water Quality Index –Calculation-Flow chart of water treatment plant, Treatment methods, Theory and Design of Sedimentation, Coagulation, Filtration, Theory of disinfection, Chlorination and other Disinfection methods, Methods of Distribution system, Layouts of Distribution networks, Analysis of Distribution networks, Components of Distribution system.

Practice:

1. To determine the physical properties of the given water samples (colour, odour, temperature and turbidity).
2. To determine pH and acidity of the given water samples
3. To determine total alkalinity of the given water samples
4. To estimate the total, calcium and magnesium hardness in the given water samples
5. To determine total dissolved solids (TDS) and electrical conductivity (EC) of The given water sample.
6. To determine optimum coagulant dose needed in water treatment using Jar test.
7. To estimate the amount of dissolved oxygen (DO) content and biochemical oxygen demand (BOD) of the given water and wastewater samples respectively.

UNIT – III

Sewage Characteristics and Treatment Methods:

Systems of sanitation, relative merits & demerits, collection and conveyance of wastewater, Classification of seweragesystems, Estimation of sewage flow and stormwater drainage, fluctuations,Types of sewers, Hydraulics of sewers and storm drains, Design of sewers, appurtenances in sewerage, Types of pumps and their suitability with regard to wastewaters, Sampling of wastewater, Physical, Chemical and Biological Examination of sewage, Primary treatment, Screens, Grit chambers, Floatation, Design of Preliminary and Primary treatmentunits.

Practice:

1. To determine the total settleable solids present in the given water sample using Imhoff cone setup
2. To determine the chemical oxygen demand (COD) of the given waste water sample.
3. To determine the total nitrogen and phosphorous content present in the given waste water sample.

UNIT – IV

Secondary and Tertiary Treatment Methods:

Aerobic and anaerobic treatment process comparison, Activated Sludge Process, principles, designs, and operational problems, Oxidation ponds, Trickling Filters–mechanism of impurities removal, classification, design, operation and maintenance problems, RBCs, Fluidized bed reactors, Removal of Nitrogen and Phosphorus, Septic Tanks and Imhoff tanks.

UNIT – V

Sludge Management and Recycling of Treated Water:

Characteristics of sludge, handling and treatment of sludge-thickening, Anaerobic digestion of sludge, Sludge drying beds, Methods of disposal, Disposal into water bodies, Oxygen Sag Curve, Disposal into sea, Disposal on land, Sewage thickness, Importance of Recycling, Indirect and Direct methods of recycling.

Additional Practice:

1. To determine the total iron content of the given water sample.
2. To determine the chloride content in the given water sample.

The following titles are proposed for the Cornerstone Project,

1. Water Quality Analysis of Drinking Water Sources in a Local Area
2. Greywater Treatment Using a Laboratory-Scale Constructed Wetland
3. Study of Natural Coagulants for Turbidity Removal from Water
4. Design of a Mini Wastewater Treatment Plant Model
5. Nutrient Removal from Wastewater Using Wetland Plants
6. Low-Cost Household Water Purification System Using Natural Materials
7. Performance Study of a Laboratory Scale Rapid Sand Filter

Descriptive:

These projects focus on studying different methods of water and wastewater treatment using simple laboratory-scale systems and natural materials. The work includes analyzing the quality of drinking water from local sources, removing turbidity using natural coagulants, and developing low-cost household water purification methods. It also involves designing small treatment models such as rapid sand filters, constructed wetlands, and mini wastewater treatment plants to treat greywater and remove nutrients from wastewater. Through these studies, students will evaluate the efficiency of various treatment techniques using basic water quality parameters and understand practical approaches to improving water quality and sustainable water management.

Students are not limited to the above titles and may choose their own project topics based on the recommendations and approval of the course coordinator.

CIE: 50 Marks: Internal Exam 1 (8), Internal Exam 2 (12), Learning Activity (5)

Day-to-Day Activity: Cornerstone Project: Review1-(5), Review2-(5) Lab Test (15)

SEE: 50 Marks: Theory Exam (50)

Note:

- The cornerstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The evaluation of the Cornerstone Project shall be based on the project implementation, oral presentation, 10-minute video presentation, report and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.
- Finally, the Source code of the cornerstone Project has to be pushed into the Students GitHub repository (if applicable).

Text Books:

1. Water Supply Engineering, B.C.Punmia, Laxmi Publications, (ISBN: 9788170080923)
2. Water Supply and Sanitary Engineering, G.S.Birdie, and J.S.Birdie, Dhanpat Rai Publishing Company, (ISBN: 139788187433798)

Reference Books:

1. Environmental Engineering Vol1 Water supply Engineering, S.K.Garg, Khanna Publications. (ISBN: 9788174091208)
2. Environmental Engineering Vol2 Water supply Engineering, S.K.Garg, Khanna Publication. (ISBN: 13978-8174091208)
3. Environmental Engineering, Howard S Peavy, Donald R Rowe, George Tchobanoglous, Mc Grawhill.(ISBN: 9780070491342)

Web Links:

1. <https://archive.nptel.ac.in/courses/105/105/105105178/>
2. <https://www.coursera.org/learn/water>

Transportation Engineering

Course Code:2501CE12

L	T	P	C
1	1	1	3

Course Outcomes:

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

- CO1:** Outline the importance of highway engineering in India
- CO2:** Design the geometric parameters of highway.
- CO3:** Determine the characteristics of traffic flow.
- CO4:** Analyze and Design of Pavements.
- CO5:** Explain the basic concepts of pavement construction techniques and 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	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	-	-	-	1	-	-	-	-
CO3	3	2	3	-	-	-	1	-	-	-	-
CO4	3	2	3	-	-	-	1	-	-	-	-
CO5	2	1	1	1	-	1	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Highway Planning:

Different modes of transportation, Characteristics of Road Transportation, Highway Development plans in India, Classification of Roads, Network patterns. Principles of highway alignment, requirements and controlling factors. Engineering surveys for alignment.

UNIT – II

Highway Geometric Design:

Factors affecting geometric design, Design controls and Criteria, Highway Cross Section Elements, Sight Distance Elements, Stopping Sight Distance, Overtaking Sight Distance and intermediate Sight Distance, Design of Horizontal Alignment, Design of Super elevation and Extra widening, Design of vertical alignment - gradients, summit and vertical curves.

UNIT – III

Traffic Engineering:

Basic parameters of traffic volume, speed and density, Traffic volume studies, Traffic signs and road markings, objectives, classification and uses. Principles of design of at-grade intersections, channelized, rotary and signalized intersections, Introduction to grade separated interchanges.

UNIT – IV

Pavement Materials and Design:

Desirable properties of subgrade soil, road aggregates and bituminous materials – Tests on Aggregate and Bitumen- Pavement components and their functions- Factors influencing the design of pavements - Design of flexible and rigid pavements as per IRC.

Practice:

- 1.To determine the crushing value of aggregates
- 2.To determine the impact value of aggregates
- 3.To determine the Flakiness index and elongation index of aggregates
- 4.To determine the Penetration value and Softening point of bitumen
- 5.To determine the Ductility value of bitumen

UNIT – V

Pavement Construction and Maintenance:

Construction of gravel, WBM, bituminous and cement concrete roads. Pavement failures - Types and causes of failures in flexible and rigid pavements. Maintenance of highway pavements. Strengthening of existing pavements - evaluation, overlay design. Recycling of pavements.

Text Books:

1. Traffic Engineering and Transport Planning, Kadiyali, L.R., Khanna Publishers, 2018, Ninth Edition.(ISBN: 13-978-8174092205)
2. Highway Engineering, S. K. Khanna & C.E.G. Justo, Nemchand & Bros, 10th edition. (ISBN:9788185204321)

Reference Books:

1. Principles of Transportation Engineering, Chakroborty, P. and Animesh Das., Prentice Hall of India Pvt. Ltd, New Delhi, India, Second Edition. (ISBN: 13-9788120353459)
2. Transportation Engineering: An Introduction, Jotin Khisty C., and B. Kent Lall., Prentice Hall of India Pvt. Ltd, New Delhi, India, Third Edition. (ISBN: 13-978-9332569706)
3. Principles of Pavement Design, Yoder E.J. and M.W. Witczak., Second Edition, John Wiley and Sons, New York, USA. (ISBN: 13-978-0471977803)

Web Links:

1. <https://archive.nptel.ac.in/courses/105/101/105101087/>
2. <https://archive.nptel.ac.in/courses/105/105/105105215/>
3. <https://nptel.ac.in/courses/105104098>

Estimating and Costing

Course Code:2501CE13

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Outline the preparation of an approximate and detailed estimation of buildings.
- CO2:** Prepare rate analysis for different items in civil engineering works.
- CO3:** Estimate the earthwork quantities for roads, canals, and steel quantity in RCC elements
- CO4:** Apply principles of estimation for the valuation of buildings.
- CO5:** Apply appropriate method to estimate different items in buildings.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I**Methods of Estimates:**

General items of work in building – standard units –principles of working out quantities for approximate, detailed and abstract estimates –methods of estimates of buildings.

Specifications. Necessity, Types of specifications, Specifications for different civil engineering materials.

UNIT-II

Rate Analysis:

Quantity of materials per unit rate of work, Labour estimate, Scheduled of rates – lead statement - Analysis of Rates for cement concrete, R.C.C., brick masonry, Stone masonry, Hollow block masonry, Plastering, Painting, Flooring, Road works, Sanitary Works, Water supply works and Electrical works.

UNIT – III

Road Estimates:

Volume of earthwork, Different methods, Earthwork for roads, earthwork in canals. Quantity Estimation for Structural Steel , Estimate of R.C.C and structural Steel - Scheduling - Slab - beam-column.

UNIT – IV

Valuation :

Purpose, Difference between value and cost, Qualifications and functions of a valuer, Scrap & salvage value, Sinking fund, and Capitalized value.

UNIT – V

Quantity Estimation For Building:

Estimation of building - Short wall and long wall method - Centre line method - Load-bearing structures and framed structures.

Text Books:

1. Estimating and Costing in Civil Engineering: Theory and Practice Including Specifications and Valuation , B.N. Dutta, published by UBS Publishers in 2020. (ISBN: 978-8194194801)
2. A Textbook of Estimating and Costing for Civil Engineering, G.S. Birdie, published by Dhanpat Rai Publishing Company. (ISBN: 978-8187433172)

Reference Books:

1. A Textbook of Estimating and Costing (Civil) , D.D. Kohli and R.C. Kohli, published by S Chand Publishing, (ISBN: 978-8121903245)
2. Estimating, Costing and Valuation, Rangwala, Charotar Publishing House Pvt.Ltd.(ISBN: 978-9385039261)

Web Links:

1. <https://www.udemy.com/course/estimating-and-costing/>
2. <https://nptel.ac.in/courses/105103093/15>
3. <https://esub.com/4-types-construction-contracts/>

Design of Reinforced Concrete Elements

Course Code:2501CE14

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain design philosophies of reinforced concrete members and concepts of Limit state method.
- CO2:** Design RC beams by limit state of flexure
- CO3:** Design RC beams subjected to shear, torsion, and bond.
- CO4:** Design various types of reinforced concrete compression members.
- CO5:** Design various isolated Footings, slabs and stair case.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	3	-	-	1	-	-	-	-	-
CO2	2	1	3	-	-	1	2	-	-	-	-
CO3	2	1	3	-	-	1	2	-	-	-	-
CO4	2	1	3	-	-	1	2	-	-	-	-
CO5	2	1	3	-	-	1	2	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

Design philosophies, Design codes and handbooks, loading standards, working stress method design constants- Concepts of limit state design.

Design For Flexure:

Limit state analysis and design of singly and doubly reinforced sections- effective depth- Flanged beam sections.

UNIT – II

Design For Shear, Torsion and Bond:

Limit state analysis and design of section for shear and torsion – concept of bond, anchorage and development length. Limit state design for serviceability.

UNIT – III

Design of Compression Members:

Design of short and long columns – under axial loads, uni- axial bending and biaxial bending – Braced and un-braced columns, Circular column with helical reinforcement.

UNIT – IV

Footings:

Design of isolated and footings - rectangular footings subjected to axial loads, uni- axial and bi-axial bending moments.

UNIT – V

Slabs & Staircase:

Classification of slabs, design of one-way slabs and two - way slabs, using IS Coefficients (conventional).

Design of Staircase

Design of waist slab staircase.

Text Books:

1. Design of Reinforced Concrete Structures, Krishna Raju N., 4th Edition, CBS Publisher, 2019. (ISBN: 978-8123909899)
2. Reinforced Concrete Structures, S. Unnikrishna Pillai & Devdas Menon, Tata McGraw Hill, New Delhi.(ISBN: 9789354601026)

Reference Books:

1. Design of Concrete Structures, Dolan CW, Darwin D., Nilson AH, McGraw-Hill. (ISBN: 978-0073293493)
2. IS 456 Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards.
3. SP 16: 1980 Design Aids for Reinforced Concrete to IS 456: 1978, Bureau of Indian Standards.

Web Links:

1. <https://nptel.ac.in/courses/111/107/111107105/>
2. <https://nptel.ac.in/courses/111/105/111105041/>

Design of Steel Structures

Course Code:2501CE24

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain design philosophies of steel structures and types of steel connections.
- CO2:** Design Bolted & Welded connections for steel members.
- CO3:** Design Steel members subjected to Flexure, Tension and Compression.
- CO4:** Design slab base and gusset base for column.
- CO5:** Design Welded Plate Girder and Gantry Girder.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Connections :

Introduction – Properties of structural steel – IS Rolled steel sections - Lap and Butt connections - Eccentric connections.

Welded Connections:

Introduction - Strength of welds - Butt and fillet welds - Design of Butt and fillet weld subjected to moment acting in the plane and at right angles to the plane of the joints.

UNIT – II

Beams:

Design of simple and compound beams - Curtailment of flange plates - Beam to beam connection -Design of laterally supported and unsupported beams.

UNIT – III

Tension & Compression Members:

Introduction to different modes of failures – Design strength - Design of tension members.

Design of compression members - Design of built-up sections (Laced and Battened Columns)- Column splicing.

UNIT – IV

Column Foundations:

Introduction - Design of slab base - Design of gusset base- Column bases subjected to moment.

UNIT – V

Girders :

Design of plate girder - Welded -curtailment of flange plates and stiffeners. Design of Gantry girders.

Text Books:

1. Design of steel structures, S.K. Duggal, Tata McGraw Hill, and New Delhi, 2019.(ISBN: 978-0070260689)
2. Design of steel structures, S.S.Bavakatti, I.K.International Publishing House Pvt. Ltd. (ISBN: 978-9382332091)

Reference Books:

1. Structural Design in Steel, Sarwar AlamRaz, 3rd Edition, New Age International Publishers, New Delhi, 2020. (ISBN: 9788122432282)
2. Design of Steel Structures, P. Dayaratnam, S. Chand Publishers, 2019. (ISBN: 978-8121923200)
3. IS 800 General Construction in Steel - Code of Practice, Bureau of Indian Standards.

Web Links:

1. <https://nptel.ac.in/courses/105106112/>
2. <https://law.resource.org/pub/in/bis/S03/is.sp.6.6.1972.pdf>

Hydrology & Irrigation with ML Techniques

Course Code:2501CE15

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain hydrological cycle and Machine learning algorithm in rainfall runoff modelling.
- CO2:** Analyze different types of hydrographs and flood prediction with AI tools.
- CO3:** Classify the various irrigation systems and diversion head works.
- CO4:** Explain the various design considerations of canal structures and cross drainage works.
- CO5:** Examine the behavior of gravity dams and earthen dams

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

Hydrologic cycle – Precipitation - measurement - rain gauge network - presentation of rainfall data - continuity and consistency of rainfall data. Evaporation and Evapotranspiration - Factors affecting - measurement and control. Infiltration- Factors affecting - measurement - and infiltration indices. Runoff: Catchment characteristics - factors affecting runoff. Introduction to ML algorithms in flood forecasting and rainfall-runoff modeling.

UNIT – II

Hydrograph Analysis:

Components of hydrograph - unit hydrograph -assumptions - derivation of unit

hydrograph - principle of superposition and S-hydrograph methods - limitations and applications of unit hydrograph. Introduction to AI techniques for pattern recognition in hydrological data to predict the hydrograph for a given catchment.

UNIT – III

Irrigation:

Types of irrigation systems - soil moisture constants - irrigation water requirements - consumptive use and its estimation - duty and delta - factors affecting - depth and frequency of irrigation .

Diversion Head Works:

Diversion Head Works: Types of diversion head works - weirs and barrages - layout of diversion head works and Components. Bligh's creep theory - Khosla's theory.

UNIT – IV

Canals:

Classification, design of non-erodible canals - design of erodible canals -Kennedy's silt theory and Lacey's regime theory.

Canal Structures:

Falls – Types, Canal Regulation and Cross Drainage works: Head and cross regulators - Types and selection of cross drainage works.

UNIT – V

Reservoir Planning and Earthen Dam:

Investigations - site selection for reservoir and dams. Earth Dams: Types, causes of failure - seepage - measures for control of seepage-filters.

Gravity Dams And Spillways:

Forces acting on a gravity dam - causes of failure of a gravity dam - elementary and practical profile of a gravity dam. Introduction to spillways and its types.

Text Books:

1. Engineering Hydrology, Subramanya.K and Pryank J Sharma, Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 6th Edition, 2024. (ISBN 0074624490)
2. Irrigation and water power Engineering, Dr.B.C.Punmia and Dr.Pande - B.B.Lal,Laxmi Publications Pvt. Ltd., New Delhi, 16th Edition 2021. (ISBN-10: 8131807630)

Reference Books:

1. Water Resources Engineering, Mays L.W, Wiley India Pvt. Ltd. (ISBN 0471705251)
2. Irrigation and Water Resources Engineering, G.L.Asawa,New Age International Publishers. (ISBN-13. 978-8122516732)

Web Links:

1. <http://nptel.ac.in/courses/105104103/>
2. <http://www.academicpub.org/jwrhe/>
3. <https://nptel.ac.in/downloads/105105110/>

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS01/ 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	FC	2		2	4	50	50	100	-
2501EE01	Basic Electrical & Electronics Engineering	FC	2		2	4	50	50	100	-
2501MB01	Engineering Economics & Management	FC	2			2	50	50	100	-
	Total		6		4	10				

Programming for Problem Solving using C
(Common to CE,EEE, ME, ECE,CSE, IT, AIML, CSE(DS), PT&Min.E)
(Syllabus for the batch admitted in the year 2025)

Course Code: 2501CS01	L	T	P	C
Course Outcomes:	2		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 dynamic 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. Explore different platforms
 - a. Basic linux environment and its editors like Vi, Vim & Emacs etc.
 - b. Exposure to turbo C, gcc.
 - c. Explore to hacker rank or any other Online coding platform and compiler environment.

- d. "Hello world" in C.
<https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B>
 - 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>
<https://maya.technicalhub.io/owl-program-details/668b9ec2e069313510b0235a>
 - 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.
<https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30>
<https://maya.technicalhub.io/owl-program-details/66a0c0dda7d31805366af641>
 - e. Distance travelled by an object.
<https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a>
 - f. Calculate Simple interest and compound interest.
<https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab>
 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.
<https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c>
<https://maya.technicalhub.io/owl-program-details/6688cf91e467bfe336f8352f>
https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com
<https://maya.technicalhub.io/owl-program-details/6688ea3ce467bfe336f8ab9d>
 - d. Find the maximum of three numbers using conditional operator.
<https://maya.technicalhub.io/owl-program-details/668690d230bfbd35127c9bf5>
 - 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.
<https://maya.technicalhub.io/owl-program-details/66868f6730bfd35127c9ba7>
 - 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>
<https://maya.technicalhub.io/owl-program-details/66864717f56afec5c0c917e1>
 - c. Given number is a prime or not. (Also Prime numbers between a given range.)
<https://maya.technicalhub.io/owl-program-details/6687b69ddfe02cea4b5404a3>
 - d. Armstrong Number or not.
 - e. Palindrome or not.
<https://maya.technicalhub.io/owl-program-details/6687af17dfe02cea4b5376ae>
 - 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.
<https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20>

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.
 - c. Search an element in array (Linear Search).
<https://maya.technicalhub.io/owl-program-details/6687c40ffd042085d9ec15d6>
 - d. Find min and max elements in array.
<https://maya.technicalhub.io/owl-program-details/66879493dfe02cea4b529041>

- e. Insert an element into array.
- f. Eliminate duplicate elements from array.
<https://maya.technicalhub.io/owl-program-details/66e920a1aca93b27f3364b57>
- g. Sorting of elements in an array using Bubble sort.
- 2. 2-Dimensional Arrays
 - a) Sum of two 2-D arrays.
<https://maya.technicalhub.io/owl-program-details/66864fa9f56afec5c0c924f6>
 - 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.
 - b) Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits
Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
<https://maya.technicalhub.io/owl-program-details/6698e2fbc6bd470f35b73d8>
<https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e>
 - c) 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.
<https://maya.technicalhub.io/owl-program-details/6698ed2dc6bd470f35b7ae7>

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: Nth factorial using recursion.
4. Objective: Find the super digit of the integer.
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.

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/>

Additional Practice:

S.No.	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICECP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/
17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/
24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/

26	Easy	Missing Number	https://leetcode.com/problems/missing-number/
27	Easy	Contains Duplicate	https://leetcode.com/problems/contains-duplicate/
28	Easy	Valid Anagram	https://leetcode.com/problems/valid-anagram/
29	Easy	Valid Parentheses	https://leetcode.com/problems/valid-parentheses/
30	Easy	Fibonacci Number	https://leetcode.com/problems/fibonacci-number/
31	Easy	Climbing Stairs	https://leetcode.com/problems/climbing-stairs/
32	Easy	Binary Search	https://leetcode.com/problems/binary-search/
33	Easy	Number of 1 Bits	https://leetcode.com/problems/number-of-1-bits/
34	Easy	Hamming Weight	https://leetcode.com/problems/number-of-1-bits/description/
35	Easy	Power of Two	https://leetcode.com/problems/power-of-two/
36	Easy	Power of Three	https://leetcode.com/problems/power-of-three/
37	Easy	Same Tree	https://leetcode.com/problems/same-tree/
38	Easy	Maximum Subarray	https://leetcode.com/problems/maximum-subarray/
39	Medium	Chef and Notebooks	https://www.codechef.com/problems/CNOTE
40	Medium	Chef and Wildcard Matching	https://www.codechef.com/search?q=TWOSTR
41	Medium	Minimum Moves	https://www.codechef.com/search?q=SALARY
42	Medium	Lucky Four	https://www.codechef.com/search?q=LUCKFOUR
43	Medium	Maximum Difference	https://www.codechef.com/search?q=MAXDIFF
44	Medium	Uncle Johny	https://www.codechef.com/search?q=JOHNY
45	Medium	Chef and Strings	https://www.codechef.com/search?q=CHFSTLT
46	Medium	Two vs Rib	https://www.codechef.com/search?q=TWOVRIB
47	Medium	Chef and Array	https://www.codechef.com/search?q=CHFARRP
48	Medium	Add Two Numbers	https://leetcode.com/problems/add-two-numbers/
49	Medium	Longest Substring Without Repeating Characters	https://leetcode.com/problems/longest-substring-without-repeating-characters/
50	Medium	Longest Palindromic Substring	https://leetcode.com/problems/longest-palindromic-substring/
51	Medium	3Sum	https://leetcode.com/problems/3sum/
52	Medium	Container With Most Water	https://leetcode.com/problems/container-with-most-water/

53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/
58	Medium	Spiral Matrix	https://leetcode.com/problems/spiral-matrix/
59	Medium	Jump Game	https://leetcode.com/problems/jump-game/
60	Medium	Permutations	https://leetcode.com/problems/permutations/
61	Medium	Combination Sum	https://leetcode.com/problems/combination-sum/
62	Medium	Search in Rotated Sorted Array	https://leetcode.com/problems/search-in-rotated-sorted-array/
63	Medium	Group Anagrams	https://leetcode.com/problems/group-anagrams/
64	Medium	Sort Colors	https://leetcode.com/problems/sort-colors/
65	Medium	Subsets	https://leetcode.com/problems/subsets/
66	Medium	Reverse Linked List II	https://leetcode.com/problems/reverse-linked-list-ii/
67	Medium	Add Two Numbers II	https://leetcode.com/problems/add-two-numbers-ii/
68	Medium	Reorder List	https://leetcode.com/problems/reorder-list/
69	Medium	Linked List Cycle II	https://leetcode.com/problems/linked-list-cycle-ii/
70	Medium	K-th Largest Element in an Array	https://leetcode.com/problems/kth-largest-element-in-an-array/
71	Medium	Product of Array Except Self	https://leetcode.com/problems/product-of-array-except-self/
72	Medium	Word Search	https://leetcode.com/problems/word-search/
73	Medium	Unique Paths	https://leetcode.com/problems/unique-paths/
74	Medium	Minimum Path Sum	https://leetcode.com/problems/minimum-path-sum/
75	Medium	Temperature Converter - II	https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B

76	Medium	Reverse	https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true
77	Medium	Sentence in a new line	https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true
78	Hard	Median of Two Sorted Arrays	https://leetcode.com/problems/median-of-two-sorted-arrays/
79	Hard	Regular Expression Matching	https://leetcode.com/problems/regular-expression-matching/
80	Hard	Wildcard Matching	https://leetcode.com/problems/wildcard-matching/
81	Hard	Trapping Rain Water	https://leetcode.com/problems/trapping-rain-water/
82	Hard	First Missing Positive	https://leetcode.com/problems/first-missing-positive/
83	Hard	Longest Valid Parentheses	https://leetcode.com/problems/longest-valid-parentheses/
84	Hard	Merge k Sorted Lists	https://leetcode.com/problems/merge-k-sorted-lists/
85	Hard	Reverse Nodes in k-Group	https://leetcode.com/problems/reverse-nodes-in-k-group/description/
86	Hard	Sudoku Solver	https://leetcode.com/problems/sudoku-solver/
87	Hard	N-Queens	https://leetcode.com/problems/n-queens/description/
88	Hard	Edit Distance	https://leetcode.com/problems/edit-distance/
89	Hard	Word Ladder II	https://leetcode.com/problems/word-ladder-ii/
90	Hard	Maximal Rectangle	https://leetcode.com/problems/maximal-rectangle/
91	Hard	Binary Tree Maximum Path Sum	https://leetcode.com/problems/binary-tree-maximum-path-sum/
92	Hard	Serialize and Deserialize Binary Tree	https://leetcode.com/problems/serialize-and-deserialize-binary-tree/
93	Hard	Variadic functions in C	https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true
94	Hard	Small Triangles, Large Triangles	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true
95	Hard	Permutations of Strings	https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true

Maya Programs

S.No.	Problem Name	Maya Program Link
1	Can Cross the Bridge	https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd
2	Hypotenuse	https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135
3	Heron's Formula	https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5
4	Loss Percentage	https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a

5	King Tours	https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1
6	Profit Percentage	https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694
7	Area and Perimeter of Square	https://maya.technicalhub.io/owl-program-details/6686546930bfd35127c869c
8	Volume of Sphere	https://maya.technicalhub.io/owl-program-details/6686565530bfd35127c8818
9	Required Points	https://maya.technicalhub.io/owl-program-details/66865b1130bfd35127c8a04
10	Instant Noodles	https://maya.technicalhub.io/owl-program-details/66865ddb30bfd35127c8c0a
11	Find Second Number	https://maya.technicalhub.io/owl-program-details/668660a530bfd35127c8cde
12	Kmph to Mps	https://maya.technicalhub.io/owl-program-details/668663ce30bfd35127c8dfb
13	Inches to Centimeters	https://maya.technicalhub.io/owl-program-details/6686665e30bfd35127c8f3a
14	Capacity	https://maya.technicalhub.io/owl-program-details/668678aa30bfd35127c95b9
15	Average of Two Numbers	https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6
16	Compound Interest	https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab
17	Average Weight	https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a
18	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1

19	Distance Between Two Points	https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a
20	Days into Years, Weeks	https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8
21	Convert Seconds to Hours, Minutes and Seconds	https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b
22	Hours and Minutes	https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673
23	Romeo and Juliet	https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b
24	Gross Salary of an Employee	https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682
25	Surface Area and Volume of a Cube	https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca
26	Area of Trapezium	https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e
27	Swap Two Numbers	https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55
28	Last Two Digits of a Given Year	https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90

29	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfc02cea4b5488a1
30	Uppercase Letters in a String	https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c
31	Factors Finding	https://maya.technicalhub.io/owl-program-details/66866c4a30bfd35127c90b4
32	String Copy	https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a
33	Recursive Digit Sum	https://www.hackerrank.com/challenges/recursive-digit-sum/problem

	Basic Programs	Aditya's Internal Coding Platform (Maya)	Code chef	Hacker rank	Leet code	Total
Unit-1	4	8	2	5	0	19
Unit-2	4	4	1	4	0	13
Unit-3	8	7	0	2	0	17
Unit-4	3	0	0	3	0	6
Unit-5	7	0	4	4	0	15
Additional Practice	0	33	22	5	68	128
Total	26	52	29	23	68	198

Problem Solving Through C Programming
(Common to CE, EEE, ME, ECE, CSE, AIML, CSE(DS), PT & Min.E)
(Revised Syllabus for batches admitted from 2026 Onwards)

Course Code: 2601DS01	L	T	P	C
	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 and dynamic memory allocation.
- CO5:** Develop programs using structures and file handling 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, characteristics of algorithm, flowcharts, 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 and operator precedence.

Practice 1:

1. Explore different platforms
 - a. Basic linux environment and its editors like Vi, Vim & Emacs etc.
 - b. Exposure to turbo C, gcc.
 - c. Explore to hacker rank or any other Online coding platform and compiler environment.
 - d. “Hello world” in C.
<https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B>
 - 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.
<https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30>
 - 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.
https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com
 - 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 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.

<https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20>

UNIT – III

Arrays: Definition, types, 1-D array(declaration, initialization, representation, accessing, input and output), 2-D(declaration, initialization, representation, accessing, input and output), searching (Linear search, Binary Search non recursive) and sorting(Bubble Sort, Selection Sort, Insertion Sort).

Introduction to Strings: declaration, initialization, representation, accessing, input and output, string handling functions.

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.
Search an element in array .
 - c. Find min and max elements in array.
 - d. Insert an element into array.
 - e. Eliminate duplicate elements from array.
 - f. Sorting of elements in an array
2. 2-Dimensional Arrays
 - f) Sum of two 2-D arrays.
 - g) Multiplication of two 2-D arrays.
 - h) Transpose of a Matrix.
 - i) Trace of a Matrix.
 - j) Lower Triangular Matrix.
3. Strings
 - e) Objective: print each word of the sentence in a new line.
 - f) Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
 - g) find the frequency of each digit in the given string.
<https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true>
 - h) Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.

UNIT – IV

Pointer: Introduction to Pointers, dereferencing and address operators, pointer arithmetic, array manipulation using pointers, Dynamic memory allocation, Null Pointer, generic pointer, dangling pointer, pointer to pointer.

Functions: Introduction to Functions, Function Declaration and Definition, Function call Return **Types and Arguments**, Scope and Lifetime of Variables (block scope, function scope, program scope and file scope), **storage classes, recursion**, functions and arrays, Command line Arguments, functions and pointers.

Practice:

1. Functions in C

- a. Objective: Learn simple usage of functions. <https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true>
- b. Objective: Fibonacci Numbers using recursive function.
<https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem>
- c. Objective: Nth factorial using recursion.
- d. Objective: Find the super digit of the integer.
- e. Implement LCM
- f. Objective: Calculate the Nth term of series.

<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>

2. 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>

UNIT – V

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

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

Practice:

a. Structures

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.

b. 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.

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/>

Additional Practice:

S.No.	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICEC/PP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/
17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/

24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/
26	Easy	Missing Number	https://leetcode.com/problems/missing-number/
27	Easy	Contains Duplicate	https://leetcode.com/problems/contains-duplicate/
28	Easy	Valid Anagram	https://leetcode.com/problems/valid-anagram/
29	Easy	Valid Parentheses	https://leetcode.com/problems/valid-parentheses/
30	Easy	Fibonacci Number	https://leetcode.com/problems/fibonacci-number/
31	Easy	Climbing Stairs	https://leetcode.com/problems/climbing-stairs/
32	Easy	Binary Search	https://leetcode.com/problems/binary-search/
33	Easy	Number of 1 Bits	https://leetcode.com/problems/number-of-1-bits/
34	Easy	Hamming Weight	https://leetcode.com/problems/number-of-1-bits/description/
35	Easy	Power of Two	https://leetcode.com/problems/power-of-two/
36	Easy	Power of Three	https://leetcode.com/problems/power-of-three/
37	Easy	Same Tree	https://leetcode.com/problems/same-tree/
38	Easy	Maximum Subarray	https://leetcode.com/problems/maximum-subarray/
39	Medium	Chef and Notebooks	https://www.codechef.com/problems/CNOTE
40	Medium	Chef and Wildcard Matching	https://www.codechef.com/search?q=TWOSTR
41	Medium	Minimum Moves	https://www.codechef.com/search?q=SALARY
42	Medium	Lucky Four	https://www.codechef.com/search?q=LUCKFOUR
43	Medium	Maximum Difference	https://www.codechef.com/search?q=MAXDIFF
44	Medium	Uncle Johny	https://www.codechef.com/search?q=JOHNY
45	Medium	Chef and Strings	https://www.codechef.com/search?q=CHEFSTLT
46	Medium	Two vs Rib	https://www.codechef.com/search?q=TWOVRIB
47	Medium	Chef and Array	https://www.codechef.com/search?q=CHFARRP
48	Medium	Add Two Numbers	https://leetcode.com/problems/add-two-numbers/
49	Medium	Longest Substring Without Repeating Characters	https://leetcode.com/problems/longest-substring-without-repeating-characters/
50	Medium	Longest Palindromic Substring	https://leetcode.com/problems/longest-palindromic-substring/
51	Medium	3Sum	https://leetcode.com/problems/3sum/
52	Medium	Container With Most Water	https://leetcode.com/problems/container-with-most-water/

53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/
58	Medium	Spiral Matrix	https://leetcode.com/problems/spiral-matrix/
59	Medium	Jump Game	https://leetcode.com/problems/jump-game/
60	Medium	Permutations	https://leetcode.com/problems/permutations/
61	Medium	Combination Sum	https://leetcode.com/problems/combination-sum/
62	Medium	Search in Rotated Sorted Array	https://leetcode.com/problems/search-in-rotated-sorted-array/
63	Medium	Group Anagrams	https://leetcode.com/problems/group-anagrams/
64	Medium	Sort Colors	https://leetcode.com/problems/sort-colors/
65	Medium	Subsets	https://leetcode.com/problems/subsets/
66	Medium	Reverse Linked List II	https://leetcode.com/problems/reverse-linked-list-ii/
67	Medium	Add Two Numbers II	https://leetcode.com/problems/add-two-numbers-ii/
68	Medium	Reorder List	https://leetcode.com/problems/reorder-list/
69	Medium	Linked List Cycle II	https://leetcode.com/problems/linked-list-cycle-ii/
70	Medium	K-th Largest Element in an Array	https://leetcode.com/problems/kth-largest-element-in-an-array/
71	Medium	Product of Array Except Self	https://leetcode.com/problems/product-of-array-except-self/
72	Medium	Word Search	https://leetcode.com/problems/word-search/
73	Medium	Unique Paths	https://leetcode.com/problems/unique-paths/
74	Medium	Minimum Path Sum	https://leetcode.com/problems/minimum-path-sum/
75	Medium	Temperature Converter - II	https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B
76	Medium	Reverse	https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true
77	Medium	Sentence in a new line	https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true

78	Hard	Median of Two Sorted Arrays	https://leetcode.com/problems/median-of-two-sorted-arrays/
79	Hard	Regular Expression Matching	https://leetcode.com/problems/regular-expression-matching/
80	Hard	Wildcard Matching	https://leetcode.com/problems/wildcard-matching/
81	Hard	Trapping Rain Water	https://leetcode.com/problems/trapping-rain-water/
82	Hard	First Missing Positive	https://leetcode.com/problems/first-missing-positive/
83	Hard	Longest Valid Parentheses	https://leetcode.com/problems/longest-valid-parentheses/
84	Hard	Merge k Sorted Lists	https://leetcode.com/problems/merge-k-sorted-lists/
85	Hard	Reverse Nodes in k-Group	https://leetcode.com/problems/reverse-nodes-in-k-group/description/
86	Hard	Sudoku Solver	https://leetcode.com/problems/sudoku-solver/
87	Hard	N-Queens	https://leetcode.com/problems/n-queens/description/
88	Hard	Edit Distance	https://leetcode.com/problems/edit-distance/
89	Hard	Word Ladder II	https://leetcode.com/problems/word-ladder-ii/
90	Hard	Maximal Rectangle	https://leetcode.com/problems/maximal-rectangle/
91	Hard	Binary Tree Maximum Path Sum	https://leetcode.com/problems/binary-tree-maximum-path-sum/
92	Hard	Serialize and Deserialize Binary Tree	https://leetcode.com/problems/serialize-and-deserialize-binary-tree/
93	Hard	Variadic functions in C	https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true
94	Hard	Small Triangles, Large Triangles	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true
95	Hard	Permutations of Strings	https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true

	Basic Programs	Code chef	Hacker rank	Leet code	Total
Unit-1	4	2	5	0	11
Unit-2	4	1	4	0	9
Unit-3	8	0	2	0	10
Unit-4	5	0	7	0	12
Unit-5	9	0	0	0	9
Additional Practice	0	22	5	68	95
Total	26	29	23	68	146

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

L T P C
2 0 2 4

Course Code 2501EE01

Course Outcomes:

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

- CO 1: Analyze the concepts associated to AC and DC circuits.
- CO 2: Explain the operating principles of motors, generators and measuring instruments.
- CO 3: Analyze the Different Energy Resources and Equipment Safety Measures.
- CO 4: Explain the concept and the applications of semiconductor Diodes.
- CO 5: Analyze the basic electronic circuits and interpret numeric information in different code formats.

Mapping of course outcomes with program outcomes:

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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	

Mapping of course outcomes with program Specific Outcomes:

CO\PSO	PSO1	PSO2
CO1	1	
CO2	1	
CO3	1	
CO4	1	
CO5	1	

UNIT-I

DC and 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 Ohm's 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. 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 and 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 and 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, B.Tech (CE) Total Syllabus – 2025

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 and Company Ltd., New Delhi (ISBN-13: 9788121930888).
3. “Digital Fundamentals”, Thomas Floyd, Prentice Hall, 10th Edition (ISBN: 9780132737968).

Reference Books:

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

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

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 behavior 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

Mapping of Course Outcomes with Program Specific Outcomes:

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

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, Dr. A. R. Aryasri, TMH, ISBN 978-0070078031
2. Managerial Economics and Financial Analysis, Dr. N. Appa Rao, Dr. P. Vijay Kumar, Cengage Publications, New Delhi, ISBN 978-8131515952

Reference Books:

1. Principles of Marketing: A South Asian Perspective by Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshan ul Haque, Pearson Education/Prentice Hall of India, 13th Edition, ISBN 9788131731017
2. A Handbook of Human Resource Management Practice, Michael Armstrong Kogan, Page Publishers, ISBN 978-1789661033
3. Management Science, Aryasri, Tata McGraw Hill, ISBN 978-0070090279
4. Management, James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R. Gilbert Pearson Education/Prentice Hall, 6th Edition, ISBN 978-0131087477

Web Links:

1. <https://nptel.ac.in/courses/110105067>
2. <https://archive.nptel.ac.in/courses/112/107/112107143/>

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
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	-
2501CE79	Student Activity Based Learning	AC				2				
Total			2		5	9				

Essential Cognitive Skills for Engineers

(Common to all branches)

L T P C

Course Code:2501EN01

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 – 1

Outstanding people A/B/C/D

Listening Conversation about Jocelyn Bell- Burnell, Podcast: The 30-day challenge, Starting a new job, Conversation about technology

Speaking 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 – 2

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 – 3 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 – 4 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 – 5 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> ; Article: <i>Cooking in Antarctica</i> , Essay about protecting the environment
Writing	For and against essay, Arguing for and against an idea
Grammar	Future probability, Future perfect and future continuous
Vocabulary	Adjectives describing attitude, The natural world
Pronunciation	Sound and spelling : <i>th</i> , Intonation groups

Text Book:

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

Suggested Software:

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

Reference Books:

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

Web links:

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

Advanced Cognitive Skills for Engineers

(Common to all branches)

	L	T	P	C
Course Code: 2501EN02	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	-	-

Practice

Unit – 1

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 – 2	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 – 3	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 – 4	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 – 5	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:

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

Suggested Software:

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

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford University Press.2018.
2. Michael Swan- Practical English Usage
3. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India,2016

Web links:

- <https://www.cambridgeone.org/login>
- <https://www.coursera.org/>
- <https://www.skillshare.com/>
- <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)

	L	T	P	C
Course Code:2501UC07	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:

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	-
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)

	L	T	P	C
Course Code: 2501UC08	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	SEE	Total	Pre-requisite
2501CE43	Building Planning & Computer Aided Drawing	FC			2	2	50	50	100	-
2501CE17	3D Modelling of Building	FC			2	2	50	50	100	EG
2501CE18	Geospatial AI	IC			1	1	100	-	100	-
2501CE19	GeoStudio for Geotechnical Applications	AC			2	2	50	50	100	GT-1, GT-2
2501CE20	Computer-Aided Structural Analysis & Design	AC			2	2	50	50	100	SA
Total					9	9				

BUILDING PLANNING & COMPUTER AIDED DRAWING

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:** Study the CAD software and basic functions.
- CO2:** Plan different types of buildings as per NBC regulations and building laws
- CO3:** Evaluate plans of Single storied building & multistoried buildings
- CO4:** Develop different sections at different elevations
- CO5:** 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	2	-	-	-	3	3	2	2	2	2	2
CO4	2	-	-	-	3	3	2	2	2	2	2
CO5	2	-	-	-	3	3	2	2	2	2	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

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 commercial 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/>

3D-Modelling of Building

Course Code:2501CE17

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Acquire knowledge of BIM techniques.
- CO2:** Explain the detailing of structure in Revit software.
- CO3:** Sketch the 3D drawing (steel structures and RCC structures).
- CO4:** Find quantities of material, and bar bending schedules.
- CO5:** Sketch the duplication, elevation, and sections of a given 3D 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	1	-	-	-	3	-	-	1	-	-	1
CO2	1	-	-	-	3	-	-	1	-	-	1
CO3	1	-	-	-	3	-	2	1	-	-	1
CO4	1	-	-	-	3	-	-	1	-	-	1
CO5	1	-	-	-	3	-	-	1	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

1. Create levels, grids, and sections
2. Modify and edit tools
3. Creation of wall and its types, Wall articulation with materials
4. Draw the structural views (plan, elevation, isometric views).
5. Create a Virtual walk-through
6. Draw the RCC drawing detailing (Beams, columns, slabs, footing, etc.,).
7. Determining the rebar quantities from Revit software and placed inside the created model and 3D views and detail views can be generated.

8. Determine the quantities regarding the volume of concrete required for beams, columns, slabs and other structural elements, and costs related to the same can be calculated
9. Determining the bar bending schedules through Revit software.

Text Books:

1. Building Information Modelling, Karen M. Kensek, Taylor and Francis. (ISBN:9781315797076)
2. Building Information Modelling (BIM) in Design, Construction and Operations, C. A. Brebbia, L. Mahdjoubi, R. Laing, WIT Press, Wiley Publishers. (ISBN:978-1-84564-914-2)

Reference Books:

1. Heritage Building Information Modelling, Gehan Ahmed Nagy, John Counsell, CRC Press. (ISBN:9781315628011)
2. Building Information Modelling Technology Foundations and Industry Practice, André Borrmann, Christian Koch, Jakob Beetz, Markus Konig, Springer International Publishing, 2018. (ISBN:13-978-3319928616)

Web Links:

1. <https://www.autodesk.com/industry/aec/bim>
2. <https://www.sciencedirect.com/topics/engineering/building-information-modeling>

Geospatial AI

Course Code:2501CE18

L	T	P	C
0	0	1	1

Course Outcomes:

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

- CO1:** Study the interaction of electromagnetic radiation with atmosphere and earth material.
- CO2:** Gain knowledge about the concepts of interpretation of satellite imagery and civil engineering applications.
- CO3:** Explain the fundamentals of maps, their characteristics and GIS, its components
- CO4:** Apply various spatial analysis tools for deriving GIS based outcome
- CO5:** Create a error free GIS database for civil engineering 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	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2		2	1	-	-	2	-	-
CO4	2	3	-	-	3	-	-	-	-	2	-
CO5	2	-	2	-	2	-	-	-	-	2	-

Mapping of course outcomes with program Specific Outcomes:

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

Practice:

1. Introducing to the interface and tools of ArcGIS/ERDAS Imagine.
2. Downloading, storing and uploading of remotely sensed data from open-source websites into GIS software's.
3. Perform Subset/clip, Composite/Layer staking and creating mosaic of satellite images.
4. Creating shape/AOI files and perform Geo-referencing.
5. Perform LULC supervised image classification using Landsat 8.
6. Perform LULC unsupervised image classification using Landsat 8.
7. Generate thematic and Choropleth maps on any one theme using GIS software.
8. Perform change detection analysis on urban sprawl for a given area.
9. Perform morphometric analysis and extract DEM for drainage basin for a given

- area.
10. Simple exercises on AI in GIS.

Text Books:

1. Remote Sensing and GIS, Basudev Bhatta, Oxford Publishers. (ISBN: 978-0849330520)
2. **Artificial Intelligence- Saroj Kaushik, CENGAGE Learning. (ISBN: 978-8131510995)**

Reference Books:

1. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2018. (ISBN: 978-1337560092)
2. R Cookbook, Paul Teetor, Oreilly. (ISBN: 978-1449307264)

Web Links:

1. <https://www.usgs.gov/centers/eros/science/usgs-eros-archive-landsat-archives-landsat-collection-2-us-analysis-ready-data>
2. <https://glovis.usgs.gov/app>
3. <https://earthexplorer.usgs.gov/>

Geostudio for Geotechnical Applications

Course Code:2501CE19

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Acquire proficiency in using GeoStudio software for geotechnical applications.
- CO2:** Perform slope stability analysis using GeoStudio and interpret the results.
- CO3:** Conduct seepage analysis using GeoStudio and interpret the flow patterns.
- CO4:** Perform consolidation analysis using GeoStudio and understand settlement behaviour.
- CO5:** Apply numerical methods to solve geotechnical engineering problems.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

1. Introduction to GeoStudio software suite
2. Basics of slope stability analysis using GeoStudio
3. Seepage analysis using GeoStudio (Finite Element Method)
4. Consolidation analysis using GeoStudio (Finite Difference Method)
5. Application of numerical methods in geotechnical engineering
6. Case studies and hands-on exercises using GeoStudio.

Text Books:

1. Practical Geotechnical Design with Geostudio, G.R.Siegel, wiley.

Reference Books:

1. Geotechnical Engineering: A Practical Problem Solving Approach., N. Sivakugan and B. M. Das,

Web Links:

1. https://www.seequent.com/community/on-demand-videos/?tx_category=geostudioGeotechnical Engineering Portal

Computer-Aided Structural Analysis & Design

Course Code:2501CE20

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Solve Matrix Problems using MATLAB software
- CO2:** Analyse beams and frames using various design software
- CO3:** Analyse and design structures for dead and live loads
- CO4:** Analyse and design structures subjected to wind and earthquake loads.
- CO5:** Model simple beams and frames using finite element 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	2	-	-	3	2	-	2	-	-	1
CO2	2	2	1	-	3	1	-	2	-	-	1
CO3	3	3	2	-	3	1	-	2	-	-	1
CO4	3	3	2	-	3	1	-	2	-	-	1
CO5	3	3	1	-	3	1	-	2	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

- Solving Matrix Problems using MATLAB.
- Introduction to STAAD Pro software and basic beam analysis.
- Analysis of beams and portal frames using SAP, ETABS, and Staad Pro. V8i.
- Analysis and design of structures for dead and live loads.
- Analysis and design of structures subjected to wind and earthquake loads. (Minimum five storey).
- Introduction to finite element packages (ANSYS & ABAQUS).

Text Books:

- Matrix methods of Structural Analysis: Theory and Problems, C. Natarajan and P. Revathi, PHI Pvt Ltd, India. (ISBN: 978-8120349001)
- Advanced methods of Structural Analysis, Igor A. Karnovsky and Olga Lebed, Springer New York. (ISBN: 978-1441910462)

Reference Books:

1. Design of Steel structures, Subramanian, N, Oxford University press, New Delhi.(ISBN: 978-0199460915)
2. Advanced Reinforced Concrete Design, Varghese, P.C, Prentice-Hall of India, New Delhi.(ISBN: 9788120327870)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_ce37/preview
2. <https://nptel.ac.in/courses/112104031>

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
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
2501CS02	Data Analysis using Python	IC			2	2	50	50	100	PPSC
Total					17	3				

Employability Skills- I

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

	L	T	P	C
Course Code: 2501UC11	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 with Program Outcomes:

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

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,AIIML,CSE(DS),PT&Min.E,Agri.E)

	L	T	P	C
Course Code: 2501UC13	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 with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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.
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Employability Skills- III

(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,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 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

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Employability Skills- IV

(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,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 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:

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- 2 www.bankersadda.com

Employability Skills- V
(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,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 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

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

	L	T	P	C
Course Code:2501CS02	0	0	2	2

Course Outcomes:

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

- CO1:** Make use of control statements and data structures to solve problems
- CO2:** Apply OOPs concepts and files to develop applications.
- CO3:** Explain the data collection, management and storage for processing using Numpy
- CO4:** Make use of Pandas to create and manipulate data structures like Series and DataFrames.
- CO5:** Create plots using Matplotlib library for better visualization.

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

UNIT-I

Introduction: History of Python, Applications of Python,Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation, Operators and Expressions, Control Flow- if, if-elif-else, for, while, break, continue, Data Structures Lists - Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences. Comprehensions, Defining Functions, Calling Functions, Passing Arguments.

- 1.1) Write a program that asks the user for a weight in kilograms and converts it to pounds. There are 2.2 pounds in a kilogram.
- 1.2) Write a program that uses a for loop to print the numbers 8, 11, 14, 17, 20, . . . , 83, 86, 89.
- 1.3) Split a string into array of characters in Python.
- 1.4) write a Python program to get the largest number from a list.
- 1.5) Write a Python program to calculate the nth Fibonacci number using a function.

UNIT-II

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,Errors and Exceptions: Syntax Errors, Exceptions, Handling Exceptions, Raising Exceptions, Userdefined Exceptions.

- 2.1) Write a Python program that defines a Car class with attributes like make, model, and year, and methods like start() to start the car and stop() to stop it.
- 2.2) Write a Python program that demonstrates inheritance by creating a base class Animal and derived classes like Dog, Cat, etc., each with their specific behaviors.
- 2.3) Define a base class called Animal with a method make_sound(). Implement derived classes like Dog, Cat, and Bird that override the make_sound() method to produce different sounds. Demonstrate polymorphism by calling the method on objects of different classes.
- 2.4) Write a Python program that demonstrates error handling using the try-except block to handle division by zero.

UNIT-III

Numpy: Introduction to numpy, creating arrays, using arrays and scalars, Indexing Arrays, Array transposition, Universal array function, Array Processing, Array Input and Output, Examples.

- 3.1) Write a NumPy program using methods – info, add, array, all, greater, greater_equal, less and less_equal, equal, allclose, zeros, ones, linspace, tolist.
 - a. To get help on the add function
 - b. To test whether none of the elements of a given array is zero.
 - c. To create an element-wise comparison (greater, greater_equal, less and less_equal, equal, equal within a tolerance) of two given arrays.
- 3.2) Write a NumPy program using NumPy methods - max, min, argmax, argmin, argmax, repr, count, bincount, unique.
 - a. To extract all numbers from a given array which are less and greater than a specified number.
 - b. To find the indices of the maximum and minimum numbers along the given axis of an array.

UNIT-IV

Pandas: Exploring Data using Series, Exploring Data using DataFrames, Index objects, Re index, Drop Entry, Selecting Entries, Data Alignment, Rank and Sort, Summary Statistics, Data Munging in Python using Pandas, Index Hierarchy, Example Problem.

4.1) Pandas Data Series:

- i) Write a Pandas program to create and display a one-dimensional array-like object containing an array of data using Pandas module.
- ii) Write a Pandas program to convert a Panda module Series to Python list and its type.

4.2) Pandas Data Frames:

Consider Sample Python dictionary data and list labels:

```
exam_data = {'name': ['Anastasia', 'Dima', 'Katherine', 'James', 'Emily', 'Michael', 'Matthew', 'Laura', 'Kevin', 'Jonas'],
'score': [12.5, 9, 16.5, np.nan, 9, 20, 14.5, np.nan, 8, 19],
'attempts': [1, 3, 2, 3, 2, 3, 1, 1, 2, 1],
'qualify': ['yes', 'no', 'yes', 'no', 'no', 'yes', 'yes', 'no', 'no', 'yes']}
labels = ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j']
```

- i) Write a Pandas program to create and display a Data Frame from a specified dictionary

data which has the index labels.

ii) Write a Pandas program to change the name 'James' to 'Suresh' in name column of the Data Frame.

iii) Write a Pandas program to insert a new column in existing Data Frame. iv) Write a Pandas program to get list from Data Frame column headers. v) Write a Pandas program to get list from Data Frame column headers.

UNIT-V

Introduction to Matplotlib: Introduction to Matplotlib Library, Plotting Data: Line Plots, Scatter Plots, Customizing Plots, Common Types of Plots Bar Charts: Simple Bar Plot, Horizontal Bar Plot, Advanced Plot Customizations.

5.1) Create a series of plots to analyze a given dataset.

5.2) Generate a subplot layout with various plot types (scatter, line, bar).

5.3) Visualize time-series data and customize axis labels and date formats.

5.4) Create a 3D plot.

Additional Practice:

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

2. Write a Python program to develop a GUI based Calculator application.

3. Write a Python program to develop a GUI based todo list application for adding, deleting and updating tasks.

Reference Books:

1. Python for Everybody Exploring Data in Python 3, Charles Russell Severance, SueBlumenberg. ISBN:978-1530051120.
2. Code with Python: Suresh Sundaradasu, S.Rama Sree ISBN: 978-9355017574.
3. Python Programming, Dr. Maganti Venkatesh, Monelli Ayyavaraiah, Niveditha Ravindra Pandey, Neethumol Sabu, Charulatha Publications ISBN:978-93-5577-695-6
4. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Wes McKinney, O'Reilly Media, ISBN: 978-1491957660.

Web Links:

1. <https://www.hackerrank.com/>
2. <https://www.codechef.com/>
3. <https://www.topcoder.com/>
4. <https://code-cracker.github.io/>

Mandatory Courses (AUC)

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 (IKS)	FC	2			0	100	-	100	-
Total			10			0				

Environmental Science

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Multidisciplinary Nature of Environmental Studies:

Definition, Scope & Importance, Need for Public Awareness.

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

UNIT – II

Ecosystem, Biodiversity & Its Conservation:

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

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

UNIT – III

Environmental Pollution & Solid Waste Management:

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

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

Solid Waste Management:

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

UNIT – IV

Social Issues & The Environment:

Social Issues & the Environment: From Unsustainable to Sustainable development – Urban problems related to Energy & Water. Resettlement & rehabilitation of people, Environmental ethics, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, & holocaust. Environment Protection Act – Air (Prevention & Control of Pollution) Act. – Water (Prevention & control of Pollution) Act-Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

UNIT – V

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

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses, Erach Bharucha for University Grants Commission, Universities Press. ISBN: 9788173718625
2. Environmental Studies, 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://www.youtube.com/watch?v=mOwyPENHhbc>
- 2 https://www.youtube.com/watch?v=_mgvsPnCYj4
- 3 <https://www.youtube.com/watch?v=L5B-JMnBIyQ>

Constitution of India
(CE,EEE, ME, ECE,CSE, IT, AIML, CSE(DS), PT&Min.E)

	L	T	P	C
Course Code:2501AC02	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 & its importance for building a democratic India
- CO2** Compare the functioning of three wings of the government i.e., executive, legislative & judiciary
- CO3** Interpret the value of the fundamental rights & duties for becoming good citizen of India
- CO4** Compare the decentralization of power between central, state & local self-government
- CO5** Extend the knowledge in strengthening of the constitutional institutions like CAG, Election Commission & UPSC for sustaining democracy.
- CO6:** Underst& the Electoral Process & Amendment procedure.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Indian Constitution:

Constitution’ meaning of the term, Indian Constitution - Sources & constitutional history, Features - Citizenship, Preamble, Fundamental Rights & Duties, Directive Principles of State Policy.

UNIT – II

Union Government & its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power & position, PM & Council of ministers,

Cabinet & Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court & High Court:
Powers & Functions

UNIT – III

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

UNIT – IV

Local Administration: District's Administration Head - Role & Importance, Municipalities - Mayor & role of Elected Representative - CEO of Municipal Corporation .

PanchayatiRaj: Functions PRI: Zila Panchayat, Elected officials & their roles, CEO Zila Panchayat: Block level Organizational Hierarchy – (Different departments), Village level – Role of Elected & Appointed officials – Importance of grass root democracy.

UNIT – V

Election Commission: Election Commission- Role of Chief Election Commissioner & Election Commissionerate State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC & 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/109104074/8
- 2 nptel.ac.in/courses/109104045/
- 3 nptel.ac.in/courses/101104065/
- 4 www.hss.iitb.ac.in/en/lecture-details
- 5 www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

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

	L	T	P	C
Course Code:2501AC03	2	0	0	0

Course Outcomes:

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

- CO1** Explain the characteristics & process of research.
- CO2** Select the research problem by applying problem identification techniques.
- CO3** Formulate & 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
- CO6:** Analyze the results of research using coefficient of variation, correlation & regression

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
CO6:	1	-	-	2	-	-	-	-	-	2	1

UNIT – I

Meaning of Research: Function of Research - Characteristics of Research – Steps involved in Research – Research in Pure & Applied Sciences - Inter Disciplinary Research. Factors which hinder Research – Significance of Research - Research & 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 & 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 & Report Writing: Meaning & 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 & Tools :

Introduction of statistics – Functions – Limitations – Measures of central tendency – Arithmetic mean – Median – Mode – Standard deviation – Co-efficient of variation (Discrete series & continuous series) – Correlation – Regression.

Text Books:

Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint. ISBN: 9788122515223

A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press. ISBN: 9780367135720

Reference Books:

Thesis and Assignment Writing, J. Anderson, Wiley Eastern Ltd. ISBN: 978-8126530755

Research Methodology, Mukul Gupta, Deepa Gupta – PHI Learning Private Ltd., New Delhi. ISBN: 9788120349469

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://www.youtube.com/watch?v=IZLn9_PA_4s

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

	L	T	P	C
Course Code: 2501AC04	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 & infer rights on such Intellectual Property owners
- CO3:** Explain the process of patenting
- CO4:** Apply for Trade marks & Copyrights.
- CO5:** Explain the methods to protect Trade secrets
- CO6:** Interpret the legal issues on Intellectual Property Rights & cyber laws

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
CO6	1	-	-	-	-	1	-	3	-	-	2

UNIT – I

Introduction to Intellectual Property Rights (IPR):

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

UNIT – II

Copyrights & Neighboring Rights:

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

UNIT – III

Patents:

Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent & Process Patent - Patent Search - Patent Registration & Granting of Patent - Exclusive Rights – Limitations - Ownership & Transfer — Revocation of Patent – Patent

Appellate Board - Infringement of Patent – Double Patenting — Patent Cooperation Treaty – New developments in Patents – Software Protection & Computer related Innovations.

UNIT – IV

Trademarks & Trade secrets:

Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark & 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 & 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 & Cyber Crime :

Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online & Computer Transactions - E-commerce - Data Security – Authentication & Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention & 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: Structural Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE57	Construction & Project Management	FC	2			2	50	50	100	--
2501CE25	Repair & Rehabilitation of Structures	FC	3			3	50	50	100	-
2501CE26	Fire & Safety Engineering	FC	3			3	50	50	100	-
2501CE27	Green Buildings	FC	3			3	50	50	100	-
2501CE29	Construction Equipment & Machinery	FC	3			3	50	50	100	CM&CT
2501CE28	Finite Element Methods	IC	2	1		3	50	50	100	SA
2501CE31	Construction Contract Management	IC	3			3	50	50	100	-
2501CE30	Pre-stressed Concrete Structures	IC	3			3	50	50	100	-
2501CE32	Design of Ocean Structures & Foundation	IC	2	1		3	50	50	100	-
2501CE33	Analysis & Design of Masonry Structures	IC	2	1		3	50	50	100	-
2501CE34	Design of Tall Buildings	AC	2	1		3	50	50	100	-
Total			28	4		32				

Construction & Project Management

Course Code:2501CE57

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Understand and apply management principles in construction and organizational settings.
- CO2:** Understand contracts, tenders, execution, and government project terminology.
- CO3:** Plan, schedule, and manage construction and international project methods.
- CO4:** Apply project planning, scheduling, and control using PERT/CPM.
- CO5:** Ensure construction safety, labor welfare, and legal compliance 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	2	2	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	2	-	-	-	2	-
CO3	1	1	3	-	-	2	-	-	-	-	-
CO4	2	2	-	-	-	-	-	1	-	2	-
CO5	1	1	-	-	-	-	1	2	-	2	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Principles of Management:

Definition - Importance – Functions of Management - Relevance to government and Quasi Government departments - Private Contractors - Contracting firms - Organizational structure. Construction safety measures.

UNIT – II

Contracts and Documentation:

Various features of Contract document, preparation of a tender document for the construction project, Various technical and accounting terms used in government organizations, Methods of execution of works in government organizations.

UNIT – III

Construction Planning and Projects:

Describe various planning methods for construction works, Prepare Construction schedule. Tendering - Arbitration - International projects - Detailed Project Reports (DPR) / Build Own Operate (BOO) / Build Own Operate Transfer (BOOT) Projects / Build Operate and Transfer (BOT) - case studies.

UNIT – IV

Construction Project Management:

Project Planning, Project Scheduling, Project Controlling, Bar charts & Milestone charts, Development of Network, Network analysis, Network rules, Work Breakdown Structure, and Elements of PERT and CPM.

UNIT – V

Construction safety measures & Labor Welfare

Explain need of safety management in Construction, Describe Safety measures in Construction as per IS code.

Relationships between management and labor - Problems - Labor legislation Minimum Wages act - Industrial Psychology - Safety procedures in construction

Text Books:

1. Construction project management Theory and Practice, Kumar Neeraj Jha, Pearson. (ISBN: 13-978-9332542013).
2. Construction planning, Equipment and method, Purifoy and Schlender, Shapira, Tata McGraw-Hill. (ISBN: 978-0070706996).

Reference Books:

1. Construction Technology, Subir K, Sarkar and Subhajit Saraswati, Oxford University press. (ISBN: 13-978-0195694833)
2. Project planning and control with PERT and CPM, Dr. B. C. Punmia, K. Khandelwal, Laxmi publication. (ISBN: 13-978-8131806982)
3. Construction Project Management, K. K. Chitkara, McGraw Hill. (ISBN: 13-978-0070680753).

Web Links:

1. <https://archive.nptel.ac.in/courses/105/104/105104161/>
2. <https://archive.nptel.ac.in/courses/105/103/105103093/>
3. <https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/construction-technology-and-management/>

Repair & Rehabilitation of Structures

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	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

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, Shotcreting, 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/>

Fire & Safety Engineering

Course Code:2501CE26

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Study the effect of fire on materials used for construction
Explain the various method of test for non-combustibility and fire resistance; and
- CO2:** will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
- CO3:** Explain the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
- CO4:** Study the various method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
- CO5:** Classify the various safety techniques and improve the analytical and intelligence to take the right decision at right time.

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	1	-	2	-	-	3	-	-	1	-	-
CO4	-	-	-	-	-	1	-	-	-	-	-
CO5	2	-	1	-	-	1	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

Eherent Safety Concepts :

Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials- concrete, steel, masonry and wood; Behavior of non-structural materials on fire- plastics, glass, textile fibres and other house hold materials.

UNIT – II

Plant Locations:

Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements- standard heating condition, Indian standard test method, performance criteria.

UNIT – III

Working Conditions:

Fire separation between building- principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens- solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors- Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors.

UNIT – IV

Fire Severity And Repair Techniques:

Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT – V

Working at Heights:

Safe Access - Requirement for Safe Work Platforms- Stairways - Gangways and Ramps-Fall Prevention & Fall Protection - Safety Belts - Safety nets - Fall Arrestors-Working on Fragile Roofs - Work Permit Systems-Accident Case Studies.

Text Books:

1. Principles of fire safety standards for building construction , Roytman, M. Y, Amerind Publishing Co. Pvt. Ltd., New Delhi. (ISBN: 13-978-8120350380).
2. Fire safety engineering design of structures , John A. Purkiss, Butterworth Heinemann, Oxford, U. (2nd edn.). (ISBN: 13-978-0750664431).

Reference Books:

- Design of buildings for fire safety , Smith, E.E. and Harmathy, T.Z. (Editors)
1. ASTM Special Publication 685, American Society for Testing and Materials, Boston, U.S.A. (ISBN: 13-978-0803147522).
2. Butcher, E. G. and Parnell, A. C, JohnWiley and Sons Ltd., New York, U.S.A. (ISBN: 13-978-0471102397).
3. Designing of fire safety Jain, V.K New Age International(P) Ltd., New Delhi,2010. (ISBN:13-978-9389802191)

Web Links:

1. <https://archive.nptel.ac.in/courses/105/102/105102176/>
2. Industrial Safety Engineering - Course (nptel.ac.in)
3. NPTEL : NOC:Fire Protection, Services and Maintenance Management of Building (Civil Engineering) (digimat.in)
4. NPTEL : NOC:Fire Protection, Services and Maintenance Management of Building (Civil Engineering) (digimat.in)

Green Buildings

Course Code:2501CE27

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Define sustainability and a green building, along with its features and benefits.
- CO2:** Describe the methods used to maintain indoor environmental quality.
- CO3:** Describe the water efficiency methods
- CO4:** Design sustainable and energy efficient civil engineering projects.
- CO5:** 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	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

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 Principles 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/>

Construction Equipment & Machinery

Course Code:2501CE29

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Develop knowledge on planning of equipment and selection of equipment
- CO2:** Explain the knowledge on fundamentals of earth work operations, earthmoving operations and types of earth work equipment
- CO3:** Develop the knowledge on special construction equipment
- CO4:** Apply the knowledge on asphalt and concrete plants
- CO5:** Apply the knowledge and select the proper materials handling equipment

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Construction Equipment:

Identification-Planning of equipment – Selection of equipment -Equipment management in projects - Maintenance management - Equipment cost - Operating cost - Cost control of equipment –Depreciation analysis-Replacement analysis-Safety management.

UNIT – II

Equipment for Earthwork:

Fundamentals of earthwork operations - Earth moving operations - Types of earthwork equipment-Tractors, motor graders, scrapers, front end loaders-Dozer, excavators, rippers, loaders, trucks and hauling equipment, compacting equipment, finishing equipment-Case studies on earthwork equipment.

UNIT – III

Other Construction Equipment:

Equipment for dredging, trenching, drag line and clamshells, tunneling - Jacking equipment -Equipment for drilling and blasting - Pile driving equipment - Erection equipment - Crane, mobile crane-Types of pumps used in construction - Equipment for dewatering, grouting and demolition.

UNIT – IV

Asphalt and Concrete Plants:

Aggregate production - Different crushers - Feeders - Screening equipment - Handling equipment -Batching and mixing equipment - Ready mix concrete equipment, concrete pumping equipment –Asphalt plant-Asphalt pavers-Asphalt compacting equipment

UNIT – V

Materials Handling Equipment:

Forklifts and related equipment - Portable material bins - Material handling conveyors – Material handling cranes-Industrial trucks –Aerial transporting equipment.

Text Books:

1. Construction Planning, Equipment and Methods, Peurifoy, R.L., Schexnayder, C., Schmitt, R.L. and Aviad Shapira., 9th Edn. Mc GrawHill, Singapore, 2018. (ISBN: 13978-1260108804)
2. Construction Equipment and Management for Engineers Estimators and Owners, Granberg G., Popescu M Taylor and Francis Publishers, New York. (ISBN:13978-1498788489)

Reference Books:

1. Construction Equipment and Job Planning, Deodhar, S.V. 4thEdn. Khanna Publishers, New Delhi, 2020. (ISBN:13978-8174091147)
2. Building Construction, Planning Techniques and Method of Construction, Arora S.P. and Bindra S.P., B Dhanpat Rai and Sons,2018. (ISBN: 13978-8189928803)
3. Construction Equipment and Management, Sharma S.C. Khanna Publishers, New Delhi. (ISBN: 978-9382609056)

Web Links:

1. <https://archive.nptel.ac.in/courses/105/102/105102088/>

Finite Element Methods

Course Code:2501CE28

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Summarize the direct and formal methods for deriving finite element Equations.
- CO2:** Solve engineering problems in truss elements.
- CO3:** Apply FEM for analysis of beams and frames.
- CO4:** Explain the principles of stress-strain behaviour of continuum
- CO5:** Discuss the role and significance of shape functions in finite element formulations.

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	3	2	1	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	3	1	-	-	-	-	-	-	-	-
CO5	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:

Review of stiffness method- Principle of Stationary potential energy -Potential energy of an elastic body- Rayleigh-Ritz method of functional approximation - variational approaches- weighted residual methods.

UNIT – II

Finite Element formulation of Truss Element:

Stiffness matrix- properties of stiffness matrix – Selection of approximate displacement functions- solution of a plane truss- transformation matrix and stiffness matrix for a 3-D truss- Inclined and skewed supports- Galerkin's method for 1-D truss– Computation of stress in a truss element.

UNIT – III

Finite Element formulation of Beam Elements:

Beam stiffness- assemblage of beam stiffness matrix- Examples of beam analysis for concentrated and distributed loading- Galerkin's method - 2-D Arbitrarily oriented beam element – inclined and skewed supports – rigid plane frame examples.

UNIT – IV

Plane Stress and Plane Strain Analysis:

Derivation of CST and LST stiffness matrix and equations- treatment of body and surface forces- Finite Element solution for plane stress - comparison of CST and LST elements– convergence of solution- interpretation of stresses.

UNIT – V

Isoparametric Elements & Numerical Integration:

Introduction - Isoparametric formulation - Higher order elements - Derivation of shape functions for a four noded quadrilateral element using natural coordinates - strain displacement matrix - stress- strain relationship matrix - stiffness matrix for isoparametric element - Numerical Integration - Gauss quadrature method for rectangular elements.

Text Books:

1. Finite element Analysis in Engineering, S.Md.Jalaludeen, Anuradha Publications. (ISBN:13 978-8184722376)
2. Finite Element Analysis, S.S.Bhavakatti, New age international publisher.(ISBN: 13978-8122436716)

Reference Books:

1. An introduction to Finite Element Method, JN Reddy, McGraw-Hill.(ISBN:13978-0070607415)
2. Finite Element Method with applications in Engineering. YM esai, Eldho & Shah, Pearson Publishes. (ISBN:9788131724644)

Web Links:

1. <https://nptel.ac.in/courses/105105041/>

Construction Contract Management

Course Code:2501CE31

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Decide suitable contracts for a given project scenario and stakeholders of the contract
- CO2:** Identify the best form of contract for a specific project and design performance parameters
- CO3:** Summarize tender processing and assess various contractual provisions in tender documents and develop a bidding strategy
- CO4:** Understand the conditions of the contract
- CO5:** Formulate contract management processes involved in construction projects

Mapping of course out comes 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
CO2	3	3	-	-	-	-	-	2	-	-	2
CO3	3	3	-	-	-	-	-	-	-	-	2
CO4	2	2	-	-	-	-	-	-	-	-	2
CO5	3	3	-	-	-	-	-	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT - I

Introduction to Contract:

Definition and legal issues in contract, Essential requirement of a contract as per Indian

Contract Act 1872, Characteristics of a good contract, Legal enforceability of contract, Breach & termination of contracts, Major stakeholders in construction contracts, Overview of Activities in Contract Management.

UNIT-II

Construction Contracts:

Type of construction contracts: Lump sum contracts, Fixed price contracts, Percentage rate contracts, Cost plus contracts, Target contracts, Design-Build contracts, Turn-key contracts, BOT contracts. Parties to a Contract, Contract Formation, Common contract clauses: Notice to proceed, rights and duties of various parties, Contract Duration and Price.

UNIT-III

Tendering: Process of tendering: Tender notice, EOI, RFQ & RFP, Bid security, Prequalification process, Bidding Models and bidding strategy, Tender submission and evaluation, Tender rejection, Security deposits/performance guarantee & Defect liability, Contract agreement & contract documents

Performance Parameters: Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination.

UNIT-IV

Conditions of Contracts :General conditions & special conditions, Contract conditions for payments, Time delay, Scope changes, Extra claims, Termination of contracts, subcontracting

UNIT-V

Contract Administration: Elements of contract management, Major stakeholders in construction contracts, Contract administration; Duties and responsibilities of parties, Stakeholder agreements, Contract risk management, Management reporting, Dispute resolution mechanisms: Negotiation, Mediation.

Text Books:

1. Construction Contracts, Keith Collier, Reston Publishing Company, Inc, Reston, Virginia. (ISBN: 9780835906801)
2. Construction Contracts - Law and Management , John Murdoch & Will Hughes, Spon Press, Taylor & Francis Group. (ISBN: 9780415655247)

Reference Books:

1. Construction and Contract Management Vol.1 , V. K. Raina, Raina's (Second Edition), SPD Publishers, ISBN: 9788180141262)
2. Govt of India, Central Public Works Department, "CPWD 7/8: General Conditions of Contracts."

Web Links:

1. https://indiatradefair.com/uploads/tender/tender_led_boards_15_09_2016.PDF
2. <https://nptel.ac.in/courses/105103093/15>
3. <https://esub.com/4-types-construction-contracts/>
4. http://www.niperhyd.ac.in/Tenders/CPWD_GCC.pdf

PRE STRESSED CONCRETE

Course Code:2501CE30

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain concepts of prestressing.
- CO2:** Estimate losses in prestressed concrete.
- CO3:** Calculate the flexural strength and deflection of prestressed concrete beam.
- CO4:** Design prestressed concrete member for bending, shear, and torsion.
- CO5:** Design of end zone reinforcement for pre tensioned and post tensioned members

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Basic concepts of Prestressing:

Basic concepts of Prestressing – Advantages and Applications of Prestressed Concretes – High Strength Concrete – Permissible Stresses – Shrinkage – Creep – Deformation Characteristics – High strength Steel – Types – Strength – Permissible Stresses – Relaxation of Stress – Stress Corrosion – Durability – Fire Resistance – Cover Requirements.

Prestressing Systems:

Introduction – Tensioning devices – Pre-tensioning Systems – Post tensioning Systems – Basic Assumptions in Analysis of prestress and design – Analysis of prestress – Resultant

Stresses at a section – pressure line – Concepts of load balancing – Stresses in Tendons – Cracking moment.

UNIT – II

Losses of Pre-stressing:

Losses of Pre-stressing – Loss of Pre-stress in pre-tensioned and post tensioned members – Elastic shortening of concrete – shrinkage of concrete – creep of concrete – Relaxation of steel – slip in anchorage – differential shrinkage – bending of members and frictional losses – Total losses allowed for design.

UNIT – III

Deflections and Flexure Strength:

Importance of control of deflections – Factors influencing – Prediction of short term and long term deflections – Types of flexural failure – Code procedures – Design of sections for flexure.

UNIT – IV

Design for Shear and Torsion:

Shear and Principal Stresses – Design of Shear reinforcements – Codal Provisions – Design for Torsion – Design for Combined bending, shear, and torsion.

UNIT – V

Transfer of Stresses:

Transfer of Prestress in pre tensioned members – Transmission length – Bond stresses – end zone reinforcement – Codal provisions – Anchorage zone Stresses in Post tensioned members – stress distribution in end block – Anchorage Zone reinforcement.

Text Books:

1. Prestressed Concrete, Krishna Raju N, Tata Mc.Graw Hill Publications, 6th Edition. (ISBN: 13 - 978-9387886209)
2. Prestressed Concrete, Rajagopalan. N, Narosa publications, 2nd Edition. (ISBN:13-978-8173195433).

Reference Books:

1. Prestressed concrete, Srikanth, B. Vanakudu, Khanna Publications. (ISBN: 13-978-9386173317).
2. Prestressed Concrete, Ramamrutham S, Publications, 5th Edition. (ISBN:9789384378370).
3. Design of Prestressed Concrete Structures, Lin T.Y. & Ned H. Burns, John Wiley & Sons, 3rd Edition. (ISBN:13-978-9812531179).

Web Links:

1. <https://nptel.ac.in/courses/105106118/>
2. <https://lecturenotes.in/subject/245/prestressed-concrete-structures-pcs>
3. <https://nptel.ac.in/courses/105106117/>

Design of Ocean Structures & Foundations

Course Code: 2501CE32

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Describe concept of ocean structures
- CO2:** Classify various loads on offshore structures.
- CO3:** Design of steel member/joint of offshore structures.
- CO4:** Evaluate and design various types of pile foundations
- CO5:** Apply pile installation methods and understand related stresses

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction

Fixed offshore platforms (jackets, gravity platforms, articulated towers); superstructure & foundation, floating platforms (semi-submersibles, jack-ups, TLP, FPSOs, pipe laying barges).

UNIT – II

Loads on Ocean Structures:

Wind Loads; Wave and Current Loads; Calculation based on Maximum base Shear

and Overturning Moments; Design Wave heights and Spectral Definition; Hydrodynamic Coefficients and Marine growth, Seismic Loads, Allowable stresses - Various design methods and Code Provisions.

UNIT – III

Steel Tubular Member Design:

Introduction to tubular joints, Principles of WSD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses-Elastic stress distribution - Punching shear Stress - Overlapping braces - Stress Concentration-Design of tubular joints as per API Code- S-N curves and fatigue damage calculations.

UNIT – IV

Pile foundation

Jacket main piles, skirt piles, driven piles, drilled and grouted piles, steel and concrete piles, axial capacity, point bearing and skin friction, factor of safety, lateral load on piles, p-y, t-z and q-z curves, pile group effect, scour around piles, seabed subsidence and design of piles against seabed movement, negative skin friction, cyclic degradation, main pile to jacket connections, skirt pile to jacket connections, API RP 2A provisions

UNIT – V

Pile Installation

Minimum pile wall thickness, pile handling stresses, static and dynamic stresses, pile stickup, stresses during stickup, wave and current loads, hammer selection, pile driving stresses, wave equation analysis, pile driving fatigue, API RP 2A guidelines.

Text Books:

1. Hydrodynamics of Offshore Structures, S.K. Chakrabarti, Springer Verlag. (ISBN-10. 0387173196)
2. Handbook of Offshore Engineering, S.K. Chakrabarti, Elseviers. (ISBN-13. 978-0080443812)

Reference Books:

1. Pile Design and Construction, M. J. Tomlinson, E & FN Spon.(ISBN-10. 9781466592636
2. Marine Technology Reference Book , Morgan, N., , Butterworths,7. B.C.(ISBN-13. 978-0408027847)

Web Links:

1. <https://archive.nptel.ac.in/courses/114/106/114106011/>
2. <https://archive.nptel.ac.in/courses/114/106/114106015/>

Analysis & Design of Masonry Structures

Course Code:2501CE33

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Select suitable material for masonry construction by understanding engineering properties.
- CO2:** Compute loads, load combinations and analyze the stresses in masonry.
- CO3:** **Design masonry under compression (Axial load) for various requirements and conditions.**
- CO4:** Design masonry under bending (Eccentric, lateral, transverse load) for various requirements and conditions.
- CO5:** Assess the behavior of shear wall and reinforced masonry.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Masonry Units, Materials, types and masonry construction::

Bricks, Stone and Block masonry units strength, modulus of elasticity and water absorption of masonry materials—classification and properties of mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks.

Strength and Stability:

Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.

UNIT – II**Permissible stresses:**

Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses.

Design Considerations:

Effective height of wall and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.

UNIT – III**Load considerations and design of Masonry subjected to axial loads:**

Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.

UNIT – V**Design of Laterally and transversely loaded walls:**

Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs. In-filled frames: Types – modes of failures – design criteria of masonry retaining walls.

Text Books:

1. Brick and Reinforced Brick Structures, Dayaratnam P, , Scientific International Pvt. Ltd. (ISBN: 13978-9386479792).
2. Building and Construction Materials, M. L. Gambhir, McGraw Hill education Pvt. Ltd. (ISBN:13-9789383286843).

Reference Books:

1. Structural Masonry, Henry, A.W., Macmillan Education Ltd. (ISBN: 13978-0333733097)
2. IS 1905–1987 Code of practice for structural use of un-reinforced masonry- (3rd revision) BIS, New Delhi.
3. SP20(S&T)–1991, Hand book on masonry design and construction (1st revision) BIS, New Delhi.

Web Links:

1. <https://archive.nptel.ac.in/courses/114/106/114106011/>
2. <https://www.engineeringtrainer.com/shop/inco1501-product-design-of-offshore-structures-438>

Design of Tall Buildings

Course Code:2501CE34

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain different types of concrete used in construction of tall buildings.
- CO2:** Calculate different types of loads acting on buildings
- CO3:** Summarize the behaviour of various structural systems
- CO4:** Analyze and design of various structural systems for tall buildings.
- CO5:** Analyze stability of structural members in tall buildings

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Design Philosophies and Materials:

Introduction-Modern concepts, High performance concrete Fibre reinforced concrete – Lightweight concrete – Self compacting concrete.

UNIT – II

Gravity and Lateral Loading:

Dead load, live load, impact load, construction load, and sequential loading – Wind loading – Static and dynamic approach analytical method – Wind tunnel experimental methods – Earthquake loading – Equivalent lateral load analysis – Response spectrum method – Combination of loads.

UNIT – III

Behaviour of Structural Systems:

Factors affecting the growth – Height and structural form – behavior of braced frames – Rigid frames – in-filled frames – Shear walls – Coupled shear walls – Wall – Frames.

UNIT – IV

Analysis and Design:

Modelling for approximate analysis – Accurate analysis and reduction techniques – Analysis of structures as an integral unit – Analysis for member forces – Drift and twist – Computerized 3D analysis – Design for differential movement – Creep and Shrinkage effects – Temperature effects and fire Resistance.

UNIT – V

Stability Analysis:

Overall buckling analysis of frames, wall – Frames – Approximate methods – Second order effect of gravity loading $P-\Delta$ Effects – Simultaneous first order and $P-\Delta$ analysis Translational instability- Torsional instability – Effect of stiffness of members and foundation rotation in stability of structures.

Text Books:

1. Building Structures-Analysis and Design, Bryan Stafford Smith and Alex Coull, Tall, John Wiley and Sons, Inc. (ISBN: 13-978-0471512370).
2. Structural Analysis and Design of Tall Buildings, Taranath B.S, McGraw-Hill, 2021. (ISBN: 13-978-0070628786).

Reference Books:

1. Structural Concepts and Systems for Architects and Engineers, Lin T.Y. and Burry D. Stotes, John Wiley, Van Nostrand Reinhold Co Publishers. (ISBN: 13-978-0471085386).
2. Analysis of Tall & complex structures, FENG FU, BH Publications. (ISBN: 9781498706797).
3. Design of Tall Buildings, Mark Srkisian, Routledge Publishers, 2019. (ISBN: 13-9781138886711).

Web Links:

1. <http://www.madehow.com/Volume-6/Skyscraper.html>
2. <https://www.bdcnetwork.com/5-innovations-high-rise-building-design>
3. <https://theconstructor.org/structural-engg/high-rise-structures/5/>

Minor Stream: Environmental Geotechnics

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE41	Geoenvironmental Engineering	FC	2			2	50	50	100	ES
2501CE40	Fundamentals of Soil Behaviour	FC	2	1		3	50	50	100	-
2501CE39	Flow & Transport in Porous Media	FC	3			3	50	50	100	-
2501CE44	Land fill Engineering & Remediation Technology	FC	3			3	50	50	100	-
2501CE36	Environmental Impact & Risk Management	FC	3			3	50	50	100	-
2501CE35	Climate Change and Environmental Issues	IC	3			3	50	50	100	-
2501CE42	Ground Improvement Techniques	IC	3			3	50	50	100	GTE-2
2501CE38	Expansive Soils	IC	3			3	50	50	100	GTE-1&2
2501CE37	Environmental Management	IC	3			3	50	50	100	-
2501CE45	Marine Foundations	AC	3			3	50	50	100	GTE-2
2501CE73	Water Resource Management	AC	3			3	50	50	100	-
Total			31	1		32				

Geoenvironmental Engineering

Course Code:2501CE41

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Assess the contamination in the soil.
- CO2:** Study the contaminant transport process and methods for groundwater contamination comport.
- CO3:** Prepare the suitable disposal system for particular waste.
- CO4:** Evaluate the methods for stabilizing waste and assess the utilization of solid waste for soil improvement.
- CO5:** Select suitable ground water remediation methods based on contamination.

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			3				
CO3	3	3	3				3				
CO4	3	3	2				3				
CO5	3	3	2				3				

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-1

Introduction:

Emergence of Geo-Environmental engineering, Types of Geo-Environmental problems, inorganic and organic toxic chemicals, composition of soils, soil properties, inorganic and organic geochemistry.

UNIT – II

Contaminant Transport and Fate :

Transport processes, chemical mass transfer processes, biological processes, contaminant transport and fate modeling, landfill and surface impoundments, in-situ barriers, ground water contamination.

UNIT – III

Subsurface Contamination and Waste Containment:

Sources and types of contamination, remediation approach, contaminated site characterization, risk assessment and remedial strategy. Vertical and bottom barriers, surface caps, ground water pumping systems, subsurface drains, liner systems.

UNIT – IV

Soil Remediation:

Soil vapour extraction, soil washing, stabilization and solidification, electrokinetic remediation, thermal desorption, vitrification, bioremediation, phytoremediation, soil fracturing.

UNIT – V

Ground Water Remediation:

Pump and treat, In-situ flushing, permeable reactive barriers, in-situ air sparing monitored natural attenuation, bioremediation.

Text Books:

1. Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies ,Sharma H.D. and Reddy K.R., John Wiley& Sons, Inc., USA. (ISBN: 978-0471415120)
2. Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and Mitigation, Yong, R. N. CRC Press, New York. (ISBN: 978-0849334354)

Reference Books:

1. Geoenvironmental Engineering, Principles and Applications, Reddi L.N. and Inyang, H. I., Marcel Dekker Inc. New York. (ISBN: 978-0824798227)

Web Links:

1. <https://nptel.ac.in/courses/105102160>
2. <https://archive.nptel.ac.in/courses/105/103/105103025/>

Fundamentals of Soil Behaviour

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:** Analyze effective stress and evaluate permeability characteristics of soil.
- CO3:** Evaluate soil compressibility and determine consolidation parameters.
- CO4:** Asses the shear strength characteristics using appropriate laboratory and insite methods.
- CO5:** Apply critical state models to understand elastic and plastic behaviour of soils.

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	3		2			1				
CO3	3	3	1	3							
CO4	3	3	2	3							
CO5	3	3		2	1						

Mapping of Course Outcomes with Program Specific Outcomes:

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

Flow & Transport in Porous Media

Course Code:2501CE39

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Understand the basics of groundwater flow and transport in groundwater.
- CO2:** Analyze groundwater flow and well hydraulics.
- CO3:** Understand multiple well systems, unsaturated zones, and fractured formations flow.
- CO4:** Assess saline water intrusion and develop groundwater management strategies.
- CO5:** Evaluate groundwater quality, contaminant transport, and apply predictive modelling 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	3		3	1						
CO3	3	3		2	1						
CO4	3	3	2	2	1						
CO5	3	3		3	2						

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Groundwater Basics and Hydrologic Cycle :

Groundwater and the hydrologic cycle. Occurrence and movement of groundwater - origin, age, distribution, types of aquifers. Darcy's law, hydraulic head and fluid potential, hydraulic conductivity and permeability.

UNIT – II

Aquifer Dynamics and Hydraulic Principles:

Heterogeneity and anisotropy of hydraulic conductivity, porosity and void ratio, compressibility and effective stress, transmissivity and storativity. Steady State and transient flow - formulation of the governing equations, limitations of the Darcian approach. Groundwater and well hydraulics - steady flow to a well fully penetrating an aquifer (confined and unconfined), unsteady radial flow to a well fully penetrating an aquifer (confined, unconfined and leaky), the effect of wellbore storage.

UNIT – III

Complex Well Systems and Unsaturated Flow:

Multiple well systems, partially penetrating wells, bounded aquifers, characteristic well losses, specific capacity. Slug tests. Introduction to flow in the unsaturated zone and flow in fractured formations.

UNIT – IV

Saline Water Intrusion and Groundwater Management:

Saline water intrusion in coastal aquifers: occurrence, shape and structure of the interface, upconing, control of saline water intrusion. Groundwater modelling, Inverse modelling in groundwater. Artificial recharge of aquifers - concepts, hydraulics and methods. Groundwater budget. Groundwater resource estimation.

UNIT – V

Groundwater Contamination and Quality:

Introduction to groundwater contamination. Quality of groundwater - measures of quality, groundwater samples, physical, chemical and biological analyses, water quality criteria, and salinity. Transport and transformation of contaminants in groundwater - processes, formulation of the governing equations and initial and boundary conditions, modelling, solutions for simple cases.

Text Books:

1. Applied Hydrogeology , C. W. Fetter, 4th ed., Prentice Hall, Inc. (ISBN: 978-0130882394)
2. Contaminant Hydrogeology , C. W. Fetter, 2nd ed., Waveland Press. (ISBN: 978-1577665830)

Reference Books:

1. Numerical Groundwater Hydrology , A.K. Rastogi, Penram International Publishing (India) Pvt. Ltd. (ISBN: 978-8187972122)
2. Applied Flow and Solute Transport Modeling in Aquifers , Vedat Batu, Taylor and Francis/CRC Press. (ISBN: 978-0849343721)

Web Links:

1. <https://archive.nptel.ac.in/courses/103/105/103105160/>

Landfill Engineering & Remediation Technology

Course Code:2501CE44

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Acquire knowledge on waste management hierarchy and landfill basics.
- CO2:** Design of liners and various components of waste disposal units.
- CO3:** Evaluate and implement effective strategies for leachate and landfill gas management.
- CO4:** Implement landfill operation, closure, and environmental controls.
- CO5:** Apply a risk-based assessment of contaminated sites and implement site remediation 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	3				
CO2	3	3	3	2			3				
CO3	3	3	2	2	2		3				
CO4	3	3	2	2		3	3				
CO5	3	3	3	2		3	3				

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Landfill Basics :

Waste management Hierarchy- Need for landfills –Environmental Protection by Landfills- Landfill Classification – Sanitary and Secure Landfills - Components and Configuration - Legal framework for landfilling – Landfill Site investigation- Regional Landfills- Environmental control using site design – Landfill Design Tasks.

UNIT – II

Landfill Liners and Cover Systems:

Landfill barrier system components – Design of Compacted clay liners: Factors affecting hydraulic conductivity , Water content-density criteria, Thickness, Desiccation - Geosynthetic Clay Liners and Geomembranes; types, manufacturing, handling, seaming and testing - Asphalt Barriers and Capillary barrier - Composite Liner system design- liner construction and quality control- Leakage through Liners- vapor transmission and chemical compatibility - Installation of Geomembranes - Liner Leakage Mechanism – Diffusion - Controls on advection through liners - Single phase flow-advection-diffusion- Landfill cover systems- Design of Cover Systems – Daily Cover – Intermediate Cover – Final Cover - Flow through Landfill Covers- Design and Analysis of Slope Stability- Anchor Trenches- Access ramps - Erosion control.

UNIT – III

Leachate and Landfill Gas Management:

Waste decomposition in landfills - Factors affecting leachate and landfill gas generation – Factors affecting Leachate Quantity in active and post closure conditions- Hydrologic Evaluation of Landfill Performance (HELP) model – Leachate Drainage Layer – Geotextile and Geonet design – Leachate Collection and Removal systems- Temporal trends in leachate composition – Design of Landfill gas collection and removal systems- Gas condensate issues & knockouts - Leachate treatment methods (biological and physico-chemical)- Leachate re-circulation & bioreactor landfills- monitoring and control of leachate and Landfill gas- Landfill Settlement.

UNIT – IV

Landfill Operation and Closure :

Landfill Construction and Operational Controls – Fill Sequencing Plans – Cell Construction- Dozer and Compactor operations-Selection of Landfill Equipment- Landfill Administration-Record Keeping - Topographic mapping-Environmental Controls – Odour, Vector and Litter Control – Landfill Safety - Fire Control – Ground and Surface water Monitoring – Methane Gas monitoring - Audits of landfill environmental performance and management – Post Closure care and use of landfills – Landfill Economics- landfill construction and operational cost estimation – establishing tipping fees.

UNIT – V

Contaminated Site Remediation:

Contaminated sites - Fate and behaviour of toxics and persistent substances in the environment – Engineering Issues in Site Remediation - Site Characterization - Framework for risk assessment at landfill sites - Remediation Principles: Source Control and Management of Migration Covers, Cut-off Walls, Solidification / Stabilization - Pump-and-Treat Systems - Solvent Vapor Extraction, Air Sparging, Soil Flushing – Bioremediation - Natural Attenuation - Remedy Selection and Risk Assessment – Geotechnical Aspects of In Situ Remediation Technology - Specific case studies in contaminated site remediation – Rehabilitation of Open dumps- Landfill Mining.

Text Books:

1. Solid Waste Management: Principles and Practice , M. N. Rao, PHI Learning Pvt. Ltd. (ISBN: 978-8120338695)
2. Geotechnical Aspects of Landfill Design and Construction , R. M. Koerner and D. H. Gray, Prentice Hall, New Jersey. (ISBN: 978-0130125064)

Reference Books:

1. Handbook of Solid Waste Management , G. Tchobanoglous, F. Kreith, and M. E. Williams, Asian Books Pvt. Ltd. (ISBN: 978-0071356237)
2. The Handbook of Landfill Operations, Neal Bolton P.E , Blue Ridge Services Inc., Atascadero, CA – ISBN 0-9646956-0-x. (ISBN: 0-9646956-0-X)

Web Links:

1. <https://archive.nptel.ac.in/courses/105/107/105107181/>
2. <http://www.digimat.in/nptel/courses/video/105105160/L47.html>

Environmental Impact & Risk Management

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	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

	PSO1	PSO2
CO1:	1	2
CO2:	-	1
CO3:	-	3
CO4:	-	1
CO5:	-	1

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>

Climate Change & Global Environmental Issues

Course Code:2501CE35

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1** Identify the major global climate changes and the upstream drivers behind these changes
- CO2** Illustrate the health risks of climate variability and change, including the sources of vulnerability and exposure to those risks
- CO3** Explain highly vulnerable populations domestically and globally
- CO4** Identify key interventions to promote climate-resilient health systems
- CO5** Enumerate key issues in implementing, monitoring, evaluating, learning from, and continuously updating, adaptation policies and programs

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit-I

Global climate change:

Introduction - Climate change – Factors influencing Climate change - Stratospheric ozone depletion and public health - and health impacts due to climate change – impacts on materials

Unit-II

Global bio-geo chemical cycles Carbon cycle: The Global Carbon Cycle, the Ocean Carbon Cycle, the Terrestrial Carbon Cycle Nitrogen cycle: nitrogen fixation, nitrogen assimilation, ammonification, nitrification and denitrification

Unit-III

Greenhouse Effect:

Non-CO₂ Greenhouse Gases and Aerosols, Temp, Radiation, & Energy Health exposures, weather, climate variability, climate change, and climate change epidemiology

Unit-IV

Climate Sensitivity:

Linking Human Dimension to Climate Change; Econometric Models and GHG Emissions, Scenarios

Unit-V

Climate Projections:

Strategies to Slow & Stabilize Climate Change; Sequestrations of Atmospheric CO₂; Impacts of Climate Change; Climate change & policy options.

Text Books:

1. **Climate Change synthesis report, IPCC, (ISBN 92-9169-122-4)**
2. **Global Warming and Climate Change, Tapeswar Singh, Rajesh Publications, (ISBN: 978-81-85891-76-7)**

Reference Books:

1. **Kevin E Trenberth: Climate System Modeling, Cambridge University Press, (ISBN: 9780521128377)**
2. **Kendal McGuffie, Ann Henderson-Sellers: A Climate Modeling Premier, Wiley, Print (ISBN:9781119943365)**

Web Links:

1. <https://science.nasa.gov/climate-change/effects/>
2. <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/>

Ground Improvement Techniques

Course Code: 2501CE42

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify the suitable densification methods and dewatering techniques for different soil conditions.
- CO2:** Illustrate the appropriate stabilization techniques for a range of ground and site conditions.
- CO3:** Demonstrate an ability to design reinforced earth-retaining structure.
- CO4:** Explain the different types of grouts, their properties and applications.
- CO5:** Demonstrate different types of geosynthetics in field applications.

Mapping of Course Out comes 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	2	1	-	-	-	-	-	-
CO2	3	2	2	2	1	-	-	-	-	-	-
CO3	2	2	2	2	3	-	-	-	-	-	-
CO4	2	2	3	2	3	-	-	-	-	-	-
CO5	3	1	1	2	1	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit– I

In Situ Densification Methods and Dewatering:

In situ densification of granular soils -vibration at ground surface and at depth, impact at ground and at depth–in situ densification of cohesive soils–preloading–vertical drains
–sand drains and geo drains–stone columns.

Dewatering: sump sand interceptor ditches –single and multi – stage well points–vacuum well points–horizontal wells–criteria for choice of filler material around drains–electro osmosis.

Unit– II**Stabilization of soils:**

Methods of soil stabilization – mechanical – cement – lime- bitumen and polymer – use of industrial wastes like fly ash and granulated blast furnace slag.

Unit–III**Reinforced Earth Technology:**

Concept of soil reinforcement, reinforcing materials, Back fill criteria, Design of reinforcement for internal stability, Applications of Reinforced earth structures

Unit– IV**Grout Techniques:**

Types of grouts, grouting equipment and machinery, injection methods, grout monitoring, stabilization with cement, lime and chemicals, stabilization of expansive soils.

Unit– V**Geo synthetics:**

Geotextiles – types – functions, properties and applications –geogrids, geo membranes and gabions- properties and applications.

Text Books:

1. Ground Improvement techniques, Purushothama Raj Laxmi Publications, 1st Ed, New Delhi. (ISBN: 13-978-8131808573).
2. An Introduction to Ground Improvement Engineering, Mittal. S, Med tech Publisher. (ISBN:13-9789381714362).

Reference Books:

1. Ground Improvement, Moseley M.P, 2nd Ed., Blackie Academic and Professional, Boca Taton, Florida, USA. (ISBN:13-978-0415274555).
2. Ground Control and Improvement, Xanthakos P.P, Abramson, L.W and Brucwe, D.A, John Wiley and Sons, New York, USA.

Web Links:

1. <http://nptel.ac.in/courses/105108075/>
2. <https://lecturenotes.in/subject/228/ground-improvement-techniques>
3. <https://www.vidyarthiplus.com>

Expansive Soils

Course Code:2501CE38

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify the expansive soils in the field and laboratory
- CO2:** Illustrate the methods for the identification of soil structure and clay mineralogy
- CO3:** Design a suitable foundation for expansive soils.
- CO4:** Suggest a suitable method for stabilizing the expansive soils
- CO5:** Examine the liquefaction problems related to expansive soils

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Introduction and Identification:

Expansive soils of India-related civil engineering problems – formation of expansive soils in field – identification of expansive solids in laboratory by X-ray diffraction method and differential thermal analysis.

UNIT-II

Physical and Chemical Properties:

Soil structure and clay mineralogy of expansive soil- atomic bond and molecular bonds- honey comb structure-based exchanges capacity- clay water relation- electrolysis processes.

UNIT -III

Foundations:

Foundations on swelling soils-swelling potential and mechanism of volume change— chemical composition of black cotton soil-construction techniques in black cotton soil- modern method of construction in under reamed piles for expansive soil.

UNIT-IV

Improvement methods:

Stabilization of expansive soils with lime-slag (silica fume and aluminium sludge)— cement-fly ash — chemicals-reinforced earth technique —micro reinforced vegetation-vibro floatation-grouting and soil nailing.

UNIT-V

Liquefaction Hazard Mitigation:

Factors affecting the expansive soil — method of assessment for liquefaction-effect instrumentation for monitoring —consolidation of marine clay deposits-expansive soil model of Bingham fluid bounded by porous beds

Text Books:

1. son, J. D., and Miller, D.J. Expansive Soils, John Wiley and Sons, Inc., New York (ISBN: 978-0471839669)
2. Design Aids in Soil Mechanics and Foundation Engineering—S.R. Kaniraj (Tata McGraw Gill, New Delhi) 2019. (ISBN: 978-1259007834)

Reference Books:

1. Foundation Engineering (2nd Edition)– Peck, R.B., Hanson (W.E.and Thornburn. W.H. Johan Wiley, New York) (ISBN: 978-0471061794(
2. Soil Engineering in Theory and Practice (Vol.-II)– Alam Sing hand G.R.Chowdhary (Asia Publishing House, NewDelhi. (ISBN: 978-8123912930)

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_ce20/preview
2. <https://nptel.ac.in/content/storage2/courses/105101083/download/lec35.pdf>

Environmental Management

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:** Explain the concept and principles of environmental management
- CO2:** Explain the role of environmental organizations of planning for sustainable development.
- CO3:** Implement the concept of environmental management plan.
- CO4:** Examine the role of environmental impact assessment in real life.
- CO5:** Defend the knowledge of environmental legislations and acts.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

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, common wealth publishers New Delhi (ISBN: 8171692192).
An introduction to Environmental Management, Dr, Anand Bal, Himalaya
2. 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).
Environmental Management 2013, Vikas Khanna, D. R. & Chopra, A. K. & Matta,
2. 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>

Marine Foundations

Course Code:2501CE45

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Study the scope, classification, and characteristics of marine soils.
- CO2:** Comprehend the sedimentological characteristics and engineering behaviour of marine soils.
- CO3:** Apply offshore soil investigation techniques, such as sampling and in-situ strength determination.
- CO4:** Analyze the foundations for gravity and jacket-type structures.
- CO5:** Evaluate the design and stability of jack-up platforms and submarine infrastructure.

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	3	1				1				
CO3	3	3	2	3	2		1				
CO4	3	3	3	2			1				
CO5	3	3	3	2			1				

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction To Marine Geotechnical Engineering :

Scope of marine geotechnical engineering - Marine and submarine soils - Classification of marine soils - Relative distribution of marine soils in the different marine regions - General characteristics of marine deposits in some specific locations and in the Indian subcontinent.

UNIT – II

Sedimentological Characteristics of Marine Soils:

Structure of marine soils - Cementation bonding - Morphology and genesis of marine and submarine sediments - Post- depositional changes - Effect of calcium carbonate in marine deposits. Engineering behaviour of marine soils: Fine and coarse-grained deposits - Strength and deformation behaviour of fine - and coarse-grained marine deposits - Effect of cementation - Strength and deformation behaviour under static and cyclic loading.

UNIT – III

Offshore Soil Investigation:

General characteristics of offshore soil exploration - Sampling using free corer, gravity corer, tethered systems and manned submersibles - Deep penetration sampling using wire line techniques - In-situ determination of strength of submarine soils - Penetrometer, piezocone, vane and pressure meter techniques - General reconnaissance procedure for installation of fixed structures (gravity and piled type), floating structures, sea bed anchors and submarine pipelines.

UNIT – IV

Foundations For Gravity Structures:

Types of gravity structures - Installation techniques - Movement of gravity structures - Settlement of soil beneath gravity structures - Stress distribution beneath gravity structures - Stability of gravity structures under static and cyclic loads Foundations for jacket type structures: Types - Installation techniques - Design considerations - Axial and lateral load capacity of piles - Lateral load deformation behaviour of piles - Calculation of bearing capacity of piles - Design of piles subjected to lateral loads - Reese-Matlock method & p-y curves method.

UNIT – V

Foundations For Jack Up Platforms:

Types of jack up platforms - Piles and mat supported - Spud cans - Different types - Techniques for installation and removal of jack up - Stability of jack up platforms - Determination of penetration of supports - Stability under lateral loads - Stability under static and cyclic load effects. Sea bed anchors, submarine pipe lines: General introduction to sea bed anchors, moorings, submarine pipe line etc. - General design considerations (brief outline only) - geotechnical aspects in the design and installation of sea bed anchors, moorings, submarine pipelines etc.

Text Books:

1. Offshore Soil Mechanics, George, P and Wood, D, Cambridge University Press. (ISBN: 978-0521333612).
2. Pile Foundation Analysis and Design, Poulos, H. G and Davis, E. H., John Wiley. (ISBN: 978-0471692606).

Reference Books:

1. Marine Geotechnology and nearshore/offshore structures, Chaney, F. ASTM, STP. (ISBN: 978-0803109725).
Strength Testing of Marine Sediments - Laboratory and In-situ Measurements,
2. Chaney, R. C and Demars, K. R., ASTM, STP -883, 1985. (ISBN: 978-0803109633).

Web Links:

1. <https://archive.nptel.ac.in/courses/114/106/114106015/#>
2. <https://archive.nptel.ac.in/courses/105/106/105106144/>

Water Resources Management

Course Code:2501CE73

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Illustrate the important concepts of water resource management
- CO2:** Discuss the sources of water, ground water aquifers and zones
- CO3:** Describe the vulnerability conditions of flood and drought
- CO4:** Explain the different techniques of water harvesting
- CO5:** Apply the principles of remote sensing and GIS in hydrological 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	3	-	1	-	-	2	2	-	-	-	-
CO2	2	2	2	1	-	2	2	-	-	-	-
CO3	2	2	1	1	-	2	3	-	-	-	-
CO4	2	2	2	1	-	2	2	-	-	-	-
CO5	2	-	3	-	-	2	3	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction

Importance of water as a natural resource – Availability on the earth - Sources of Water – classification – importance and need of management of water resources – Water quality - Principles of water management - Role of various agencies in water resource management.

UNIT – II

Hydrologic Cycle and its components:

Surface water sources and Groundwater sources, importance, type of groundwater aquifers, groundwater zones, types of wells, concept, location, and importance. Artificial recharge of groundwater, direct and indirect methods.

UNIT – III**Floods and Drought Management:**

Flood damage, assessing flood risk, flood hazard assessment, flood impact assessment, flood risk reduction options.

Drought assessment and classification – drought analysis techniques – drought mitigation planning and management.

UNIT – IV**Rain water Harvesting:**

Necessity of Rainwater harvesting, Importance of Rainwater harvesting - Techniques of rain water harvesting – rain water harvesting from roof top – surface flow harvesting – subsurface flow harvesting – stop dams – farm ponds and dugout ponds – percolation tanks – Case studies.

UNIT – V**Water resource Systems Modelling:**

Applications of remote sensing and GIS in –delineation of surface water bodies and wetlands - hydrological modelling - Data of water resource systems for modelling – application and comparison of models – model calibration and validation – advances of water resource system models.

Text Books:

1. Sustainable Water Resources Management, Chandra S.P. Ojha , Rao Y. Surampalli , (ISBN – 9780784414767)
2. Water Resource Engineering, Wurbs R A and James R A, Prentice Hall Publishers, . (ISBN – 13 -978-0130812933)

Reference Books:

1. Disaster Management Future Challenges and Opportunities, Jagbir Singh, K International publishing house.(ISBN - 818986646X, 9788189866464)
2. Watershed Hydrology, Black P E, Prentice Hall. (ISBN – 1-57504-027-1)

Web Links:

1. https://www.ct.gov/deep/cwp/view.asp?a=2719&q=325622&depNav_GID=1654
2. http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershedmgt.html

Minor Stream: Transportation Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE53	Pavement Materials & Characterization	FC	2			2	50	50	100	-
2501CE47	Docks & Harbour Engineering	FC	3			3	50	50	100	-
2501CE54	Railway Engineering	FC	3			3	50	50	100	-
2501CE55	Road Safety Analysis	FC	3			3	50	50	100	-
2501CE48	Highway Construction & Practices	FC	3			3	50	50	100	-
2501CE52	Pavement Management Systems	FC	3			3	50	50	100	-
2501CE51	Pavement Drainage Systems	FC	3			3	50	50	100	-
2501CE46	Airport Planning & Design	IC	3			3	50	50	100	-
2501CE56	Urban Transportation Planning	IC	3			3	50	50	100	-
2501CE49	Intelligent Transportation Systems	AC	3			3	50	50	100	-
2501CE50	Pavement Design & Evaluation	AC	3			3	50	50	100	-
Total			32			32				

Pavement Materials & Characterization

Course Code:2501CE53

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Identify different pavement materials.
- CO2:** Characterization of subgrade soil for pavement design
- CO3:** Assess the suitability of aggregates used in various layers of pavement
- CO4:** Determine the optimum bitumen content by applying the bitumen mix design methods.
- CO5:** Explain various concrete properties 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	3	1	2	-	-	-	-	-	-	-
CO2	2	3	1	2	1	-	-	-	-	-	-
CO3	-	2	2	1	2	1	-	-	-	-	-

CO4	3	2	2	2	1	-	-	-	-	-	-
CO5	2	2	2	2	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

Introduction to Pavement Materials:

Pavement structure: introduction to materials used in different layers; factors affecting pavement performance; need for material characterization; performance data collection; specification development.

UNIT – II

Subgrade Soil Characterization:

Characterization of subgrade soil for pavement design: index properties, compaction characteristics; stiffness and strength of soil, resilient modulus; deformation characteristics of subgrade soil; soil Stabilization concepts: mechanical and chemical; geosynthetic application in pavements.

UNIT – III

Aggregate Characterization:

Origin, physical characterization of aggregates; requirement of aggregate property in different pavement layers: aggregate gradations; aggregate packing characteristics; factors affecting the performance of unbound aggregate layers; non-linear behavior of granular materials.

UNIT – IV

Bitumen & Bituminous Concrete Mixes:

Chemistry of bitumen, Rheology of bitumen, Elastic modulus, Dynamic modulus, visco-elastic and fatigue properties, creep test, stiffness modulus of bitumen, long term and short-term ageing Desirable properties of bituminous mixes, Design of bituminous mixes: Modified Marshall's specifications.

UNIT – V

Cement and Concrete Mixes:

Types of cements and basic cement properties, Special cements; Quality tests on cement; Introduction to advanced concretes like self-compacted concrete, Light weight concrete, Roller Compacted Concrete for pavement application; Nano technology applications in

cement concrete.

Text Books:

1. Highway Engineering, Khanna, S.K., and Justo, C.E.G., Nem Chand and Bros. Roorkee. 9th Edition. (ISBN: 9788185240633).
2. Pavement Design and Materials, Papagiannakis, A.T., Masad, E.A., Wiley, First Edition. (ISBN: 9780471214618).

Reference Books:

1. Highway Materials, Soils and Concretes , Atkins, N. Harold, Fourth Edition, Prentice-Hall. (ISBN: 9780130993045).
2. Highway Materials, Kerbs Robert D. and Richard D. Walker, McGraw-Hill. (ISBN: 9780070354654).
3. Specifications for Road and Bridge Works, Ministry of Road Transport and Highways, Indian Roads Congress, New Delhi, India, Fifth Edition. (ISBN: 9788193293201).

Web Links:

1. <https://www.pavementinteractive.org/>
2. <https://www.eng.auburn.edu/research/centers/ncat/research/other-publications.html>
3. <https://nptel.ac.in/courses/105/106/105106203/>

Docks & Harbour Engineering

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	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

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>

Railway Engineering

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 railway stations, site selection, classifications, facilities and yards.

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	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

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).
2. Transportation Engineering, Railways, Airports, Docks & Harbours, Srinivasa Kumar R, University Press, Hyderabad, 2020 (ISBN: 9789389211160).

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>

Road Safety Analysis

Course Code:2501CE55

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Analyze the effect of user, roadway, and environment characteristics on traffic
- CO2:** Plan and design of road safety improvement programs.
- CO3:** Analyze accident data and suggest safety measures.
- CO4:** Conduct road safety audit.
- CO5:** Build knowledge on accident mitigation measures

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction of Road Safety:

Road accidents, Trends, Global and Indian level, Crash Causation, Collision diagrams; Highway safety; Human factors and road user limitations; Speed and its effect on road safety; Vehicle factors; Highway safety in India.

UNIT – II

Statistical Analysis of Crash Data:

Before-after methods in crash analysis, Recording of crash data; Accident Investigation and Analysis; Statistical testing and the role of chance; Black Spot Identification and Investigations, Hot spot analysis, Case Studies.

UNIT – III

Road Safety Management System:

Multi-causal dynamic systems approach to safety; Crash Vs. Accident; Road safety improvement strategies; Elements of a road safety plan, Speed management, Safety data Needs; Intersection Safety, Safe vehicle design.

UNIT – IV

Road Safety Audits:

Key elements of a road safety audit, Road Safety Audits & Investigations, Work zone safety audit; Crash investigation and analysis, Methods for identifying hazardous road locations, Case Studies.

UNIT – V

Mitigation Measures:

Accident prevention by better planning, Accident prevention by better design of roads, Crash Countermeasures, Highway operation and accident control measures, Highway Safety Measures during construction, Highway geometry.

Text Books:

1. Observational Before-After Studies in Road Safety, Ezra Hauer, Pergamon Press. (ISBN: 9780080423931).
2. Traffic Safety, Leonard Evans, Science Serving Society. (ISBN: 9780945964235).

Reference Books:

1. The Handbook of Road Safety Measures, Rune Elvik, TrulsVaa, Alena Hoyer, Michael Sorensen, Emerald Group Publishing. Second Edition. (ISBN: 9781849502544).
2. The Traffic Safety Toolbox: A Primer on Traffic Safety, ITE. (ISBN: 9780934066918).
3. Traffic Accident Reconstruction, Lynn B. Fricke, Northwestern University Center for Public Safety. (ISBN: 9780912642031).

Web Links:

1. <http://tripp.iitd.ernet.in/publication/report>
<https://atpio.org/webinar-on-addressing-road-safety-worldwide-vulnerable-road-users-human-factors-rs-in-lmic/>
2. <https://atpio.org/webinar-on-addressing-road-safety-worldwide-vulnerable-road-users-human-factors-rs-in-lmic/>
3. <https://ebrdelearning.com/course>

Highway Construction & Practices

Course Code:2501CE48

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain various construction techniques of subgrade.
- CO2:** Explain construction techniques of unbound and bound granular layer.
- CO3:** Illustrate the functions and operations of various asphalt plant types.
- CO4:** Prepare for paving operations including new construction and overlay.
- CO5:** Understand and manage the processes involved in concrete production for pavement construction.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Construction of Subgrade:

Earthwork grading; compaction and construction of embankments; types of subgrade material, factors affecting strength gain; compaction requirement for subgrade; subgrade stabilization: preparation, compaction equipment.

UNIT – II

Construction of Unbound and Bound Granular Layers:

Gradation and material quality requirement for granular subbase and base layers, blending and proportioning, compaction requirements; field quality control; stabilized subbase and base layers: mix design, placing, laying and compaction requirements.

UNIT – III

Asphalt Plant Operations, Transport, and Delivery:

Asphalt plant functions; batch, drum, and continuous mix plants; emission controls; mix storage; asphalt mix transport: planning, haul trucks, addressing segregation, material transfer vehicle, visual inspection of the mix, and trouble shooting.

UNIT – IV

Asphalt Paving Operation:

Preparing for paving: new construction/overlay, prime coat, tack coats: recommended applications, distribution, verifying the application rates; asphalt pavers and compaction; screed operations and control; joints; compaction mechanics; cold weather paving.

UNIT – V

Construction of Concrete Pavements:

Concrete production; preparation of subgrade and base; reinforcement presetting for JPCP and CRCP; establishing string line; PCC slab constructions: slip form paving, fixed form paving; curing process.

Text Books:

1. Bituminous Road Construction in India, Kandhal, P.S., PHI Learning Pvt. Ltd, First Edition. (ISBN: 9788120335714).
2. Specifications for Road and Bridge Works, Ministry of Road Transport and Highways, Indian Roads Congress, New Delhi, India, Fifth Edition. (ISBN: 9788185730697).

Reference Books:

1. Concrete Pavement Design, Construction and Performance, Norbert, J.D., CRC Press, Second Edition. (ISBN: 9781466589240).
2. Construction of Quality Asphalt Pavements, MS-22, Asphalt Institute, 2020, Third Edition. (ISBN: 9781556893682).

Web Links:

1. <https://pavementinteractive.org/referencedesk/construction/sitepreparation/subgrade-preparation-for-new-pavements/>
2. https://www.virginiadot.org/vtrc/main/online_reports/pdf/15-r6.pdf

Pavement Management System

Course Code:2501CE52

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify and select suitable database strategies for a given pavement.
- CO2:** Determine the pavement condition using functional and structural methods.
- CO3:** Decide the type and timing of maintenance required for given pavement.
- CO4:** Apply ranking methods, benefit-cost ratio analysis, and mathematical optimization techniques
- CO5:** Estimate the life cycle cost of pavements and implementation 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	2	2	1	2	2	2	2	-	-
CO2	3	3	1	-	-	-	-	2	2	-	-
CO3	3	3	3	3	-	2	2	2	2	-	-
CO4	3	3	3	2	-	2	2	2	2	-	-
CO5	2	1	1	1	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to PMS:

Historical perspectives of PMS, Evolution of PMS concepts, basic components of PMS, Network and Project levels of PMS, data needs, GIS applications, database design, inventory and monitoring databases, planning pavement investments process and benefits of pavement management.

UNIT – II

Pavement Performance Models:

General concepts, pavement evaluation with respect to user cost, pavement evaluation technologies, techniques for developing prediction models deterministic, probabilistic, expert system of PMS models; remaining service life, AASHO, CRRI, and HDM models, deterioration concepts and modeling, priority programming methods.

UNIT – III

Design Alternatives:

Design alternatives, evaluation, and selection, a framework for pavement design, design objectives and constraints, generating alternative pavement design strategies, economic evaluation methods, economic evaluation of alternative pavement design strategies, and selecting optimal design strategies.

UNIT – IV

Pavement Prioritization Techniques:

General concepts, ranking methods and procedures, prioritization based on benefit-cost ratio, mathematical optimization for prioritization of M, R&R Work Programs, Markov and heuristic approaches.

UNIT – V

Pavement management systems:

Artificial Neural Network techniques for M, R&R Work programs, pavement life cycle cost analysis, implementation of PMS, operational issues, system complexity, feedback, other institutional issues, and PMS case studies.

Text Books:

1. Pavement Management for Airports, Roads and Parking Lots, Shahin, M.Y., Chapman & Hall, New York. (ISBN: 9780412989310).
Modern Pavement Management, Haas, R., W. R., Hudson, and J. P. Zaniewski.
2. Modern Pavement Management. Krieger Publishing Company. Malabar, Florida. (ISBN:9780894646920)

Reference Books:

1. Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation. Hudson, W. R., R. Haas, and W. Uddin., McGraw Hill. New York. (ISBN: 9780070308955).
2. Southeast Michigan Council of Governments. Pavement Management System, SEMCOG. (ISBN: 9780894646920).
3. Transportation Association of Canada. Pavement Design and Management Guide. Transportation Association of Canada, Ottawa, 1997. (ISBN:9781551871141).

Web Links:

1. <https://www.youtube.com/watch?v=IDv67Eppaos>
2. <https://ocw.mit.edu/courses/civil-and-environmental-engineering/>
3. <http://www.trb.org/Publications/PubsNCHRPProjectReportsAll.aspx>

Pavement Drainage System

Course Code:2501CE51

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Assess the impact of water on pavement performance.
- CO2:** Judge requirement of different cross drainage structures.
- CO3:** Design surface drainage system.
- CO4:** Evaluate the performance of pavement concerning sub-surface drainage methods.
- CO5:** Plan sustainable drainage 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	1	1	2	3	2	-	-	-	-	-
CO2	3	2	2	3	2	2	-	-	-	-	-
CO3	3	2	2	3	3	2	-	-	-	-	-
CO4	3	2	2	3	3	1	-	-	-	-	-
CO5	3	2	2	3	2	2	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Pavement Drainage Structures:

Pavement types, relevant pavement materials, source and role of water, factors affecting the flow of water, hydraulic conductivity, estimation of surface runoff, typical drainage in Pavements.

UNIT – II

Cross Drainage Works:

The necessity of culverts, planning of culverts and effective drainage, types and size of culverts, ditches, side drains design considerations, common culverts problems, and

solution, disposal of drainage water and maintenance of drainage system.

UNIT – III

Surface Drainage:

General, the effect of standing water on pavement performance, factors affecting the surface drainage, geometric features of pavement, maintenance of side drains, medians, culverts, the hydrological requirement of roadside drains, factors affecting runoff, and design methodologies.

UNIT – IV

Subsurface Drainage:

Permeable bases stabilized and unstabilized bases, aggregate layers, geotextiles separate layers, longitudinal drains, filter design, geocomposite design and capillary barrier drain, determination of pavement permeability, and framework for drainage systems under new concrete pavements.

UNIT – V

Sustainable Drainage:

Porous asphalt pavement design, construction, and maintenance; design of porous concrete; design of permeable interlocking concrete pavements, construction and maintenance; sustainable urban drainage systems, and applicability of specific SUDS structures.

Text Books:

1. Pavement Drainage; Theory and Practice, Sivakumar Babu G.L., Prithvi S. Kandhal, CRC Press, New Delhi, India. (ISBN: 9780367148191).
2. Principles of Pavement Design, Yoder, E.J., and Witczak, M.W., Wiley India Pvt. Ltd., New Delhi, India, Second Edition. (ISBN: 9788126530708).

Reference Books:

1. Design of Road Drainage System: A Design Reference Book, S.N. Sachdeva, 2018. (ISBN: 9789386173675).
2. An Introduction to the Principles of Pavement Drainage, J. Paul Guyer, Independently Published. (ISBN: 9788126530708).
3. Highway Drainage Guidelines, American Association of State Highway Officials (AASHTO), Fourth Edition. (ISBN: 978-1-56051-292-9).

Web Links:

1. <https://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=4986>
<https://freevidelectures.com/course/3352/geosynthetics-engineering-in-theory-and-practice/21>
2. practice/21

Airport Planning & Design

Course Code:2501CE46

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain fundamental principles and concepts of Airport planning and design.
- CO2:** Design the airport runway and airport capacity.
- CO3:** Design airport pavement systems for various loading and conditions.
- CO4:** Analyze air travel demands.
- CO5:** Apply knowledge of air traffic controls.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Airport Planning and Obstructions:

Growth of Air Transport, Technological Developments, Institutional Development for Planning, Aircraft characteristics related to airport planning and design, Future trends in Aircraft design and Airport Planning; Airport master plan, site selection, planning surveys. Airport Obstructions: Zoning Laws, Classification, Approach and Turning Zones.

UNIT – II

Runway and Taxiway Design:

Runway design: Runway Orientation, Wind rose diagram, Basic Runway Length and Factors affecting, Correction for elevation, temperature, and gradient as per ICAO and FAA, Runway Geometric Design, and Airport Classification. Taxiway Design: Factors, Geometric design standards, Exit Taxiways, Fillets, Separation clearance, Holding apron, Turn around.

UNIT – III

Design of Airport Pavements:

Design factors, Design methods for flexible Pavements and Rigid pavements, LCN Systems of pavement design, Joints in cement concrete pavements, Special consideration for design of pavement facilities, for V/STOL operations.

UNIT – IV

Air Traffic Controls (ATC):

Visual Aids: Marking and lighting; Need, Network and Aids for ATC, Radio equipment; Design of Heliports and STOLPORTS: Design Factors, Planning, Site selection. Geometric Designs, Visual Aids.

UNIT – V

Airport maintenance and Drainage:

Need for Maintenance, Airfield pavement failures, Maintenance and Rehabilitation of airfield pavement, Evaluation and Strengthening of airfield pavement, Airport drainage, Design data, Surface and Subsurface drainage, Special Characteristics, and requirements of airport drainage.

Text Books:

1. Planning and Design of Airports, Horonjeff, R., McKelvey, F.X., Sproule, W.J., and Young, S.B., McGraw-Hill, New York, USA, Fifth Edition. (ISBN: 9780071446410).
2. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, Scitech Publications (India), Chennai. (ISBN: 9788183710843).

Reference Books:

1. Airport Planning and Design, Khanna, S.K., Arora, M.G., and Jain, S.S.; Nem Chand and Bros, Roorkee, India, Sixth Edition. (ISBN: 9788185790377).
2. Air Transportation Planning and Design; Kumar, V., and Chandra, S.; Galgotia Publications Pvt. Ltd., New Delhi, India. (ISBN: 9788175153880).

Web Links:

1. <https://archive.nptel.ac.in/courses/105/107/105107123/>
2. <https://drmcet.digimat.in/nptel/courses/video/105107123/L31.html>
3. <https://hits.digimat.in/nptel/courses/video/105107123/L30.html>

Urban Transportation Planning

Course Code:2501CE56

L	T	P	C
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	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

Web Links:

1. <http://nptel.ac.in/courses/105101087/29>
2. <https://novalynx.com/store/pc/What-Is-a-Wind-Rose-d55.htm>
3. <https://ircep.gov.in/>

Intelligent Transportation Systems

Course Code:2501CE49

L	T	P	C
3	0	0	3

Course Outcomes:

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	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

Definition of 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>

Pavement Design & Evaluation

Course Code:2501CE50

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify the pavement components and compare highway and airport pavements
- CO2:** Calculate the stresses and ESWL in flexible pavements.
- CO3:** Design the flexible pavement using empirical, semi empirical and IRC methods
- CO4:** Analyze the warping, friction, wheel load stress and calculate the combined stress.
- CO5:** Design rigid pavements by IRC method.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

Pavement types and Components – Factors affecting Design and Performance of Pavements, Comparison between Highway and Airport pavements – Functions and Significance of Sub grade properties.

UNIT – II

Stresses in Flexible Pavements:

Stresses and Deflections in Homogeneous Masses – Burmister's 2-layer, 3-layer Theories – Wheel Load Stresses, ESWL of Multiple Wheels, Repeated Loads and EWL factors.

UNIT – III

Flexible Pavement Design:

Empirical – Semi-empirical and Theoretical Approaches; Principles and procedure, Design, Advantages and applications of different Pavement Design Methods – IRC Method of Design.

UNIT – IV

Stresses in Rigid Pavements:

Types of Stresses and Causes – Factors influencing the Stresses, General conditions in Rigid Pavement Analysis, ESWL, Wheel Load Stresses, Warping Stresses, Friction Stresses, Combined Stresses.

UNIT – V

Rigid Pavement Design:

Types of Joints in Cement Concrete Pavements and their Functions, Joint Spacing, Design of Slab Thickness, Design of Joint Details for Longitudinal Joints, Contraction Joints and Expansion Joints, IRC Method of Design.

Text Books:

1. Pavement Analysis and Design, Yang H. Huang, Pearson Prentice Hall, Upper Saddle River, NJ. (ISBN: 9780134732212).
2. Principles of Pavement Engineering, Nick Thom, ICE Publishing, London. (ISBN: 9780727741832).

Reference Books:

1. Pavement Design and Materials, A. T. Papagiannakis and E. A. Masad, John Wiley & Sons, Hoboken, NJ. (ISBN: 9780471264411).
2. Highway Engineering, Paul H. Wright and Karen Dixon, John Wiley & Sons, Hoboken, NJ. (ISBN: 9780471476958).
3. Airport Engineering: Planning, Design, and Development of 21st Century Airports, Norman J. Ashford, Saleh Mumayiz, and Paul H. Wright, John Wiley & Sons, Hoboken, NJ. (ISBN:978-0-470-39855-5).

Web Links:

1. https://www.fhwa.dot.gov/pavement/pub_details.cfm
2. <https://www.irc.nic.in/publication-main-page>.
3. <https://www.acpa.org/resources/>

Minor Stream: Integrated Design for Industrial Facilities Industry Integrated Program - L & T[#]

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE69	Building Information Modelling in Construction	FC			3	3	50	50	100	-
2501CE67	Sustainability Practices in Design of Buildings	IC			3	3	50	50	100	-
2501CE70	Formwork Engineering Practices	IC			2	2	50	50	100	-
2501CE72	Design & Execution of Pile Foundations	IC			3	3	50	50	100	-
2501CE61	Metro Rail Transportation Systems & Construction	IC			3	3	50	50	100	-
2501CE71	Deep Excavations, Foundations & Tunnels	AC			3	3	50	50	100	-
2501CE68	Bridge Engineering Design Practices	AC			3	3	50	50	100	-
2501CE16	Geospatial Techniques in Practice	AC			3	3	50	50	100	-
2501CE63	Pre Engineered Buildings	AC			3	3	50	50	100	-
2501CE64	Precast Members & Construction	AC			3	3	50	50	100	-
2501CE60	Hydropower Structures	AC			3	3	50	50	100	-
Total					32	32				

UNIVERSITY ELECTIVE COURSES

Branch	Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Offered to	Pre-requisite
CE	2501CE66	Natural Disaster Management & Mitigation		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE81	Wastewater Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE82	Integrated Solid Waste Management for a Smart City		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE83	Watershed Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE53	Electric Power Generation, Transmission & Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME36	Sustainable Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ECE	2501EC97	Biomedical Electronics	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	

ECE	2501EC98	Fundamentals of Wireless Communications	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA3	Introduction to Quantum Computing	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	FC	2		2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2		2	4	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS
IT	2501CS07	Computer Networks	AC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2		1	3	50	50	CE, EEE, ECE, PT, Min.E	-
AI&ML	2501AI05	Machine Learning	AC	2		2	4	50	50	CE, ECE, PT, Min.E	DAUP
DS	2501CS34	Fundamental of Data Science	FC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS

Natural Disaster Management & Mitigation

(EEE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501CE66

L	T	P	C
3	0	0	3

Course Outcomes:

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

CO1: Explain the aspects of disaster management and adopt remedial measures.

CO2: Explain disaster risk assessment and coping measures.

CO3: Explain the vulnerability conditions.

CO4: Assess the impact of hazards on structures.

CO5: Adopt the rehabilitation procedures.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction Concept of Disaster Management. Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels.

UNIT – II

Overview of Disaster Situations:

Overview of Disaster Situations in India Vulnerability of profile of India and Vulnerability mapping including disaster – prone areas, communities, places. Disaster preparedness – ways and means; skills and strategies; rescue, relief reconstruction. Case Studies: Lessons and Experiences from Various Important Disasters in India and Biological disasters – SARS- spread and transmissions -pandemic, endemic and epidemic.

UNIT – III

Flood:

Flood and Drought Disaster Raising flood damage, assessing flood risk, flood hazard assessment, flood impact assessment, flood risk reduction options. Drought and development, relief management and prevention, drought mitigation and management-integrating technology and people.

UNIT – IV

Overview of Disaster Situations:

Landslide and Earthquake Disaster Land slide hazards zonation mapping and geo environmental problems associated with the occurrence of landslides. The use of electrical resistivity method in the study of landslide. Causes and effects of earthquakes. Secondary effects. Criteria for earthquake resistant design.

UNIT – V

Cyclone and Fire Disaster:

Cyclone and Fire Disaster Cyclone occurrence and hazards. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Types of fire. Fire safety and firefighting method, fire detectors, fire extinguishers. Rehabilitation: Rehabilitation programmes, Management of Relief Camp.

Text Books

1. Disaster Management, RB Singh (Ed), Rawat Publications. (ISBN: 13-978-8131600337).
2. Disaster Management Future Challenges and Opportunities, Jagbir Singh, I.K International publishing house. (ISBN: 13-978-8189866464).

Reference Books:

1. Natural Hazards in the Urban habitat by Iyengar, CBRI, Tata McGraw Hill. (ISBN:13-9780074631881).
2. Natural Disaster management, Jon Ingleton (Ed), Tulor Rose. (ISBN:13-978-0953614011).
3. Anthropology of Disaster management, Sachindra Narayan, Gyan Publishing house. (ISBN: 13-978-8121206839).

Web Links:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/dm%20notes.pdf

Waste Water Management

(EEE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501CE81

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 sanitation and wastewater management.
- CO2:** Explain the various methods of sewage flow estimation and pumping systems.
- CO3:** Identify the various characteristics of sewage and the treatment system.
- CO4:** Outline the various secondary treatment technologies for waste water
- CO5:** Explain the different tertiary and effluent disposal 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	2	3									
CO2	2	3				1					
CO3	3	3	1			2					
CO4	2	2	1	2		2					
CO5	2	2	1			2					

UNIT – I

Introduction:

Introduction to sanitation–systems of sanitation–relative merits and demerits –need for waste water management–basic terminology in waste water–generation of waste water–types – collection and conveyance of waste water– classification of sewerage systems.

UNIT – II

Sewage Flow and Pumping:

Estimation of sewage flow and storm water drainage–fluctuations. Types of sewers– hydraulics of sewers– appurtenances in sewerage. Pumping of waste water:pumping stations–location–components– types of pumps and their suitability with regards to waste waters.

UNIT – IV

Secondary Treatment:

Aerobic and anaerobic treatment process-comparison. Aerobic units: Activated sludge process, principles, modifications of activated sludge processes–Oxidation ponds–Trickling filters– Rotating biological contactors. Anaerobic units: UASB Reactor, principle and working.

UNIT – V

Tertiary Treatment and Disposal:

Removal of Nutrients–Nitrification and Denitrification–Ion exchange–membrane processes –MF, UF, NF, RO. Disposal of sewage–Methods of disposal–Effluent Standards. Need, Scope and demand for waste water recycling.

Text Books:

1. Wastewater Engineering: Treatment and Resource Recovery, Metcalf & Eddy, McGraw-Hill, New York, 5th Edition. (ISBN: 13-978-0073401188).
2. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill , 2018. (ISBN: 13-978-0070495395).

Reference Books:

1. Environmental Engineering-II: Sewage disposal and Air pollution Engineering, Garg & S.K., Khanna Publications. (ISBN:978-81-7409-230-4)
2. Environmental Engineering by D. Srinivasan, PHI Learning private Limited, New Delhi. (ISBN:13-9788120336001)
3. Elements of Environmental Engineering, K.N. Duggal, S.Chand& Company Ltd. New Delhi. (ISBN: 13-978-8121915472).
4. Wastewater Treatment for pollution control and Reuse, Soli J Areivala, Sham R Asolekar, Mc- GrawHill, New Delhi. (ISBN:9780070620995).

Web Links:

1. https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf
2. <http://www.civil.iitm.ac.in/dwwm/sites/default/files/presentations>
3. https://www.researchgate.net/publication/221911472_Wastewater_Management

Integrated Solid Waste Management for A Smart City

(EEE,ME,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code: 2501CE82

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Understand Fundamental Concepts of Solid Waste Management
- CO2:** Analyze Municipal Solid Waste Management Practices
- CO3:** Evaluate Disposal Methods and Technologies
- CO4:** Apply Knowledge of Construction and Demolition (C&D) Waste Management
- CO5:** Examine E-Waste and Hazardous Waste Management

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11
CO1	1					3	2				
CO2	1					3	2				
CO3	1					3	2				
CO4	1					3	2				
CO5	1					3	2				

UNIT – I

Introduction:

Solid Waste Management- Definition, Concept of 4Rs (reduce, reuse, recycle and recover) of waste management, Elements of a waste management system, Issues in Solid Waste Management, Integrated Waste Management Hierarchy: Source reduction, Recycling, Waste-to-Energy and Landfilling, Review of waste management under Swachh Bharat Mission and Smart Cities Program.

UNIT – II

Municipal Solid Waste:

Waste Composition and Quantities, Collection, Transportation, Segregation, and Processing.

UNIT – III

Disposal of Municipal Solid Waste:

Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste, Municipal Solid Waste (MSW) Rules 2016, Current Issues in Solid Waste Management and Review of MSW Management

UNIT – IV

Construction and Demolition (C&D) Waste Management:

Overview, Components; C&D Waste Management Rules 2016, Beneficial Reuse of C & D Waste Materials.

UNIT – V

Electronic Waste (E-Waste) Management:

Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management

Challenges.

Hazardous Wastes:

Definition, Classification, Risk assessment, Transportation of hazardous waste, Current Management Practices: Environmental audit, Containment, Remedial alternatives.

Text Books:

1. Solid Waste Engineering, William A Worrell and P. Aarne Vesilind, Cengage Learning, 2nd Edition (SI Edition). (ISBN: 13-978-8131520420).
2. Integrated Solid Waste management, George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Tata McGraw Hill. (ISBN: 13-978-0070632370).

Reference Books:

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India.
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website
3. Construction and Demolition Waste Management Rules, 2016, MoEF&CC
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.

Web Links:

1. <https://nptel.ac.in/courses/105/105/105105160/>
2. <http://swachhbharatmission.gov.in/sbmcms/index.html>
3. <http://swachhbharaturban.gov.in/>

Watershed Management

(EEE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501CE83

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the objectives and characteristics of watershed management.
- CO2:** Classify the types of soil erosion and control methods.
- CO3:** Explain different water harvesting techniques.
- CO4:** Organize the land and drought management techniques.
- CO5:** Create hydrological models

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

UNIT – I

Introduction:

Introduction - Concept of watershed development – objectives of watershed development – need for watershed development - integrated and multidisciplinary approach for watershed management. Characteristics of Watershed: Size – shape – physiography – slope – climate – drainage – land use – vegetation – geology and soils – hydrology and hydrogeology – socio-economic characteristics – Application of artificial intelligence technology for identification of watershed characteristics.

UNIT – II

Principles of Erosion: Types and causes of erosion – factors affecting erosion– estimation of soil loss due to erosion- Universal soil loss equation. Measures to Control Erosion: Contour techniques – ploughing – furrowing – trenching – bunding – terracing – gully control – check dams – rock-fill dams – brushwood dam – Gabion.

UNIT – III

Water Harvesting: Techniques of rainwater harvesting – rainwater harvesting from rooftop – surface flow harvesting – subsurface flow harvesting – stop dams – farm ponds and dugout ponds – percolation tanks.

UNIT – IV

Land Management: Land use and Land capability classification – management of forest – agricultural – grassland and wild land land grading operation –reclamation of saline and alkaline soils. Drought Management: Drought assessment and classification – drought analysis techniques – drought mitigation planning.

UNIT – V

Beyond BIM - Emerging Trends

Watershed Modelling: Data of watershed for modelling – application and comparison of watershed models – model calibration and validation – advances of watershed models.

Text Books:

1. Watershed Management, Das MM and M.D Saikia, PHI Learning Pvt. Ltd.(ISBN:13-978-8120346765).
2. Land and Water Management, Murthy.VVN, Kalyani Publications. (ISBN: 13-978-9327214659)

Reference Books:

1. Water Resource Engineering, Wurbs R A and James R A, Prentice Hall Publishers. (ISBN: 13-978-8120321519).
2. Watershed Hydrology, Black P E, Prentice Hall. (ISBN: 13-978-1575040271).
3. Watershed Management, Murthy J V S, New Age International Publishers. (ISBN:13-978-8122435184).

Web Links:

1. https://www.ct.gov/deep/cwp/view.asp?a=2719&q=325622&depNav_GID=1654
2. http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershedmgt.html
3. <https://yourstory.com/2017/11/watershed-management/>

Electric Power Generation, Transmission & Distribution Systems

(CE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501EE53

L	T	P	C
3	0	0	3

Course Outcomes:

At the end of the course, student 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	PO10	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 &, A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd (ISBN: 978817700207).
2. Generation, Distribution & 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: 978070151413).

Web Links:

1. <https://www.slideshare.net/ntpc-project-korbasuper-themal-power-plant>
2. <https://www.euronuclear.org/1-information/energy-uses.html>
3. <https://www.slideshare.net/9anku/electrical-distribution-system>

Electric Energy Storage Systems
(CE,ME,ECE,CSE,IT,AIML,CSE(DS), PT, Min.E.)

L T P C

Course Code:2501EE36

3 0 0 3

Course Outcomes:

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

- CO1** Analyze the characteristics of electrical energy storage technologies.
- CO2** Analyze the needs for electrical energy storage.
- CO3** Analyze the needs for electrical energy storage.
- CO4** Understand the various types of electrical energy storage systems.
- CO5** Identify various real time applications of energy storage 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	3	1	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-
CO3	2	1	3	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-

UNIT – I

Electrical Energy Storage (EES) Technologies: Characteristics of electricity, Electricity & the roles of EES, High generation cost during peak-demand periods, Need for continuous & flexible supply, Long distance between generation & consumption, Congestion in power grids, Transmission by cable.

UNIT – II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT – III

Features of Energy Storage Systems: Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H₂), Synthetic natural gas (SNG).

UNIT – IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT – V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management & control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems & distributed generation (Virtual Power Plant), Battery SCADA aggregation of many dispersed batteries.

Text Books:

1. Energy Storage Benefits & Market Analysis, by James M. Eyer, Joseph J. Iannucci & Garth P. Corey Sandia National Laboratories.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Boks:

1. Energy Storage for the Electricity Grid: Benefits & Market Potential Assessment Guide, Jim Eyer, Garth Corey, Sandia National Laboratories.
2. Energy Storage by Mullick & Garg (ISBN: 9789027719300)

Web Links:

1. <https://nptel.ac.in/courses/112/105/112105221/>
2. <https://nptel.ac.in/courses/112/107/112107283/>
3. <https://nptel.ac.in/content/storage2/courses/10810309>

Electrical Safety

(CE,ME,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

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: 978071745130)
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>

Hybrid & Electric Vehicles

(CE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code:2501EE54

L	T	P	C
3	0	0	3

Course Outcomes:

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

CO1: Describe the History of Hybrid Electric vehicles

CO2: Classify the various electric drivetrain topologies

CO3: Articulate the Energy Storage Requirements in Hybrid & Electric Vehicles

CO4: Illustrate the Charging Infrastructure

CO5: Evaluate Energy Management Strategies used in hybrid & electric vehicle

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction to Hybrid Electric Vehicles: History of hybrid & electric vehicles, social & environmental importance of hybrid & electric vehicles, impact of modern drive-trains on energy supplies-Challenges & Key Technologies of EVs – Challenges for EV Industry in India

UNIT – II

Electric Drive-trains:

Basic concept of electric traction - introduction to various electric drivetrain topologies - Power flow control in electric drive-train topologies - fuel efficiency analysis

Electric Propulsion unit:

Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, configuration and control of Induction Motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency

UNIT – III

Energy Storage:

Introduction to Energy Storage Requirements in Hybrid & Electric Vehicles -Battery based energy storage & its analysis - Fuel Cell based energy storage & its analysis - Super Capacitor based energy storage- Flywheel based energy storage & its analysis.

UNIT – IV

Sizing the drive system:

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT – V

Energy Management Strategies

Introduction to Energy Management Strategies used in hybrid & electric vehicle, Classification of different Energy Management strategies - Comparison of different Energy Management Strategies - Implementation issues of energy strategies - Effect of charging infrastructure on grid protection & control.

Text Books:

1. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley-Blackwell (ISBN: 9781119942733).
2. Energy Management Strategies for Electric & Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer (ISBN: 9781493955237).

Reference Books:

1. Electric Vehicle Battery Systems, Sandeep Dhameja, Elsevier (ISBN: 9780750699167).
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press (ISBN: 9781138072855).
3. Hybrid electric Vehicles Principles & applications with practical perspectives, Chris Mi, M. Abul Masrur, D. Wenzhong Gao, A Dearborn, John Wiley & Sons Ltd (ISBN: 9781118970560).

Solar Energy Systems
(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501ME37

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 of solar radiation and its measurement
CO2: Describe the working principle of different types of collectors and its types
CO3: Explain the various solar thermal energy technologies and their applications
CO4: Analyze the various solar PV cell materials and conversion techniques.
CO5: Apply solar passive building techniques for cooling and heating 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	-	-	-	3	-	-	-	-	-
CO2	2	1	-	-	-	3	-	-	-	-	-
CO3	2	1	-	-	-	3	-	-	-	-	-
CO4	2	1	-	-	-	3	-	-	-	-	-
CO5	2	1	-	-	-	3	-	-	-	-	-

UNIT – I

Solar Radiation and its measurement: Solar angles, Sun path diagrams, Radiation, extra terrestrial characteristics, Solar energy measuring instruments: Pyranometer, Pyrheliometer, Sunshine recorder. Estimation of average solar radiation and estimation on horizontal and tilted surfaces

UNIT – II

Solar Collectors for Industrial process heat: Flat plate collector, Materials for flat plate collector and their properties, classification, evacuated tubular collectors, concentrator collectors, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus, Heliostats.

UNIT – III

Solar Thermal Technologies: Working principle, types, design, and operation, Solar heating and cooling systems, Thermal Energy storage systems, Solar Desalination, Solar cooker, Solar Pond, Solar drying, Solar chimney, Solar water disinfection (SODIS), Solar furnaces.

UNIT – IV

Solar Cells: Semiconductor materials, Doping, PN junction and characteristics, Photovoltaic effect, Photovoltaic material, Parameters of solar cells, Effects of cell temperature on cell efficiency, Types of solar cells, Solar modules and arrays, Solar cell power plant, Silicon, thin film and polymer processing, Silicon wafer based solar cells, Hybrid organic- inorganic solar cells.

UNIT – V

Solar Passive Architecture: Thermal comfort, bioclimatic classification. Passive heating concepts: direct heat gain, indirect heat gain, isolated gain and sunspaces
 Passive cooling concepts: evaporative cooling, Radiative cooling, shading - paints and cavity walls for cooling, roof radiation traps, thermal comfort.

Text Books:

1. Solar Energy-Principles of Thermal Collection and Storage, S P Sukhatme & J K Nayak, McGraw Hill Education, 3rd Edition, 2009, ISBN : 9780070142961.
2. Principles of Solar Engineering, D.Yogi Goswami, Frank Kreith and Jan F. Kreider Taylor and Francis, 2nd Edition, 2000, ISBN : 9781560327141.

Reference Books:

1. Solar Energy- Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa publishing house. 1st Edition, 2002, ISBN : 9780849325093.
2. Solar Energy and Non-conventional Energy Sources, Domkundwar, Dhanpat Rai & Co, (P) Ltd., 2nd Edition, ASIN : B0BQWR83GF

Web Links:

1. <https://archive.nptel.ac.in/courses/115/103/115103123/>
2. <https://www.nrel.gov/research/re-solar.html>

Industry 5.0 for Engineers

(CE,EEE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code: 2501ME58

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the basic concept of Industry 5.0.
- CO2:** Explain the concepts of Industrial IOT, IOS and Predictive Analytics
- CO3:** Explain the cyber physical systems and AI technologies
- CO4:** Analyse the applications of Industry 5.0 in various sectors
- CO5:** Analyse case studies on automation and healthcare services

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

UNIT – I

Introduction to Industry 5.0: Introduction of Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes.

UNIT – II

Importance of Internet of Things (IOTs): Introduction to Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Services, Fundamental of Predictive Analytics, Smart Logistics, Smart Devices and Products.

UNIT – III

Technology Evolution: Basics of cyber Physical Systems, Process Automations and Collaborative robots, Fundamental to artificial Intelligence, Mobile Computing, Cyber Security, Ethical technology, Responsive and distributed supply chain system, Human-centric and Value-oriented approaches.

UNIT – IV

Technology Implementation and Case Studies: 3D printing, Solar energy sector, Healthcare sector, Maintain records related to education, finance, clean bioenergy generation and Intelligent NextG Wireless Networks.

UNIT – V

Case studies on CNC/NC automation - Benefits, challenges, and industry applications. In-house, Healthcare services-Examples of innovations improving patient care and operational efficiency.

Text Books:

1. Uthayan Elangovan, Industry 5.0, “The Future of the Industrial Economy”, First Edition, Taylor & Francis, ISBN: 978-1-032-04127-8, 2022.
2. Alessandro Massaro, “Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances”, Wiley-IEEE Press, 2021, ISBN: 2021028944.

Reference Books:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016.
2. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
3. Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, “The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0”, Industrial Press Inc., U.S. ISBN 0831136367, Nov 2021.
4. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, “Healthcare 4.0 Next Generation Processes with the Latest Technologies”, Palgrave Pivot, 2019, ISBN 978-981-13-8113-3.

Web Links:

1. <http://www.mqtt.org/>
2. <https://opcfoundation.org/about/opc-technologies/opc-ua/>
3. <https://www.ethercat.org/default.htm>

Organizational Behaviour

(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501ME73

L P T C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the roles, approaches of organizational behaviour models.
- CO2:** Summarize the behaviour of individuals and groups in organizations in terms of organizational behaviour.
- CO3:** Illustrate various stress and emotional organizational behaviour concepts, models and theories to real life management situations.
- CO4:** Analyze the functions of organizational communication and culture for effective communication and managing cultural diversity
- CO5:** Organize different groups and teams in the organization for better results.

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

UNIT – I

Organizational Behaviour: Concept of Organizational Behaviour (OB)- Importance of Organizational Behaviour- Key Elements of Organizational Behaviour, Role of Managers in OB- Interpersonal Roles-Informational Roles- Decisional Roles, Approaches to Organizational Behaviour

UNIT – II

Interpersonal Behaviour: Nature and meaning of Interpersonal Behaviour, Concept of Self, Transaction Analysis (TA), Benefits and uses of Transactional Analysis, Johari Window Model

Personality: Definition and Meaning of Personality - Importance of Personality, Determinants of Personality, Theories of Personality, Personality Traits Influencing OB.

UNIT – III

Emotions: Nature and Meaning of Emotions - Characteristics of Emotions, Theories of Emotions, Emotions in the Context of OB. **Organizational Stress:** Definition and Meaning, Sources of Stress, Types of Stress, Impact of Stress on Organizations, Stress Management Techniques.

UNIT – IV

Organizational Communication: Meaning and Importance of Communication, Functions, process, types, Interpersonal Communication, Organizational Communication, Tips for Effective Communication.

Organization Culture: Meaning and Nature of Organization Culture – Origin of Organization Culture, Functions of Organization Culture, Types of Culture, Creating and Maintaining Organization Culture, Managing Cultural Diversity

UNIT – V

Groups and Teams: Meaning and Importance of Groups, Reasons for Group Formation, Types of Groups, Stages of Group Development, Meaning and Importance of Teams, Types of Teams, Creating an Effective Team.

Text Books:

1. Organizational Behaviour, K. Ashwathappa, Himalaya Publishing House, ISBN-13. 978-8184889390.
2. Management and Organizational Behaviour - (Text and Cases), Dr.P.Subba Rao and Prof. N.Sambasiva Rao, Himalaya Publishing House, Mumbai, ISBN: 978-93-5025-951-2.

Reference Books:

1. Understanding Organisational Behaviour, Udai Pareek, Oxford Higher Education, 2nd Edition, ISBN-13: 978-0195690866
2. Mc Shane & Von Glinov, Organisational Behaviour, Tata McGraw Hill, 4th Edition, ISBN-13, 978-1259927676.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg51/preview
2. <https://www.udemy.com/course/organisational-behaviour/>

Sustainable Energy Systems
(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501ME36

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Demonstrate the various components of solar thermal energy systems.
CO2: Describe the working of Wind turbines.
CO3: Explain the principle and working of Biomass and Geothermal Energy systems
CO4: Explain the Ocean, Tidal, Wave and hydro energy conversion systems.
CO5: Illustrate working of hybrid energy 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	-	-	-	-	3	-	-	-	-	-
CO2	2	-	-	-	-	3	-	-	-	-	-
CO3	2	-	-	-	-	3	-	-	-	-	-
CO4	2	-	-	-	-	3	-	-	-	-	-
CO5	2	-	-	-	-	3	-	-	-	-	-

UNIT – I

Introduction to Renewable energy sources: Energy demand and availability, energy crisis, renewable and non-renewable energy resources, environmental impact of conventional energy usage.

Solar Energy: Overview of the fundamental physics of solar radiation. Solar energy collectors.

Solar energy storage: Stratified storage, well mixed storage, comparison, Hot water system, solar ponds, non-convective solar pond, extraction of thermal energy and application of solar ponds.

Solar PV systems and its applications. Solar cell, module, and array.

UNIT – II

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for windfarms. Horizontal and vertical axis wind mills, Wind farms- offshore, Onshore, various methods of control, and Environmental issues – Applications.

UNIT – III

Biomass: Bio-resources, Conversion process, Biomass gasifier - Types of biomass gasifiers, Biodiesel production – Ethanol production -Applications.

Geothermal Energy: Origin and types of geothermal energy and utilisation, Power generation from Geothermal energy, Environmental impact.

UNIT – IV

Ocean, Wave & Tidal Energy: Introduction - Resource Assessment - Power generation through OTEC systems. Wave and Tidal energy- Working principle, Availability, and energy conversion systems.

Mini & Micro Hydropower: Introduction, Power from water, System components of Mini and Micro Hydropower, Micro Hydropower plant in India, Potential Hydropower plant projects identified in India.

UNIT – V

Hybrid Energy Systems: Systems for processes and power applications – solar – wind – Biomass hybrid technologies

Fuel cell: Working principle- types - construction and applications. Solar – Fuel cell hybrid systems.

Text Books:

1. Renewable Energy: Power for a Sustainable Future, Boyle, G, Oxford University Press, 3rd Edition, 2012, ISBN : 9780199681273.
2. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, 6th edition, ISBN : 9788174090737.

Reference Books:

1. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 3rd edition, 2015, ISBN : 9780415584388.
2. Non-Conventional Energy Resources, B H Khan, TMH Publishers, 3rd Edition, 2017, ISBN : 9789352601882.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2. <https://www.energy.gov/eere/renewable-energy>

Biomedical Electronics
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

Course Code: 2501EC97

L	T	P	C
3	0	0	3

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

- CO1:** Understand the basic medical instrumentation system and bioelectric potentials.
- CO2:** Illustrate different types of electrodes to acquire bio-signals.
- CO3:** Demonstrate clinical laboratory measurements and assistive devices.
- CO4:** Discuss the latest developments in medical imaging systems.
- CO5:** Outline patient care and safety while using biomedical equipment.

Mapping of Course Outcomes with Program Outcomes:

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

Components of Medical Instrumentation Systems

Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. Sources of Bioelectric Potentials, Resting and Action Potentials.

UNIT – II

Bio-Potential Electrodes and Physiological Transducers:

Electrode potential and its equivalent circuit, Types of Electrodes: Surface Electrodes, Needle Electrodes, Micro Electrodes. Biochemical Transducers.

Bio-Signal Acquisition:

Electrical Conduction system of the heart, Electrocardiogram, ECG leads, Einthoven triangle, Plethysmography, EEG 10-20 lead system and EMG. basics of biomedical signal acquisition, common signal artifacts and simple noise reduction techniques.

UNIT – III

Clinical laboratory Measurements:

Blood cell Counter, Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter, automated blood pressure measurements.

Physiological Assist Devices & Therapeutic Equipment:

Pacemakers - External & internal, Defibrillators- External & internal, Hemodialysis machine.

UNIT – IV

Monitory and Imaging Equipment:

Spirometry, Ventilators, Arrhythmia Monitor, Foetal Monitor and Incubator. X-ray machine, Computed Tomography (CT), Magnetic Resonance Imaging System, Ultrasound Imaging system.

UNIT – V

Patient Care and Safety:

The elements of Intensive Care Monitor, Diagnosis, Calibration and reparability of Patient Monitoring equipment, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, and Isolated Power Distribution System.

Text Books:

1. Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, *Biomedical Instrumentation and Measurements*.
2nd Edition, PHI, 2004.
2. Dr. M. Arumugam, *Biomedical Instrumentation*. 2nd Edition, Anuradha publications, 2002.

Reference Books:

1. R.S. Khandpur, *Hand-book of Biomedical Instrumentation*. 2nd Edition, TMH, 2003.
2. John G. Webster, *Medical Instrumentation, Application and Design*. John Wiley, 3rd Edition, 2009.
3. Onkar N. Pandey, Rakesh Kumar, *Bio-Medical Electronics and Instrumentation*. 3rd Edition, Katson Books, 2002.

Web Links:

- 1 https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_bt49.
- 2 https://www.youtube.com/watch?v=Qq3t01LytkU&list=PLnsf_0i_t0FC4EdRdhLwjQgp5cYytJ5Oe.

Fundamentals of Wireless Communications
(CE,EEE,ME,CSE,IT,DS,AIIML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code:2501EC98	3	0	0	3

Course Outcomes:

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

- CO1:** Explain the fundamentals of wireless communication systems, spectrum allocation, and wireless standards.
- CO2:** Understand Analog ,digital and multicarrier OFDM modulation techinqies.
- CO3:** Compare multiple access techniques used in wireless communication systems.
- CO4:** Explain the architecture and standards of WPAN, WLAN, and WMAN technologies.
- CO5:** Compare cellular generations and LTE network architecture for modern mobile communications.

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	3	2	1	1						2
CO3	3	3	2								1
CO4	3	2	1	1	1						1
CO5	3	3	2	2	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

Overview of Wireless Communication:

History of wireless communication, Current Wireless Systems: Cellular Telephone Systems, Generations, Cordless Phones, Wireless LANs, Wide Area Wireless Data Services, Broadband Wireless Access, Paging systems, Satellite Networks, Bluetooth, ZigBee, Ultra-wideband Radios. The Wireless Spectrum: Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, Standards.

UNIT – II

Modulation for Wireless Communication:

Need for Modulation, Analog Modulation, Amplitude modulation, Double sideband Supressed carrier, single sideband supressed carrier, Angle modulation, Digital modulation: Amplitude Shift Keying,

Frequency Shift Keying Techniques, Phase-Shift Keying Techniques, BPSK and QPSK. Multicarrier-Modulation, Orthogonal Frequency Division Multiplexing.

UNIT – III

Multiple Access Techniques:

Contention-free multiple access schemes, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Space-division, contention-based multiple access schemes (ALOHA and CSMA).

UNIT – IV

Wireless Personal Area Networks:

Bluetooth, UWB and ZigBee, wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), wireless metropolitan area networks (WiMAX).

UNIT – V

Wireless Mobile Networks and Applications:

Principles of Cellular Networks, First- Generation Analog, Second- Generation TDMA, CDMA, Third- Generation Systems, Fourth Generation Systems, LTE Architecture, Evolved Packet Core, LTE Resource Management.

Text Books:

1. Wireless communications- Goldsmith Andrea, Cambridge university press, 2005, ISBN: 9780511841224.
2. Wireless communication networks and systems-Cory Beard, and William Stallings, Pearson education (Global Edition), 2015, ISBN: 978-1292108728

Reference Books:

1. Wireless Communication the Fundamental and Advanced Concepts-Sanjay Kumar River Publishers, Denmark, 2015 ISBN: 9781000795325
2. Wireless communications: Principles and Practice, 2nd Edition, Theodore S. Rappaport, Pearson education, 2010.
3. Fundamentals of wireless communication.- Tse, David, and Pramod Viswanath. Cambridge university press, 2005.

Web Links:

1. <https://nptel.ac.in/courses/106106167> by Prof. David Koilpillai, IIT Madras
2. <https://nptel.ac.in/courses/117104115> by Aditya K. Jagannatham, IIT Kanpur

Principles Of Embedded Systems
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501EC99	3	0	0	3

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

- CO1:** Summarize the building blocks of an embedded system.
- CO2:** Interpret the hardware modules required to design an embedded system.
- CO3:** Infer the firmware design approaches for an embedded system.
- CO4:** Illustrate the hardware integration with firmware.
- CO5:** Outline the process of embedded system development and choose the tools for embedded system implementation and testing.

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	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Embedded system-Definition, History of Embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system, core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT – II

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, multi processors architectures.

UNIT – III

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, Interrupt sources, ISR concept, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C.

UNIT – IV

RealTime Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

Hardware Software Co-Design:

Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT – V

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation and Testing: The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine.

Text Books:

1. Introduction to Embedded Systems, Shibu.K.V, Tata McGraw Hill Education Private Limited, 2nd Edition, 2016.
2. Embedded Systems – SoC, IoT, AI and Real-Time Systems, Raj Kamal, McGraw Hill Education India 4th Edition, 2020.

Reference Books:

1. Embedded System Design, Frank Vahid and Tony Givargis, John Wiley Publications, 2013.
2. Hardware Software Co-Design Principles and Practice, J.Staunstrup, Springer Publications, 2013
3. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, 3rd Edition, 2013.

Web Links:

1. <https://www.coursera.org/learn/introduction-embedded-systems>
2. <https://www.linkedin.com/learning/introduction-to-embedded-systems-with-rust>
3. <https://www.udemy.com/course/embedded-systems-and-microcontrollers/>

Electronics For Health Care
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA0	3	0	0	3

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

CO1: Know about health care data and its conversion to information and to knowledge.

CO2: Acquire knowledge on (Electronic Health Records) EHRs and their Implementation.

CO3: Understand the working of electronic devices used for the patient monitoring.

CO4: Know the concepts of Telemedicine and therapeutic devices used inside the human body.

CO5: Understand and analyse the working principles, design, and clinical applications of therapeutic devices.

Mapping of Course Outcomes with Program Outcomes:

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

Health care data, Information and Knowledge: Definitions and Concepts, Converting Data to Information to Knowledge, Clinical Data Warehouses, what makes Health Informatics Difficult, Why Health IT fails Sometimes, Terminology of Analytics, Challenges to Data Analytics, Research and application of analytics, Role of Informatics in analytics.

UNIT-II:

Electronic Health Records: Introduction, Need for Electronic Health Records, Institute of Medicine's Vision for EHRs, Electronic Health Record Key Component, Electronic Prescribing, Electronic Health Record Adoption, Electronic Health Record Adoption and Meaningful use Challenges, Electronic Health Record Examples, Logical Steps to Selecting and Implementing an HER.

UNIT-III:

Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors, Measurement of Heart Rate, Measurement of Pulse Rate, Blood Pressure Measurement, Measurement of Temperature, Measurement of Respiration Rate, Catheterization Laboratory Instrumentation.

UNIT-IV:

Biomedical Telemetry and Telemedicine: Wireless Telemetry, Single Channel Telemetry Systems, Multi-channel Wireless Telemetry Systems, Multi-patient Telemetry, Implantable Telemetry Systems, Transmission of Analog Physiological Signals, Over Telephone, Telemedicine.

UNIT-V:

Therapeutic Devices: Need for Cardiac Pacemaker, Implantable Pacemakers, DC Defibrillator, Electronics in the Anaesthetic Machine.

Text Books:

1. Robret E. Hoyt MD FACP “Health Informatics” sixth edition 2007.
2. R. S. Kandpur “Biomedical Instrumentation Technology and Applications” second edition
Tata McGraw-Hill.

Reference Books:

1. Edward H. Shortliffe, James J. Cimino “Biomedical Informatics, Computer applications in
Health care and Biomedicine” third edition Springer.
2. G.V.R.K. Acharyulu, Bhimaraya Metri, L. Kalyan Viswanath REDDY “Health care and
Hospital Management Contemporary Issues and Strategies”.

Web Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge25.
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs82.
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_bt09.

Basics of VLSI Design

(CE,EEE,ME,CSE,IT,DS,AIIML,PT,Min.E, Ag.E)

Course Code: 2501ECA1

L	T	P	C
3	0	0	3

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

- CO1:** Outline the fundamental concepts related to MOS and Bi-CMOS Circuits fabrication.
- CO2:** Analyze the electrical properties of MOS and Bi-CMOS Circuits.
- CO3:** Make use of design rules for developing stick and layout diagrams.
- CO4:** Interpret the issues related to subsystem design.
- CO5:** Interpret FPGA and ASIC design approaches for semi-custom design.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, Bi-CMOS Technology, Comparison between CMOS and Bipolar technologies.

UNIT – II

Basic Electrical Properties of MOS and Bi-CMOS Circuits: I_{ds} versus V_{ds} Relationships, Threshold Voltage, MOS transistor Trans-conductance, Output Conductance and Figure of Merit, The Pass transistor, NMOS Inverter, Alternative forms of the pull-up, The CMOS Inverter, Bi- CMOS Inverter, Transistor switches, Schematics of Inverter, NAND, NOR gates using NMOS, PMOS, and CMOS technologies.

UNIT – III

MOS Circuit Design Processes: MOS Layers, Design Rules, General observations of design rules, 2 μ m Double Metal, Double Poly, CMOS rules, 1.2 μ m Double Metal, Double Poly CMOS rules, Stick Diagrams, Layout Diagrams of NAND and NOR gates and CMOS inverter.

UNIT – IV

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances.

UNIT – V

IC Design: PLAs, PLDs, FPGA, ASIC, Selection of an Appropriate Integrated Circuit.

FPGA Design Process: Architectures of Popular FPGAs, Choosing an FPGA, FPGA Design Process, FPGA Families of Different Vendors, FPGA Design Examples.

Text Books:

1. Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell, Sholeh Eshraghian, Prentice-Hall of India Private Limited, ISBN: 978-8120327726
2. VLSI Design, Black Book by Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc, ISBN: 978-9350048047

Reference Books:

1. **CMOS Digital Integrated Circuits Analysis & Design, Sung-Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw-Hill, 3rd Edition, ISBN: 978-0072460537**
2. **Modern VLSI Design-Wolf Wayne, Pearson Edition, 3rd Edition, ISBN: 978-0130619709**
3. VLSI Design, K. LalKishore, V.S.V.Prabhakar, I.K. International Publishing House Private Limited, 1st Edition, ISBN: 978-9380026671

Web Links:

1. **NPTEL – VLSI Physical Design-** <https://nptel.ac.in/courses/106105161>
2. **NPTEL – Advanced VLSI Design** <https://nptel.ac.in/courses/117/101/117101004>.

System on Chip Design

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA2	3	0	0	3

Course Outcomes:

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

- CO1:** Explain all the building blocks of SoC.
- CO2:** Classify the concept of processors and instruction handling.
- CO3:** Analyze vector, VLIW and superscalar processors.
- CO4:** Develop a Memory as part of SoC.
- CO5:** Illustrate the concepts of interconnect optimization and configuration in SoC.

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to the System Approach:

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT – II

Processors:

Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers:minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT – III

Memory Design for SOC:

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

UNIT – IV

Interconnect Customization:

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor.

UNIT – V

Interconnect Configuration:

Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

Text Books:

1. Computer System Design System-on-Chip, Michael J. Flynn and Wayne Luk, Wiley India Pvt. Ltd, ISBN: 978-0470643365.
2. ARM System on Chip Architecture, Steve Furber, Addison Wesley Professional, 2nd Edition, ISBN : 9780201675191 .

Reference Books:

1. Design of System on a Chip: Devices and Components, Ricardo Reis, Springer 1st Edition, ISBN: 978-1441954541.
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), Jason Andrews, Newnes, BK and CDROM, ISBN: 978-0750677301.
3. System on Chip Verification–Methodologies and Techniques, Prakash Rashinkar, Peter Paterson and Leena Singh L, Kluwer Academic Publishers, ISBN: 978-0792372790.

Web Links:

1. <https://www.peterindia.net/System-On-ChipLinks.html>
2. <https://www.ieee-socc.org/>
3. <http://nptel.ac.in/courses/108102045/10> (Prof. Santanu Chaudhary, IIT Delhi)

Introduction to Quantum Computing

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA3	3	0	0	3

Course Outcomes:

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

CO1: Understand the fundamentals of quantum computing and qubits.

CO2: Build simple quantum circuits.

CO3: Analyze quantum circuits and algorithms.

CO4: Identify different quantum hardware technologies and their challenges.

CO5: Outline real time applications of quantum computing in various fields

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		2	1		1	2
CO3	2		1			2	2	1		2	2
CO4	2	2	3			2	2	2		2	
CO5	3	3	3	2		2	2	3		2	

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamentals of Quantum Computing:

Evolution from Classical Computing to Quantum Computing, Need for Quantum Computing, Classical Bits vs Qubits, Principles of Quantum Mechanics for Computing, Superposition and Measurement, Quantum States and Bloch Sphere Representation, Introduction to Quantum Gates, Quantum Computing Platforms and Ecosystem.

UNIT – II

Quantum Circuits and Computing Concepts:

Quantum Circuit Model, Single Qubit and Multi-Qubit Systems, Common Quantum Gates: Pauli, Hadamard, Phase, CNOT, Quantum Entanglement, Quantum Parallelism, Quantum Teleportation (Conceptual Understanding), Basic Quantum Circuit Design, Introduction to Quantum Simulators.

UNIT – III

Quantum Algorithms:

Introduction to Quantum Algorithms, Deutsch–Jozsa Algorithm, Grover’s Search Algorithm, Shor’s Factorization Algorithm (Overview), Quantum Fourier Transform (Basic Idea), Quantum Speedup and Computational Advantage, Hybrid Quantum-Classical Computing, Introduction to Quantum Machine Learning.

UNIT – IV

Quantum Hardware and Programming:

Overview of Quantum Hardware Technologies: Superconducting Qubits, Trapped Ion Systems, Photonic Quantum Computing. Noise and Decoherence, Quantum Error Correction (Basic Concepts), Introduction to NISQ Devices, Basics of Quantum Programming using Python and Qiskit, Introduction to IBM Quantum Experience.

UNIT – V

Applications of Quantum Computing:

Quantum Cryptography and Cybersecurity, Quantum Computing in Healthcare and Drug Discovery, Optimization Problems and Smart Systems, Quantum in Finance & Logistics, Quantum computing for Industrial Applications and Future Scope, Ethical and Societal Impact of Quantum Technologies.

Text Books:

1. Quantum Computation and Quantum Information – Michael A. Nielsen & Isaac L. Chuang.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, First Edition, 2011.

Reference Books:

1. **Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia**, Programming Quantum Computers: Essential Algorithms and Code Samples, O'Reilly Media, First Edition, 2019.

Web Links:

1. https://quantum.cloud.ibm.com/?utm_source=chatgpt.com
2. <https://quantum.cloud.ibm.com/docs/en/guides>

Data Structures

(CE, ME, PT, Min.E.)

L T P C

Course Code: 2501CS03

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 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:

4. Write a C program to find the total, average of n students using structures
5. Copy one structure variable to another structure of the same type.
6. 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.
<https://www.hackerrank.com/contests/hw1/challenges/merge-sort>
2. Implement Quick sort using arrays
<https://www.hackerrank.com/challenges/quicksort1/problem>

3. Implement Radix Sort using arrays
https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm_source

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.
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source

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
<https://www.hackerrank.com/challenges/balanced-brackets/problem>
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List
<https://leetcode.com/problems/implement-queue-using-stacks/description/>
https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
<https://leetcode.com/problems/design-circular-queue/description/>

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).
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
2. Implement Binary search Tree (BST) Traversals.
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>
3. Graph Traversal using Breadth First Search (BFS)
<https://www.hackerrank.com/challenges/bfsshortreach/problem>
4. Graph Traversal using Depth First Search (DFS)
<https://leetcode.com/problems/number-of-islands/description/>

Text Books:

1. Data Structures using C, Rema Theraja, Oxford University Press, 3rd Edition. ISBN: 978-9354979453
2. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

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, ISBN: 978-0716782506
3. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407
4. 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/data-structures/>
4. <https://www.coursera.org/specializations/data-structures-algorithms>
5. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Structs and enums	https://www.hackerrank.com/challenges/too-high-boxes/problem
2	Easy	Structs and enums	https://www.codechef.com/problems/HS08TEST?tab=statement
3	Medium	Structs and enums	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem
4	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
5	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
6	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
7	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
8	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
9	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
10	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
11	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
12	Medium	Stack	https://leetcode.com/problems/remove-k-digits/description/

		applications	
13	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
14	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
15	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Aditya's Internal coding Platform(Maya)	Code chef	hackerrank	Leet code	Geek for Geeks
Unit-1	3	0	0	0	0	0
Unit-2	0	0	0	3	0	0
Unit-3	0	0	1	0	2	0
Unit-4	0	0	0	1	5	0
Unit-5	0	0	0	4	3	0
Additional Practice	0	0	1	5	8	1
Total	3	0	2	13	18	1

Data Structures using C++

(CE, ME, PT, Min.E.)

(Revised Syllabus for batches admitted from 2026 Onwards)

	L	T	P	C
Course Code: 2601DS02	2	0	2	4

Course Outcomes:

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

- CO1:** Apply C++ features for problem solving.
- CO2:** Apply various sorting techniques to solve computing problems.
- CO3:** Make use of linear data structures to solve real time problems.
- CO4:** Develop applications using Tree data structures.
- CO5:** Solve problems using Graph 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	1	1	1					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	2	-
CO2	2	-
CO3	2	-
CO4	2	-
CO5	2	-

UNIT – I

An Overview of C++: Structure of C++ program, Input and output in C++, Class, Objects, Members Functions, Access Specifiers, Introduction to Constructors and Destructor.

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

Practice:

- Find the roots of a quadratic equation.
- Find factorial of a given number using recursion
- Palindrome Number
<https://leetcode.com/problems/palindrome-number/description/>
- Class and Objects
<https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true>

5. Program to illustrate the use of Constructors and Destructors.
6. C++ Class Templates
<https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true>

UNIT – II

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

Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.

Linked Lists: Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

Practice:

1. Single Linked List: Perform different operations in single linked list.
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source
4. Reversing a Linked List

UNIT – III

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
<https://www.hackerrank.com/challenges/balanced-brackets/problem>
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List
<https://leetcode.com/problems/implement-queue-using-stacks/description/>
https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
<https://leetcode.com/problems/design-circular-queue/description/>

UNIT – IV

Trees: Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.

Binary Search Trees – Definition, Operations: Searching, Insertion, Deletion.

Practice:

1. Implement Binary search tree (BST).

<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>

<https://leetcode.com/problems/delete-node-in-a-bst/description/>

2. Implement Binary search Tree (BST) Traversals.

<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>

<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>

<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>

UNIT – V

Graphs: Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjacency list, Graph Traversals (BFS & DFS), Bi-Connected Components.

Practice:

1. Graph Traversal using Breadth First Search (BFS)

<https://www.hackerrank.com/challenges/bfsshortreach/problem>

2. Graph Traversal using Depth First Search (DFS)

<https://leetcode.com/problems/number-of-islands/description/>

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
2. Fundamentals of Data Structures in C++, Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, ISBN: 81-7515-278-8
3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition, ISBN : 9780133522884.
2. Object oriented programming in C++, Joyce Farrell, Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek, Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

Web Links:

1. <http://nptel.ac.in/courses/106105151/>
2. <https://nptel.ac.in/courses/106102064>
3. <https://archive.nptel.ac.in/courses/106/105/106105225/>
4. <https://www.udemy.com/topic/data-structures/>
5. <https://www.coursera.org/specializations/data-structures-algorithms>
6. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
2	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
3	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
4	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
5	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
6	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
7	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
8	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
9	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
10	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
11	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
12	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Code chef	Hacker rank	Leet code	Geek for Geeks
Unit-1	3	0	2	1	0
Unit-2	0	1	3	2	0
Unit-3	0	0	1	5	0
Unit-4	0	0	3	2	0
Unit-5	0	0	1	1	0
Additional Practice	0	0	3	8	1
Total	3	1	13	19	1

Operating Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

	L	T	P	C
Course Code: 2501CS13	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		
CO2	1	3		1					2		1
CO3	1	3		1					2		1
CO4	1	3		1					1		1
CO5	2	2							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, Open-Source Operating Systems. System Structures: Operating System Services, User and Operating-System 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. Multiprogramming-Memory management-Implementation of fork (), wait (), exec() and exit (), System calls

UNIT – II

Process Concept: Process scheduling, Operations on processes, Inter-process 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: FCFS and SJF
2. Simulate the following CPU scheduling algorithms: Priority and Round Robin

UNIT – III

Inter-process 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 on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped 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: Sequenced, Indexed and 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 William Stallings, Operating Systems: Internals and Design Principles. Prentice-Hall, 7th Edition. 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, Dhamdhere 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 <https://in.udacity.com/auth?next=/course/introduction-to-operating-systems--ud923>

Database Management Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

Course Code: 2501IT05

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO** Describe the Fundamental concepts of DBMS.
- CO** Interpret relational database using SQL.
- CO** Make use of normalization techniques for database design.
- CO** Illustrate the mechanisms of transaction management.
- CO** 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

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

Indexing Techniques: Introduction, 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.

Database Tuning: Introduction, Database Performance Tuning, Query Optimization: Introduction, Query Optimization algorithms, Backup and Recovery.

Practice

1. Create a Primary , Secondary Index on a Column.
2. Retrieve Data Using an Index.
3. Insert Data and Update Indexes.
4. 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. Database Systems, RamezElmasri, Shamkant B. Navathe, 7th Edition, Pearson, ISBN: 978-0137504277.
2. Database Systems, Carlos Coronel, Steven Morris, Peter Rob, 10th Edition, Cengage, ISBN: 978-0357517864.
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/

Computer Networks

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

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

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 Algorithm: 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>

Artificial Intelligence

(CE, EEE, ECE, PT, Min.E.)

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 foundations, history, and applications of Artificial Intelligence using modern tools
- CO2:** Develop AI-based problem-solving models using Python
- CO3:** Implement search and optimization algorithms using Python libraries
- CO4:** Apply knowledge representation techniques using Python frameworks
- CO5:** Design simple intelligent systems and expert systems using Python

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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 to AI & Python Foundations

What is AI? Foundations and History of AI, AI Applications in real-world systems, Intelligent Agents and Environment, Rationality and Types of Agents, Fundamentals of Python for AI applications.

Practice (Python-based):

1. Implement simple AI agent (e.g., vacuum cleaner agent simulation)
2. Rule-Based AI Agent (Weather Decision Agent)

Unit – II

Problem Solving & Search Algorithms

Problem formulation and state space representation, Control strategies, Search strategies, Uninformed Search: BFS, DFS, Uniform Cost Search, Informed Search: Greedy, A* Algorithm, Heuristics and evaluation functions.

Practice (Python):

1. Implement DFS algorithm for Water Jug Problem
2. Solve Tic-Tac-Toe using BFS search strategy.
3. Implement A* Algorithm for pathfinding (e.g., grid navigation)

Unit – III

Optimization & Game Playing

Problem graphs, Matching, Indexing, Local Search Algorithms: Hill Climbing, Simulated Annealing, Optimization Problems, Searching with Nondeterministic Actions, Constraint Satisfaction Problems (CSP), Game Playing: Minimax Algorithm, Alpha-Beta Pruning

Practice (Python):

1. Solve 8-Puzzle using Hill Climbing
2. Implement Travelling Salesman Problem (TSP) using heuristic approach

Unit – IV

Knowledge Representation

Knowledge Representation Techniques, Propositional Logic & Predicate Logic, Inference & Resolution, Semantic Networks and Frames, Representation of knowledge through Planning generation Systems-K Strips Strategic explanations Why, why not and how explanations.

Practice (Python):

1. a) Implement Predicate Logic using Python (SymPy / logic module)
b) Develop a Semantic Network (e.g., Animals or Transport)
2. Create a Frame-based system (Restaurant domain)

Unit – V

Expert Systems & Modern AI Applications

Expert Systems Architecture, Knowledge Acquisition & Representation, Meta knowledge, Rule-based Systems, Ethics in AI, Typical expert systems – EMYCIN, DART, XOON, Expert systems shells.

Practice (Python):

1. Build a Travel Recommendation Expert System
2. Develop a Student Career Guidance System

Text Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig (need to add details)
2. Artificial Intelligence: Foundations of Computational Agents – Poole & Mackworth

Reference Books

1. Artificial Intelligence with Python – Prateek Joshi
2. Hands-On Machine Learning with Scikit-Learn & TensorFlow – Aurélien Géron
3. Python AI Projects for Beginners – Prateek Joshi

Web Resources

1. <https://docs.python.org>
2. <https://nptel.ac.in/courses/106105077>
3. <https://nptel.ac.in/courses/106106126>

Machine Learning (CE, ECE, PT, Min.E.)

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	PO3	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 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.

Corner Stone Project:

PROJECT 1: Intelligent Loan Risk Assessment System (End-to-End ML Pipeline)

Project Implementation, Documentation and Viva Voce

• Implementation mainly focuses on

- Collecting and integrating multiple datasets (loan + financial history)
- Advanced preprocessing (missing values, outliers, feature engineering)
- Implementing multiple models (Logistic Regression, Random Forest, XGBoost)
- Handling imbalanced data (SMOTE / resampling techniques)
- Model evaluation using ROC-AUC, F1-score, cross-validation
- Building a simple UI (Streamlit/Web app) for predictions
- Model comparison and optimization

• Documentation must contain

- Objective & real-world problem definition
- Dataset merging and preprocessing pipeline
- Feature engineering techniques
- Model comparison and evaluation metrics
- System architecture diagram
- Screenshots (UI + outputs)

- Enhancements (hyperparameter tuning, deployment)

PROJECT 2: Smart Disease Prediction System with Model Ensemble

• Implementation mainly focuses on

- Using medical datasets (heart disease/diabetes/multi-disease)
- Data preprocessing and feature selection
- Applying multiple classifiers (SVM, kNN, Random Forest, Gradient Boosting)
- Ensemble learning (Voting / Stacking models)
- Model evaluation using confusion matrix, ROC curves
- Explainability (feature importance / SHAP basics)
- Web-based prediction interface

• Documentation must contain

- Objective
- Dataset and preprocessing steps
- Model architecture and ensemble approach
- Evaluation metrics and comparison
- Screenshots (prediction system)
- Enhancements (multi-disease prediction)

PROJECT 3: Real-Time Sentiment Analysis System with Web Scraping

• Implementation mainly focuses on

- Scraping live data (Twitter/news using APIs or scraping tools)
- Text preprocessing (stopwords, stemming, vectorization – TF-IDF)
- Training models (Naïve Bayes, Logistic Regression, LSTM optional)
- Real-time sentiment prediction
- Visualization dashboard (charts for sentiment trends)
- Handling large-scale streaming data

• Documentation must contain

- Objective
- Data collection methodology (APIs/web scraping)
- NLP preprocessing pipeline
- Model building and evaluation
- Dashboard explanation
- Screenshots
- Enhancements (real-time alerts, topic modeling)

PROJECT 4: Heart Disease Prediction using SVM

• Implementation mainly focuses on

- Loading patient dataset
- Applying Support Vector Machine (SVM)
- Data preprocessing and feature scaling
- Classification of patients (disease/no disease)
- Model evaluation using confusion matrix

- **Documentation must contain**

- Objective
- Dataset description
- SVM working principle
- Evaluation metrics
- Output results
- Screenshots
- Enhancements (kernel comparison)

PROJECT 5: Customer Segmentation using Clustering

- **Implementation mainly focuses on**

- Loading customer dataset
- Applying K-Means clustering
- Identifying groups based on features
- Visualizing clusters using plots
- Comparing clustering results

- **Documentation must contain**

- Objective
- Dataset details
- Clustering technique explanation
- Cluster visualization
- Results interpretation
- Screenshots
- Enhancements (DBSCAN comparison)

PROJECT 6: Fake News Detection System using Machine Learning

- **Implementation mainly focuses on**

- Dataset collection (news datasets / scraping)
- Text preprocessing (tokenization, TF-IDF, n-grams)
- Applying classification models (Logistic Regression, SVM, Random Forest)
- Model evaluation using precision, recall, F1-score
- Comparing multiple models
- Building a simple interface for prediction

- **Documentation must contain**

- Objective
- Dataset description
- NLP pipeline
- Model comparison
- Evaluation metrics
- Screenshots
- Enhancements (deep learning models)

PROJECT 7: Sentiment Analysis using Ensemble Learning

- **Implementation mainly focuses on**

- Collecting dataset (Twitter/Kaggle)

- Text preprocessing
- Applying Bagging and Boosting techniques
- Training ensemble models (Random Forest / AdaBoost)
- Predicting sentiment (positive/negative)

• **Documentation must contain**

- Objective
- Dataset source
- Preprocessing steps
- Ensemble methods explanation
- Performance comparison
- Screenshots
- Enhancements (real-time data analysis)

PROJECT 8: Model Evaluation and Comparison System

• **Implementation mainly focuses on**

- Implementing multiple models (kNN, SVM, Regression)
- Performing cross-validation
- Calculating accuracy, precision, recall, F1-score
- Comparing model performance
- Visualizing results using graphs

• **Documentation must contain**

- Objective
- Models used
- Evaluation metrics explanation
- Comparison results
- Graphs and charts
- Screenshots
- Enhancements (hyperparameter tuning)

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

Note:

- Students must submit the Certificate of Completion offered by any Industry.
- The capstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The SEE – Lab shall be evaluated for 50 marks based on project implementation, oral presentation, 10-minute video presentation, and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.

Fundamentals of Data Science (CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

Course Code: 2501CS34

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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	

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	2	
CO2	1	
CO3	2	
CO4	2	
CO5	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 Scrapping, 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, ISBN:978-1-449-31979-3, 1st edition, ISBN · 9781449319793.
- 2 Doing Data Science ,Rachel Schutt & O'neil, O'REILLY, ISBN:978-1-449-35865-5, 1st edition, ISBN: 9781449358655.

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 ,Matt Harrison, Analysis, and Visualization , O'Reilly. ISBN: 9781787123137

Web Links:

- 1 https://onlinecourses.nptel.ac.in/noc24_cs68/preview
- 2 https://onlinecourses.nptel.ac.in/noc24_cs133/preview
- 3 <https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/>