B. TECH. PROGRAM CURRICULUM - 2025

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

Version 2.0

PETROLEUM TECHNOLOGY

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 06-06-2026 & Academic Council meeting on 20-06-2026

ADITYA UNIVERSITY

Aditya Nagar, ADB Road, Surampalem - 533 437

Department of Petroleum Technology

Department Vision

To be a globally recognized centre of excellence in petroleum engineering education, fostering research, innovation, and sustainable solutions.

Department Mission

M1: Provide transformative learning through practice, and industry collaboration.

M2: Advance in impactful research through innovation and technology.

M3: Apply sustainable practices to address global resource and environmental challenges.

Program Educational Objectives (PEOs)

Graduates of the Program will

PEO 1: Pursue lifelong learning and growth in petroleum and related fields.

PEO 2: Develop solutions for petroleum industry challenges in exploration, production, and management.

PEO 3: Demonstrate research ability, teamwork, and leadership.

Program Specific Outcomes (PSOs)

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

PSO 1: Solve exploration and production problems using modern tools.

PSO 2: Design and optimize petroleum processing systems and equipment.

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 Petroleum Technology

B. Tech (PT) Program Curriculum-2025

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

UG Programs Offered

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

- Minor Stream in Pipeline and Petroleum Transport Engineering
- Minor Stream in Fire and Safety in Petroleum Industries

VISION & MISSION OF THE UNIVERSITY

VISION:

To be a globally recognized University through excellence in Education, Innovation, and Sustainable growth

MISSION:

M1: Deliver collaborative education to prepare students for global challenges through transformative learning

M2: Vibrant research ecosystem, innovation, and sustainable growth.

M3: Sustainable and inclusive community, global challenges.

VISION & MISSION OF THE DEPARTMENT

VISION:

To gain global recognition in petroleum education in research excellence, innovation, and sustainable solutions.

MISSION:

M1: Offer transformative learning for lifelong growth in petroleum engineering**.**

M2: Drive impactful research in innovation, and technology.

M3: Empower students to tackle global challenges in resource and environmental sustainability.

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the Program will

PEO 1: Pursue continuous professional growth through self-learning and further education in Petroleum and related fields.

PEO 2: Use engineering skills, critical thinking, and problem-solving to address societal, technical, and business challenges.

PEO 3: Demonstrate research skills, team spirit or leadership qualities**.**

PROGRAM OUTCOMES (POs)

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

PO 1 **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO 2 **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO 3 **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO 4 **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO 5 **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO 6 **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO 7 **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO 8 **Individual and Collaborative Team work**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO 9 **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective

reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO 10 **Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO 11 **Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUTCOMES (PSOs)

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

PSO 1: Solve petroleum technology problems using analytical methods, modern tools, and techniques.

PSO 2: Design, operate, maintain, and troubleshoot petroleum process equipment.

Credit Division Category-wise

S. No.	Broad Category of Course	UGC	Credits
1	Major (Core) 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)	09	09
4	Ability Enhancement Courses (AEC)	08	09
5	Skill Enhancement Courses (SEC)	09	09
6	Value Added Courses (VAC)	6-8	04
7	Summer Internship (SI)	2-4	04
8	Full Semester Internship (PROJ)	12	12
9	Mandatory Course (MC)	00	00
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
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501PT06	Geology & Sedimentology for Petroleum Engineers	FC	1	1	2	4	50	50	100	-
2501PT10	Petroleum Geology & Exploration Techniques	FC	1	1	2	4	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2		1	3	50	50	100	LA&C
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	-
2501MA06	Complex Variables & Statistical Methods	IC	2	1		3	50	50	100	-
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	FC			2	2	50	50	100	-
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	FC	2		2	4	50	50	100	BIL
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100	-	100	-
2501PT01	Drilling Engineering	IC	2		2	4	50	50	100	GSPE & PGET
2501PT04	Fluid Mechanics for Petroleum Engineers	IC	1	1	2	4	50	50	100	-
2501PT09	Petroleum Formation Evaluation	IC	1	1		2	50	50	100	PGET
2501PT08	Instrumentation & Process Control	IC	2		2	4	50	50	100	-
2501PT05	Fundamentals of Liquefied Natural Gas	IC	3			3	50	50	100	FMPE
2501PT02	Elements of Reservoir Engineering	IC	2		2	4	50	50	100	GSPE

2501PT11	Petroleum Production Engineering	IC	1	1		2	50	50	100	ERE
2501PT12	Petroleum Refinery Engineering	IC	3			3	50	50	100	PPE
2501PT07	Heat Transfer in Petroleum Operations	IC	1	1	2	4	50	50	100	FMPE
2501PT14	Safety & Environmental Engineering Practices in Petroleum Industry	IC	2			2	50	50	100	-
2501PT17	Well Workover & Stimulation	AC	1	1		2	50	50	100	ERE
2501PT13	Reservoir Modelling & Simulation	AC	1	1	2	4	50	50	100	ERE
2501PT15	Surface Production Operations	IC	2			2	50	50	100	-
2501PT16	Unconventional Hydrocarbon Resources	AC	1	1		2	50	50	100	ERE
2501PT03	Enhanced Oil Recovery	AC	2	1		3	50	50	100	PPE
Total			**42**	**13**	**26**	**81**				

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE01	Basic Electrical & Electronics Engineering	FC	2		2	4	50	50	100	-
2501MB02	Engineering Economics	IC	3			3	50	50	100	-
2501MB03	Management Science	AC	2			2	50	50	100	-
	Total		**7**		**2**	**9**				

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EN01	Essential Cognitive Skills for Engineers	FC			1	1	100	-	100	-
2501EN02/ 2501UC05/ 2501UC04/ 2501UC03/ 2501UC06	Advanced Cognitive Skills for Engineers **(or)** Proficiency in Foreign Language ((Japanese/ German/ French/ Spanish)	FC			1	1	100	-	100	-
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	-
2501PT52	Student Activity Based Learning	AC			2	2	100	-	100	-
Total			**2**		**7**	**9**				

Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT19	MATLAB For Petroleum Engineers Lab	IC			2	2	50	50	100	-
2501PT51	Well Control and Pressure Control Lab	IC			1	1	100	-	100	-
2501PT20	Petroleum Equipment Design and Simulation Lab	IC			2	2	50	50	100	SPO
2501PT18	Drilling Simulation Lab	AC			2	2	50	50	100	-
2501PT21	Unit Operations Using SCI Lab	AC			2	2	50	50	100	FMPE & HTPO
Total					**9**	**9**				

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS02	Data Analysis Using Python	IC			2	2	50	50	100	PPSC
2501CS04	Internet of Things	FC			1	1	50	50	100	-
2501UC11	Employability Skills-I	FC			3	0	100	-	100	-
2501UC13	Employability Skills-II	FC			3	0	100	-	100	ES-I
2501UC14	Employability Skills-III	IC			3	0	100	-	100	ES-II
2501UC15	Employability Skills-IV	IC			3	0	100	-	100	ES-III
2501UC16	Employability Skills-V	AC			3	1	100	-	100	ES-IV
Total					**18**	**4**				

Summer Internships (SI)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT22	Summer Internship-I	IC			2	2	100	-	100	-
2501PT23	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
2501PT24	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**				

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 Stream Courses (MSC)

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	-
2501PT34	Transportation of Petroleum Products	FC	3			3	50	50	100	-
2501PT31	Pipeline Engineering	FC	3			3	50	50	100	-
2501PT29	Operational & Maintenance of Pipelines	IC	3			3	50	50	100	PE
2501PT26	Flow Assurance	IC	2			2	50	50	100	IPE
2501PT28	Midstream Project Economic Analysis	IC	3			3	50	50	100	TPP
2501PT33	Storage & Transportation of Crude oil & Natural Gas	IC	3			3	50	50	100	TPP & UOPI
2501PT25	Data Analytics & AI For Process Industry	IC	3			3	50	50	100	UOPI
2501PT30	Petroleum Economics Polices & Regulations	AC	3			3	50	50	100	MPEA
2501PT32	Pipeline Project Management	AC	3			3	50	50	100	OMP
Total			**32**			**32**				

Pipeline and Petroleum Transport Engineering:

Fire and Safety in Petroleum Industries:

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT39	Fundamentals of Petroleum Engineering	FC	2			2	50	50	100	-
2501PT38	Fire Risk & Control	FC	3			3	50	50	100	-
2501PT41	Occupational Health & Safety	FC	3			3	50	50	100	-
2501PT45	Statutory Rules & Regulation	FC	3			3	50	50	100	-
2501PT36	Advances In Sustainable Development	IC	3			3	50	50	100	OHS
2501PT40	Hazard Identification & Risk Assessment	IC	3			3	50	50	100	OHS
2501PT46	Structural Fire Protection System	IC	3			3	50	50	100	FRC
2501PT42	Process Safety & Security	IC	3			3	50	50	100	OHS
2501PT44	Safety In Engineering Industry	AC	3			3	50	50	100	HIRA
2501PT43	Safety In Drilling	AC	3			3	50	50	100	HIRA
2501PT37	Disaster Risk Management	AC	3			3	50	50	100	-
Total			**32**			**32**				

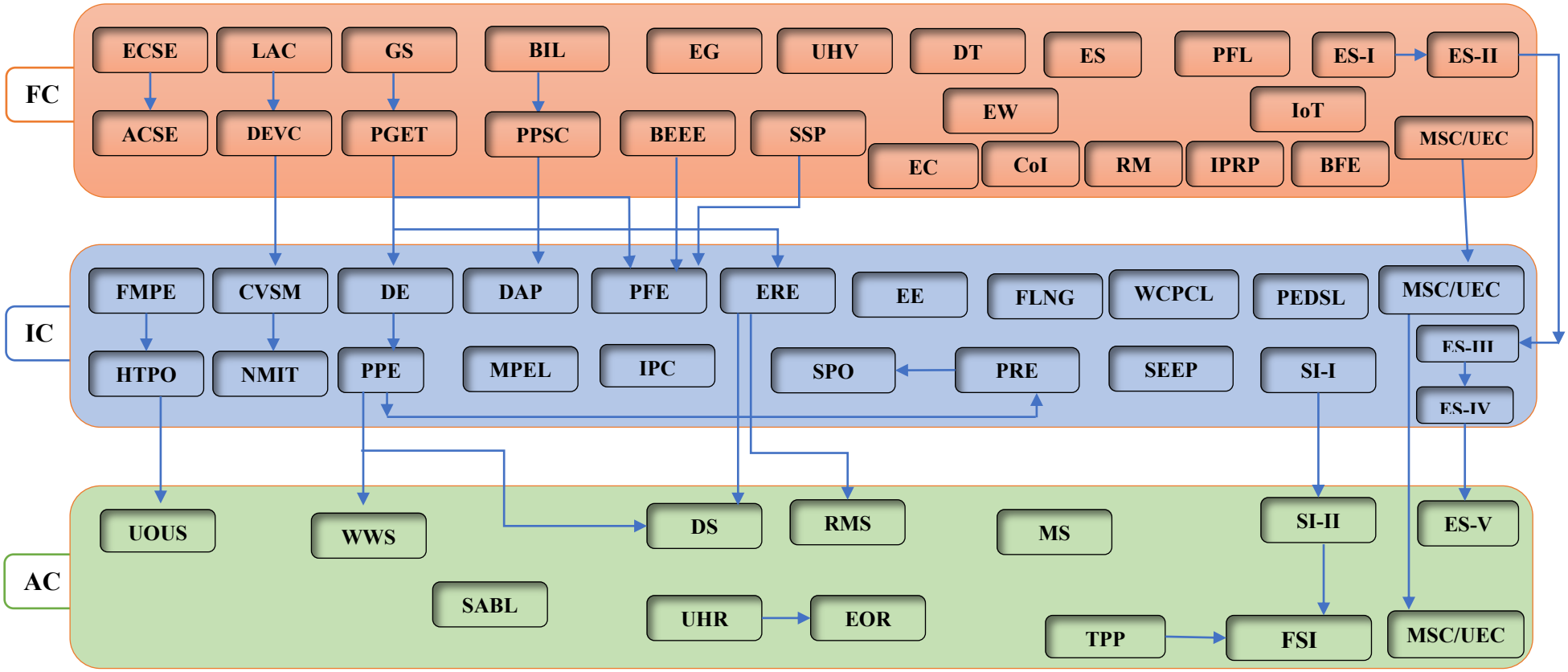
UNIVERSITY OPEN ELECTIVE COURSE S (UEC)

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 C 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

B. TECH (PT) PROGRAM CURRICULUM
PRE-REQUISITE FLOW CHART



FC: Foundation Courses

LAC: Linear Algebra & Calculus
DEVC: Differential Equations & Vector Calculus
GS: Geology & Sedimentology for Petroleum Engineers
PGET: Petroleum Geology & Exploration Techniques
EC: Engineering Chemistry
SSP: Solid State Physics
PPSC.: Programming for Problem Solving Using C
BIL: Business Intelligence Lab
BEEE: Basic Electrical & Electronics Engineering
ECSE: Essential Cognitive Skills for Engineers
ACSE: Advanced Cognitive Skills for Engineers
PFL: Proficiency in Foreign language
DT: Design Thinking using AI
UHV: Universal Human Values
EG: Engineering Graphics
EW: Engineering Workshop
IoT: Internet of Things
ES: Environmental Science
CoI: Constitution of India
RM: Research Methodology
IPRP: Intellectual Property Rights & Patents
BFE: Biology for Engineers
ES-I: Employability Skills-I
ES-II: Employability Skills-II
MSC/UEC: Minor Stream Course / University Elective Courses

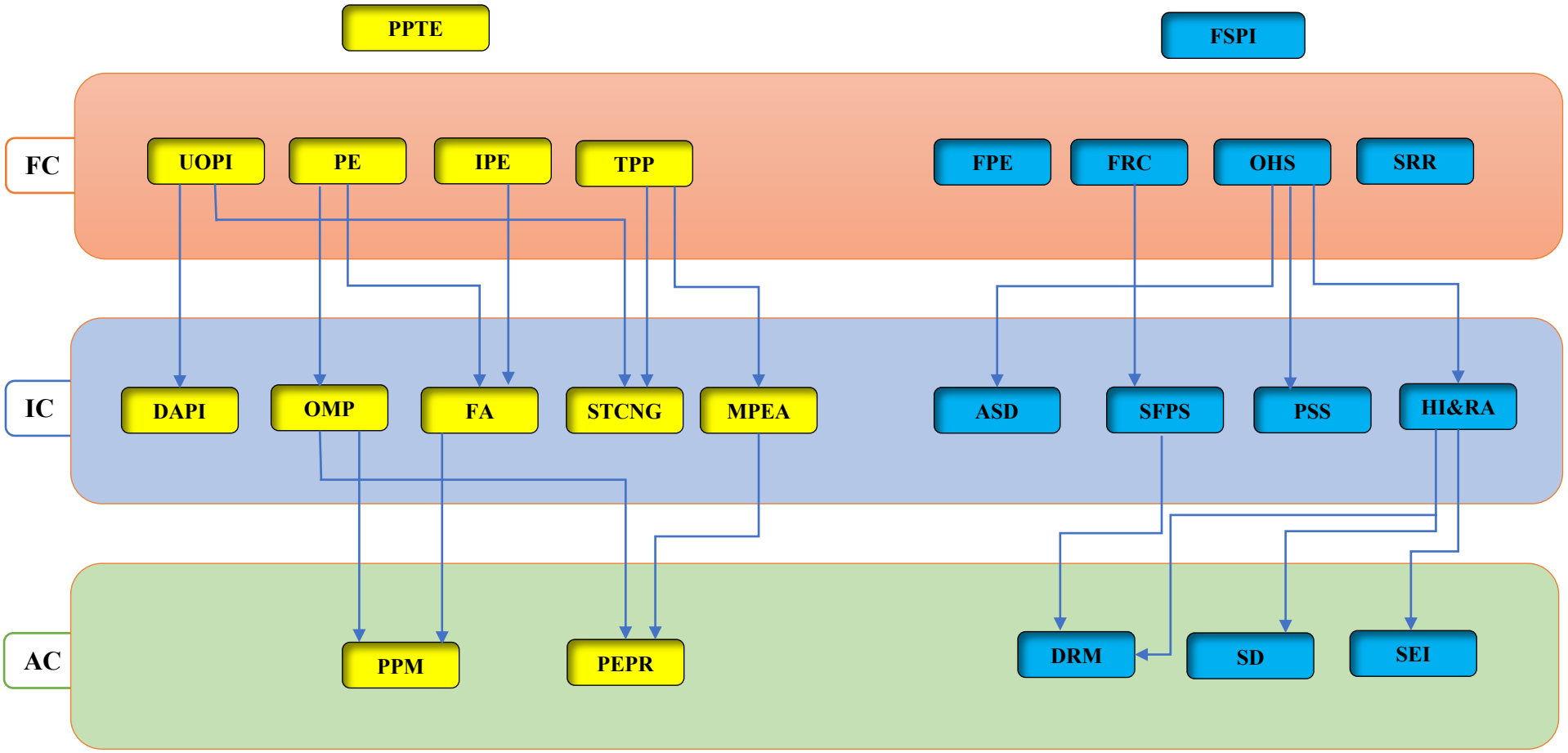
IC: Intermediate-level Courses

NMIT: Numerical Methods & Integral Transforms
EE: Engineering Economics
DE: Drilling Engineering
FMPE: Fluid Mechanics for Petroleum Engineers
HTPO: Heat Transfer in Petroleum Operations
DAP: Data Analysis Using Python
CVSM: Complex Variables & Statistical Methods
PFE: Petroleum Formation Evaluation
IPC: Instrumentation & Process Control
FLNG: Fundamentals of Liquefied Natural gas
ERE: Elements of Reservoir Engineering
WCPCL: Well Control & Pressure Control Lab
MPEL: MATLAB for Petroleum Engineers Lab
PEDSL: Petroleum Equipment Design & Simulation Lab
SI-I: Summer Internship-I
PPE: Petroleum Production Engineering
PRE: Petroleum Refinery Engineering
SEEP: Safety & Environmental Engineering Practices in Petroleum Industry
SPO: Surface Production Operations
ES-III: Employability Skills-III
ES-IV: Employability Skills-IV

AC: Advanced Courses

DSL: Drilling Simulation Lab
MS: Management Science
WWS: Well Workover & Stimulation
RMS: Reservoir Modelling & Simulation
UOUS: Unit Operations Using SCI Lab
UHR: Unconventional Hydrocarbon Resources
EOR: Enhanced Oil Recovery
SI-II: Summer Internship-II
TPP: Technical Paper Publication
FSI: Full Semester Internship
ES-V: Employability Skills-V
SABL: Student Activity Based Learning

B. TECH (PT) MINOR STREAM COURSES
PRE-REQUISITE FLOW CHART



Minor Stream	Foundation Courses		Intermediate Level Courses		Advanced Courses	
PPTE: Pipeline and Petroleum Transport Engineering	**UOPI**	Unit Operations in Petroleum Industry	**DAPI**	Data Analytics & AI for Process Industry	**PPM**	Pipeline Project Management
	PE	Pipeline Engineering	**OMP**	Operational & Maintenance of Pipelines	**PEPR**	Petroleum Economics Polices & Regulations
	IPE	Introduction to Petroleum Engineering	**FA**	Flow Assurance		
	TPP	Transportation of Petroleum Products	**STCNG**	Storage & Transportation of Crude oil & Natural Gas		
			MPEA	Midstream Project Economic Analysis		
FSPI: Fire and Safety in Petroleum Industries	**FPE**	Fundamentals of Petroleum Engineering	**ASD**	Advances In Sustainable Development	**DRM**	Disaster Risk Management
	FRC	Fire Risk & Control	**SFPS**	Structural Fire Protection System	**SD**	Safety In Drilling
	OHS	Occupational Health & Safety	**PSS**	Process Safety & security	**SEI**	Safety In Engineering Industry
	SRR	Statutory Rules & Regulation	**HI&RA**	Hazard Identification & Risk Assessment		

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
2501PT06	Geology & Sedimentology for Petroleum Engineers	MCC	FC	1	1	2	4	6
2501ME01	Engineering Graphics	MCC	FC	1		2	3	5
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	MCC	FC			2	2	4
2501ME03	Engineering Workshop	MCC	FC			1	1	2
2501EN01	Essential Cognitive Skills for Engineers	AEC	FC			1	1	2
2501UC07	Design Thinking using AI	AEC	FC			1	1	2
Total				**6**	**2**	**10**	**18**	**28**

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
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	MCC	FC	2		2	4	6
2501PT10	Petroleum Geology & Exploration Techniques	MCC	IC	1	1	2	4	6
2501EE01	Basic Electrical & Electronics Engineering	MDC	FC	2		2	4	6
2501MB03	Management Science	MDC	AC	2			2	2
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	0	3
2501AC01	Environmental Science	MC	FC				0	2
Total				**13**	**2**	**11**	**23**	**36**

III SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA06	Complex Variables & Statistical Methods	MCC	IC	2	1		3	3
2501PT04	Fluid Mechanics for Petroleum Engineers	MCC	IC	1	1	2	4	6
2501PT08	Instrumentation & Process Control	MCC	IC	2		2	4	6
-	Minor Stream Course - 1 / University Open Elective Course - 1	MSC / UEC	FC/ IC	2			2	2
-	Minor Stream Course - 2 / University Open Elective Course -2	MSC / UEC	FC/ IC	3			3	3
2501MB02	Engineering Economics	MDC	IC	3			3	3
2501UC13	Employability Skills -II	VAC	FC			3	0	3
2501AC02	Constitution of India	MC	FC					2
Total				**13**	**2**	**7**	**19**	**28**

IV SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA05	Numerical Methods & Integral Transforms	MCC	IC	2	1		3	3
2501PT07	Heat Transfer in Petroleum Operations	MCC	IC	1	1	2	4	6
2501PT05	Fundamentals of Liquefied Natural gas	MCC	IC	3			3	3
2501PT02	Elements of Reservoir Engineering	MCC	IC	2		2	4	6
-	Minor Stream Course - 3 / University Open Elective Course - 3	MSC / UEC	IC/ AC	3			3	3
2501PT51	Well Control and Pressure Control Lab	SEC	IC			1	1	2
2501PT19	MATLAB For Petroleum Engineers Lab	SEC	IC			2	2	4
2501CS02	Data Analysis Using Python	VAC	FC			1	1	2
2501UC14	Employability Skills -III	VAC	IC			3	0	3
2501AC03	Research Methodology	MC	FC				0	2
Total				**11**	**2**	**11**	**21**	**34**

V SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501PT09	Petroleum Formation Evaluation	MCC	IC	1	1		2	2
2501PT01	Drilling Engineering	MCC	IC	2		2	4	6
2501PT11	Petroleum Production Engineering	MCC	IC	1	1		2	2
2501PT15	Surface Production Operations	MCC	IC	2			2	2
-	Minor Stream Course – 4 / University Open Elective Course -4	MSC / UEC	IC/ AC	3			3	3
-	Minor Stream Course - 5 / University Open Elective Course - 5	MSC / UEC	IC/ AC	3			3	3
-	Minor Stream Course – 6 / University Open Elective Course -6	MSC / UEC	IC/ AC	3			3	3
2501PT18	Drilling Simulation Lab	SEC	AC			2	2	4
2501CS04	Internet of Things	VAC	FC			1	1	2
2501UC15	Employability Skills -IV	VAC	IC			3	0	3
2501PT22	Summer Internship-I	SI	IC			2	2	4
2501AC04	Intellectual Property Rights & Patents	MC	FC				0	2
	Total			**15**	**2**	**10**	**24**	**36**

VI SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501PT14	Safety & Environmental Engineering Practices in Petroleum Industry	MCC	IC	2			2	2
2501PT17	Well Workover & Stimulation	MCC	AC	1	1		2	2
2501PT13	Reservoir Modelling & Simulation	MCC	AC	1	1	2	4	6
2501PT12	Petroleum Refinery Engineering	MCC	IC	3			3	3
-	Minor Stream Course - 7 / University Open Elective Course – 7	MSC / UEC	IC/ AC	3			3	3
-	Minor Stream Course – 8 / University Open Elective Course -8	MSC / UEC	IC/ AC	3			3	3
2501PT20	Petroleum Equipment Design & Simulation Lab	SEC	IC			2	2	4
2501AC05	Indian Knowledge Systems	MC	FC				0	2
	Total			**13**	**2**	**4**	**19**	**25**

VII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501PT16	Unconventional Hydrocarbon Resources	MCC	AC	1	1		2	2
2501PT03	Enhanced Oil Recovery	MCC	AC	2	1		3	3
-	Minor Stream Course - 9 / University Open Elective Course – 9	MSC / UEC	IC/ AC	3			3	3
-	Minor Stream Course – 10 / University Open Elective Course -10	MSC / UEC	IC/ AC	3			3	3
-	Minor Stream Course – 11/ University Open Elective Course -11	MSC / UEC	IC/ AC	3			3	3
2501PT21	Unit Operations Using SCI Lab	SEC	AC			2	2	4
2501PT23	Summer Internship-II	SI	AC			2	2	4
	Total			**12**	**2**	**4**	**18**	**22**

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
2501PT52	Student Activity Based Learning	AEC	AC			2	2	4
2501PT24	Full Semester Internship	PROJ	AC			12	12	24
	Total					**19**	**17**	**35**

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 Petroleum Technology (offered to other branches students)

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		1	1		2				
2501PT05	Fundamentals of Liquefied Natural Gas **(or)**	IC	3			3	50	50	100	-
2501PT49	Natural Gas Hydrates	AC	3			3				
2501PT50	Artificial Lift Techniques **(or)**	AC	3			3	50	50	100	-
2501PT03	Enhanced Oil Recovery		2	1		3				
2501PT12	Petroleum Refinery Engineering	AC	3			3	50	50	100	-
Total			**18**	**2**		**20**				

Minor Degree in Civil Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CE25	Repair & Rehabilitation of Structures	FC	3			3	50	50	100	-
2501CE43	Building Planning & Computer-Aided Drawing	FC			2	2	50	50	100	-
2501CE27	Green Buildings	FC	3			3	50	50	100	-
2501CE40	Fundamentals of Soil Behaviour	FC	2	1		3	50	50	100	-
2501CE54	Railway Engineering (or) Docks & Harbour Engineering	FC	3			3	50	50	100	-
2501CE47										
2501CE36	Environmental Impact & Risk Management (or) Environmental Management	IC	3			3	50	50	100	-
2501CE37										
2501CE56	Urban Transportation Planning (or) Intelligent Transportation Systems	IC	3			3	50	50	100	-
2501CE49										
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) Utilization of Electrical Energy	IC	3			3	50	50	100	EPGDS / BEEE/ ISM
2501EE27										
2501EE37	Hybrid Electric Vehicles (or) Special Electric machines	AC	3			3	50	50	100	FPE/ OCEM
2501EE35										
2501EE43	Electrical Safety (or) Methods & Algorithms for Intelligent Control	AC	3			3	50	50	100	EPGDS/PSA
2501EE30										
	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) Mechanics of Solids	IC	3			3	50	50	100	SSP/ MP
2501ME78										
2501ME12	Heat Power Engineering (or) Refrigeration & Air Conditioning	IC	2	1		3	50	50	100	ETD
2501ME40										
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) Advanced Engineering Metrology	AC	3			3	50	50	100	SSP/ MP
2501ME80										
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
241EC87	Fundamentals of Communications	FC	2		1	3	50	50	100	-
241EC88	Fundamentals of Signal Processing	FC	2		1	3	50	50	100	-
241EC89	Analog & Digital Circuits	IC	2			2	50	50	100	BEEE
241EC42	Wireless LAN's & PAN's	IC	3			3	50	50	100	-
241EC90 / 241EC91	Linear & Digital IC Applications (or) Sensors and Actuators	IC	3			3	50	50	100	ADC
241EC92 / 241EC93	Embedded Microcontrollers (or) Digital System Design	IC	2		1	3	50	50	100	ADC, PPSC
241EC67	Introduction to Internet of Things (or) Modern Wireless Communications	AC	2		1	3	50	50	100	EM, WLANS&PANS
241EC74			3			3	50	50	100	FC
Total			**16**		**4**	**20**				

Minor Degree in Computer Science and Engineering

Course Code	Course Name	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 / 2501IT06	Object Oriented Programming through C++ (or) Java Programming	IC	2		2	4	50	50	100	PPSC
2501CS16	Introduction to MERN Stack Development (or) Information Security Analysis & Audit	IC			2	2	50	50	100	JP
2501CS30			2			2	50	50	100	-
2501CS18	Advanced MERN Stack Development (or) Flutter Fundamentals	AC			2	2	50	50	100	IMSD
2501IT12					2	2	50	50	100	-
Total			**12**		**8**	**20**				

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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) Business Intelligence & Analytics	IC	2		1	3	50	50	100	PPSC
2501CS36										
2501AI04	Big Data Analytics (or) Data Visualization Techniques	AC	2		1	3	50	50	100	DM
2501AI48										DAP
2501CS41	Social Network Analysis (or) Social Networks & Semantic Web	AC	2		1	3	50	50	100	
2501CS40										
Total			**13**		**7**	**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) Fundamentals of Data Science	IC	2		1	3	50	50	100	AI
2501CS34		IC	2		1	3	50	50	100	PPSC
2501AI47	Natural Language Processing and Text Analytics (or) Data Visualization Techniques	AC	2		1	3	50	50	100	DAP
2501AI48										
2501AI16	Prompt Engineering & GenAI (or) Social Network Analysis	AC	2		1	3	50	50	100	ML
2501CS41										
2501AI17	Federated Machine Learning	AC	2			2	50	50	100	ML

Total	14		6	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 2501MN08	Underground Coal Mining Technology (or) Underground Metal Mining Technology	IC	3			3	50	50	100	DMD
2501MN14 2501MN28	Mine Legislation & General Safety (or) Environmental Pollution & Control	AC	3			3	50	50	100	UCMT / UMMT
2501MN45 2501MN46	Industrial Safety Practices (or) Ground Control	AC	2			2	50	50	100	-
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	0	0	3	50	50	100	-
2501AE83	Post-harvest Engineering of Cereal Crops	FC	3	0	0	3	50	50	100	-
2501AE84	Ground Water Hydrology	FC	3	0	0	3	50	50	100	-
2501AE85	Micro Irrigation Systems	IC	2	0	0	2	50	50	100	-
2501AE86 2501AE87	Surface Water Hydrology (or) Land & Water Management Engineering	IC	3	0	0	3	50	50	100	GWH

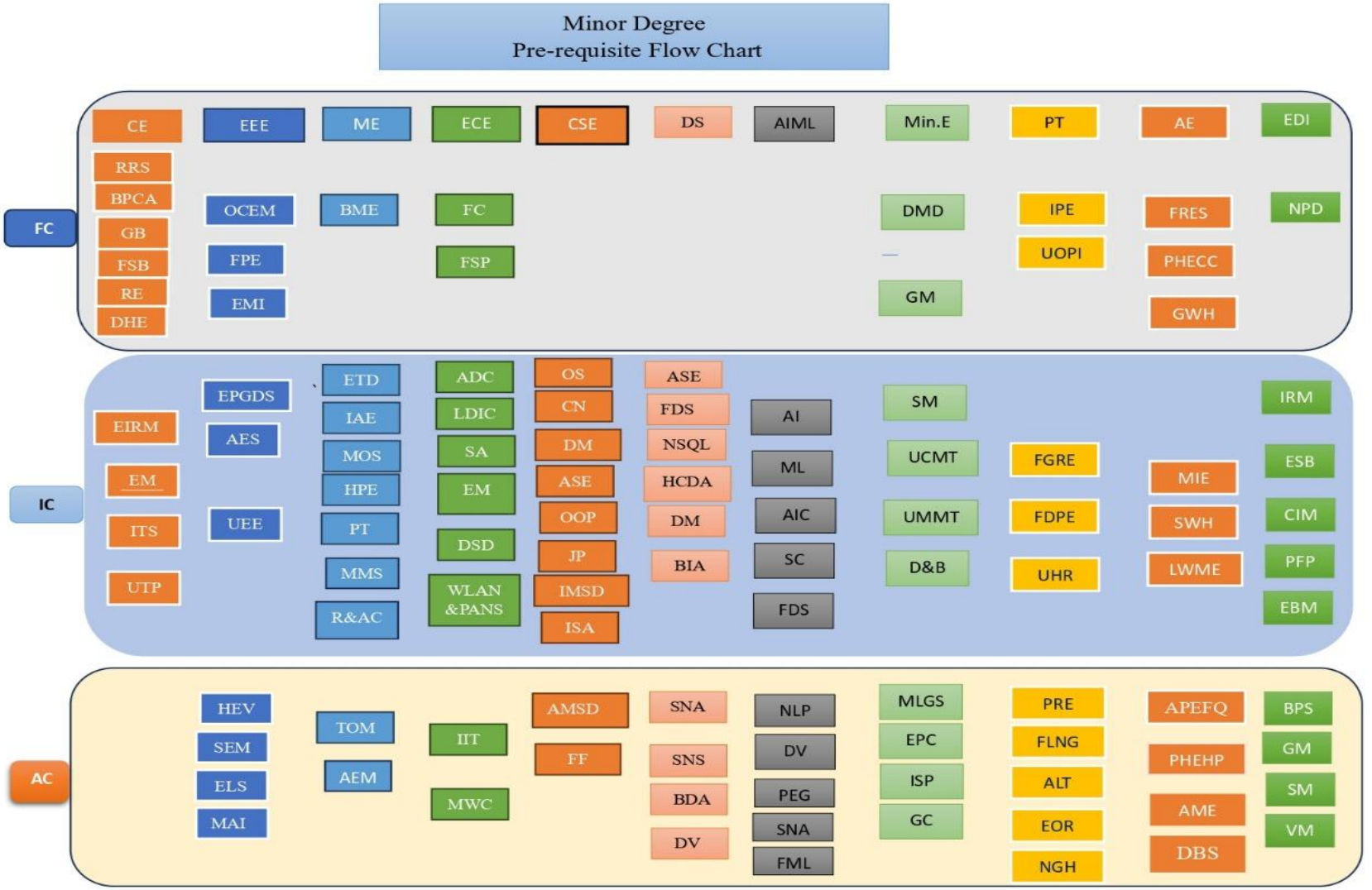
2501AE88 2501AE89	Agricultural Process Engineering & Food Quality (or) Post-harvest Engineering for Horticultural Produce	AC	3	0	0	3	50	50	100	PHECC
2501AE90 2501AE91	Agricultural Machinery & Equipment (or) Design of Bio-energy systems	AC	3	0	0	3	50	50	100	FRES
Total			**20**			**20**				

Minor Degree in Entrepreneurship Development & Incubation

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


Minor Degree
Pre-requisite Flow Chart
FC
CE
EEE
ME
ECE
CSE
DS
AIML
Min.E
PT
AE
EDI
RRS
BPCA
GB
FSB
RE
DHE
OCEM
FPE
EMI
BME
FC
FSP
DMD
GM
IPE
UOPI
FRES
PHECC
GWH
NPD
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EIRM
EM
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OOP
JP
IMSD
ISA
ASE
FDS
NSQL
HCDA
DM
BIA
AI
ML
AIC
SC
FDS
SM
UCMT
UMMT
D&B
FGRE
FDPE
UHR
MIE
SWH
LWME
IRM
ESB
CIM
PFP
EBM
AC
HEV
SEM
ELS
MAI
TOM
AEM
IIT
MWC
AMSD
FF
SNA
SNS
BDA
DV
NLP
DV
PEG
SNA
FML
MLGS
EPC
ISP
GC
PRE
FLNG
ALT
EOR
NGH
APEFQ
PHEHP
AME
DBS
BPS
GM
SM
VM

Dept.	FOUNDATION COURSE		INTERMEDIATE- LEVEL COURSE		ADVANCED COURSE	
	RRS	Repair & Rehabilitation of Structures	EIRM	Environmental Impact & Risk Management		
	BPCA	Building Planning & Computer-Aided Drawing	EM	Environmental Management		
CE	GB	Green Building	UTP	Urban Transportation Planning		
	FSB	Fundamental of Soil Behaviour	ITS	Intelligent Transportation Systems		
	RE	Railway Engineering				
	DHE	Docks & Harbour Engineering				
	OCEM	Operation control of Electric Machines	AES	Alternative Energy Sources	MAI	Methods &Algorithms for Intelligent Control
EEE	FPE	Fundamentals of Power Electronics	EPGDS	Electric Power Generation, Transmission & Distribution Systems	HEV	Hybrid Electric Vehicles
	EMI	Electrical Measurements & Instrumentation	UEE	Utilization of Electrical Energy	SEM	Special Electric Machines
					ES	Electrical Safety
	BME	Basic Mechanical Engineering	ETD	Engineering Thermodynamics	TOM	Theory of Machines
			IAE	Introduction to Automobile Engineering	AEM	Advanced Engineering Metrology
			MOS	Mechanics of Solids		
ME			HPE	Heat Power Engineering		
			PT	Production Technology		
			MMS	Metallurgy & Material Science		
			R&AC	Refrigeration & Air Conditioning		
			ADC	Analog & Digital Circuits		
	FC	Fundamentals of Communications	LDIC	Linear & Digital IC Applications	IIT	Introduction to Internet of things
			SA	Sensors & Actuators		
ECE	FSP	Fundamentals of Signal Processing	EM	Embedded Microcontrollers	MWC	Modern Wireless Communications
			DSD	Digital System Design		
			WLAN& PAN	Wireless LANS & PANS		
			ASE	Agile Software Engineering		
CSE			OOP	Object Oriented Programming through C++	AMSD	Advanced MERN Stack Development

DS			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		
			DM	Data Mining	SNA	Social Network Analysis
			FDS	Fundamentals of Data Science	DV	Data Visualization Techniques
			ASE	Agile Software Engineering	BDA	Big Data Analytics
			NSQL	NoSQL Databases	SNSW	Social Networks and Semantic Web
			BIA	Business Intelligence & Analytics		
			HCDA	Health Care Data Analysis		
AIML			ML	Machine Learning	DV	Data Visualization Techniques
			AI	Artificial Intelligence	PEG	Prompt Engineering and GenAI
			AI C	AI Chatbot	SNA	Social Network Analysis
			FDS	Fundamentals of Data Science	FML	Federated Machine Learning
			SC	Soft Computing	NLP	Natural Language Processing and Text analytics
Min. E	DMD	Development of Mineral Deposits	SM	Surface Mining	MLGS	Mine Legislation and General Safety
	GM	Green Mining	UCMT	Underground Coal Mining Technology	EPC	Environmental Pollution & Control
			UMMT	Underground Metal Mining Technology	ISP	Industrial Safety Practices
			DB	Drilling & Blasting	GC	Ground Control
PT	IPE	Introduction to Petroleum Engineering	FGRE	Fundamentals of Geology and Reservoir Engineering	PRE	Petroleum Refinery Engineering
	UOPI	Unit operations in Petroleum Industry	FDPE	Fundamentals of Drilling and Production Engineering	FLNG	Fundamentals of Liquefied Natural Gas
			UHR	Unconventional Hydrocarbon Resources	NGH	Natural Gas Hydrates
					ALT	Artificial Lift Techniques
					EOR	Enhanced Oil Recovery
Ag. E	GWH	Ground Water Hydrology	LWME	Land and Water Management	DBS	Design of Bio-Energy Systems
	PHECC	Post-harvest Engineering of Cereal Crops	SWH	Surface Water Hydrology	PHEHP	Post-Harvest Engineering for Horticultural Produce
			MIE	Micro Irrigation Systems	AME	Agricultural Machinery and Equipment
	FRES	Fundamentals of Renewable Energy Sources			APEFQ	Agriculture Process Engineering and Food Quality

EDC	NPD	New Product Development	ESB	Entrepreneurship and Small Business Management	BPS	Business Policy & Strategic Management
			CIM	Change & Innovations Management	GM	Green Marketing
			PFP	Personal Financial Planning	SM	Startup Management
			EBM	E-Business Management	VM	Venture Management
			IRM	Insurance and Risk Management		

Major (Core) Courses (MCC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501PT06	Geology & Sedimentology for Petroleum Engineers	FC	1	1	2	4	50	50	100	-
2501PT10	Petroleum Geology & Exploration Techniques	FC	1	1	2	4	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2		1	3	50	50	100	LA&C
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	-
2501MA06	Complex Variables & Statistical Methods	IC	2	1		3	50	50	100	-
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	FC			2	2	50	50	100	-
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	FC	2		2	4	50	50	100	BIL
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100	-	100	-
2501PT01	Drilling Engineering	IC	2		2	4	50	50	100	GSPE & PGET
2501PT04	Fluid Mechanics for Petroleum Engineers	IC	1	1	2	4	50	50	100	-

2501PT09	Petroleum Formation Evaluation	IC	1	1		2	50	50	100	PGET
2501PT08	Instrumentation & Process Control	IC	2		2	4	50	50	100	-
2501PT05	Fundamentals of Liquefied Natural Gas	IC	3			3	50	50	100	FMPE
2501PT02	Elements of Reservoir Engineering	IC	2		2	4	50	50	100	GSPE
2501PT11	Petroleum Production Engineering	IC	1	1		2	50	50	100	ERE
2501PT12	Petroleum Refinery Engineering	IC	3			3	50	50	100	PPE
2501PT07	Heat Transfer in Petroleum Operations	IC	1	1	2	4	50	50	100	FMPE
2501PT14	Safety & Environmental Engineering Practices in Petroleum Industry	IC	2			2	50	50	100	-
2501PT17	Well Workover & Stimulation	AC	1	1		2	50	50	100	ERE
2501PT13	Reservoir Modelling & Simulation	AC	1	1	2	4	50	50	100	ERE
2501PT15	Surface Production Operations	IC	2			2	50	50	100	-
2501PT16	Unconventional Hydrocarbon Resources	AC	1	1		2	50	50	100	ERE
2501PT03	Enhanced Oil Recovery	AC	2	1		3	50	50	100	PPE
Total			**42**	**13**	**26**	**81**				

Engineering Chemistry

(Common to CE, ME, PT & Min. E)

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,Functionsoflubricants,Propertiesoflubricating 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

Linear Algebra & 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)

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

UNIT – II

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

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

Text Books:

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

Reference Books:

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

Web Links:

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

Solid State Physics

(Common to CE, ME, PT & Min. E)

	L	T	P	C
Course Code:2501PH01	**2**	**0**	**1**	**3**

Course Outcomes:
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. "AText book of Engineering Physics" by 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" by R K Gaur and S L Gupta, Dhanpat Rai Publications. **ISBN:** 978-8189928223
3. "Physics for Engineers" by T.Vijaya Krishna, Cengage publications.**ISBN:** 978-93-5350-755-8

Reference Books:

1. "Engineering Physics" by M.R.Srinivasan, New Age international publishers (2009). **ISBN**: 978-1848290501
2. "Text book of Engineering Physics" by S. O. Pillai, New Age international publishers (2012). **ISBN**: 9788122420753
3. "Introduction to Solid State Physics" by Charles Kittel, Wiley publications 8th edition (2012) **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

Geology & Sedementology for Petroleum Engineers

	L	T	P	C
Course Code: 2501PT6	**1**	**1**	**2**	**4**

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

CO1: Explain the general facts of the earth.
CO2: Explain the formation of different structures.
CO3: Describe the origin of rocks, especially sedimentalogy.
CO4: Describe the different depositional environments and basins.
CO5: Apply the uses of micro fossils in oil exploration.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
The Earth: Introduction to origin, age, internal structure, and constitution of earth; Introduction to earth's lithosphere, atmosphere, hydrosphere, and biosphere. Plate tectonic theory, tectonic elements of continents and oceans; continental drift.

UNIT – II
Domain of Structural Geology: Concepts of strike and dip; parameters controlling deformation of rocks; deformation in rocks – descriptions of folds, joints, faults and their classifications; unconformity; geological maps and sections; map symbols.

UNIT – III
Origin of igneous, sedimentary, and metamorphic rocks
Sedimentology: Subaerial weathering processes: physical and chemical weathering; distinction between soil, alluvium, and sediments;

Sedimentary textures: grain size, particle shape,sorting and fabric and their effect on porosity and permeability of sedimentary rocks;
Sedimentary structures: stratification and bedforms, bedding planemarkings; paleocurrent analysis.

UNIT – IV

Sedimentary Rocks and Depositional Environments: Diagenesis of siliciclastic sedments. Classification of siliciclastic sedimentary rocks: rudaceous, aranaceous, and luteceous sedimentary rocks; carbonate sedimentary rocks: classification, diagenesis.
Introduction to different types of sedimentary basins, and depositional environments: Eh-pH fence diagram; continental (fluvial, lake, aeolian), marginal marine (estuarine, lacustrine), shallow marine (tidal flat, beach, deltaic), shelf and deep marine environments.

UNIT – V

Concepts of palaeontology: Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils and their uses in oil exploration.

Integrated Lab With 2 Credits

Practices:

1. Study of Sedimentary rocks in Hand Specimen: Sandstone – Detailed study of Different types of Sandstone, Ex. Arkose, Arenite, Wacke with respect to texture (grain size, shape and angularity/roundness),
2. Shale – Detailed study of different types of shales (glauconitic, fossiliferous, and carbonaceous) & their depositional environment.
3. Limestone- Detailed study of different types of Limestone and their depositional environment).
4. Study of shapes of pebbles.
5. Grain size analysis of sediment (Mean, Median, Standard deviation, Skewness, Kurtosis).
6. Measurement of the strike.and dip.
7. Location of observed outcrops on the Toposheet and Preparation of geological map of the area.
8. Study of Isopach maps and construction of sections.
9. Construction of panel and fence diagrams
10. Study of porosity and permeability from samples

Additional Practices:

1. Identification of minerals
2. Measurement of thickness of beds.
3. Field trips to the different deltaic environments of Godavari delta.

Textbooks:

1 Introduction to Sedimentology , Sengupta S.M.eISBN: 978-93-883-2799-2

2 Depositional Sedimentary Environments, Reineck H.E. and Singh I.B, Springer eISBN: 978-3-642-81498

Reference Books:

1. Elements of Mineralogy, Gribble, C. D., Rutley's, 27th Edition. CBS Publishers. eISBN: 978-94-011-6832-8
2. Principles of Physical Geology, David Duff, Homes, Nelson Thornes Ltd; 4th Revised edition. eISBN: 041240320X
3. Textbook of Physical Geology, Mahapatra, G.B., CBS Publishers. eISBN: 9788123901107

Web Links:

1. web.crc.losrios.edu/~jacksoh/classes/earthscience/Chapter1.pdf
2. science.jrank.org/pages/3820/Landform.html
3. www.manitoba.ca/iem/min-ed/kidsrock/origins/index.html
4. https://ocw.mit.edu/courses/earth-atmospheric-and.../12...sedimentary .../ch11.pdf
5. www.ucmp.berkeley.edu/fosrec/ONeill.html

Petroleum Geology & Exploration Techniques

	L	T	P	C
Course Code: 2501PT10	**1**	**1**	**2**	**4**

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

CO1: Explain its properties, origin and migration of petroleum in different rocks.
CO2: Explain the entrapment of oil and gas.
CO3: Apply the different geological approaches for exploration of oil and gas deposits.
CO4: Utilize the principles of gravity and magnetic prospecting to explore the subsurface rocks favorable for hydrocarbon deposits.
CO5: Apply different seismic refraction and reflection techniques in selected areas of structural interest revealed by the gravity and magnetic methods to locate oil bearing 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	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Physical and chemical characteristics of crude oil, Origin of petroleum: diagenesis, catagenesis and metagenesis. Source rock and maturation, Reservoir rocks and cap rocks. Migration of hydrocarbons: mechanism, pattern, and barriers.

Unit-II
Entrapment of oil and gas: types and mechanism.
Geology of sedimentary basins of India –producing and prospective basins, KG basin Mumbai Offshore and Cambay Basin

UNIT – III

Exploration Philosophy and Principles. Stages and norms of exploration.Geological techniques and procedures of petroleum exploration. Geological mapping.
Geochemical methods of prospecting: Soil geochemical surveys; Hydro-geochemistry as a tool for oil exploration

UNIT – IV

G and M Methods:Gravity and magnetic prospecting, Instruments of G&M survey, Gravity and magnetic data correction, Interpretation of G&M anomaly, Correlation of Gravityanomaly with seismic anomaly and applications in oil exploration.

UNIT – V

Body waves and surface waves, Rayleigh, Love, P and S wave, Seismic acquisition principle, Seismic refraction and reflection surveys and their applications in oil exploration, Land and marine sources, Geophone, Hydrophone and Vibrioses survey, Seismic Fold, Signal andNoise, Seismic Processing, CDP/CMP and NMO, DMO, 2D and 3D seismicsurveys.

Integrated Lab With 2 Credits

Practices:

1. Megascophic identification of source, reservoir, and cap rocks
2. Preparation of litho stratigraphic columns, litho stratigraphic correlation.
3. Identification of differences between clastic and carbonate reservoir rocks
4. Measurement of porosity of reservoir rocks
5. Measurement of permeability of reservoir rocks
6. Preparation of structural contour map and location of Oil Water Contact (OWC)
7. Basics of Contouring (Hand Drawn and Computerised)
8. Gravity Data Processing and Interpretation
9. Magnetic Processing and Interpretation
10. Seismic data interpretation (Shallow seismic-Hammer source)

Additional Practices:

1. Identifying Play, Lead and Drillable prospects from seismic data.
2. Identifying Play, Lead and Drillable prospects from gravity data.
3. Identifying Play, Lead and Drillable prospects from magnetic data.

Textbooks:

1 Reservoir Seismology , Mamdough, R. Gadallah, Pennwell Books, Pennwell Publishing Company, Tusa, Oklahoma.eISBN: 0-87814-411-0
2 Applied Geophysics, Telford, W M, Geldart, L.P., Sheriff, R.E. and Keys, D.E., Oxford and IBH Publishing Co Pvt Ltd. eISBN:0-521-32693-1

Reference Books:

1 Elements of Geology: Oil and Gas Exploration Techniques, J. Guillemot, Technip. eISBN: 978-2710806998
2 Applied Geophysics, W. M. Telford, L.P. Geldart, R.E.Shariff, Cambridge University Press.eISBN: 9780521339384

3 Exploration Geophysics: An Introduction, M.Gadallah, R.Fisher, Springer Publications. eISBN: 978-3-540-85160-8

Web Links:

1 https://link.springer.com/article/10.1007/s13369-019-03778-x
2 www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-09-13a.pdf
3 www.geol-amu.org/notes/b8-4-4.htm
4 https://www.eoas.ubc.ca/courses/eosc350/content/methods/meth_6/raypaths.html

Differential Equations and Vector Calculus

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

	L	T	P	C
Course Code: 2501MA02	**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 Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice.

Text Books:

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

Reference Books:

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

Web Links:

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

Numerical Methods & Integral Transforms

(Common to EEE, PT & Min. E)

	L	T	P	C
Course Code: 2501MA05	**2**	**1**	**0**	**3**

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

CO1: Apply numerical methods to solve the solution of equations and interpolation of polynomials.
CO2: Apply numerical methods to solve problems involving differentiation, integration and initial value problems.
CO3: Compute Fourier series of a function.
CO4: Compute the Fourier transform of a function.
CO5: Apply Laplace transform to solve initial value 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	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 formlae, 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
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

Laplace Transforms : Laplace Transform of Standard functions, Properties, Inverse Laplace transform, Properties, Convolution theorem, Solving ordinary differential equations and Simultaneous equations with constant coefficients by using Laplace Transforms.

Practice(Using any computational tool): Finding Laplace Transform of functions.

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

Text Books:

1. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN 978-8184875607
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021). ISBN 978-9383214204

Reference Books:

1. Advanced Engineering Mathematics with MATLAB, Dean G. Duffy, CRC Press. ISBN 978-1498739641
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/noc23_ma43/preview
4. https://onlinecourses.nptel.ac.in/noc22_ma62/preview

Complex Variables& Statistical Methods

(Common to EEE, PT & Min.E)

	L	T	P	C
Course Code:2501MA06	**2**	**1**	**0**	**3**

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

CO1: Examine the continuity and analyticity of functions of complex variables and Evaluate different types of complex integrals
CO2: Expand a function of complex variable as Taylor and Laurent series and evaluate residues.
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
Functions of a complex variable and Complex integration:
Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral –Cauchy's integral theorem–Cauchy's integral formula (without proofs)

UNIT – II
Series expansions and Residue Theorem:
Radius of convergence–Expansion in Taylor's series,Maclaurin's series and Laurent series.
Types of Singularities:Isolated–Essential–Pole of order m–Residues–Residue theorem (without proof)

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

SamplingTheory:

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 Wolfrum Alpha, Symbolab, Mathway, Desmos, Geogebra etc., for the practice

Text Books:

1	Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021).ISBN 978-9383214204
2	Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020.ISBN978-9353945237

Reference Books:

1	Complex Variables and Applications, J.W.Brown and R.V.Churchill, 9th edition , Mc-Graw Hill, 2021 .ISBN 9789354600364.
2	Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN 978-9351611738

Web Links:

1. https://archive.nptel.ac.in/courses/111/103/111103070/
2. https://onlinecourses.nptel.ac.in/noc20_ma50/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

Business Intelligence Lab
(Common to CE,EEE, ME, ECE,CSE, IT, AIML, CSE(DS), PT&Min.E)
(Syllabus for batches admitted in the year 2025)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice

1. Introduction to Excel

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

2. Data Analysis with Excel

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

d. Using PivotTables for data summarization and analysis

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

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

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

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

7. Data 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 & AI Tools Lab

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

(Revised Syllabus for batches admitted from 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

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

14. AI-Assisted Data Analysis (Capstone)

a. Using AI to write/explain Excel formulas and draft DAX measures.

b. Cleaning and interpreting a dataset and explaining charts with AI help.
c. 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 CO_2 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 preparation, Power BI for visualization, and AI insights to identify demographic trends and support population-based decision-making.	https://ourworldindata.org/population

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

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).

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)

	L	T	P	C
Course Code: 2501CS01	**2**	**0**	**2**	**4**

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

- **CO1:** Demonstrate basics of computer, algorithm and flow chart for problem solving.
- **CO2:** Make use of an appropriate control structures to solve given problems.
- **CO3:** Solve complex problems using arrays and strings.
- **CO4:** Develop modular programming using functions.
- **CO5:** Demonstrate 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/66868f6730bfbd35127c9ba7
   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-Demensional 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/6698e2fbcb6bd470f35b73d8
   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/6698ed2dcb6bd470f35b7ae7

UNIT – IV

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

Practice: Functions in C

1. Objective: Learn simple usage of functions.
   https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true
2. Objective: Fibonacci Numbers using recursive function.
   https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem
3. Objective: N^{th} factorial using recursion.
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/PRACTICECPP2/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=CHEFARRP
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/6686546930bfbd35127c869c
8	Volume of Sphere	https://maya.technicalhub.io/owl-program-details/6686565530bfbd35127c8818
9	Required Points	https://maya.technicalhub.io/owl-program-details/66865b1130bfbd35127c8a04
10	Instant Noodles	https://maya.technicalhub.io/owl-program-details/66865ddb30bfbd35127c8c0a
11	Find Second Number	https://maya.technicalhub.io/owl-program-details/668660a530bfbd35127c8cde
12	Kmph to Mps	https://maya.technicalhub.io/owl-program-details/668663ce30bfbd35127c8dfb
13	Inches to Centimeters	https://maya.technicalhub.io/owl-program-details/6686665e30bfbd35127c8f3a
14	Capacity	https://maya.technicalhub.io/owl-program-details/668678aa30bfbd35127c95b9
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/6687bda0dfe02cea4b5488a1

30	Uppercase Letters in a String	https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c
31	Factors Finding	https://maya.technicalhub.io/owl-program-details/66866c4a30bfbd35127c90b4
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)

	L	T	P	C
Course Code: 2601DS01	**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-Demensional Arrays
   a) Sum of two 2-D arrays. Multiplication of two 2-D arrays.
   b) Transpose of a Matrix.
   c) Trace of a Matrix.
   d) Lower Triangular Matrix.

3. Strings
   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
   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.

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:

7. **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: N^{th} 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

8. **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/PRACTICECPP2/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=CHEFARRP
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**

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	-	-

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

2. **Construction of Cycloids and Involutes**
   a) Construction of Cycloid, Epicycloid and Hypocycloid
   b) Involute of a pentagon and circle

3. **Introduction to Orthographic Projection**
   a) Principles of Projection
   b) Orthographic Projection – Four Quadrants.
   c) First angle & Third angle Projection with examples, reference plane, importance of reference lines or Plane.

d) Projections of a point situated in any one of the four quadrants.

4. **Projection of straight lines-I:**
   a) Projections of straight lines parallel to both reference planes.
   b) Projections of straight lines perpendicular to one reference plane and parallel to other reference plane
   c) Projections of straight line parallel to one plane & inclined to another plane

5. **Projection of straight lines-II:**
   a) Projections of straight line inclined to both reference planes

6. **Projection of planes:**
   a) Regular planes perpendicular to both reference planes, Parallel to one reference plane and inclined to the other reference plane
   Ex: Rectangle, Pentagon, Hexagon and Rhombus

7. **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: 9788122415452.

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2021, ISBN: 978-9385983177.
2. Computer Aided Engineering Graphics, T. Jeyapoovan,Vikas Publishing house, New Delhi, 1stEdition, 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 Workshop

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), 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

Mapping of Course Outcomes with Program Specific Outcomes:

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

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/

Drilling Engineering

Course Code: 2501PT01	L	T	P	C
	2	0	2	4

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

CO1: Apply basic Concepts of well design
CO2: Apply basic Concepts of drilling technology
CO3: Evaluate drill mud for pressure control
CO4: Evaluate the equipments and their purpose
CO5: Apply the testing tools and analysis of well 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	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	2	-	-	-	-	-	-	-	-	1
CO5	3	2	-	-	-	-	-	-	-	-	1

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Well Planning and Well Design:
Drilling programme preparation, Type of well, Prospect, GTO, Introduction to wellbore pressures

UNIT – II
Introduction to drilling Technology:
Rotary / top drive drilling, Types of onshore/offshore rigs, Introduction to hardware system (Land Rig), power generation system, Hoisting, Rotary and Drilling Fluid circulation system, mud pumps, Rig selection criteria. Horsepower calculations for draw-works and rotary. Advantages and disadvantages of top drive system.

UNIT – III
Introduction, functions, types, compositions, properties of mud, Field test, Rheology, Additives and contamination, Selection of drilling fluids and mud, Conditioning equipment, Mud

calculations, Hydrostatic pressure,Volume, Weight related calculations during drilling and tripping

UNIT – IV

Well tubular: Casing String and casing seat selection, Drill String

Drill Bits: Classification and design criteria of drag, rotary, roller, diamond and PDC bits.

Bit Selection: Conventional and Log-based. Introduction to tri-axial loading, Well Head Equipment.

Cement Selection: Functions, classification of cement, Cement additives, Methods of cementation, Equipment and accessories, Field problems pertaining to cementation job, Cement slurry calculations

UNIT – V

Well Problems and Solutions: Fatigue failure, Pipe sticking, Lost-circulation, Sloughing shale, Swabbing, surge, gas cap drilling.

Oil Well Fishing: Fish classification, tools and techniques

Integrated Lab With 2 Credits

Practices:

1. Measurement of drilling fluid Equipment: The Baroid mud balance
2. Measurement of mud viscosity. Equipment: Marsh funnel
3. Measurement of pH of mud. Equipment: pH meter and hydrino pH dispenser
4. Determination of mud rheology (Viscosity, Gel strength, and Yield point). Equipment: The Baroid rheometer
5. Determination of the loss of liquid from a mud. Equipment: Standard API filter press
6. Measurement of a drilling mud cake and evaluate resistivity. Equipment: Baroid digital resistivity meter
7. Measurement of the effect of adding bentonite on mud properties.
8. Drilling fluid contamination test (Salt, Gypsum & Cement contamination) and their effect on the drilling fluid properties.
9. Measurement of solid and liquid content and emulsification characteristics of drilling fluid. Equipment: Sand content set, fann emulsion and electrical stability testers
10. Determination the amount of Calcium Carbonate ($CaCO_3$) and Magnesium Carbonate (Dolomite) in a sample of alkaline earth carbonates such as oil well cores or drilledcuttings. Equipment: Calcimeter and Procedure is as per ASTM D 4373-84
11. Measurement of Oil, water, solid and clay content. Equipment: Oil/ water retort kit

Additional Practices:

1. Measurement of water ratios for Portland cement slurry.(Effect of water ratio on free water separation normal and minimum water content and thickening time)
   Equipment: The atmospheric consistometer
2. Measurement of compressive strength of cement test moulds and effect of temperature and pressure on setting of the slurry.
   Equipment: Compressive strength testing machine
3. Measurement of compressive strength of cement test moulds and effect of chemicals on flash setting and retardation
   Equipment: Compressive strength testing machine

Textbooks:

1. Petroleum Engineering: Drilling and Well Completions c.gatlin eISBN: 978-0136621553
2. Applied Drilling Engineering A. T. Bourgoyne eISBN: 9781555630010

Reference Books:

1. Hussain Rabia, Oil Well Drilling Engineering, Principles & Practice, Graham & Trotman, eISBN: 9780860106616
2. Well Control Problems Solutions : Neal A J.dams eISBN: 9780878141241

Web Links:

1. https://www.sciencedirect.com/science/article/pii/B9780123838469000047
2. https://petroleumpdf.com/drilling-and-well-completions-by-carl-gatlin-pdf-free-download/
3. https://www.scribd.com/doc/232062873/Carl-Gatlin-Drilling-Well-Completion-pdf
4. https://www.scribd.com/document/306762429/Bit-selection-guidelines-pdf
5. https://petrowiki.spe.org/PEH:Drilling_Problems_and_Solutions

Fluid Mechanics For Petroleum Engineers

	L	T	P	C
Course Code: 2501PT04	**1**	**1**	**2**	**4**

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

CO1: Explain the basic fluid properties and types of fluids.
CO2: Derive the equations related to fluid statics
CO3: Classify the kinematics and dynamics of fluid flow and derive its equations
CO4: Demonstrate the concept of flow measurement and dimensional analysis
CO5: Classify the pumps and compressors and solve the energy calculations

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Fluid properties
Definition of fluid; Properties of fluids: Viscosity, compressibility and bulk modulus; Shear stress in a moving fluid; Difference between liquids and gases, compressible and incompressible fluids; Newtonian and non- Newtonian fluids.

UNIT – II
Fluid statics
Continuum concept of a fluid: Statics of fluid systems, pressure and the variation of pressure due to gravity in a static fluid; Manometers: U-tube, differential and inclined manometers.

UNIT – III
Kinematics and dynamics of fluid flow
Fluid kinematics: Classification and types of flow; Velocity field and acceleration; Continuity equation and its applications;

Fluid dynamics: Reynolds experiment, laminar and turbulent flows, nature of turbulence and bound- ary layer; Euler's equation of motion; Bernoulli's theorem; Momentum equations and energy losses in fluid flow.

UNIT – IV

Dimensional analysis and flow measurement

Dimensional analysis: Dimensions of physical quantities, dimensional homogeneity, Buckingham pi theorem, important dimensionless numbers.

Flow measurement: Application of Bernoulli's equation in pitot tube, venturi meter, orifice meter, rota meter, triangular and rectangular notch, mass flow meters, etc.

UNIT – V

Pumps and compressors

Classification of pumps: Characteristic curves, selection criteria; Types of compressors: COP and selec- tion criteria; Compressible fluid flow; Ideal gas relations and energy calculations.

Integrated Lab With 2 Credits

Practice:

1. Identify laminar and turbulent flows
2. Measure the point velocities
3. Verify Bernoulli's equation
4. Calibrate Rotameter
5. Study the Variation of Orifice coefficient with Reynolds Number
6. Determine Venturi coefficient
7. Study Friction losses in Fluid flow in pipes
8. Study the coefficient of Discharge in a V-Notch
9. Study the coefficient of contraction for a given open orifice
10. Study the Characteristics of Centrifugal Pump

Additional Practice:

1. Study Pressure drop and void fraction in a fluidized bed
2. Study Pressure drop and void fraction in a packed bed
3. Study the Characteristics of reciprocating Pump

Textbooks:

1 Unit Operations of Chemical Engineering of, McCabe,W.L., J.C.Smith& Peter eISBN: 9780072848236

2 Transport Processes and Unit Operations,Christie J. Geankoplis, P eISBN: 9780205059393

Reference Books:

1 Introduction to Fluid Mechanics, Fox, R.W. and A.T.Mc.Donald, 5th Edition, John eISBN: 9781119721024

2 Chemical Engineering, Vol-1: Fluid flow, Heat Transfer and Mass Transfer, J.M. Coulson and J.F.Richardson, Pergamon Press, 4th Edition.eISBN: 9780750644440

3 Fluid Mechanics for Chemical Engineers, Noel De Nevers, Tata McGraw-Hill. eISBN: 9780071238243

Web Links:

1. www.mhhe.com/engcs/chemical/mccabe/graphics/toc.pdf
2. www.unimasr.net/ums/.../UniMasr.com_919e27ecea47b46d74dd7e268097b653.pdf
3. home.zcu.cz/~kovarikp/MT/freestudy/FLUID.../FLUID_MECHANICS_D203.pdf
4. https://www.coursehero.com
5. www.qzu.zj.cn/hgx/jpkc/hgyl/kj/huagongyuanli/syjx/801.html

Petroleum Formation Evaluation

	L	T	P	C
Course Code: 2501PT09	**1**	**1**	**0**	**2**

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

CO1: Apply the methods for core analysis and interpretation
CO2: Make use of subsurface properties of reservoir.
CO3: Interpret the different log data using different open hole interpretation techniques.
CO4: Explain the basics of casedhole logging in evaluate formation.
CO5: Apply principles of production logging techniques in production control.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Formation Evaluation Overview:
Direct and Indirect Methods, classification and logging tools. Mud Logging and cutting analysis log, Coring and Core analysis.
Petrophysical Measurements: Rock-fluid interaction, Bore hole environment and basic concepts of well log analysis and application

UNIT – II
Introduction to properties measurements:
Rock-forming minerals, types of rocks, reservoirs, source rocks, migration Archie's formulation, Capillary pressure and Leverett J-function, elastic rock properties, fluid measurements, effect of clay minerals on physical properties measurements.

UNIT – III

Openhole Well Logging: Principle, Logging tools, application & Limitations Spontaneous Potential Log, Gamma Ray Log.
Resistivity Measurement: Electrical, induction logging and micro-resistivity log
Porosity Logs: Density & Litho-density log, neutron log, sonic (acoustic) log, Electromagnetic Propagation tools. Nuclear Magnetic Resonance log

UNIT – IV

Cased Hole Logging: introduction, objectives and methods
Well Integrity evaluation: CBL and VDL logs, Ultrasonic Imaging tools
Casing inspection tools: Electromagnetic and acoustic CIT
Log Reservoir fluid Saturation Determination: tool principle and application

UNIT – V

Production Logging: Introduction, type of tools, principles, limitations and applications
Log Interpretation and Analysis Techniques: Standard log interpretation methods.
Quick-Look Interpretation: Crossplots, and Overlays Lithology/ Minerology Identification
Porosity Determination Water saturation and Resistivity Determination Clean sand & Shaly sand interpretation.

Textbooks:

1. Log Interpretation Principles/Applications, Schlumberger
2. Well Logging and Formation Evaluation, Toby Darling, Elsevier, New York. eISBN: 9780080457956

Reference Books:

1. Well Logging & Reservoir Evaluation, Oberto Serra, Editions Technip. eISBN: 9782710808817
2. Formation Evaluation, Edward J. Lynch, Harper & Row.

Web Links:

1. Sample Examination Manual, R.G.Swanson, Shell Oil Company, Published by AAPG
2. https://link.springer.com/chapter/10.1007%2F978-3-319-29710-1_3
3. petrowiki.org/Types of logs
4. www.pe.tamu.edu/blasingame/data/z_zCourse_Archive/P663.../GR%20Log.PDF
5. https://www.sciencedirect.com/science/article/pii/S0376736108705788

Instrumentation & Process Control

Course Code: 2501PT08	L	T	P	C
	2	0	2	4

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

CO1: Choose the instrument based on static and dynamic characteristics.
CO2: Categorize the various types of thermometers & pressure gauges
CO3: Explain the processes with appropriate instrumentation diagrams
CO4: Interpret the responses of first&second order systems with examples
CO5: Explain tuning a control loop and characteristics of control valves

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamentals: Elements of instruments, Functions of instruments and Characteristics of an instruments.

Industrial Thermometers: Expansion thermometers and its types, Static accuracy and response of thermometry. Thermoelectricity-Industrial Thermocouples-Thermocouple wires- Thermocouple wells and response of thermocouples; Thermal coefficient of resistance- Industrial resistance-thermometer bulbs and circuits. Radiation receiving elements-Radiation pyrometers-photoelectric and optical pyrometers.

UNIT – II

Pressure and vacuum: Liquid column manometers-Measuring elements for gauge pressure and vacuum indicating elements for pressure gauges-Static accuracy and response of pressure gauges.

Composition analysis: Spectroscopic analysis by absorption, emission and mass, Gas analysis by thermal conductivity, analysis of moisture.

UNIT – III

Flow Meters: Head flow meters-Area flow meters-Viscosity measurements.
Process Instrumentation: Controls Center-Instrumentation Diagram-Process analysis-Digital instrumentation and SCADA systems

UNIT – IV

Introduction to process dynamics and control: Response of first order systems – Physical examples of first order systems. Response of first order systems in series, higher order systems: Second order and transportation lag.

UNIT – V

Control systems, controllers and final control elements, Block diagram of a Petrochemical rector control system. Closed loop transfer functions, Transient response of simple control systems.
Stability Criterion, Routh Test, Frequency control model, Controller tuning and process identification, Control valves.

Integrated Lab With 2 Credits

Practices:

1. Experiments with single capacity system.
2. Experiments with two capacity systems with interaction
3. Experiments with two capacity systems without interaction
4. Control valve characteristics
5. Calibration and determination of time lag of various first order instruments
6. Calibration and determination of time lag of various second order instruments
7. Experiments on multi process trainer set up with computer
8. Experiments on I/P and P/I converters set up
9. Level control trainer
10. Temperature control trainer

Additional Practices:

1. Experiments on proportional, reset, rate mode of controllers
2. Estimation of damping coefficient for U-tube manometer
3. Calibration of various temperature instruments like Thermocouple, RTD and Thermistor

Textbooks:

1 Process Systems Analysis and Control, Donald Coughanowr, 3rd Ed. McGraw-Hill. eISBN: 9780071121866
2 Chemical Process Control: An Introduction to Theory and Practice, George Stephanopoulos, Pearson Education India, 1st Ed. eISBN: 9780131286290

Reference Books:

1 Process Control and Instrumentation Technology, Curtis D. Johnson, 8th Edition, Pearson publisher. eISBN: 9788120330290
2 Petrochemical Instrumentation, Dr. N. Stalin, Dr. Anil Kumar Thandlam, Ch. Venkatrao, Dr. J. Samson Isaac, 1st Edition, Scientific International Publishing House, ISBN: 9789356254695

Web Links:

1 https://www.globalspec.com/learnmore/sensors_transducers_detectors/temperature_sensing/industrial_thermometers
2 https://engineerexcel.com/vacuum-pressure/
3 http://radix.co.in/families/temperature-sensors-rtd
4 http://nptel.ac.in/courses/103103037/
5 http://www.bgu.ac.il/chem_eng/pages/Courses/oren%20courses/Chapter_10

Fundamentals of Liquefied Natural Gas

Course Code: 2501PT05	L	T	P	C
	3	0	0	3

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

CO1: Explain the LNG value chain
CO2: Classify the different liquefaction technologies of LNG
CO3: Explain the components of LNG receiving terminals
CO4: Summarize LNG storage and transportation facilities
CO5: Identify major equipment and safety aspects of LNG industry

Mapping of Course Outcomes with Program Outcomes:

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

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: Overview of LNG industry -History of LNG industry – Base load LNG – Development of an LNG Project – World and Indian Scenario– Properties of LNG.

UNIT – II
Propane precooled mixed refrigerant process – Description of Air products C3MR LNG process–. Description of Conoco Phillips optimized cascade (COPOC) process – Liquefaction– LNG flash and storage.
Other Liquefaction Processes: Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and sub cooling- Trends in LNG train capacity –strategy for grassroots plant- offshore LNG production.

UNIT – III

Gas pre-treatment: Slug catcher– NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit Receiving terminals in India – Main components and description of marine facilities – LNG tanks– Process descriptions. –Mercury and sulphur removal unit–NGL recovery–Nitrogen rejection–Helium recovery.

UNIT – IV

LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations,

Cryogenic heat exchangers: Spiral– Wound heat exchangers – Plate & fin heat exchangers – Cold boxes.

Centrifugal compressors –Axial compressors – Reciprocating compressors;

LNG pumps and liquid expanders –Loading Arms and gas turbines, Description of Regasification.

UNIT – V

Submerged combustion vaporizers- Open rack vaporizers–Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater.

Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues– Risk-based analysis of an LNG plant.

Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.

Textbooks:

1. LNG: Basics of Liquefied Natural Gas, Stanley Huang, Hwa Chiu and Doug Elliot, Ist Edition, PETEX. eISBN: 978-0886982171
2. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press. eISBN: 9780608024646

Reference Books:

1. Natural Gas by Sea: The Development of a new technology, Roger Rooks, Wither by Publishers eISBN: 9780856140549
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre.

Web Links:

1. http://folk.ntnu.no/skoge/prost/proceedings/aiche2008/data/papers/P139095.pdf
2. https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/html/index.Htm
3. http://petrowiki.org/Liquified_natural_gas_(LNG
4. http://www.chebeague.org/fairwinds/risks.htm
5. http://www.beg.utexas.edu/energyecon/LNG_Safety_and_Security_Update_2012.pdf

Elements of Reservoir Engineering

Course Code: 2501PT02	L	T	P	C
	2	0	2	4

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

- **CO1:** Apply basic Concepts of Reservoir Engineering
- **CO2:** Evaluate the porosity and Permeability from reservoir
- **CO3:** Estimate the oil and gas properties of reservoir
- **CO4:** Apply Basic radial Flow differential equation and stabilized well inflow Estimation for Different system of equations, immiscible fluid displacement and water influx models
- **CO5:** Estimate the reserves by curve analysis.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	-	-	-	-	-	-	2	-
CO2	2	3	-	-	-	-	-	-	-		-
CO3	2	3	-	-	-	-	-	-	-	2	-
CO4	2	3	-	-	-	-	-	-	-	2	-
CO5	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
Reservoir rocks and structures, Classification of sedimentary oil reservoirs
Fundamental concepts: Introduction to Hydrocarbon Reservoir, Pressure-Temperature diagram, Fluid pressure regimes.

UNIT – II
Rock properties: Porosity & Permeability, Types & Determination, Permeability in Series & parallel combination of beds Fluid saturation, Wettability, surface and interfacial tension, Capillary Pressure, Permeability- Klinkenburg effect, averaging absolute permeabilities, Rock compressibility, net pay thickness, reservoir heterogeneity.

UNIT – III
Crude oil properties: Density, gravity, viscosity, gas solubility, bubble point pressure, oil formation volume factor
Natural gas properties: Compressibility, gas formation volume factor, viscosity

UNIT – IV

Flow of Fluids through Porous Media : Fluid types, flow regimes, Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state, unsteady state and pseudosteady state flow, GOR, WOR equation

UNIT – V

Reserve Estimation: Reservoir drives, resource & reserve concept, Different reserve Estimation Techniques: Volumetric, MBE, decline curve analysis;, latest SPE/ WPC/ IS classification

Integrated Lab With 2 Credits

Practices:

1. Determination of effective porosity by gas expansion method.
2. Determination of porosity and pore size distribution by mercury injection.
3. Measurement of surface tension with the ring Tensiometer.
4. Determination of fluid density using Pycnometer and hydrometer methods.
5. Liquid viscosity measurement using capillary tube viscometer (Ostwald type).
6. Determination of capillary pressure of reservoir rock (core) using porous plate method.
7. Measurement of contact angle (between oil, water and solid surface) using imaging method.
8. Measurement of air permeability.
9. Absolute permeability measurement of water.
10. Determination of relative permeability of oil-water using unsteady state method.
11. Determination of relative permeability of gas-oil using unsteady state method.

Additional Practices:

1. Determination of water content in a given sample.
2. Measurement of interfacial tension with the ring Tensiometer.

Textbooks:

1 Fundamentals of Reservoir Engineering, L.P.Dake, Elsevier science eISBN: 9780080568980

2 Applied Petroleum Reservoir Engineering, Third Edition, B.C Craft and M.Hawkins, Revised By Ronald E.Terry & J.Brandon Rorgers, Prentice Hall, New York. eISBN: 9780133155617

Reference Books:

1 Reservoir Engineering Handbook, Tarek Ahmed, 4th Edition, Gulf Professional Publishing. eISBN: 9781856178037

2 Basic Reservoir Engineering, Rene Cosse, Editions, Technip eISBN: 9782710806301

Weblinks:

1. https://author.energy-community.org/enc-author-prd/dam/jcr:4c5bb3db-e989-4b7d-a33e244f4a51164a/1_PetroleumResEng_Basics.pdf
2. https://petrowiki.org/Fluid_sampling
3. https://petrowiki.org/Material_balance_in_oil_reservoirs
4. https://en.wikipedia.org/wiki/Darcy%27s_law
5. https://www.researchgate.net/publication/250088881_Reserves_Estimation_The_Challenge_for_the_Industry

Petroleum Production Engineering

	L	T	P	C
Course Code: 2501PT11	**1**	**1**	**0**	**2**

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

CO1: Expalin the production engineers role and activities involved in the field.
CO2: Derive the equations related to well performance and optimization
CO3: Demonstrate the various types of artificial lift methods in production
CO4: Explain the different types perforation methods used in production
CO5: Outline the various types of well stimulation techniques.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	-	-	-	-	-	2	-	-
CO2	2	3	-	-	-	-	-	-	2	-	-
CO3	2	3	-	-	-	-	-	-	2	-	-
CO4	2	3	-	-	-	-	-	-	2	-	-
CO5	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
Petroleum Production System (Surface & Subsurface Equipment)
Role of Production Engineer/activities performed at various levels of field development and its exploitation. Petroleum Production System-Well Head Equipment, Charismas tree, valves, hangers, flow control devices, packers, tubular and flow lines

UNIT – II
Well Performance analysis and Optimization
Reservoir considerations, Introduction to inflow performance, Productivity index. Formation damage diagnosis, Skin effect, IPR in case of different drive mechanism. Vogel IPR equation. Pressure loss in tubing, multiphase flow regimes. Choke performance, types of chokes. Overall production system pressure losses, Nodal system Analysis.

UNIT – III

Artificial Lift Technology

Basic principles and descriptions of Artificial Lift Methods, Continuous and Intermittent Flow Gas Lift, Design of Gas Lift System, Plunger Lift, Chamber Lift, Sucker Rod Pumping (SRP), Electrical Submersible Pumping (ESP), Hydraulic Pumping (HP).

UNIT – IV

Well Perforation

Introduction, Well Perforating Methods, Perforating Gun Types, Shaped Charge, Type, Size, Depth and Orientation of perforation holes, Shot Density, Standoff, Explosives in perforation, Explosive Train.

UNIT – V

Well Stimulation Techniques

Importance of Well Stimulation, Acid Solutions for Acidizing, Acid Additives, Matrix Acidizing, Fracture Acidizing, Hydraulic Fracturing, Wave Technology, Microbial Stimulation.

Text Books:

1. Petroleum Production Engineering: A Computer Assisted Approach, Boyun Guo, William C. Lyons, Ali Ghalambor, Elesevier Science & Technology Books, 2019 eISBN: 9780750682701
2. Petroleum Production Systems, M.J. Economides, A.Daniel Hill &C.E.Economides, Prentice Hall. eISBN: 9780137031580

Reference Books:

1. Production Technology I-II, Institute of Petroleum Engineering, Herriot Watt University.
2. The Technology of Artificial Lift Method, Vol. 1, Brown E., Pennwell Books. eISBN: 9780878140312

Web Links:

1. https://petrowiki.org/Production_system
2. https://www.globalspec.com/reference/33548/203279/chapter-3-reservoir-deliverability
3. https://www.slb.com/resource-library/oilfield-review/defining-series/defining-artificial-lift
4. https://www.drillingmanual.com/well-perforation-methods-techniques-in-oil-gas-completion/
5. https://www.petrosync.com/blog/what-is-well stimulation/

Petroleum Refinery Engineering

Course Code: 2501PT12	L	T	P	C
	3	0	0	3

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

CO1: Identify the types of petroleum feed stocks and products by their properties
CO2: Make use of process knowledge to solve operational problems and increase the efficiency
CO3: Apply the knowledge of crucial processes to meet the end product demands
CO4: Prioritize the demand of various petrochemicals to optimize the processes
CO5: Classify various petrochemical products and their uses

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Basic of Petroleum:
Role of Crude oil in global economy, Present Scenario of Crude Oil Refinery, Importance, Occurrence, Origin(formation), Exploration, Composition, Classification and Evaluation of Crude oil, Crude Assay Analysis, Distillation Characteristics such as True Boiling (TBP), American Society for Testing Materials (ASTM).

UNIT – II
Properties of Crude and Petroleum Products:
Various types of Average Boiling Points of Crude Oil & Petroleum Fractions.
Types of Gases & their Composition, Types of Gasoline & it's Important Properties and tests such as ASTM Distillation, RVP, Octane Number, Oxidation Stability, Sulphur Content etc, Various Types of Naphtha and their Important Properties & Applications.
Important Tests & Properties of Kerosene such as Flash& Fire Point, Smoke Point, Aniline Point etc.,

Types of Diesel & its Important Properties & Tests such as Pour Point, Diesel Index, Cetane Number etc.
Heavy Fractions like Lube Oil, Bitumen, Asphalt etc & their Important Properties such as Viscosity Index, Carbon Residue, Penetration Index, Softening Point etc.

UNIT – III
Processing of Petroleum:
Pretreatment of Crude (Dehydration & Desalting), Pumping of Waxy Crude, Heating of Crude, Distillation of Petroleum & Types of Reflux, ADU & VDU.

UNIT – IV
Thermal & Catalytic Cracking:
Thermal cracking – Processes, operating parameters, feed stock selection and product yields, Advantages –Types and functions of secondary processing – Visbreaking – Processes, operating parameters and advantages–Coking –Operating parameters and advantages. Fluid catalytic cracking –processes, operating parameters, feed stock selection and product yields –Advantages.

UNIT – V
Treatment Techniques:
Physical Impurities found in Crude& their Removal, Sweetening Techniques, Production and Treatment of LPG & their Methods, Dehydration and Sweetening of Gases, Gasoline Treatment such as Lead Doctoring, Merox Sweetening, Catalytic Desulphurization etc. Treatment of kerosene.
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Textbooks:

1 PetroleumRefining:Technology and Economics ,J.H.Gary and G.E.Handwerk, 5th Edition, Marcel Dekkar, Inc. eISBN: 9780203907924
2 Elements of Petroleum Processing, D S Jones, Wiley–Blackwell. eISBN: 9780471964896

Reference Books:

1 Petroleum Refining Engineering, WL Nelson, 4th Edition, McGraw Hill Company eISBN: 9780070462687
2 Fundamentals of Petroleum Chemical Technology, P Belov, Mir Publishers eISBN: 9780846404385
3 Petrochemical Processes, A. Chauvel and G.Lefebvre, Volume 1 & 2, Gulf Publishing Company eISBN: 9782710810650

Web Links:
1 https://www.scribd.com/doc/.../Surface-Production-Operations-Volume-1-Oil-System
2 www.academia.edu/.../Ken_Arnold-Surface_Production_Operations_Volume_1_3rdE
3 https://byjus.com/chemistry/petroleum/
4 https://www.slideshare.net/.../surface-production-operations-volume-iv-pumps-compr...
5 https://www.researchgate.net/publication/359449933_Petroleum_sludge_treatment_and_disposal_techniques_a_review

Heat Transfer in Petroleum Operations

	L	T	P	C
Course Code: 2501PT07	**1**	**1**	**2**	**4**

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

- **CO1:** Explain the various modes of heat transfer and derive the eqautions for conduction heat transfer
- **CO2:** Classify the relation between boundary layers and estimate the convection coefficients
- **CO3:** Explain the concepts of heat transfer with phase change
- **CO4:** Demonstrate the concept of radiation heat transfer
- **CO5:** Identify the types of heat exchangers and design the double pipe heat exchanger.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	2	-	-
CO4	1	2	-	-	-	-	-	-	2	-	-
CO5	3	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
Heat transfer by conduction
Importance of heat transfer in petrochemical engineering operations; Modes of heat transfer; One dimensional steady state heat conduction through plane and composite walls, hollow cylinder and spheres; Thermal conductivity measurement; Effect of temperature on thermal conductivity.

UNIT – II
Heat transfer by convection
Mechanism, thermal and velocity boundary layers, boundary layer thickness, relationship between hydrodynamic and thermal boundary layer thickness for flow over flat plates; Estimation of convection and its heat transfer coefficient; Correlation for heat transfer in laminar and turbulent flow; Natural convection under different conditions; Physical significance of Grashoff's and Rayleigh's numbers.

UNIT – III

Phase change Heat transfer

Pool boiling: Boiling curve, hysteresis in the boiling curve, nucleate boiling; Condensation: Physical mechanisms, types of condensation, factors affecting condensation.

UNIT – IV

Heat transfer by radiation

Introduction, theories of radiation, electromagnetic spectrum, emissivity; Radiative properties, absorptivity, reflec- tivity and transmissivity; Concept of black and grey body, radiation intensity, laws of black body radi- ation, non-black surfaces, radiation between black and grey surfaces.

UNIT – V

Heat exchangers

Classification of heat exchangers: Classification according to transfer processes, number of passes, surface compactness, construction features, flow arrangements, heat transfer mechanisms; Shell and tube heat exchanger, fouling, LMTD and its correction factor; Concept of effectiveness: NTU method, definition of effectiveness, effectiveness NTU relations in counter-flow and parallel flow configura- tions. Double pipe heat exchangers: Construction, various steps for the design.

Integrated Lab With 2 Credits

Practices:

1. Determine overall heat transfer coefficient of composite wall
2. Determine thermal conductivity of a metal rod
3. Determine natural convective heat transfer coefficient for a vertical tube
4. Determine forced convective heat transfer coefficient for air flowing through a pipe
5. Determine overall heat transfer coefficient in double pipe heat exchanger
6. Determine Stefan – Boltzmann constant
7. Determine emissivity of a given plate at various temperatures
8. Determine the radial distribution of heat in composite cylinder
9. Determine thermal conductivity of pipe insulation
10. Determine the thermal conductivity of insulating powder at various heat inputs
11. Determine critical heat flux point for pool boiling of water.

Additional Practices:

1. Determine the performance analysis of Shell and Tube Exchanger
2. Estimate un-steady state film heat transfer coefficient between the medium in which the body is cooled
3. Study the temperature distribution along the length of a pin-fin under natural.

Textbooks:

1 Unit Operations of Chemical Engineering, McCabe, W.L., J.C Smith and Peter Harriott, 7th Edition, McGraw-Hill. eISBN: 9780072848236

2 Heat Transfer, Holman, J.P., 9th Edition, Tata McGraw-Hill. eISBN: 9780071122306

Reference Books:

1. Heat Transfer, Y.V.C. Rao, Universities Press (India) Pvt. Ltd. eISBN: 9788173713842
2. A Text Book on Heat Transfer, Sukhatme, P., 5th Edition, Universities Press (India) Pvt. Ltd. eISBN: 9788173715440
3. Chemical Engineering: Fluid Flow, Heat Transfer and Mass Transfer,Coulson, J.M.; Richardson, J.F.; Backhurst, J.R.; Harker, J.H., Vol.1, 6th Edition, Reed Elsevier India eISBN: 9780750644440

Web Links:

1. http://nptel.ac.in/courses/103103032/9
2. http://www.srmuniv.ac.in/sites/default/files/downloads/unit_II_convective_heat_transfer.pdf
3. http://pages.mtu.edu/~fmorriso/cm310/lectures/2015heatlecture09.pdf
4. https://file.scirp.org/pdf/EPE20090200004_95602315.pdf
5. http://pages.mtu.edu/~fmorriso/cm310/lectures/2015heatlecture08.pdf

Safety & Environmental Engineering Practices In Petroleum Industry

Course Code: 2501PT14

L	T	P	C
2	0	0	2

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

CO1: Study the forms of hazards and safety Practices in petroleum industry.
CO2: Study of HSE Regulations and regulatory agencies for Oil and Gas Industry..
CO3: Explain the environmental issues in drilling and production operations.
CO4: Make use of the hazop study concepts for safe Practices in Petroleum industry.
CO5: Make use of HSE Policies. Disaster & crisis management in Petroleum Industry.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Safety in Petroleum industry; Setting & layout of petroleum plant. Forms of hazards: chemical, toxic, explosion, electrical, mechanical, radiation, noise hazards. Control and prevention of hazards.

UNIT – II
HSE: Definition and Explanations. Different HSE practises, implementation and evaluations. HSE Regulations and regulatory agencies for Oil and Gas Industry.

UNIT – III
Environmental issues, Impact during oil and gas operations and solutions.
Air Pollution in oil & gas industry: Sources, Damage and mitigation. Water Management: Pollution and pollutant, production water management.
Drilling Waste: Drilling fluid waste, Rock cutting, oily sludge, etc.
Offshore safety. Offshore oil spill and oil spill control. Safety and Environmental Management Systems, SEMS

UNIT – IV

Risk Analysis: hazard and operability (HAZOP) studies. hazard analysis (HAZAN), fault tree analysis, consequence analysis, scenario and probabilistic assessment. Onshore and Offshore Emergency Management Plans.

Safety System: Manual & automatic shutdown system, blow down systems. Gas detection system. Fire detection and suppression systems. Personal protection system & measures.

UNIT – V

HSE Policies. Disaster & crisis management in Petroleum Industry.

Environment: Environment concepts, impact on eco-system, air, water and soil. The impact of drilling & production operations on environment, Environmental transport of petroleum wastes.

Text Books:

1. Crowl, D.A., Louvar, J. F., "Chemical Process Safety – Fundamentals with Applications". Prentice-Hall, Pearson. eISBN: 9780134857848
2. Environmental Control in Petroleum Engineering: John C Reis eISBN: 9780080505756

Reference Books:

1. CCPS," Guidelines for Engineering Design for Process Safety", AIChE eISBN: 9780470938263
2. Environmental management in Petroleum Industry: S. K. Wahi eISBN: 978-8122403770
3. The prevention of Oil pollution: J. Wardley-Smith eISBN: 9789401173476

Web Links:

1. https://onlinecourses.nptel.ac.in/noc18_oe04/preview
2. https://en.wikipedia.org/wiki/Hazard_and_operability_study

Well Work Over & Stimulation

Course Code: 2501PT17	L	T	P	C
	1	1	0	2

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

CO1: Apply basic Concepts of effective completion types.
CO2: Evaluate the reservoir problem
CO3: Evaluate Operations and Tools for completions
CO4: Explain about Various Completion fluids and its chemistry
CO5: Apply the treatment methods for well 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	3	2	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Introduction to Completion. Well Completion design (Data gathering, well control and barriers in completion, completion types, safety and environment effect by Completion operation) Reservoir Completion (Open Hole Completion techniques, Perforating, Hydraulic Fracturing)

UNIT – II
Introduction Differentiate between reservoir problem v/s workover problem, Work-over operations, types of workover , Work over fluids. Scraping, well circulation, Shut-off, Squeeze cementing. Handling water and gas coning. Evaluation of workover jobs

UNIT – III
Specialized Components (wellheads, packers, expansion joints, safety valves, artificial lifting equipment). Completion Installation (installation types, procedures) Packers-Production packers, Packer's calculation, Well activation. Repair of wells, Paraffin and scale removal. Corrosion, Bacteria & Scale control. Sand control, Screens, Gravel packs.

UNIT – IV

Completion Fluids and Production Chemistry (types of Completion fluids, Formation compatibility, Mineral scales, Salt deposition, Waxes, Asphaltenes, Hydrates) Sand Control (rock strength and sand production prediction, mitigating sand production, formation grain size distribution, sand control methods)

UNIT – V

Well treatment; acidizing of oil & gas wells, Hydro-perforation. Hydraulic fracturing

Textbooks:

1. Well Completion Design, Jonathan Bellarby, Elsevier. eISBN: 9780080932521
2. Well Completion and Servicing, D. Perrin, Michael Caron, Georges Gaillot, Editions Technip eISBN: 9782710807650

Reference Books:

1. Production Operations: Well Completions, Workover, and Stimulation eISBN: 9780930972004
2. Well Stimulation Treatments, 2nd Ed eISBN: 9780886982096

Web Links:

1. https://www.scribd.com/document/485014588/well-completion
2. https://www.sciencedirect.com/science/article/abs/pii/S0376736108002100
3. https://www.petrosync.com/blog/well-intervention/
4. https://wiki.aapg.org/Types_of_completions
5. https://www.petrosync.com/blog/well-intervention/

Reservoir Modelling & Simulation

Course Code: 2501PT13	L	T	P	C
	1	1	2	4

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

CO1: Apply basic Concepts of Reservoir modelling and simulation.
CO2: Estimate the Basic Equations for single phase flow analysis
CO3: Apply Solution techniques of single phase flow equations
CO4: Evaluate the Multiphase flow simulation
CO5: Apply Basic single and multiphase flow for History matching.

Mapping of Course Outcomes with Program Outcomes:

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	-	-	-	-	-	-	-	-	-

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 reservoir simulation. Concepts of modelling and simulation. Introduction to integrated reservoir modeling. Use of geophysical, geological, petro physical and engineering data with geostatistical methods to create reservoir description.

UNIT – II
Basic Equations for single phase flow. Continuity equation in various flow geometries, Derivation of Generalized flow equations, Different form of flow equations, initial and boundary conditions.
Finite Difference Approximation to linear flow equations. Method of grid constructions, Approximation of spatial and time derivatives, Implementation of initial and boundary conditions, Explicit and implicit formulations, well representation, treatment of source and sink terms; Stream tube; automatic time step control; simulation of naturally fractured reservoir.

UNIT – III

Solution techniques of single phase flow equations. Linearization techniques; incompressible, slightly compressible and compressible flow problems; Use of Balance Calculation in Reservoir Simulation.

UNIT – IV

Multiphase flow simulation. Concept of Black oil and compositional models; Conservation equations in a multiphase flow system; Flow equations; Finite difference approximation; Simultaneous Solution method, Implicit Pressure Explicit Saturation method, Sequential Solution method. Multiphase flow in two and three dimensions

UNIT – V

History matching. Inverse modeling, parameterization, objective function formation, calibration and tuning algorithm, Bayesian formulation and uncertainty quantification, optimization algorithms.

Integrated Lab With 2 Credits

Practices:

1. Reservoir simulation basics. To have basic Understanding the basic concepts of simulation and modelling.
2. Overview: Geological model and flow model and transition
3. Introduction, Historical background, application of simulator,Types of model and designing of various models depending on reservoir complexities, rock properties, fluid properties – concept of black oil model, compositional model.
4. Building, running and analyzing a “black oil” reservoir simulation model by importing contour map data. To build, run, and analyze a black oil reservoir model in IMEX by importing contour map file and reservoir properties.
5. Perform history-matching of IMEX reservoir model.
6. To analyze match between simulation and production data.
7. Streamline simulation Introduction to streamline simulation& comparison of conventional/Streamline simulation
8. Integration with Economics
9. Special Concept on Coning and Compositional Models Simulation. Optimization using Economic and Techno-economic evaluation, Computation of economic indices viz."
10. Perform history-matching of reservoir or core model.
11. To analyze match between simulation and experimental data, and determine rock-fluid parameters.
12. History matching Model calibration performance -Oil & Gas field simulation

Additional Practices:

1. Reservoir optimization Oil & Gas field simulation
2. Uncertainty quantification- Oil & Gas field simulation

Textbooks:

1 K. Aziz, A. Settari, Petroleum Reservoir Simulation. Applied Science Publisher. eISBN: 9780853347873
2 Turgay Ertekin, J.H. Abou-Kassem, and G.R. King, Basic Applied Reservoir Simulation. Society of Petroleum Engineers. eISBN: 9781555630898

Reference Books:

1 Chen, Zhangxin. Reservoir simulation: mathematical techniques in oil recovery. Society for Industrial and Applied Mathematics eISBN: 9780898717075
2 Shahab D. Mohaghegh, Data-Driven Reservoir Modeling. Society of Petroleum Engineers eISBN: 9781613995600

Web Links:

1 https://www.spe-aberdeen.org/wp-content/uploads/2018/06/Devex-2018-Introduction-to-Reservoir-Simulation.pdf
2 https://www.researchgate.net/publication/256667120_The_basic_equations_of_fluid_mechanics_in_form_characteristic_of_the_finite_volume_method
3 https://petrowiki.spe.org/PEH:Reservoir_Simulation
4 https://ntnuopen.ntnu.no/ntnu-xmlui/bitstream/handle/11250/240503/747973_FULLTEXT01.pdf?sequence=1
5 http://oaktrust.library.tamu.edu/bitstream/handle/1969.1/ETD-TAMU-3035/MA-DISSERTATION.pdf?sequence=1

Surface Production Operations

Course Code: 2501PT15	L	T	P	C
	2	0	0	2

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

CO1: Explain the concept of classification and design of separators
CO2: Demonstrate the concept of surface facilities
CO3: Identify the various storage and transportation methods for oil and gas
CO4: Explain the flow assurance mitigation and pigging operations
CO5: Design principles and sizing of heat exchangers.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Separation and Treatment of produced fluid
Classification of separators, Components of separator, Types of separators, Liquid level control and relative advantages / disadvantages of different types of separators, Dehydration & Desalting of Oil, Demulsification, Effluent Treatment, and Design of Separator.

UNIT – II
Surface facilities for Production System Group Gathering Station, Central Tank farm, Feeder and Trunk pipeline system,

UNIT – III
Storage and Transportation of Oil and Gas
Storage tank for Oil, storage of LPG, Underground storage, Measurement-metering of Oil and Gas

UNIT – IV

Flow assurance and Mitigation Scale & Paraffin Deposition and their Mitigation, Flow improver (Pour point depression and Drag reducer, heat treatment), pigging in pipe lines

UNIT – V

Design of principles and sizing of heat exchangers: Process design of Shell &Tube heat exchangers -Double pipe heat exchangers- Plate and frame heat exchangers- Air cooled heat exchangers- Heat recovery units- Fired heaters- Materials of construction & mechanical design of heat exchangers.

Text Books:

1. Petroleum and Gas Field Processing, H.K .Abdel-Aal and Mohamed Aggour and M.A. Fahim, Marcel Dekkar Inc. eISBN: 9780203911099
2. Surface Production Operations, Ken Arnold & Maurice Stewart, Vol. 1 & 2, 3 Edition, Gulf Professional Publishing. eISBN: 9780884158219

Reference Books:

1. Surface Production Operations: Volume IV: Pumps an Compressors Authors: Maurice Steward, Gulf Professional Publishing Published Date: 1st December 2018 eISBN: 9780128098950
2. Engineering Data Book, 12th Edition (Electronic), FPS Version, Volume I & II, Gas Processers Suppliers Association (GPSA).
3. Plant Design and Operations, Ian Sutton, 2nd Edition,Gulf Professional Publishing, 2017. eISBN: 9780128128848
4. Essentials of Oil and Gas Utilities: Process Design, Equipment, and Operations, AlirezaBahadori, Gulf Professional Publishing; 1 edition, 2016. eISBN: 9780128030899

Web Links:

1. https://www.scribd.com/doc/.../Surface-Production-Operations-Volume-1-Oil System-
2. www.academia.edu/.../Ken_Arnold_Surface_Production_Operations_ Volume_1_3rdE
3. blog.agrostar.in/surface_production_operations_vol_2_design_of_gas_handling _syst...
4. http://acreditacion.uni.edu.pe/wp-content/uploads/2017/05/Design-of-OilGasSeparators-%E2%80%93-From-Hydrocarbon-Stream.pdf
5. https://pdfs.semanticscholar.org/5d3a/972503a6e99621738a67021c145fc2269ce8.pdf

Unconventional Hydrocarbon Resources

	L	T	P	C
Course Code: 2501PT16	**1**	**1**	**0**	**2**

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

- **CO1:** Explain the present global energy scenario
- **CO2:** Determine the Characteristics of a Tight Reservoir and Oil
- **CO3:** Illustrate the origin and characterize shale gas
- **CO4:** Demonstrate the Characteristics of Coal Bed Methane and Gas Hydrates
- **CO5:** Explain the heavy oil reservoirs and their challenges

Mapping of Course Outcomes with Program Outcomes:

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

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
Introduction to Unconventional Hydrocarbon resources, Coal Bed Methane: Geological controls in CBM plays, Resource estimation, Drilling, completion and production performance of a CBM well, Indian Scenario

UNIT – II
Tight Gas and Oil
Characteristics of a Tight Reservoir; What makes them Tight; The Permeability Jail; Where to find Tight Reservoirs; Drilling Practices for Tight reservoirs; Formation Evaluation; Hydraulic Fracturing, Post Fracture Reservoir evaluation; New Technologies

UNIT – III
Shale Gas/ Oil
Introduction, geology, important occurrences, petrophysical properties, hydro fracturing, horizontal wells, production profiles.

UNIT – IV

Coal Bed Methane and Gas Hydrates

Characteristics of Coal Bed Methane Gas; Drilling Practices for Coal Beds; Workflow for Coal Bed Formation Evaluation, Cleat, Gas Content; Hydraulic Fracturing, Depressuring and Dewatering issues Success and Lessons learnt so far; Gas Hydrates: Minerology, Chemistry and physical properties, stability, challenges and pitfalls

UNIT – V

Non-Conventional Oil

Introduction to Heavy oil, extra heavy oil, Tar Sand and bituminous, oil shales; origin and occurrence worldwide, resources, reservoir characteristics, new production technologies

Textbooks:

1. Unconventional Gas Reservoirs: Evaluation, Appraisal, and Development, Islam M.R., Gulf Professional Publishing, 2014 eISBN: 978-0128017682.
2. Coal Bed Methane: From Prospects to Pipeline, Thakur P., Aminian K., Schatzel S., Elsevier Science Publishing, 2015. eISBN: 978-0128002138

Reference Books:

1. Geophysical Characterization of Gas Hydrates: 14 (Geophysical Developments), Michael Riedel, Satinder Chopra, Society of Exploration Geophysicists; 1st edition, 2010 eISBN: 978-1560802454
2. Shale Gas: Exploration and Environmental and Economic, Anurodh Mohan Dayal, Devleena Mani, Elsevier Science Publishing, 2017. eISBN: 978-0128041519.

Web Links:

1. https://link.springer.com/article/10.1007/s13202-021-01404-x
2. https://spgindia.org/10_biennial_form/P260.pdf
3. https://www.iogp.org/wp-content/uploads/2016/10/An-introduction-to-shale-oil-and-gas-Jul2015-1.pdfhttps://link.springer.com/chapter/10.1007/978-3-030-21414-2_1
4. https://link.springer.com/chapter/10.1007/978-3-030-21414-2_1
5. https://www.open.edu/openlearn/science-maths-technology/living-without-oil/content-section-1.

Enhanced Oil Recovery

Course Code: 2501PT03	L	T	P	C
	2	1	0	3

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

- **CO1:** Explain the basic features and technical foundations of the most common EOR methods
- **CO2:** Explain the basic geological factors for flooding of reservoirs
- **CO3:** Apply screening criteria to a given reservoir to select an displacement method both technically and economically
- **CO4:** Make Use of rock, fluid, and reservoir data for the Displacement of fluids in the reservoir
- **CO5:** Apply screening criteria to a given reservoir to select a chemical method for flooding

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Principles of enhanced oil and gas recovery methods. IOR, EOR& EGR. Screening criteria for EOR methods.

UNIT – II
Geological Factors in Enhanced Oil Recovery
Reservoir heterogeneities, Examples of geological factors in enhanced recovery projects Natural fractures,
Determination of Residual Oil Saturation based on Geophysical Well logging techniques, Determination of residual saturation, Well-log-derived oil saturation determination in open hole, Residual oil saturation determination in cased wellbore

UNIT – III

Immiscible displacement: Injection well location, production well completion, surface installation.Miscible drive: Miscible slug flooding, thermodynamic miscibility, ternary diagrams, methods of miscible drive. Benham's correlations, physical and mathematical modelling.

UNIT – IV

Displacement of fluids in reservoir: capillary force; viscous force; phase trapping; mobilization of trapped phases, and alteration of viscous/capillary force ratio.

UNIT – V

Design aspects of chemical flooding. Case studies of surfactant, alkali, polymer, ASP flooding. WAG process, SWAG process, and Chemical augmented WAG process. Foam flooding.

Textbooks:

1. Enhanced Oil Recovery: Mechanisms, Technology, and Feasibility" by Ajay Mandal and Keka Oja. eISBN: 978-0128200810.
2. Applied Enhanced Oil Recovery, Aural Carcoane, Prentice Hall eISBN: 9780130442727

Reference Books:

1. Basic Concepts in Enhanced Oil Recovery Processes, Marc Baviere, SCI, eISBN: 9781851666171
2. Enhanced Oil Recovery: Proceedings of the Third European Symposium on Enhanced Oil Recovery, F. John Fayers, Elsevier eISBN: 978-3-319-31421-1
3. Enhanced Oil Recovery, Larry W. Lake, Prentice Hall, eISBN: 9780132816014

Web Links:

1. https://www.ogj.com/oil-drilling-and-production/production-operations/ior-eor.html
2. http://www.ccop.or.th/ppm/document/INWS4/INWS4DOC03c_Norway_GUNNAR.pdf
3. https://petrowiki.org/Polymer_waterflooding
4. https://www.glossary.oilfield.slb.com/en/Terms/a/alkaline_flooding.aspx
5. https://petrowiki.org/Conformance_improvement

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE01	Basic Electrical & Electronics Engineering	FC	2		2	4	50	50	100	-
2501MB02	Engineering Economics	IC	3			3	50	50	100	-
2501MB03	Management Science	AC	2			2	50	50	100	-
	Total		**7**		**2**	**9**				

Basic Electrical & Electronics Engineering

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

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. Magnetization 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, 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

(Common to ECE, PT & Min.E)

Course Code: 2501MB02	L	T	P	C
	3	0	0	3

Course Outcomes:

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

- **CO1:** Explain the Managerial Economic concepts and Illustrate the law of demand forecasting methods.
- **CO2:** Identify the production , cost behavior for managerial decision making and Break Even Point (BEP) of an enterprise.
- **CO3:** Differentiate types of market structures, business organizations along with basic knowledge on business cycle.
- **CO4:** Make use of the process & principles of accounting for the preparation of basic accounts.
- **CO5:** Utilize various techniques on investment project proposals with the help of capital budgeting techniques for decision making.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Managerial Economics and demand Analysis: Definition and Scope of Managerial Economics, Concept and determinants of demand, Demand curve, Law of Demand and its limitations, Elasticity of demand and its types, Demand forecasting and its Methods.

UNIT – II

Production and Cost Analyses: Concept of production function – Law of variable proportions-Isoquants and Iso costs- cost concepts: opportunity costs, explicit and implicit costs- Fixed costs, Variable costs and total costs – Cost –Volume-Profit analysis-Determination of breakeven point (simple problems)- Managerial significance and limitations of breakeven point.

UNIT – III

Introduction to Markets, Pricing Policies & Types of Business Organization and Business Cycles.

Market structures: Perfect competition, monopoly, monopolistic competition and oligopoly –Features – Methods of pricing: Average cost pricing, Limit pricing, Market skimming pricing. Features and evaluation of Sole Trader, Partnership, Joint Stock Company – Business cycles : Phases of business cycles.

UNIT – IV

Introduction to Accounting & Financing Analysis: Introduction to double entry systems – Journal entries – Ledger – Trail balance – Trading and Profit and Loss account-simple problem.

UNIT – V

Capital and Capital Budgeting:Capital Budgeting: Meaning of Capital- Methods of Capital Budgeting-Traditional Methods(pay back period, accounting rate of return) and modern methods(Discounted cash flow method, Net Present Value. method, Internal Rate of Return Method and ProfitAbility Enhancement Courses Index)- Simple Problems.

Text Books:

1. Managerial Economics and Financial Analysis, A.R. Aryasri , McGrawHill Education. ISBN: 978-0070078031
2. Managerial Economics and Financial Analysis, N.Appa Rao, P.Vijay Kumar, Cengage Publications. ISBN: 978-8131515952

Reference Books:

1. Managerial Economics , V. Maheswari , Sultan Chand Publications. ISBN: 81-8054-914-4
2. Managerial Economics, Suma Damodaran : Oxford University Press. ISBN: 978-0198061113

Web Links:

1. https://www.udemy.com/course/introduction-to-managerial economics/?couponCode=LETSLEARNNOWPP
2. https://archive.nptel.ac.in/courses/110/101/110101149/

Management Science
(Common to ECE & PT)

	L	T	P	C
Course Code: 2501MB03	**2**	**0**	**0**	**2**

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

- **CO1:** Apply management and motivation theories to renovate the practice of management.
- **CO2:** Explain concepts of quality management and use process control charts, concepts and tools of quality engineering in the design of products and process controls.
- **CO3:** Appraise the functional management challenges associated with high levels of change in the organizations.
- **CO4:** Identify activities with their interdependency and use scheduling techniques of project management PERT/CPM.
- **CO5:** Develop global vision and management skills both at strategic level and interpersonal level.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I
Introduction to Management: Concept nature and importance of management, Generic functions, Principles and Types of Management, Theories of motivation, Decision making process, Designing organization structure.

UNIT – II
Operations Management: Work study, Statistical quality control, Control charts (P-chart, R-chart, and C-chart), Need for inventory control, EOQ, ABC analysis, and Types of ABC analysis (HML, SDE, VED, and FSN analysis).

UNIT – III
Functional Management: Concept of HRM, HRD and PMIR, Functions of HR Manager, Job evaluation and merit rating, Marketing management, functions of marketing, channels of distributions.

UNIT – IV
Project Management: Development of Network, Difference between PERT and CPM, Identifying critical path, (Simple Problems).

UNIT – V
Strategic Management: Vision, Mission, Goals, Strategy, Elements of corporate planning process, SWOT analysis, Steps in strategy formulation and implementation.

Text Books:

1. Management Science, Aryasri, Tata McGraw Hill. ISBN: 9780070090279
2. Management, James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R, Pearson Education/Prentice Hall, 6th Edition.ISBN: 9788131707043

Reference Books:

1. Principles of Marketing, , 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

Web Links:

1. https://archive.nptel.ac.in/courses/122/106/122106031/
2. https://www.google.com/search?sca_esv=680b12c94771f77f&sca_upv=1&rlz=1C1VDKB_enGBIN1079IN1079&tbm=vid&sxsrf=ADLYWIKvg0FuUABCxWsswlpWIfSE3hFy0A:1716531957118&q=management+science+online+video+lectures&sa=X&ved=2ahUKEwissbLs06WGAxVX2.wGHYpkDOMQ8ccDegQIExAF

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/ 2501UC05/ 2501UC04/ 2501UC03/ 2501UC06	Advanced Cognitive Skills for Engineers **(or)** Proficiency in Foreign Language ((Japanese/ German/ French/ Spanish)	FC			1	1	100	-	100	-
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	-
2501PT52	Student Activity Based Learning	AC			2	2	100	-	100	-
Total			**2**		**7**	**9**				

Essential Cognitive Skills for Engineers

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

	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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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: How to survive…an animal attack, Leaflet: Be wise and survive
Writing	Guidelines, organizing guidelines in a leaflet
Grammar	Narrative tenses, Future time clauses and conditionals
Vocabulary	Expressions with get, 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; *Learning to learn*, Article: *Born to be the best*; Three articles about athletes, Article: *Fitness: Seattle snapshot*
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: *Training for the emergency frontline,* Advert for being an international student 'buddy'
Writing	Job application, Giving a positive impression
Grammar	*Used to* and *would*
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: *Are you an optimist or a pessimist?; Article: Why we think we're going to have a long and happy life*, Quiz: *The unknown continent*; Article: *Cooking in Antarctica*, 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: *th,* Intonation groups

Text Book:

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

Suggested Software:

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

Reference Books:

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

Web links:

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

Advanced Cognitive Skills for Engineers

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

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

Course Outcomes:

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

CO1: Recognize the basics of communication and summarize formal and informal language expressions in all aspects.

CO2: Establish and maintain interpersonal relationships and transmit the message through different language activities.

CO3: Use language effectively to prepare and demonstrate proficiency in facing various types of interviews.

CO4: Demonstrate and exhibit professionalism in participating in various public speaking activities like debates, group discussions and presentation skills.

CO5: Identify the basic elements of writing and apply the fundamentals to compose e-mails catering to different professional needs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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 bout four tourist destinations; Website: *Where to go?*
Writing	Travel blog, Using descriptive language
Grammar	Infinitives and *–ing* 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: *Quick-slow down!*, Article: *Who puts the 'real' in reality* TV? Email: Complaining about an important issue.
Writing	Email of complaint, Using formal language

Grammar	*Too/enough; so/such*, Causative *have/get*
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: *Is it time to give up on cash?*, Newspaper article: *The honesty experiment*, Review: *Crime with a smile*
Writing	Review, Organising a review
Grammar	First and second conditionals, Third conditional; *should have+past participle*
Vocabulary	Money and finance, Crime
Pronunciation	Stressed and unstressed words; Sound and spelling: *l,* 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: *Too good to be true?*, Article: *The rise and fall of Barry Minkow,* Essay: *The Value of alternative medicine*
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 : *ui*, 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: *The Wreck of the Titan*, Article: *Dream to help*, Story: Rosa's diary: *The ultimate goal*
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. ISBN: 978-1107468726

Suggested Software:

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

Reference Books:

1. Raman Meenakshi, Sangeeta-Sharma. Technical Communication. Oxford University Press.2018. ISBN: 9789354972256
2. Michael Swan- Practical English Usage ISBN: 9780194202466
3. Taylor Grant: English Conversation Practice, Tata McGraw-Hill Education India,2016 ISBN: 978-0070996038

Web links:

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

Design Thinking using AI

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

	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 by 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 by Harvard Business Press. ISBN: 9781422177808

Reference Books:

1. Engineering Design Process by Yousef Haik and Tamer M.Shahin, Cengage Learning, Second Edition. ISBN: 978-8131529041
2. Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author). ISBN: 978-0231163569

Web Links:

1. www.tuto2.u.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
2501PT19	MATLAB For Petroleum Engineers Lab	IC			2	2	50	50	100	-
2501PT51	Well Control and Pressure Control Lab	IC			1	1	100	-	100	-
2501PT20	Petroleum Equipment Design and Simulation Lab	IC			2	2	50	50	100	SPO
2501PT18	Drilling Simulation Lab	AC			2	2	50	50	100	-
2501PT21	Unit Operations Using SCI Lab	AC			2	2	50	50	100	FMPE & HTPO
Total					**9**	**9**				

MATLAB for Petrolem Engineers Lab

	L	T	P	C
Course Code: 2501PT19	**0**	**0**	**2**	**2**

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

- **CO1:** Develop a program to create geological model using simple matlab code.
- **CO2:** Make use of different homogeneous models for geological layers.
- **CO3:** Apply the concepts of flow models in porous media.
- **CO4:** Build grids of structured, unstructured and complex grids.
- **CO5:** Develop GUI for the Grids Generated using the MRST

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

List of Practices

1. Data representation, error analysis, introduction to MATLAB; Applied MATLAB programming
2. Structured programming and looping
3. Numerical solution of algebraic and transcendental equations.
4. Create a geological model is a grid describing the geometry of the reservoir rock, here chosen as a regular 1 × 1 × 30 Cartesian grid.
5. Curve fitting: Straight line fit, polynomial curve fit and exponential curve Fit.
6. Numerical integration: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule,
7. Solution of simultaneous algebraic equations: Gauss elimination method.

8. Numerical solution of ordinary differential equation: Taylor's method, Euler's method, Runge- Kutta method, modified Euler's method; Predictor corrector method: Adam's method and Milne's method.
9. consider a reservoir consisting of a homogeneous 500 × 500 × 25 m3 sand box with an isotropic permeability of 100 mD, represented on a regular 20 × 20 × 5 Cartesian grid.
10. Optimization algorithms and introduction to Simulink.

Additional Practices:

1. Consider a homogeneous reservoir in the form of a 2D rectangle [0,4] × [0,1]. Flow is driven from the north to the south side of the reservoir by a fluid source with unit rate located at (2,0.975)
2. Construct a Radial symmetric grids graded towards the origin are commonly used to increase resolution near wells.
3. Construct an areal Voronoi grid from a set of generating points obtained by perturbing the vertices of a regular Cartesian grid and then use the function makeLayeredGrid to extrude this Voronoi grid to 3D along vertical pillars in the z-direction.

Textbooks:

1 Knut-Andreas Lie ,An introduction to reservoir simulation using matbabgnu and Octave, User Guide for the MATLAB Reservoir Simulation Toolbox (MRST),Cambridge press, 2019 eISBN: 9781108492430

2 Chapra, S., "Applied Numerical Methods with MATLAB for Engineers and Scientists", Edition: 4, McGraw-Hill Education (2017). eISBN: 9780077144883

Reference Books:

1 Pratap, R. "Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers'', Ox- ford University Press, (2010). eISBN: 9780199731244

2 Ahuja, P. "Introduction to Numerical Methods in Chemical Engineering", PHI Learning Pvt., Edi- tion: 2 (2019). eISBN: 9789389347173

Web Links:

1 https://www.mathworks.com/academia/books/an-introduction-to-reservoir-simulation-using-matlab-gnu-octave-lie.html

2 https://www.sintef.no/contentassets/8af8db2e42614f7fb94fb0c68f5bc256/mrst-book-2016.pdf

3 https://www.cambridge.org/core/books/an-introduction-to-reservoir-simulation-using-matlabgnu-octave/modeling-reservoir-rocks/D54C1FD08E64FDD810436E0651E40650

Well Control & Pressure Control Lab

L	T	P	C
0	0	1	1

Course Code: 2501PT51

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

CO 1: Make use of excel to solve the area and volume calculations.
CO 2: Calculate the examples related to volume, capacities and displacements
CO 3: Explain the well control risk and borehole geometry
CO 4: Study and solve the gas laws and its characteristics
CO 5: Study the concept of circulating system.

Mapping of course outcomes with program outcomes:

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

List of Experiments:

1. **Introductory Concepts:** Areas and Volumes
   - I. Perimeter and area
   - II. Units of area
   - III. Angles
   - IV. Areas of regular shapes
   - V. Conservation of area
2. **Volumes, Capacities and Displacements**
   - I. Calculating mud pit volumes and capacity
   - II. Calculating the volume of a cylinder
   - III. Calculating the capacity of a cylinder in bbl/ft
   - IV. Calculating annular volumes
   - V. Calculating annular capacities
   - VI. Calculating drill pipe, casing and tubing capacities
   - VII. Calculating metal displacement
   - VIII. Calculating closed end displacements

3. **Well Control Risks When Tripping**
    I. Tripping 'dry' and tripping 'wet'
    II. Tripping into the well
    III. Tripping out of the well
    IV. Trip tanks
    V. Trip sheets
4. **Borehole Geometry**
    I. Drill string capacity and annular volumes
    II. Surface and subsea well geometry
    III. Calculating drill string capacity and annular volumes for a surface well
    IV. Calculating drill string capacity and annular volumes for a subsea well
5. **Gas and its characteristics**
    I. Gas and gas characteristics
    II. Gas mass
    III. Gas density
    IV. Pressure gradient
6. **Gas Laws**
    I. How gas changes with pressure
    II. Gas density changes with pressure
    III. High pressure gases
    IV. Ideal gas law
7. **Accumulator bottles**
    I. Accumulator capacity calculations
    II. Accumulator pre-charge
    III. Accumulator minimum operating pressure
    IV. Accumulator maximum operating pressure
    V. Useable hydraulic fluid volume
8. **The Circulating System**
    I. Understanding pump pressure
    II. Combining several pipe sections into a system
    III. The drilling circulating system
    IV. Mud pump pressure in a circulating system
    V. Changes in pump rate
    VI. Changes in drilling fluid density
9. **Effect of Circulation on Bottomhole Pressure**
    I. The effect of circulating pressures on bottomhole pressure (BHP)
    II. The effect of annular pressure loss on BHP
    III. Equivalent circulating density (ECD)
10. **Pump outputs, Strokes and Circulating time**
    I. Pump output and pump strokes
    II. Calculating the required number of strokes
    III. Calculating the time required to pump a volume of fluid
    IV. Using both formulas with given well data

Reference Books:

1. Drilling Engineering" by J.J. Azar and G. Robello Samuel ISBN: 978-0750678613
2. Applied Drilling Engineering" by Adam T. Bourgoyne Jr., et al. ISBN: 978-0884152585

Web Links:

I. https://iwcf.org/well-control-pressure-calculations/#/

Petroleum Equipment Design & Simulation Lab

	L	T	P	C
Course Code: 2501PT20	**0**	**0**	**2**	**2**

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

CO1: Design and simulation of the two-phase, three phase separators and compressors
CO2: Design and simulation of absorber-stripper unit for removal of CO2 and H2S from natural gas
CO3: Size /rate the pipeline & pumping systems for liquid pumping & simulate water hammer conditions
CO4: Design and simulation of flash vaporization units
CO5: Generating sized equipment data sheets as per the industry standards with required information fordetailed design / manufacture

Mapping of Course Outcomes with Program Outcomes:

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
CO5	-	-	-	-	2	-	-	-	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

List of Practices:

1. Study Oil- Water separator
2. Study Gas- Oil-Water separator
3. Study Lean / rich amine heat exchanger
4. Study Air-cooled heat exchanger.
5. Study CO2 and H2S absorber unit using, MEA/DEA amine solution.
6. Study Stripping unit
7. Study Single stage flash vaporization unit

8. Study three stage flash vaporization unit.
9. Study Liquid pumping system & simulation of water-hammer phenomena
10. Study Gas Compressor unit

List of Additional Practices:

1. Study Expander
2. Study Conversion Reaction
3. Study Equilibrium Reaction

Reference Books:

1. Process Modeling, Simulation and Control for Chemical Engineering, Luyben, McGraw Hill Education;2 editions, 2013. eISBN: 9780070391598
2. Optimization of Chemical Processes, Thomas F. Edgar, David M. Himmelblau, Thomas E. Casson, 2ndEdition, 2001. eISBN: 9780071189774
3. Elements of Chemical Reaction Engineering, Fogler H.S, Prentice Hall India Learning Private Limited;4 edition, 2008. eISBN: 9780131278394

Web Links:

1. https://petrowiki.org/Oil_and_gas_separators
2. http://www.thermopedia.com/content/551/
3. https://en.wikipedia.org/wiki/Amine_gas_treating
4. www.chemprosys.com/products/evoporators/multi-stage-flash/
5. https://worldwidescience.org/topicpages/w/water+hammer+phenomena.html

Drilling Simulation Lab

	L	T	P	C
Course Code: 2501PT18	**0**	**0**	**2**	**2**

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

CO1: Evaluate the suitability of drilling Simulator by performing different laboratory tests
CO2: Analyse the effect of adding different drilling parameters with simulatio
CO3: Analyse the effect of adding different kick parameters with simulatio
CO4: Estimate the kick bynusing methods.
CO5: Function effectively as an individual, and as a member or leader while performing lab experiments.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

List of Practices:

1. Drilling a vertical well up to a certain depth using the various drilling systems such as the hoisting system and the rotary system.
2. Calculation and monitoring of all the drilling parameters such as the drilling rate (rate of penetration, ROP), rotary speed, drill pipe pressure, casing pressure, mud weight etc.
3. Setting up of a situation where a kick is induced into a well and fixing it using the driller's method (two circulation method). Preparation of a kill sheet.
4. Resolving a kick using the wait of weight method (Engineer's method, one circulation method). Preparation of a kill sheet.
5. Resolving a kick using the volumetric method. Preparation of a kill sheet.
6. Resolving a kick using the concurrent method. Preparation of a kill sheet.

7. Resolving the drilling problem when a choke is plugged.
8. Resolving a drilling problem when a choke is washout out.
9. Resolving a drilling problem when a bit nozzle is plugged.
10. Evaluate the effect of differential sticking on drilling.

Additional Practices:

1. Resolving a drilling problem when the well is packed-off.
2. Evaluate the effect of surge and swabbing on drilling.

Text Books:

1 Lab Manual For Drilling Simulator

Reference Books:

1 Well Control Problems Solutions : Neal A J.dams 1983 eISBN: 9780878141241

Unit Operations Using SCI Lab

Course Code: 2501PT21	L	T	P	C
	0	0	2	2

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

- **CO1:** Develop simulation to optimize column performance with Distillation Column.
- **CO2:** Make use of various methods to determine heat transfer coefficients.
- **CO3:** Apply hydrodynamics and reaction kinetics within fluidized bed systems
- **CO4:** Develop empirical models to predict pump performance under varying conditions
- **CO5:** Simulate the evaporation of a liquid in a single-effect or multi-effect evaporator

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

List of Practices:

1. Distillation Column Simulation:
   Simulate the operation of a distillation column to separate a binary mixture using the McCabe-Thiele method or other equilibrium-based approaches.
2. Heat Exchanger Performance Analysis:
   Analyze the heat transfer characteristics of a shell-and-tube heat exchanger under various operating conditions.
3. Fluidized Bed Reactor Simulation:
   Simulate the behavior of a fluidized bed reactor for gas-solid reactions and investigate the effects of different parameters on reactor performance.
4. Pump Performance Curve Estimation:
   Estimate the performance curve of a centrifugal pump by analyzing its head-flow characteristics using experimental data.
5. Mixer-Settler Design and Optimization:
   Design and optimize a mixer-settler unit for liquid-liquid extraction processes, considering factors such as residence time and phase distribution.

6. Fluid Flow in Pipes:
   Analyze the pressure drop and flow characteristics of fluids in pipes of different diameters and lengths using SCILAB's fluid dynamics simulation capabilities.
7. Solid-Liquid Filtration Experiment:
   Simulate the filtration process in a filter press or filter medium to determine the filtration rate, cake formation, and pressure drop.
8. Crystallization Process Modelling:
   Model the crystallization process in a batch or continuous crystallizer to predict crystal size distribution and yield under varying conditions.
9. Evaporation Process Simulation:
   Simulate the evaporation of a liquid in a single-effect or multi-effect evaporator to determine heat transfer coefficients and evaporation rates.
10. Absorption Tower Design:
    Design and analyze the performance of a packed or tray absorption tower for gas-liquid mass transfer processes, such as CO2 removal from flue gases.

Additional Practices:

1. Centrifugation Experiment:
   Analyze the separation efficiency of a centrifuge for solid-liquid or liquid-liquid separation processes and optimize operating parameters.
2. Fluid Mixing Analysis:
   Investigate the mixing efficiency and time required to achieve homogeneity in a stirred tank reactor or mixing vessel under different agitation speeds.
3. Gas-Liquid Mass Transfer Experiment:
   Study the mass transfer characteristics of a gas-liquid contactor, such as a bubble column or stirred tank, for absorption or stripping processes.

Text Books:

1 Scilab Code for Unit Operations of Chemical Engineering, Warren L. McCabe, Julian C. Smith, Peter Harriott, McGraw Hill, 2010. eISBN: 0-07-112738-0

2 Introduction to Scilab: For Engineers and Scientists, Sandeep Nagar, APress; 1st ed. Edition, 2017. eISBN: 978-1484231959

Reference Books:

1 Introduction to Scilab, Rachna Verma, Arvind Verma, independently published, 2018. eISBN: 9789353008390

2 Scilab: from Theory to Practice - I. Fundamentals, Philippe Roux, Éditions D-BookeR, 2016 eISBN: 9782822702928

Web Links:

1 https://www.opensourceforu.com/2015/05/using-scilab-with-the-mccabe-thiele-method/

2 https://www.colan.org/process-modeling-component/scilab-unit-operation/

3 https://kpriet.ac.in/stories/898/dynamic-simulation-of-a-distillation-column-in-dwsim

4 http://surl.li/tvqos

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS02	Data Analysis Using Python	IC			2	2	50	50	100	PPSC
2501CS04	Internet of Things	FC			1	1	50	50	100	-
2501UC11	Employability Skills-I	FC			3	0	100	-	100	-
2501UC13	Employability Skills-II	FC			3	0	100	-	100	ES-I
2501UC14	Employability Skills-III	IC			3	0	100	-	100	ES-II
2501UC15	Employability Skills-IV	IC			3	0	100	-	100	ES-III
2501UC16	Employability Skills-V	AC			3	1	100	-	100	ES-IV
Total					**18**	**4**				

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 Data Frames.
- **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	-	1
CO2	1	2	3	-	2	-	-	1	1	-	1
CO3	1	3	2	-	2	-	-	1	1	-	1
CO4	1	2	3	-	2	-	-	1	1	-	1
CO5	1	2	3	-	2	-	-	1	1	-	1

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 DataSeries:
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 it's type.
4.2) Pandas DataFrames:
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 DataFrame 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 DataFrame.
iii)Write a Pandas program to insert a new column in existing DataFrame. iv)Write a Pandas program to get list from DataFrame column headers. v)Write a Pandas program to get list from DataFrame 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 to do 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, NeethumolSabu,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/

Internet of Things

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

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

Practice:

1. Study of Arduino UNO and Raspberry Pi boards including architecture, pin configuration, power supply, communication interfaces and development environments.
2. Study of commonly used sensors and actuators such as temperature sensor, moisture sensor, LDR, ultrasonic sensor, IR sensor, PIR sensor, LED and motor. Identify their working principles and applications.
3. Design and implement basic digital input–output operations using Arduino by controlling LED/buzzer.
4. Interface an analog sensor (LDR) with Arduino and display sensor values on Serial Monitor.

5. Interface a digital sensor (Ultrasonic sensor) with Arduino and display measured values on Serial Monitor.
6. Develop conditional logic using Arduino to control LED or buzzer based on sensor threshold values.
7. Interface a servo motor with Arduino and control its angular position based on sensor input to demonstrate automatic gate or smart irrigation model.
8. Design and implement a multi-sensor monitoring system using Arduino to read analog and digital sensors simultaneously and display results on Serial Monitor.
9. Create a cloud platform account, explore available IoT services and register a device (Thing) on the platform.
10. Demonstration of IoT based system to upload sensor data to cloud platform and visualize the received data in graphical form.

Additional Practice (Any 2 from the following)

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

Reference Books:

1 An Introduction to Internet of Things, Connecting devices, Edge Gateway and Cloud with Applications, Rahul Dubey, Cengage, 2019. ISBN: 9789353501020
2 Adrian McEwen, Designing the Internet of Things, Wiley Publishers. ISBN:978-1118430620
3 IoT Fundamentals, Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetette, rob Barton, Jerome Henry, CISCO, Pearson, 2018. ISBN:9789386873743
4 Internet of Things, by Vengalapudi Appala Konda and Prof. Sangareddy B. Krutakoti, Scientific International Publishing House, First Edition, 2024. ISBN: 978-93-6132-958-6.

Web Links:

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

Employability Skills- I

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

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

Course Outcomes:

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

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

Mapping 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	-	-	-	-	-	-	-	2	3	-	1

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

1. Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND.
2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal.
3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND.

Reference Books:

1. Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications.
2. Analytical Reasoning – Jaikishan and Premkishan Arihant Publications.
3. A New Approach to Objective English – R. S. Dhillon DGP Publications.

Web Links:

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

Employability Skills- II

(Common to CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min.E & Ag.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.
2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal.
3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND.

Reference Books:

1. Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications.
2. Analytical Reasoning – Jaikishan and Premkishan Arihant Publications.
3. A New Approach to Objective English – R. S. Dhillon DGP Publications.

Web Links:

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

Employability Skills- III

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

	L	T	P	C
Course Code: 2501UC14	**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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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.
2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal.
3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND.

Reference Books:
1. Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications.
2. Analytical Reasoning – Jaikishan and Premkishan Arihant Publications.
3. A New Approach to Objective English – R. S. Dhillon DGP Publications.

Web Links:
1. www.indiabix.com
2. www.bankersadda.com

Employability Skills- IV

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

	L	T	P	C
Course Code: 2501UC15	**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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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.
2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal.
3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND.

Reference Books:

1. Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications.
2. Analytical Reasoning – Jaikishan and Premkishan Arihant Publications.
3. A New Approach to Objective English – R. S. Dhillon DGP Publications.

Web Links:
1. www.indiabix.com
2. www.bankersadda.com

Employability Skills- V

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

	L	T	P	C
Course Code: 2501UC16	**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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
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.
2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal.
3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND.

Reference Books:
1. Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications.
2. Analytical Reasoning – Jaikishan and Premkishan Arihant Publications.
3. A New Approach to Objective English – R. S. Dhillon DGP Publications.

Web Links:
1. www.indiabix.com
2. www.bankersadda.com

Mandatory Courses (MC)

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

Environmental Science

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

	L	T	P	C
Course Code: 2501AC01	**2**	**0**	**0**	**0**

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I
Multidisciplinary Nature of Environmental Studies:
Definition, Scope and Importance, Need for Public Awareness.
Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems.

UNIT – II
Ecosystem, Biodiversity and Its Conservation:
Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers, and decomposers. Food chains, food webs and ecological pyramids.
Biodiversity And Its Conservation: Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Values of biodiversity. Hot-spots of biodiversity – Threats to biodiversity. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III
Environmental Pollution and Solid Waste Management:
Environmental Pollution: Definition, Cause, effects, and control measures of:
a. Air Pollution.

b. Water Pollution
c. Soil Pollution
d. Marine Pollution
e. Noise Pollution
Solid Waste Management:
Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution

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

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

Text Books:
1. Textbook of Environmental Studies for Undergraduate Courses, 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://archive.nptel.ac.in/courses/127/105/127105018/
2. https://onlinecourses.swayam2.ac.in/cec24_ge05/preview

Constitution of India

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

	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 and its importance for building a democratic India
- **CO2:** Compare the functioning of three wings of the government i.e.., executive, legislative and judiciary
- **CO3:** Interpret the value of the fundamental rights and duties for becoming good citizen of India
- **CO4:** Compare the decentralization of power between central, state and local self-government
- **CO5:** Extend the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Indian Constitution:

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

UNIT – II

Union Government and its Administration Structure of the Indian Union:

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

UNIT – III

State Government and its Administration Governor:

Role and Position - CM and Council of ministers, State Secretariat: Organization, Structure and Functions

UNIT – IV

Local Administration:

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

UNIT – V

Election Commission:

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

Text Books:

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

Reference Books:

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

Web Links:

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

Research Methodology

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

	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 and process of research.
CO2: Select the research problem by applying problem identification techniques.
CO3: Formulate and execute research design process.
CO4: Report the results of research process adhering to professional ethics.
CO5: Analyze the results of research using statistical measures of central tendancy

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Meaning of Research:

Function of Research - Characteristics of Research – Steps involved in Research – Research in Pure and Applied Sciences - Inter Disciplinary Research. Factors which hinder Research – Significance of Research - Research and scientific methods – Research Process– Criteria of good Research – Problems encountered by Researchers – Literature review.

UNIT – II

Identification of Research Problem :

Selecting the Research problem – Necessity of defining the problem – Goals and Criteria for identifying problems for research. Perception of Research problem – Techniques involved in defining the problem.

UNIT – III

Research Design :

Formulation of Research design – Need for Research design – Features of a good design – Important concepts related to Research design.

UNIT – IV

Interpretation and Report Writing:

Meaning and Technique of interpretation – Precautions in interpretation – Significance of report writing – Different steps in writing a report – Layout of a Research report.

UNIT – V

Statistical Techniques and Tools :

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

Text Books:

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

Reference Books:

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

Web Links:

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

Intellectual Property Rights & Patents

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

Patents: Introduction to Patents - Laws Relating to Patents in India – Patent Requirements – Product Patent and Process Patent - Patent Search - Patent Registration and Granting of Patent - Exclusive Rights – Limitations - Ownership and Transfer — Revocation of Patent – Patent Appellate Board - Infringement of Patent – Double Patenting — Patent Cooperation Treaty – New developments in Patents – Software Protection and Computer related Innovations.

UNIT – IV

Trademarks and Trade secrets: Introduction to Trademarks – Laws Relating to Trademarks – Functions of Trademark – Distinction between Trademark and Property Mark – Marks Covered under Trademark Law - Trade Mark Registration – Trade Mark Maintenance – Transfer of rights - Deceptive Similarities - Likelihood of Confusion - Dilution of Ownership – Trademarks Claims and Infringement – Remedies – Passing off Action - Introduction to Trade Secrets – General Principles - Maintaining Trade Secret – Physical Security – Employee Access Limitation – Employee Confidentiality Agreements.

UNIT – V

Cyber Law and Cyber Crime : Introduction to Cyber Law – Information Technology Act 2000 - Protection of Online and Computer Transactions - E-commerce - Data Security – Authentication and Confidentiality - Privacy - Digital Signatures – Certifying Authorities - Cyber Crimes - Prevention and Punishment – Liability of Network Providers. Relevant Cases Shall be dealt where ever necessary.

Text Books:

1. Fundamentals of IPR for Engineers- Kompal Bansal &Parishit Bansal, B. S. Publications (Press). ISBN: 9788178002774.
2. Intellectual Property -Deborah E.Bouchoux, Third Edition, Cengage Learning, New Delhi. ISBN: 0 340 67786 4.

Reference Books:

1. Intellectual property rights- Prabuddha Ganuli, Tata Mcgraw hill. ISBN: 978-0070077171.
2. Intellectual property rights M.Ashok kumar and Mohd.Iqbal Ali:, Serials Publications. ISBN: 9788183871648.
3. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi. ISBN: 979-8886848229.
4. Intellectual Property- Richard Stim, Cengage Learning, New Delhi. ISBN: 978-0766826656.

Web Links:

1. http://www.wipo.int/portal/en/index.html
2. https://indiankanoon.org/
3. http://www.ipindia.nic.in/patents.htm
4. http://www.ipindia.nic.in/trade-marks.htm
5. http://copyright.gov.in

Indian Knowledge Systems (IKS)

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

	L	T	P	C
Course Code: 2501AC05	**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 Courses

Pipeline and Petroleum Transport Engineering:

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	-
2501PT34	Transportation of Petroleum Products	FC	3			3	50	50	100	-
2501PT31	Pipeline Engineering	FC	3			3	50	50	100	-
2501PT29	Operational & Maintenance of Pipelines	IC	3			3	50	50	100	PE
2501PT26	Flow Assurance	IC	2			2	50	50	100	IPE
2501PT28	Midstream Project Economic Analysis	IC	3			3	50	50	100	TPP
2501PT33	Storage & Transportation of Crude oil & Natural Gas	IC	3			3	50	50	100	TPP & UOPI
2501PT25	Data Analytics & AI For Process Industry	IC	3			3	50	50	100	UOPI
2501PT30	Petroleum Economics Polices & Regulations	AC	3			3	50	50	100	MPEA
2501PT32	Pipeline Project Management	AC	3			3	50	50	100	OMP
Total			**32**			**32**				

Introduction To Petroleum Engineering

Course Code: 2501PT27	L	T	P	C
	3	0	0	3

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

CO 1: Identify the various streams in the petroleum industry.
CO 2: Outline the onshore and offshore reservoirs.
CO 3: List out the various artificial lift techniques.
CO 4: Illustrate various attributes in mid-stream processing and storage.
CO 5: Describe the crude oil products and their specifications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

What is Petroleum Engineering & Significance? Introduction Petroleum Industry- Upstream Sector- Midstream Processing-Downstream Processing-Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II

Exploration & Production-Indian and World Scenario of Petroleum and Natural Gas Resources- The Reservoir-Reservoir fluids- Hydrocarbon Phase diagrams- Onshore and Offshore Reservoirs

Reservoir Drives. Exploration and Drilling Rigs- Rig Components-Drill and drill bits-Drilling fluids.

UNIT III

Well Completions Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.

Artificial Lift: Principles and operation of Rod Pumps Down Hole Pumps - Gas Lift - Plunger Lift- Electrical submersible pumps.

UNIT IV

Separation of Reservoir Fluids- Manifolds and Gathering - Production Separators - Gas Treatment and Compression - Oil & Gas Storage.

Midstream processing: Transportation of Crude Oil & its Products and Natural Gas- World and Indian pipeline scenario- Design of Oil and Gas pipelines Safety aspects of pipelines- Environmental issues.

UNIT V

Crude Oil Refining: Classification and Composition - Constituents - Products and their specifications- Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Text Books:

1. Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, ABB ATPA Oil and Gas. eISBN: 978-1329783454
2. John R. Fanchi and Christiansen, R.L. Introduction to Petroleum Engineering, John Wiley & Sons. eISBN:9781119193463

Reference Books:

1. Production and transport of oil and gas (part B: gathering and transport); Szilas A.P; Elsevier publications, 2nd Edition. eISBN: 0-444-99564-1
2. Subsea Engineering Handbook; Yong Bai., QiangBai; Gulf Professional Publishing; Elsevier eISBN: 978-1-85617-689-7

Web Links:

1. https://www.studentenergy.org
2. https://petrowiki.org/Hydrate_problems_in_production
3. https://en.wikipedia.org/wiki/Pipeline_transport
4. https://petrowiki.org/Production_system

Unit Operations in Petroleum Industry

Course Code: 2501PT35	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Understand the Heat and Mass Transfer Principles
CO2: Prioritize Proficiency in Conduction Mechanisms
CO3: Explain Mastery of Convective Heat Transfer
CO4: Apply Knowledge of Heat Exchange Equipment and Evaporation
CO5: Distinguish Mass Transfer and Distillation Techniques

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit – I

Introduction: Objective, scope and outcome of the course.

Conduction: Introduction to unit operation and its application in petroleum engineering. Heat Transfer and its application, Modes of heat transfer one dimensional and two-dimensional, heat rate equations, Theory of insulation, critical radius calculations, types of insulation material, conduction through slab, cylinder and sphere.

Unit – II

Convection: Convective heat transfer, natural and forced convection, co/counter/cross current contacting for heat transfer, individual and overall heat transfer coefficient, Fouling factor, Heat transfer with and without phase change conditions**.**

Unit – III

Heat Exchange equipment: Introduction to double pipe, shell and tube exchangers, condensers, extended surface equipment.

Evaporation- Type of evaporators and their applications single and multiple effect evaporators, operation of forward– backward and mixed feed operations.

Unit – IV

Mass transfer and its application: Analogies in transfer process, basic concept of diffusion and interphase mass transfer. Mass transfer theory film theory Penetration and surface renewal theory.

Unit – V

Distillation: Rectification, reflux ratio, calculation of numbers of plates by McCabe Thiele method, optimum reflux ratio

Basic introduction to absorption, liquid liquid extraction, leaching

Drying: Equilibrium mechanism theory of drying, drying rate curve

Text Books:

1. Heat and Mass Transfer: Fundamentals and Applications by Yunus A. Çengel and Afshin J. Ghajar. eISBN: 978-9339223199
2. Introduction to Chemical Engineering Thermodynamics" by J.M. Smith, H.C. Van Ness, and M.M. Abbott. eISBN: 978-0070145870

Reference Books:

1. Transport Processes and Separation Process Principles" by Christie John Geankoplis. eISBN: 9789332549432
2. Process Heat Transfer" by Donald Q. Kern. eISBN: 978-0074632178

Weblinks:

1. https://onlinecourses.nptel.ac.in/noc22_me139/preview
2. https://www.engineeringtoolbox.com/convective-heat-transfer-d_430.html
3. https://www.thomasnet.com/articles/process-equipment/double-pipe-heat-exchangers/
4. https://pages.mtu.edu/~fmorriso/cm3120/lectures/2020%20CM3120%20First%20Diffusion%20Lecture%209.pdf
5. http://www.dempt.co.za/mso2015/handout4.pdf

Transportation of Petroleum Products

	L	T	P	C
Course Code: 2501PT34	**3**	**0**	**0**	**3**

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

CO1: Understand the Pipeline Construction and Operation.
CO2: Prioritize Proficiency in Instrumentation and Control.
CO3: Apply Knowledge of Safety, Traffic Management, and Supply Scenarios.
CO4: Understand the Product Quality Control and Bulk Distribution.
CO5: Make Awareness of Pricing Mechanisms and Conservation Efforts.

Mapping of Course Outcomes with Program Outcomes:

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	-	-

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: Objective, scope and outcome of the course.
Basics of Pipeline construction: operation and protection. Pump and compressor.

Unit – II
Instrumentation and Control: Metering and measurements of oil and gas.
Traffic management, Fire and safety rules. Indian and Global supply scenario of petroleum and petroleum products.

Unit – III
Product quality control. Bulk distribution and handling-domestic, commercial and industrial. Storage of petroleum products in fixed installations. Standards and regulations.

Unit – IV
Role of International oil companies and OPEC pricing mechanism. Administered and market determined, pricing mechanism in India.

Unit – V

Conservation of petroleum & its products. Spot and other market control mechanism.

Text Books:

1. Petroleum Transportation and Production: Oil Spill and Pollution Control by Marshall Sittig, Noyes Publications.eISBN: 9780815507017
2. Petroleum Storage & Transportation: Petroleum liquids transportation, William E. Swales, National Petroleum Council. Committee on Petroleum Storage & Transportation. eISBN: 9780686292821.

Reference Books:

1. Petroleum Transportation Handbook, Harold Sill Bell, McGraw-Hill. eISBN: 9780070049336
2. Green Gasoline: A Green Spark Transportation Fuel, Mohammad Aslam; Shrikant Maktedar; Anil Kumar Sarma, Green Chemistry Series, 2023. eISBN: 9781837670843.

Web Links:

1. https://www.eit.edu.au/resources/pipeline-systems-designing-construction-maintenance-and-asset-management/
2. https://blog.epcland.com/instrumentation-and-control-engineering/
3. https://archive.org/download/za.sans.10087.3.2008/za.sans.10087.3.2008.pdf
4. https://www.oxfordenergy.org/wpcms/wp-content/uploads/2010/11/WPM31-OPECPricingPowerTheNeedForANewPerspective-BassamFattouh-2007.pdf
5. https://ongcindia.com/documents/77751/2593733/syllabus222_20.pdf

Pipeline Engineering

Course Code: 2501PT31	L	T	P	C
	3	0	0	3

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

CO1: Illustrate pipeline route selection and survey operations.
CO2: Apply the pipeline mechanical design and pipeline protection.
CO3: Summarize the natural gas transmission in pipelines.
CO4: Explain the performance of compressors and coolers
CO5: Facilitate the fundamentals of transient analysis.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit – I

Elements of pipeline design: Fluid properties – Environment - Effects of pressure and temperature - Supply / Demand scenario - Route selection for onshore and offshore - Codes and standards - Environmental and hydrological considerations – Economics - Materials / Construction – Operation - Pipeline protection - Pipeline integrity monitoring.

Pipeline route selection, survey, geotechnical guidelines, construction and commissioning:Introduction - Preliminary routeselection - Key factors for route selection - Engineering survey - Legal survey - Construction / As-built survey - Geotechnical design

Unit – II

Materials selection: Elements of design – Materials designation standards.

Pipeline mechanical design: Codes and standards – Location classification – Pipeline design formula – Expansion and flexibility – Joint design for pipes of unequal wall thickness – Value assemblies – Scraper traps – Buoyancy control – Crossings – Depth of cover – Aerial markings – Warning signs.

Pipeline construction: Construction – Commissioning.

Pipeline protection, Instrumentation, and Pigging: Pipeline coating – Cathodic protection – Cathodic protection calculations for land pipelines – Internal corrosion – Flow meters and their calibration – Sensors – Pigs.

Unit – III

Natural gas transmission: General flow equation – Steady state - Impact of gas molecular weight and compressibility factor on flow capacity - Flow regimes - Widely used steady-state flow equations – Summary of the impact of different gas and pipeline parameters on the gas flow efficiency – Pressure drop calculation for pipeline in series and parallel – Pipeline gas velocity – Erosional velocity – Optimum pressure drop for design purposes – Pipeline packing – Determining gas leakage using pressure drop method – Wall thickness / pipe grade – Temperature profile – Optimization process – Gas transmission solved problems.

Unit – IV

Gas compression:Types of compressors – Compressor drivers – Compressor station configuration – Thermodynamics of isothermal and adiabatic gas compression – Temperature change in adiabatic gas compression – Thermodynamics of poly-tropic gas compression – Gas compressors in series – Centrifugal compressor horsepower – Enthalpy / Entropy charts (Mollier diagram) – Centrifugal compressor performance curve-Reciprocation compressors.

Coolers: Gas coolers – Air-cooled heat exchangers –Heat transfer equations for coolers – Fanair mass flow rate – Required fan power – Gas pressure drop-in coolers – Iterative procedure for calculations based on unknown T2.

Unit – V

Liquid flow and pumps:Fully developed laminar flow in a pipe – Turbulent flow – Multiphase flow - Centrifugal pumps – Retrofitting for centrifugal pumps (Radial-flow) – Pump station control – Pump station piping design.

Transient flow in liquid and gas pipelines:Purpose of transient analysis – Theoretical fundamentals and transient solution technique – Applications – Computer applications – Corrosion, Safety and Maintenance Considerations.

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2ndEdition, ASME Press. eISBN: 9780791802037
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press). eISBN: 9781420041429

Reference Books:

1. Outlines of Chemicals Technology, Dryden, C.E., Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press eISBN: 9788185336601
2. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press. eISBN: 9780824707128

Web Links:

1. http://petrowiki.org/Pipelines
2. http://www.pipingguide.net/2008/01/piping-codes-standards.html
3. http://naturalgas.org/naturalgas/transport/
4. http://physics.bu.edu/~duffy/py105/Firstlaw.html
5. http://petrowiki.org/Centrifugal_pumps

Operational & Maintenance of Pipelines

Course Code: 2501PT29	L	T	P	C
	3	0	0	3

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

CO1: Explain the Elements of Pipeline operation and maintenance
CO2: Explain the Operation and maintenance organization in pipeline
CO3: Explain overview of pipeline system operation
CO4: Apply pipeline system maintenance
CO5: Explain the Valves and operations in pipeline

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	2	-	-
CO5	3	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
Elements of Pipeline Operation and Maintenance, Background and History, Trends in Pipeline System Development, Pipeline Transmission Systems, Operation and Maintenance Elements

Unit – II
Operation and Maintenance Organization, Introduction, General Functions in a Pipeline Organization Factors that Influence Organizational Structure, Organizational Structure of a Pipeline Codes, Policies and Procedures,Asset Management

Unit – III
Overview of Pipeline System Operation, Pipeline Operational Planning, Gas Pipeline Transportation, Liquid Transportation, Heavy oil Transportation, Special Operational Activities, Special Issues

Unit – IV

Pipeline System Maintenance, Overview of Pipeline Maintenance Activities, Right-of-way and Site Maintenance, Pipeline Pigging, Pipeline Repair, Pipeline Segment Replacement, Pipeline Protection/Corrosion Control, Pipeline Welding Techniques and Branch Connections,operation of pumps and compressors including maintenance

Unit – V

Valves & Operators, General and History, Valve Standards/Applicable Codes, Definition and Types for Pipeline Applications, Valve Operators, Automatic Line-Break Controls, Side/Takeoff Valves, Station Tie-ins, Valve Assemblies, Valve Automation For Liquid Pipelines, Valve Characteristics, Pressure Drop ,Valve Application Ranking and Identification, Valve Maintenance Requirement

Text Books:

1. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2ndEdition, ASME Press eISBN: 9780791802037
2. Pipeline Engineering, Henry Liu, Lewis Publishers (CRC Press) eISBN: 9781420041429

Reference Books:

1. Piping Calculation Manual, E. ShashiMenon, McGraw-Hill eISBN: 9780071502113.
2. Pipeline Planning and Construction Field Manual, E. ShashiMenon, Gulf Professional Publishing eISBN: 9780123858817
3. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7 Edition, eISBN: 9780128018942
4. Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair, George A. Antaki, CRC Press eISBN: 9780824707128.

Web Links:

1. http://petrowiki.org/Pipelines
2. http://www.pipingguide.net/2008/01/piping-codes-standards.htm
3. http://naturalgas.org/naturalgas/transport
4. http://physics.bu.edu/~duffy/py105/Firstlaw.htm
5. http://petrowiki.org/Centrifugal_pump

Flow Assurance

Course Code: 2501PT26	L	T	P	C
	2	0	0	2

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

CO1: Solve flow assurance calculations and size the piping & distribution system.
CO2: Explain the concepts of non-Newtonian fluid & friction, transient flow, transient flow and heat transfer fundamentals.
CO3: Apply the concepts of emulsion, phase behavior, hydrocarbon flow, single, two, three & four phase regimes during design
CO4: Apply three phase gas-liquid-solid flow
CO5: Explain the concepts of wax management, asphaltenes, hydrate remediation interprets phase behavior and hydrocarbon flow

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I:
Introduction to flow assurance:
Pipe friction; Friction in Non-circular pipes; Friction loss in components.

UNIT-II:
Fluid Flow and Heat Transfer Fundamentals:
Non-Newtonian Fluid & Friction; Transient flow; Transient flow; Simplified liquid flow solution; Heat Transfer Fundamentals; U-Value; Steady State / Transient Heat Transfer; Thermal management strategy and Insulation; Simulation Results & Program Testing

UNIT –III:
Composition & properties of Hydrocarbons:
Emulsion, Phase Behavior, Hydrocarbon Flow; Single, two, three & four phase regimes; conservation equations; 2 & 3 fluid models; friction, deposition & entrainment, solving two-phase three fluid equations; gas & Liquid slug including boiling & condensation.

UNIT-IV:
Hydraulics:
Two Phase Liquid-Liquid Flow; Two Phase Liquid-Gas Flow, Two Phase Liquid-Solid Flow; Three Phase Gas-Liquid-Liquid Flow; Three phase Gas-Liquid-Solid Flow

UNIT-V:
Hydrates, Wax &Asphaltenes:
Physics & Phase Behavior; Hydrate Prevention; Hydrate Remediation; Hydrate Control Design Philosophies; Recovery of Thermodynamic Hydrate Inhibitors.
Wax; Wax Management; Wax remediation; Asphaltenes; Asphaltene control design philosophies

Text Books:
1.2) Pipe Flow-1 Single Phase Flow Assurance – Over Bratland (e-Book). eISBN: 9780123820356.
1.3) Subsea Engineering Handbook – Yong Bai & Qiang Bai – Gulf Professional Publishing. eISBN: 9780123852402

Reference Books:
1. Pipe Flow-2 Multi Phase Flow Assurance – Over Bratland (e-Book). eISBN: 9780123858749
2. Natural Gas Hydrates in Flow Assurance – Dendy Sloan et.al – GPP. eISBN: 9780123865488.
3. Natural Gas Hydrates, Experimental Techniques and their applications, Yuguang Ye, Changling Liu, Springer Berlin Heidelberg. eISBN: 9783540937240

Web Links:
1. https://en.wikipedia.org/wiki/Flow_assurance
2. https://en.wikipedia.org/wiki/Non-Newtonian_fluid
3. http://www.oilfieldwiki.com/wiki
4. https://en.wikipedia.org/wiki/Hydraulics
5. http://spe-iran.org/workshop1

Midstream Project Economic Analysis

Course Code: 2501PT28	L	T	P	C
	3	0	0	3

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

CO1: Understand the petroleum economics in all its aspects: reserves, investments, players, costs, benchmarking.
CO2: Explain the concepts and make simplified forecast of oil production.
CO3: Understand of Oil and Gas Market as well as International Trading.
CO4: Apply cash flow techniques in economic analysis and evaluations
CO5: Understand of different kind of international agreements and especially Production Sharing Agreements

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	-	-	-	-	-	-	-	-	-
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
Introduction: Petroleum Industry, the main aspects.
Midstream and Downstream segments. The modern tendencies and the current condition of the industry.

Unit-II
Reserves and production forecast. Reserves classification. Approaches in production forecast. Decline curve, decline rate. Frequently used exponential decline curve. Oil and Gas Market. Main Players
Crude oil supply and demand. Crude oil characteristics, pricing, benchmarks. Sale contracts. Gas sales. International oil trading. Platts quotations. Wet and paper barrel, hedging.

Unit-III
Cash flow Capital and operating expenditures. Constructing a project Cash Flow. Economic Decision Tools. Economic indicators and yardsticks. The time value of money. Discounted Cash Flow.

Unit-IV
Risk and Uncertainties. Probability and frequency distribution. Sensitivity and risk analyses. Decision tree analysis. Monte Carlo simulation. Financing and Ownerships. Source of financing. Cost of capital

Unit-V
Petroleum Industry Accounting. Costs and taxes. Depreciation, Depletion and Amortization. Oil Company's annual report.
Budgeting, planning, scheduling. Authorization for expenditure (AFE) Economic Analysis. Rate acceleration projects. Equipment replacement. Leasing. International Agreements Production Sharing Agreement

Text Books:
1. Fraser H.Allen and Richard D.Seba, Economics of Worldwide Petroleum Production. Third Edition eISBN: 9781560325010
2. Rognvaldur Hannesson, Petroleum Economics: issues and strategies of oil and natural gas production eISBN: 9783540240483

Reference Books:
1. Project Finance for the International Petroleum Industry, Robert Clews, 2016. eISBN: 9780750655541

Web Links:
1. https://www.petrosync.com/blog/oil-and-gas-industry/
2. https://mdpi-res.com/d_attachment/energies/energies-16-04117/article_deploy/energies-16-04117.pdf?version=1684225862
3. https://www.smartsheet.com/content/project-cash-flow
4. https://medium.com/analytics-vidhya/building-a-probabilistic-risk-estimate-using-monte-carlo-simulations-cf904b1ab503
5. https://www.pwc.com/id/en/publications/assets/eumpublications/financial-reporting-in-the-oil-and-gas-industry.pdf

Storage & Transportation of Oil & Natural Gas

	L	T	P	C
Course Code: 2501PT33	**3**	**0**	**0**	**3**

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

CO1: Recognize specified equipment for testing various samples
CO2: Apply various apparatus/equipment for the analysis of various petroleum products
CO3: Illustrate the storage facilities for petroleum products.
CO4: Identify the physical properties of different petroleum products
CO5: Choose transport properties of different petroleum products

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit – I
Introduction
Crude oil Trade, Selection of Port Location, Ship Building/Shipyards

Unit – II
Natural Gas Regasification Technology
Commercial Sourcing of Natural Gas, Different Kinds of Regasification Techniques, Regasification Process & Cold Utilization, Synchronization of Degasified natural gas and Pipelines, Current Status in India.

Unit – III
Crude Oil Transportation
Transportation techniques of crude oil, Pipeline specification, Corrosion Prevention techniques, Pressure drop, Pumps and Booster station, Wax deposition and prevention, Chemical treatment.

Unit – IV

Design Basic Engineering Aspects of Terminal Design, Design of Liquefaction Train, Ship Building/Shipyards, Storage Facilities.

Unit – V

Characteristics Of Storage Technical Qualities and Storage, Properties of Storage Reservoir, Rocks & Fluids. Flow through Storage Reservoir; Gas Flow Performance, Gas Deliverability.

Design & Development of Underground Storage Fields: Operation of Storage Fields. Recent Developments Advanced Storage Techniques, Case Histories.

Text Books:

1 Oilfield Processing: Crude Oil (Oilfield Processing of Petroleum R. Solvay, Pennwell Books). eISBN: 9780878143181.
2 Advances in Environmental Control Technology: Storage Tank Paul Cheremisinoff Gulf Professional Publishing; 1ST edition eISBN: 9780884153518

Reference Books:

1 Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011. eISBN: 9781463706146
2 Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS eISBN: 9782708007275

Web Links:

1 https://www.samco.in/knowledge-center/articles/crude-oil-trading-the-ultimate-beginners strategyguide/#:~:text=Strategies%20%26%20Tips%20for%20Crude%20Oil%20Trading%201,Trading%20Strategy.%20...%204%20Spread%20Trading%20Strategy.%20
2 https://en.wikipedia.org/wiki/Natural_gas
3 https://www.breakthroughfuel.com/blog/oil-in-motion-visibility-into-crude-oil-transportation
4 https://crp.trb.org/acrpwebresource2/overview-of-air-cargo-terminal-design aspects/
5 https://www.osti.gov/biblio/780306

Data Analytics & AI For Process Industry

Course Code: 2501PT25	L	T	P	C
	3	0	0	3

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

CO1: Understand the Data Analytics and AI
CO2: Explain the concepts in Data Science Languages.
CO3: Apply the Knowledge of Data Warehousing and OLAP
CO4: Apply Mastery of Statistical Methods and Techniques
CO5: Explain the Competence in Classification and Big Data Tools

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	-	-	-	-	-	-	-	-	-
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
Introduction: Introduction to Data Analytics and Artificial Intelligence- Some illustrations of AI problems-Data-Information-Knowledge-Applications of Data Analytics-Introduction to the Languages of Data Science: R, SQL, and Python.

Unit-II
Data warehousing: Introduction to Data warehousing, Concepts of Data warehousing-OLAP-Data Preparation and Visualization.

Unit-III
Descriptive Statistics: Central Tendency and Variability, Inferential Statistics-Probability-Central Limit Theorem-Exploratory Data Analysis-Hypothesis Testing-Linear Regression.

Unit-IV
Classification: KNN, Naïve Bayes and Logistic Regression-K-means and Hierarchical Clustering-Decision Trees-Support Vector Machines-Neural Networks-Association Rule Mining.

Unit-V

Introduction to Big Data and Hadoop: Managing Big Data-Hadoop Ecosystem Tools (Sqoop and Hive).

Introduction to Spark: Big Data Analysis using Spark R-Spark SQL-Case studies

Text Books:

1. Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis. Springer 2012. eISBN: 9783642201526
2. Wes McKinney, Python for Data Analysis. O'Reilly 2013. eISBN: 9781449323592.

Reference Books:

1. Keith R. Holdaway, Harness Oil and Gas Big Data with Analytics: Optimize Exploration and Production with Data-Driven Models. Wiley (2014). eISBN: 9781118468220.
2. Robert Haining, Spatial Data Analysis: Theory and Practice. Cambridge University Press (2003). eISBN: 9780521777865

Web links:

1. https://www.coursera.org/articles/ai-in-data-science
2. https://www.digitalvidya.com/blog/introduction-to-data-warehousing/
3. https://www.geeksforgeeks.org/descriptive-statistics/
4. https://www.datasciencecentral.com/comparing-classifiers-decision-trees-knn-naive-bayes/
5. https://www.geeksforgeeks.org/hadoop-components-functionality-and-challenges-in-big-data/

Petroleum Economics, Policies & Regulations

	L	T	P	C
Course Code: 2501PT30	**3**	**0**	**0**	**3**

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

CO1: Identify the importance of petroleum sector in the world economy
CO2: Explain various analysis and techniques of economics in petroleum industry
CO3: Apply project evaluation methods in petroleum industry
CO4: Identify the Demand and Marketing of Petroleum Products
CO5: Study the laws and regulations in petroleum industries.

Mapping of Course Outcomes with Program Outcomes:

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

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: Role and Value of Oil and Gas - Government and corporate interests, Evolution of national oil companies -Organization of Petroleum Exporting Countries - Political Environment related to Petroleum Industry. Principles, Methods, and Techniques of Petroleum Engineering Economics: Time value in capital expenditures, Depreciation, and depletion in oil projects- Financial measures and profitability analysis.

Unit – II
Risk analysis:Analysis of alternative selections and replacements- Risk, uncertainty, and decision analysis, Break even and sensitivity analysis- Optimization Techniques.

Unit – III
Application and Project Evaluation: Oil fields exploration and drilling operations-Oil fields' estimation of oil reserves and evaluation of an oil property- Project financial analysis. Project development and Joint development utilization Oil fields production operations- Oil transportation- Crude oil processing.

Unit – IV

Demand and Marketing of Petroleum Products: Crude oil fundamentals - Price of crude - Crude oil prices in transactions. Internal Markets and Prices -Marketing and sale of Motor – Aviation – Lubricant -Asphalt and Propane. Transportation: Fundamentals of transportation –Pipelines -Oil tankers - Downstream transportations. Distribution of Petroleum Products.

Unit – V

Petroleum or Oil & Gas Policies and Regulations: Petroleum and Oil & Gas Rules and Regulations in India – The Oil fields Regulations and Development Act –NELP & OALP – Functions of Directorate General of Hydrocarbons – Petroleum and Natural Gas Regulatory Board.

Text Books:

1 Petroleum Economics and Engineering, Third Edition, Hussein K. Abdel- Aal, Mohammed A. Alsahlawi, CRC Press, 2013. eISBN: 9781466583714
2 The Global Oil & Gas Industry: Management, Strategy and Finance, Andrew Inkpen & Michael H. Moffett, 2011. eISBN: 9780123858804

Reference Books:

1 Petroleum Economics, Jean Masseron, Technip; 4threvised Edition, 2000.eISBN: 9782710807573.

Web Links:

1 https://ivypanda.com/essays/petroleum-industrys-ethical-and-societal-overview/
2 https://en.wikipedia.org/wiki/Mathematical_optimization
3 https://www.pmclounge.com/types-of-project-management-life cycle/#:~:text=%20Types%20of%20Project%20Management%20Life%20Cycle%20,Small%2C%20usable%20pieces%20of%20the%20project...%20More%20

Pipeline Project Management

Course Code: 2501PT32	L	T	P	C
	3	0	0	3

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

CO1: Explain pipeline integrity management and framework
CO2: Apply Engineering concepts for pipeline integrity
CO3: Explain Elements of a pipeline integrity management system
CO4: Apply Integrity hazard and threat susceptibility and assessment
CO5: Explain the Consequences assessment for pipelines

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit – I

Pipeline Integrity Management: Integrity Management (IM) core purpose, Key Integrity Management Terminology, First Hydrocarbon Transmission Pipelines, Reservoirs and Legislation, Pipeline Integrity Management Eras, History and Evolution , Pipeline Integrity Management Framework

Unit – II

Engineering Concepts for Pipeline Integrity: Design of Pipelines,Line Pipe, Pipeline Routing, The Design Process,Pipeline Construction Elaboration of contents of required Offshore pipelines

Unit – III

Elements of a Pipeline Integrity Management System (PIMS), Management Systems and Pipeline Integrity, Integrity Management Program (IMP), PIMS: Management System and Integrity, Management Program Linkage, PIMS Policy and Commitment, PIMS Planning:

Purpose and High Level Processes, PIMS Implementation, Conformance and Compliance Verification and Action Plans, Management Review: Integrity Performance and KPIs

Unit – IV

Integrity Hazard and Threat Susceptibility and Assessment, Introduction, Threat Management Cycle, Pipeline Integrity Threat Assessment Process, Pipeline Integrity Hazards and Threats, Pipeline Integrity Hazard Identification, Threat Susceptibility Assessment ,Pipeline Threat Assessment

Unit – V

Consequence Assessment for Pipelines

Introduction, Pipeline Consequence Categories, Consequence Assessment Process, Consequence Analysis: Fluid Discharge and Dispersion, Consequence Classification along the Pipeline,Validation of the Consequence Classification, Consequence Assessment Results, Content and Format

Text Books:

1. Pipeline Integrity Management Systems, A practical Approach, Rafael. G. Mora, Phil Hopkins, EdgarI.Cote, Taylor shie, ASME press, 2016 eISBN: 9780791875767
2. Pipeline Design and Construction: A Practical Approach, M. Mohitpour, H. Golshan and M.A. Murray, 2ndEdition, ASME Press, 2007. eISBN: 9780791802037

Reference Books:

1. Piping Calculation Manual, E. ShashiMenon, McGraw-Hill, 2004. eISBN: 9780071408810.
2. Pipeline Planning and Construction Field Manual, E. ShashiMenon, Gulf Professional Publishing, 2011. eISBN: 9780123858774.
3. Pipeline Rules of Thumb Handbook, E. W. McAllister, 7 Edition, 2009. eISBN: 9780123819787.

Web Links:

1. http://petrowiki.org/Pipelines
2. http://www.pipingguide.net/2008/01/piping-codes-standards.html
3. http://naturalgas.org/naturalgas/transport/
4. http://physics.bu.edu/~duffy/py105/Firstlaw.html
5. http://petrowiki.org/Centrifugal_pumps

Minor Stream: Fire and Safety in Petroleum Industries

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT39	Fundamentals of Petroleum Engineering	FC	2			2	50	50	100	-
2501PT38	Fire Risk & Control	FC	3			3	50	50	100	-
2501PT41	Occupational Health & Safety	FC	3			3	50	50	100	-
2501PT45	Statutory Rules & Regulation	FC	3			3	50	50	100	-
2501PT36	Advances In Sustainable Development	IC	3			3	50	50	100	OHS
2501PT40	Hazard Identification & Risk Assessment	IC	3			3	50	50	100	OHS
2501PT46	Structural Fire Protection System	IC	3			3	50	50	100	FRC
2501PT42	Process Safety & Security	IC	3			3	50	50	100	OHS
2501PT44	Safety In Engineering Industry	AC	3			3	50	50	100	HIRA
2501PT43	Safety In Drilling	AC	3			3	50	50	100	HIRA
2501PT37	Disaster Risk Management	AC	3			3	50	50	100	-
Total			**32**			**32**				

Fundamentals of Petroleum Engineering

Course Code: 2501PT39	L	T	P	C
	2	0	0	2

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

CO 1: Identify the various streams in the petroleum industry.
CO 2: Outline the onshore and offshore reservoirs.
CO 3: List out the various artificial lift techniques.
CO 4: Illustrate various attributes in mid-stream processing and storage.
CO 5: Describe the crude oil products and their specifications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I
What is Petroleum Engineering & Significance? Introduction Petroleum Industry- Upstream Sector- Midstream Processing-Downstream Processing-Indian and World Scenario of Petroleum and Natural Gas- Petroleum Trade- Geopolitics.

UNIT II
Exploration & Production-Indian and World Scenario of Petroleum and Natural Gas Resources- The Reservoir-Reservoir fluids- Hydrocarbon Phase diagrams-Onshore and Offshore Reservoirs - Reservoir Drives. Exploration and Drilling Rigs- Rig Components-Drill and drill bits- Drilling fluids.

UNIT III

Well Completions Production System: Sketches of Well - Well head- Christmas tree and Casing and various other parts- Cementing-Safety Systems.

Artificial Lift: Principles and operation of Rod Pumps Down hole Pumps - Gas Lift - Plunger Lift- Electrical submersible pumps.

UNIT IV

Separation of Reservoir Fluids- Manifolds and Gathering - Production Separators - Gas Treatment and Compression - Oil & Gas Storage.

Midstream processing: Transportation of Crude Oil & its Products and Natural Gas- - World and Indian pipeline scenario- Design of Oil and Gas pipelines Safety aspects of pipelines- Environmental issues.

UNIT V

Crude Oil Refining: Classification and Composition - Constituents - Products and their specifications- Pre-treatment of crude oil- Refinery distillation- Safety in refinery operations.

Text Books:

1. Havard Devold, Oil and Gas Production Handbook: An Introduction to Oil & Gas Production, ABB ATPA Oil and Gas. eISBN: 978-1329783454
2. John R. Fanchi and Christiansen, R.L. Introduction to Petroleum Engineering, John Wiley & Sons. eISBN:9781119193463

Reference Books:

1. Production and transport of oil and gas (part B: gathering and transport); Szilas A.P; Elsevier publications, 2nd Edition. eISBN: 0-444-99564-1
2. Subsea Engineering Handbook; Yong Bai., QiangBai; Gulf Professional Publishing; Elsevier eISBN: 978-1-85617-689-7

Web Links:

1. https://www.studentenergy.org
2. https://petrowiki.org/Hydrate_problems_in_production
3. https://en.wikipedia.org/wiki/Pipeline_transport
4. https://petrowiki.org/Production_system

Fire Risk & Control

Course Code: 2501PT38	L	T	P	C
	3	0	0	3

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

CO 1: Know the fundamentals of fire & explosion and their general requirements.
CO 2: Apply their learning in implementing fire safety requirements at the work place to minimize fire incidence.
CO 3: Develop skill set or competency in assessing /analyzing or comparing fire safety system requirements towards minimization of fire & explosion in
CO 4: Do the inspection/ audit at the workplace in accordance with required requirements.
CO 5: Use an engineered approach in establishing or maintaining updated fire prevention measures specific to the organizational scope.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Fire Chemistry
Physics and chemistry of fire, Fire Properties of Solids, Liquids and Gases, Fire spread, Toxicity of Products of Combustion, Theory of Combustion and Explosion, Vapour Clouds, Flash Fire, Jet Fires, Pool Fires, Unconfined Vapour Cloud Explosion, Shock Waves, Auto-Ignition, Boiling Liquid expanding Vapour Explosion. Toxic effects of combustion gases.

UNIT II:
Fire Prevention & Protection
Sources of Ignition- Fire Triangle, Principles of Fire Extinguishing, Active and Passive Fire Protection Systems, Various Classes of Fires, A, B, C, D, E types of Fire Extinguishers, Fire Stoppers, Hydrant Pipes, Hoses, Monitors, Fire Watchers, Lay Out of Stand Pipes, Fire Station, Fire Alarms and Sirens, Maintenance of Fire Trucks, Foam Generators, Escape from Fire, Rescue Operations, Fire Drills, Notice, First Aid for burns

UNIT III:

Fire Alarm & Detection System

Industrial fire Protection System , Sprinkler-Hydrants -Stand Pipes, Special Fire Suppression Systems (Deluge and Emulsifier), Selection Criteria of the above Installations, Reliability, Maintenance , Evaluation and Standards, Alarm and Detection Systems, Other Suppression Systems (CO2 System - Foam System , Dry Chemical Powder (DCP) System, Halon System), Need For Halon Replacement, Smoke Venting, Portable Extinguishers, Flammable Liquids, Tank Farms, Indices of In flammability, Fire Fighting Systems

UNIT IV:

Fire Assurance & Measurements

Fire Load, Fire Resistant Material and Fire Testing, Structural Fire Protection, Structural Integrity, Exits and Egress, Fire Certificates, Fire Safety requirements for high-rise Buildings.

UNIT V:

Fire & Explosion Principles

Principles of Explosion, Detonation and Blast Waves, Explosion Parameter, Explosion Venting, Inert Gases, Plant for Generation of Inert Gas, Rupture Disc in Process Vessels & Lines Explosion, Suppression System based on Carbon Dioxide (CO2) & Halons Hazards in LPG, Ammonia (NH3), Sulphur Dioxide (SO3), Chlorine (CL2) etc. Indian Explosive Act and Rules, Static and Mobile Pressure Vessel (SMPV) rules.

Textbooks

1. Rao and Saluja (1997), Electrical Safety, Fire Safety Engineering and Safety Management, New Delhi: Khanna Publishers. eISBN: 9788174090144
2. Prekash Sesha (2017), Manual of Fire Safety, New Delhi: CBS Publication eISBN: 9789386419277

Reference books

1 M. Ya Roytman (1975), Principles of fire safety standards for building construction, Washington DC: Amerind. eISBN: 9780846300590.
2 V K Jain (2001), Fire Safety in Building, New Delhi: New Age International. eISBN: 9788122413485
3 Purkiss and Yuan Li (2013), Fire Safety Engineering Design of Structures, Florida: CRC Press. eISBN: 9780415502362.

Web links

1. https://maiif.org/wp-content/uploads/2017/08/Guide-for-Conducting-Marine-Fire-Investigations-Chapter-1.pdf
2. https://fire.nv.gov/uploadedfiles/firenvgov/content/bureaus/FST/4-ifipp-PSsm.pdf
3. https://www.scribd.com/doc/296196433/Fire-Protection-of-Buildings
4. https://mohua.gov.in/upload/uploadfiles/files/Chap-7.pdf

Occupational Health & Safety

Course Code: 2501PT41	L	T	P	C
	3	0	0	3

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

CO1: Understand the types of occupational hazards in the workplace and their effects on human health.
CO2: Identify the root causes of workplace illness and adapt effective ways to control it.
CO3: Apply effective industrial hygiene program for the workplace and monitor its effectiveness.
CO4: Develop and standardize the most effective occupational health and safety program in the workplace.
CO5: Distinguish Biological and Ergonomic 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	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Human Anatomy, & Hazard
Definition- Anatomy and Physiology of human organs – The lungs, Skin, Ear, Eyes and skin – Functions of organs – Impairment of organs – Effects of various hazards on organs; Cardiopulmonary resuscitation; Audiometric tests, eye tests, vital functional tests; Exposure routes of toxic materials and protective mechanisms; Recognition of health hazards, and Methods for measuring and evaluating health hazards.

UNIT II:
Physical Hazards
Noise-exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, hearing conservation programs; vibration, types, effects, instrument measurement procedure, permissible exposure limit; Ionizing and Non-Ionizing radiation, types, effects, monitoring instruments, control programs; Thermal Heat stress - Methods for controlling thermal exposures.

UNIT III:
Chemical Hazards
Chemical hazards-Classification-dust, fumes, mist, vapor, fog, gases, types, concentration, Threshold Limit Value (TLV) - Methods of Evaluation- Sampling methodology- Industrial Hygiene calculations,

Air Sampling Methods; dust sample collection devices, personal sampling, methods of control; Toxicology, classes of toxicants- sources; human health risk assessment and Environmental risk assessment. Weapons of Mass Destruction (WMD)-Toxic Chemicals-effects Effects of various chemicals on human health- Lead, nickel, chromium, manganese toxicity, gas poisoning – prevention methods.

UNIT IV:

Occupational Health & Toxicology

Concept and spectrum of health - Medical Surveillance, Medical Surveillance Program Development, Emergency Treatment, Non-Emergency Treatment; Occupational-related diseases; evaluation of physiological requirements of jobs – parameters of measurements –personal hygiene.

UNIT V:

Biological & Ergonomic

Classification of Bio-hazardous agents –bacterial agents, viral agents, fungal, parasitic agents, - infectious diseases; Biohazard control program, employee health program-laboratory safety program-animal care and handling; Ergonomics-Concepts, objectives, Work Related Musculoskeletal Disorders –Carpal Tunnel Syndrome (CTS)- Tendon pain disorders of the neck- back injuries, Ergonomic management program; Pandemic and Management with Case Study

Textbooks

1. National Safety Council. (2010). Handbook of occupational safety and health. Chicago, IL: Author. eISBN: 9780879122747
2. Stellman, J. M. (Ed.). (2012). Encyclopedia of occupational health and safety (Vols. I and II). Geneva, Switzerland: International Labour Organization. eISBN: 9789221267120
3. Leatham, D. G., & Reynolds, J. R. (2018). Occupational health and safety (3rd ed.). eISBN: 9780128147204

Reference Books

1. Plog, B. A., Quinlan, P. J., & Villareal, J. (2012). Fundamentals of industrial hygiene (6th ed.). National Safety Council. eISBN: 9780879122846
2. Allsopp, W. D., & Mastor, M. S. (2018). Occupational safety and health engineering (4th ed.). eISBN: 9781119395680.
3. Plog, B. A., & Lees, F. N. (2021). Fundamentals of industrial hygiene (6th ed.). eISBN: 9781119550124.

Web links

1. https://byjus.com/biology/human-body-anatomy/
2. https://egyankosh.ac.in/bitstream/123456789/70614/1/Unit-1.pdf
3. https://www.acgih.org/science/tlv-bei-guidelines/tlv-chemical-substances-introduction/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6309353/

Statutory Rules & Regulation

Course Code: 2501PT45	L	T	P	C
	3	0	0	3

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

- **CO 1:** Know the fundamentals of abbreviation as per different statues for safety, health, welfare and environment.
- **CO 2:** Demonstrate understanding of basic terms and definitions as per different acts and rules.
- **CO 3:** Understand statutory requirements concerning safety, welfare and health of workers engaged in industries
- **CO 4:** Apply the legal aspects granting of license for storage, transportation and usage of explosive and flammable substance as per various acts and rules
- **CO 5:** Evaluate the compliance legal and other requirements in a workplace

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Factories Act 1948
Definitions, preliminary, inspecting staff, Health, Safety, Provisions relating to hazardous processes, welfare, working hours of adults, Employment of young persons, Special provisions, Penalties, Supplemental. All related amendments.

UNIT II:
Dock Workers (Safety, Health & Welfare) Act, 1986
Definitions, Powers of Inspectors, Power of Govt. to direct Inquiry, Obligation of Dock workers, General Provisions relating to rules and regulations. Dock workers (SHW) Rules- Definitions, Inspection Procedure, Inquiry into certain accidents, Advisory Committee, Inquiry in Public. Dock workers (SHW) Regulations- Definitions, Power of Inspectors. Penalties, Responsibilities, Safety Officers, Reporting of accidents, Emergency Action Plan, Safety Committee, Occupational Health services for dock workers, various safety and health regulations in brief.

UNIT III:

Explosives Act 1884, Petroleum Act 1934.

Explosives Act: Definitions; Grant of license, Notice of Accidents, Inquiry into ordinary and serious accidents, Punishment for offences, Extension of definition to other explosive substances.

Petroleum Act - Definitions, Control over Petroleum import, transport, storage, production, refining and blending, Need for license, exemption. Inspection and sampling for testing, Notice of Accidents and Inquiries. Petroleum Rules - Definitions, brief idea on the rules relating to safety aspects in transport, storage, refining and blending of petroleum, Notice of Accidents.

UNIT IV:

Social Legislations In India

Workmen's Compensation Act. ESI Act & Rules. Public Liability Act & Rules- Substantive provisions in the above Acts and Rules.

UNIT V:

Environmental Legislations in India

Pollution Water Act: Definitions, Powers and Functions of Central, State and Joint Boards, Provisions regarding prevention and control of water pollution, Penalties, Central & State Water Laboratories, Power to make rules, Power of supersession and overriding effect. Rules on Consent for Establishment. Air Act - Definitions, Power & Functions of Boards, Prevention & Control of Air Pollution, Penalties, Application for Consent as per Air Rules. Environment (Protection) Act- Definitions, general powers of central government, prevention, control and abatement of environmental pollution. EP Rules- Definitions, standards for emission, prohibition and restrictions on siting and operation of industries. MSIHC Rules- Definitions, Duties of Authorities, Notification of Major Accidents Safety Reports, On-site & Off-site Emergency Plan, Giving safety information to public. Chemical Accidents (Emergency Planning, Preparedness and Response) Rules- Definitions, Constitution, functions & powers of various Crisis groups.

Textbooks:

1. Ganguly, S., & Changeriya, K. (2018). Health safety and environment (safety management). New Age International. eISBN: 9789386240424.
2. Sharma, J. P. (2019). Factories Act, 1948. LexisNexis India eISBN: 9789351436870.

Reference books:

1. Sahu, G. J. (2014). Environmental jurisprudence and the Supreme Court: Litigation, interpretation, implementation. LexisNexis India. eISBN: 9789351436160
2. Diwan, S., & Rosencranz, A. (2001). Environmental law and policy in India: Cases, materials and statutes (2nd ed.). Oxford University Press. eISBN: 9780195672280

Web Links:

1. https://unacademy.com/content/bpsc/study-material/general-awareness/factories-act-1948/
2. https://indiacode.nic.in/bitstream/123456789/1867/1/A1986-54.pdf
3. https://www.acgih.org/science/tlv-bei-guidelines/tlv-chemical-substances-introduction/
4. https://egyankosh.ac.in/bitstream/123456789/17197/1/Unit-5.pdf
5. https://www.clearias.com/environmental-laws-india/

Advances in Sustainable Development

Course Code: 2501PT36	L	T	P	C
	3	0	0	3

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

CO-1: Recall and describe the three pillars of sustainable development: social, environmental, and economic, and explain their interconnectedness.
CO-2: Explain the significance of the Anthropocene era and its implications for Earth's environment, climate, and resources.
CO-3: Understand and discuss the major global trends, including population growth, urbanization, and the challenges related to energy, water, food, and globalization.
CO-4: Apply critical thinking to analyze the roles and contributions of various actors in advancing sustainable development initiatives.
CO-5: Analyze and evaluate the effectiveness of global policy frameworks and sustainability indicators in addressing contemporary challenges and propose potential improvements or adaptations.

Mapping of Course Outcomes with Program Outcomes:

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	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Concept Of Sustainable Development
Understand the Foundations of Sustainable Development: Analyze Global Trends and Contemporary Challenges, Evaluate Stakeholder Roles, and Contributions. The Three Pillars of Sustainability, Sustainable Development Goals (SDGs), Stakeholders in Sustainable Development, Policies and Strategies for Sustainability, Sustainable Communities.

UNIT II:
Sustainability and The Triple Bottom Line
Introduction to Sustainability and the Triple Bottom Line, Economic Sustainability, Social Sustainability, Environmental Sustainability, The Triple Bottom Line Framework, Sustainability Reporting and Metrics, Sustainable Supply Chain Management, (CSR), Sustainable Business Models, Green Marketing and Consumer Behaviour.

UNIT III:

Sustainable Development and International Response

Role of developed countries in the development of developing countries, international summits, Stockholm to Johannesburg, Rio Principles, Agenda 21, Conventions, Agreements, Tokyo Declaration, Doubling Statement, Transboundary issues:

UNIT IV:

Sustainable Development of Socio-Economic Systems

Demographic dynamics of sustainability, Policies for socio-economic development, Strategies for implementing eco-development programmed, Sustainable development through trade, Economic growth, Urbanization and Sustainable Cities, Sustainable Energy and Agriculture, Sustainable Livelihoods, Ecotourism.

UNIT V:

Framework For Achieving Sustainability

Sustainability indicators, Hurdles to Sustainability, Operational guidelines, Interconnected prerequisites for sustainable development, Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities, Business and Industry, Science and Technology for sustainable development, Constraints and barriers for sustainable development.

Textbooks

1. Boubel, R. W., Fox, D. L., & Stern, A. C. (2011). Fundamentals of air pollution (4th ed.). Academic Press. eISBN: 9780123821732.
2. Cunniff, P. E. (1987). Environmental noise pollution. McGraw-Hill. eISBN: 9780471189435

Reference books

1. CPHEEO, Ministry of Urban Development, GoI. (1999). Manual on water supply and treatment. New Delhi, India: Author. eISBN:
2. Masters, G. M. (2011). Introduction to environmental engineering and science. New Delhi, India: Prentice-Hall of India. eISBN: 9788131717086

Web links

1. https://byjus.com/commerce/meaning-and-features-of-sustainable-development/
2. https://www.era-environmental.com/blog/sustainability-management-triple-bottom-line
3. https://www.un.org/en/our-work/support-sustainable-development-and-climate-action
4. https://www.tandfonline.com/doi/full/10.1080/1331677X.2021.1989319
5. https://tracextech.com/5-widely-used-sustainability-frameworks-and-standards/

Hazard Identification & Risk Assessment

Course Code: 2501PT40	L	T	P	C
	3	0	0	3

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

CO1: Identify the Hazard and risk analysis
CO2: Summarize impacts of petroleum industry wastes and waste treatment methods.
CO3: Demonstrate the oil mines regulations in various petroleum industry operations.
CO4: Makeuse of thehazop study concepts for safe Practices in Petroleum industry.
CO5: Illustrate the fire triangle, different methods of suppression of hydrocarbon fires.

Mapping of Course Outcomes with Program Outcomes:

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	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Hazard Identification
Introduction - Hazard - Process - Hazard - Monitoring - Risk - Issues - Perception - Management Assessment-Analysis-Safety Audits-Management System Audits-Check Lists-Material Safety Data.

UNIT II:
Risk Analysis
What If Analysis-Event Tree-Fault Tree Analysis-Hazard and Operability Studies- Coarse Hazard Studies-Human Error Analysis-Safety Review System-Hazard Warning Methods-Hazard Warning Analysis- Plant Safety Audit.

UNIT III:
Software for Risk Analysis
Basic Concepts of Risk Analysis - Quantitative - Qualitative Methods - Hazard Models System-Hazard Assessment Systems - Principles of Applications of Software's- ALOHA - Hazard Operability Studies (HAZOP) - EFFECTS - Hazard Analysis (HAZAN) - PHAST - SAFETI -Failure Mode and Effect Analysis (FMEA).

UNIT IV:
Risk Control & Management
Impact estimation: Property, People, Man and Machine System, Job and Personal Risk Factors-Standards-Selection and Training-Body Size and Posture-Body Dimension (Static/Dynamic)-

Adjustment Range- Penalties. - Guide Lines for Safe Design and Postures- Evaluation and Methods of Reducing Posture Strain.

UNIT V:

Man-Machine Interface-Controls-Types of Control-Identification and Selection-Types of Displays-Compatibility and Stereotypes of Important Operations-Fatigue and Vigilance- Measurement Characteristics and Strategies for Enhanced Performance Human Factor Engineering & Behavioral based safety.

Text Books

1. American Institute of Chemical Engineers (AIChE). (1992). Guidelines for hazard evaluation procedures (2nd ed.). Centre for Chemical Process Safety. eISBN: 9780470926063
2. American Institute of Chemical Engineers (AIChE). (2000). Guidelines for chemical process quantitative risk analysis (2nd ed.). Centre for Chemical Process Safety. eISBN: 9780470926070.

Reference Books

1. Lees, F. P. (1996). Loss prevention in the process industries (2nd ed.). Butterworth-Heinemann. eISBN: 9780750628223
2. National Safety Council. (n.d.). Accident prevention manual for business and industry, Vol. I. eISBN: 9780879123222

Web Links

1. https://www.osha.gov/safety-management/hazard-Identification
2. https://www.investopedia.com/terms/r/risk-analysis.asp
3. https://clickup.com/blog/risk-management-software/
4. https://www.investopedia.com/terms/r/risk-control.asp
5. https://www.upm.com/investors/governance/risk-management-and-control/

Structural Fire Protection System

Course Code: 2501PT46	L	T	P	C
	3	0	0	3

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

CO-1: To explain the building's materialistic properties and their effect on fire exposure.
CO-2: Resolve the structural fire safety issues and challenges in occupancies by applying their skills and potential.
CO-3: Analyze or assess the fire safety conditions at the workplace and recommend for best fire-resistant and retardant material for minimizing fire vulnerabilities.
CO-4: Use their skills and potential to assist in planning and designing passive fire protection systems at the workplace.
CO-5: Design and develop a new methodology, process/ procedure for structural fire protection.

Mapping of Course Outcomes with Program Outcomes:

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	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Fire & Life Safety
Life Safety Objectives- Life safety, Property protection, Environmental protection; Fire Development-Fire behaviour, Human Behavior, Fire detection and Fire protection (Active/passive); Conceptual framework of fire safety-Scenario analysis, QRA; Fire Resistance- Objective example and fire design; Effect of temperature on the building material – Steel, Concrete. Wood, Glass & Plastics.

UNIT II:
Classification of Buildings, Zoning
Classification of buildings, Zoning- Building by-laws Compartments and compartmentation, elements of building contributing to a compartment; Standard Time-Temperature curves for building and oil/gas fires and associated standards;

UNIT III:
Fire Severity & Fire Resistance

Fire Severity & Fire Resistance- fire resistance, fire severity, fire resistance test, specifying fire resistance, fire resistance of assemblies. Means and methods of enhancing fire resistance of materials; fire doors; fire stops; products of combustion from various materials;

UNIT IV:

Health Effects of Smoke and Fire Products

Health effects of smoke and fire products- burns; Stack effect; smoke vents; pressurization of staircases; evacuation planning; special aspects of fire safety in high-rise and multi-occupancy premises. Layout, separation, and segregation for fire safety in industrial facilities; exposure protection.

UNIT V:

Introduction to Fire Modelling

Introduction to fire modelling- Various fire modelling methods, Applications; Advanced calculation methods- fire models, thermal response model, advanced structural models, hand calculation methods.

Text books

1. M. Ya Roytman (1975), Principles of fire safety standards for building construction, Washington DC: Amerind. eISBN: 9780750623451
2. V K Jain (2001), Fire Safety in Building, New Delhi: New Age International. eISBN: 9788122413485.

Reference books

1. A. K. Dass (2014), Principles of Fire Safety Engineering: Understanding Fire and Fire Protection, New Jersey: Prentice Hall. eISBN: 9789389347241
2. Bureau of Indian Standards (2008), Selection, Installation and Maintenance of Automatic Fire Detection and Alarm System – Code of Practice", New Delhi: IS 2189:2008. eISBN: 9389347246

Web links

1. https://www.iafc.org/about-iafc/sections/fire-life-safety
2. https://www.findlaw.com/realestate/land-use-laws/types-of-zoning.html
3. https://www.venicefse.org/edizione2019/wp-content/uploads/2019/11/VanCoile_FireResistance_11_exclVideo-1.pdf
4. https://www.airnow.gov/sites/default/files/2021-08/how-smoke-from-fire-can-affect-your-health-2021-v1-d1.pdf
5. http://www.fireng.org/p/introduction-to-fire-modelling.html

Process Safety & Security

Course Code: 2501PT42	L	T	P	C
	3	0	0	3

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

CO-1: Understand the typical sources of risk in a process plant by hazard identification and examination of systems and accidents.
CO-2: Apply the knowledge of process safety and security to prevent high consequence incidents.
CO-3: Analyze the risk and estimate the consequences of failure of the system.
CO-4: Design safety and security systems for process industries to prevent major accidents from occurring.
CO-5: Analyze the chemical plant security

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Inherently Safer Design
Inherently safer design concepts and principles, Strategies, Approaches, Advantages, and disadvantages. Human factors in ISD, Process safety elements in ISD, Effective strategies of ISD; safety during startup and shutdown – safety checks in the design of the equipment, reactor safety, scrubbers and flares; safety in erection and commissioning of chemical plants. emergency safety devices.

UNIT II:
Safety In the Design of Chemical Process Plants
Design principles – reliability and safety in designing, Feasibility study, project organization and documentation, Types of contracts and liability, Basic engineering, detailed engineering, Understanding P&ID, and PFD. Material and heat balance, equipment, pipework, Assembly, commission, time schedule, aspects of safety licensing– new concepts in safety design and operation-Pressure vessel testing standards and methods.

UNIT III:

Reaction Kinetics

Stoichiometry of chemical reactions- key components-extent of reaction, conversion, selectivity, and yield. Chemical thermodynamics-reaction enthalpy-temperature and pressure dependency, chemical equilibrium, Free Gibbs enthalpy, Pressure influence on Chemical equilibrium, Kinetics-reaction rate-rate laws, decomposition-estimation of the chemical parameter. Thermochemical screening-Differential scanning calorimeter, Accelerated rate calorimetry, Thermo-gravimetry analyzer, Reaction calorimetry, Case studies. Stability and sensitivity tests, Hazard prediction by thermodynamic calculations.

UNIT IV:

Safety In the Operation of Chemical Process Plants

Properties of chemicals – Safety Data Sheets, Operational activities and hazards – safe operation of pumps, compressors, heaters, columns, reactors, pressure vessels, storage vessels, piping systems – effects of pressure, temperature, flow rate, and humidity on operations; corrosion and control its measures- condition monitoring; control valves – safety valves – pressure reducing valves, drains, bypass valves. Chemical splashes, eye irritation, and automatic showers. Storage -layouts-venting-relief valve size calculation- Hydrogen Safety-Handling-Storage, hazards, Preventive measures, case studies. Storage and handling of hazardous chemicals and industrial gases, safe disposal methods-safety in Pipeline transportation of materials, Color coding of pipelines. - Level and flow indicators, -Alarms, and lightning protection;

UNIT V:

Chemical Plant Security

Safety vs Security, Concept of security, Security Threats and vulnerability, Security risk standards, Security Vulnerability Assessment methods-API 780, CCPS SVA, VAM-CF, Security Risk Factor Table, Applications of Dynamic Risk Assessment. Prevention of Security incidents in various infrastructures handling hazardous materials- Industrial Vigilance, Case studies. Cybersecurity in process plants.

Textbooks

1. Crowl, D. A., & Louvar, J. F. (2002). Chemical process safety: Fundamentals with applications. Prentice Hall. eISBN: 9780132560707.
2. Security risk assessment: In the chemical and process industry (Integrated Security Science Book). De Gruyter. eISBN: 9783110497762

Reference books

1. Lees, F. P. (2005). Lees' handbook of loss prevention in chemical process industries: Hazard identification, assessment and control (3rd ed.). Butterworth-Heinemann. eISBN: 9780750663062.
2. Arendt, J. L., & Lorenzo, V. (2000). Evaluating process safety in the chemical industry. Centre for Chemical Process Safety, American Institute of Chemical Engineers. eISBN: 9780816906296.

Web links

1. https://www.icheme.org/media/8500/xxv-paper-33.pdf
2. https://www.linkedin.com/pulse/safety-design-process-plants-damian-connelly-6123687000219340800
3. https://byjus.com/jee/chemical-kinetics/
4. https://www.mt.com/in/en/home/applications/L1_AutoChem_Applications/Process-Safety.html#:~:text=To%20ensure%20safe%20and%20compliant,or%20environmental%20degradation%20or%20pollution.
5. https://www.cisa.gov/topics/critical-infrastructure-security-and-resilience/chemical-security

Safety in Engineering Industry

Course Code: 2501PT44	L	T	P	C
	3	0	0	3

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

CO1: Develop management plans to prevent accidents in construction Industry.
CO2: Prepare plans to safe guard workers in construction of high-risk Buildings.
CO3: Ensure safety while operating construction machinery.
CO4: Outline safety plans for demolition of buildings.
CO5: Prepare fire safety plans for a given building.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT I:
Safety In Metal Working Machinery and Woodworking Machines
Introduction to manufacturing processes, General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machines, planar machine and grinding machines, CNC machines, Woodworking machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

UNIT II:
Principles of Machine Guarding
Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding- Guarding and guarding devices- types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability- case studies, benefits of good guarding systems.

UNIT III:
Safety In Welding and Gas Cutting
Gas welding and oxygen cutting, resistance welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-color coding – flashback arrestor –

leak detection- pipe line safety-storage and handling of gas cylinders. Underwater welding-Hazards and control measures

UNIT IV:

Safety In Cold Forming and Hot Working of Metals

Cold working, power presses, point of operation safeguarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot- operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safeguards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes. Rapid Prototyping-Hazards and control measures.

UNIT V:

Safety In Finishing, Inspection and Testing

Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation. Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

Textbooks

1. National Safety Council (1988). Accident prevention manual (13th ed.). Engineering and Technology. eISBN: 9780879120269
2. International Labour Organization. (n.d.). ILO encyclopaedia of occupational health and safety (Part XIII, Manufacturing industries). eISBN: 9789221092032

Reference books

1. Grimaldi, J. V., & Simonds, R. H. (2011). Safety management (9th ed.). Prentice Hall. eISBN: 9780256066982
2. Krishnan, N. V. (2018). Safety management in industry (7th ed.). Jaico Publishing House. eISBN: 9788172240295

Web links

1. https://www.scribd.com/presentation/554701362/Unit-1-Copy
2. https://www.dir.ca.gov/dosh/cal_vpp/best_Practices_symposiums/machine-guarding.barry-blodgett.pdf
3. https://www.lsu.edu/ehs/references/university-safety-manual/4J_Welding_cutting.php
4. https://rlsdhamal.com/safety-in-hot-and-cold-processes-manufacturing-of-steel/#:~:text=Good%20insulation%20over%20hot%20metal,dusts%2C%20fumes%2C%20gases%20etc.
5. https://www.engr.washington.edu/files/mycoe/safety/Workplace_A.PDF

Safety in Drilling

Course Code: 2501PT43	L	T	P	C
	3	0	0	3

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

CO-1: Describe the function, working principle of Drilling rig and its various components.
CO-2: Calculate drilling efficiency and selection of Drilling tubulars & Circulation.
CO-3: Demonstrate the various safety issues considered during drilling.
CO-4: Detail and suggest prevention of Kick Causes and Indicators
CO-5: Describe about Safety Issued in Oil and Gas Production

Mapping of Course Outcomes with Program Outcomes:

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	-	-	-	-	-	-	-	-	-

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 Drilling Rig and Components
Hoisting System: Component Parts; Derricks, Mast, Substructures, Weight Indicator, Wire Line and Draw Works, Power System: Prime Moves, Transmission System, Rotary System: Swivel, Kelly, Rotary Table.

UNIT II:
Fundamentals of Drilling Tubulars & Circulation
Tubulars: Drill Pipe, Tool Joint, Casing Pipe, Design Consideration, Circulation System: Drilling Fluid Types, Preparation and Conditioning System, Additive, Pumping System, Cutting Removal, Pressure Loss Circulation, Drilling Practices: Bit Choice, Weight on Bit, Rotary Speed, Hydraulic Effect, Air-Gas Drilling, Coring, Drilling Efficiency.

UNIT III:
Cementation & Safety Issues in Drilling
Cementing Operations: Cement Types, Additives, Process and Equipment, Complication: Lost Circulation, Fishing, Blow Outs, Well Planning: GTO, Safety Consideration in well Completion

UNIT IV:

Basics of Well Control

Oil field Pressure, Kick Causes and Indicators, well control equipment's, Types of Well control, Kill Sheet.

UNIT V:

Production

Well Completion Practices: Well- Head Assemble, Installation and Testing, Activation, Well Testing, Self-Flowing Wells, Gas Lift: Sucker Rod and Down Hole Motor Pumping of Oil, Safety Issued in Oil and Gas Production.

Textbooks

1. IADC Well CAP Drilling Well Control and Blowout Prevention Training Program (2017). International Association of Drilling Contractors. eISBN:
2. API Recommended Practice 51 Recommended Practice for Blowout Prevention Equipment Systems for Drilling Wells (2016). American Petroleum Institute. eISBN:

Reference books

1. Taylor, I. L. (Ed.). (n.d.). Methods of exploration and production of petroleum resources (Vol. V). eISBN:
2. Hyne, F. J. (1991). Dictionary of petroleum exploration, drilling & production. PennWell Books. eISBN:

Web links

1. https://en.wikipedia.org/wiki/List_of_components_of_oil_drilling_rigs
2. https://www.slideshare.net/slideshow/q931de1b03/41904147
3. https://www.saigaogroup.com/news/cementing-complex-problems.html
4. https://petex.utexas.edu/images/book_previews/Practical-Well-Control_previewwtrmrk.pdf
5. https://en.wikipedia.org/wiki/Completion_(oil_and_gas_wells)

Disaster Risk Management

Course Code: 2501PT37	L	T	P	C
	3	0	0	3

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

CO-1: Understand basic concept and appreciate the institutional framework in India for disaster preparedness and mitigation.
CO-2: Characterize and analyzes natural and manmade hazards, to identify their causes, mechanisms and evaluate their significance for the human population.
CO-3: Create strategies and implementation plan for Prevention, Responsive mitigation and recovery during industrial or natural disasters.
CO4: Apply the best Practices and gaps from case studies on natural and manmade disasters.
CO5: Explain relief and rehabilitation in disasters

Mapping of Course Outcomes with Program Outcomes:

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	-	-

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 - Hazards and Disasters
Introduction - Hazards and Disasters, Risk and Vulnerability in Disasters, Natural and Man-made disasters, earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes. Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, Institutional framework in India for disaster preparedness and mitigation, Common disaster types in India; Legislations in India on disaster management; National disaster management policy; The Sendai Framework for Disaster Risk Reduction- targets, priorities for action, guiding principles.

UNIT II:
Natural Disaster: Earthquake, Landslide and Forest Fire
Earthquakes and its types, magnitude and intensity, seismic zones of India, major fault systems of India plate, flood types and its management, drought types and its management, Landslide and land degradation: Causes – tectonic conditions – erosion – avalanches – rock fall –damage assessment. Forest fire, causes, control and prevention, urban fire, building construction and structural fire protection, electric hazard, shock and protection, aircraft fire, actions required for rescue and fire fighting in air crafts.

UNIT III:

Floods, Tsunami Marine Environment Pollution and Control

Floods: General characteristics causes – geomorphology and floods – flood forecasting – river and coastal flood – flash flood – lake outburst – risks, environmental planning – flood control and management. Drought control and management, Cyclone and Tsunami: Structure and nature of cyclones and Tsunamis – characteristics hazard donation – factors-hazard potential – impact assessment. Coastal and marine environment pollution and control – marine environment degradation – land use changes in coastal zones – wave – tidal storms – erosion habitat pollution – sediment discharge and control. Droughts Causes – vulnerability – tides – famines – desert and desertification.

UNIT IV:

Man Made Disaster

Manmade hazards: Toxic chemicals, noise pollution, industrial disaster and accident, Terrorist disaster / War, Hazardous wastes, reactivity, toxicity, nuclear war, biological weapons, biodiversity extinction and deforestation. causes and adverse effects Epidemics. National & Worldwide Scenario: History of disasters - various disasters in various countries - Worldwide Aid and Agencies, Study of different case studies on natural disaster & man-made disaster.

UNIT V

Relief And Rehabilitation in Disasters

Relief and rehabilitation in disasters at local, national and global levels, Disaster Risk Assessment, understanding hazards, vulnerability and exposure, risk analysis and risk mapping techniques, Disaster risk reduction, Disaster Preparedness and response, disaster recovery and rehabilitation, emergency planning and preparedness, post disaster assessment and recovery planning, reconstruction and infrastructure building, vulnerability and capacity assessment, Community Engagement and public awareness, communication strategies for raising public awareness about disaster risk, Case Studies and Practical real applications : Analysing real world disaster and their application

Textbooks

1. Donald Hyndman, David Hyndman “Natural Hazards and Disasters” Third Edition,JHJK Publisher: Cengage Learning, Inc; 3rd ed. edition (25 August 2010) eISBN: 9780495416657
2. Coppola P Damon, 2007. Introduction to International Disaster Management, Carter, Nick 1991. eISBN: 9780123738900.

Reference Books

1. Government of India, Ministry of Home Affairs, National Disaster Management Division, 2004, Disaster Management in India – A Status Report eISBN:
2. Disaster Management Guidelines, GOI-UND Disaster Risk Program (2009-2012) eISBN:

Web links

1. https://www.msajce-edu.in/academics/civil/LectureNote/GE8071-LN.pdf
2. https://egyankosh.ac.in/bitstream/123456789/112449/1/Unit-2.pdf

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 C 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,AIML,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 transmisstions -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,AIML,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– typesofpumpsand 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,AIML,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. AarneVeslind, 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,AIML,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,AIML,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
3	0	0	3

Course Code:2501EE36

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 Underst& 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-dem& 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, St&ards 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,AIML,CSE(DS), PT, Min.E.)

	L	T	P	C
Course Code: 2501EE43	**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 & St&ards: 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 st&ard for electrical safety in work place- occupational safety & health administration st&ards, 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,AIML,CSE(DS), PT, Min.E.)

	L	T	P	C
Course Code:2501EE54	**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,AIML,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 Krieth 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,AIML,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,ISBN978-981-13-8113-3.

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,AIML,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,AIML,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,AIML,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,AIML,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,AIML,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,AIML,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. Shortlliffe, 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,AIML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA1	**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: Ids versus Vds 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, 2µm Double Metal, Double Poly, CMOS rules, 1.2µm 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,AIML,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-Verificationof 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,AIML,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: Difinition 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 applications	https://leetcode.com/problems/remove-k-digits/description/
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**	**Hacker rank**	**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:

1. Find the roots of a quadratic equation.
2. Find factorial of a given number using recursion
3. Palindrome Number
   https://leetcode.com/problems/palindrome-number/description/
4. 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, 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 Adjaceny 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, DineshMehta, 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++, JoyceeFarrell,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 Educatio, 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.)

	L	T	P	C
Course Code: 2501IT05	**2**	**0**	**2**	**4**

Course Outcomes:

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

- **CO1:** Describe the Fundamental concepts of DBMS.
- **CO2:** Interpret relational database using SQL.
- **CO3:** Make use of normalization techniques for database design.
- **CO4:** Illustrate the mechanisms of transaction management.
- **CO5:** Optimize database performance with advanced indexing, query optimization, and ro 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 corelated 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 exampe: 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.)

	L	T	P	C
Course Code: 2501CS07	**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 farming 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 polices, 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.)

	L	T	P	C
Course Code: 2501AI02	**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.)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	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 andwrong 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 heartpatients.

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 toperform 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.)

	L	T	P	C
Course Code: 2501CS34	**2**	**0**	**1**	**3**

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

- **CO1:** Explain fundamental concepts of Data Science.
- **CO2:** Implement Data Collection and Preprocessing Techniques.
- **CO3:** Demonstrate Proficiency in Data Loading, Storage, and File Handling
- **CO4:** Conduct Exploratory Data Analysis (EDA) using Visualization and Statistical Techniques.
- **CO5:** Make use of Neo4j, Cypher tools to manage and analyze graph data.

Mapping of Course Outcomes with Program Outcomes:

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

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 Scraping, Binary Data Formats,Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in Mongo DB.

Practice:

1. Read data from a JSON file into a DataFrame using Pandas (pd.read_json) or R (jsonlite). Parse nested JSON structures and convert them into a flat table format.
2. Perform web scraping on an HTML page using BeautifulSoup in Python or rvest in R. Extract data from HTML tables and convert it into a DataFrame.

UNIT – IV

Exploratory Data Analysis (EDA): Descriptive Statistics, Data Visualization Techniques, Correlation and Covariance Analysis, Univariate, Bivariate, and Multivariate Analysis, Pattern Detection and Anomaly Identification.

Practice:

1. Plotting histograms and box plots to understand the distribution of a single variable.
2. Creating scatter plots and calculating correlation coefficients to study the relationship between two variables.

UNIT – V

Data Science Tools: Neo4j for dealing with graph databases, graph query language Cypher, libraries like nltk and SQLite for handling Text mining and analytics.

Practice:

1. Get hands-on experience with Neo4j to understand how to manage and query graph databases.
2. Practice writing Cypher queries to interact with graph data in Neo4j.

Text Books:

1 Python for Data Analysis ,Wes McKinney, O'REILLY, 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/