

B. TECH. PROGRAM CURRICULUM - 2025

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

Version 2.0

MINING ENGINEERING

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

Version 2.0–Approved in the BoS meeting on 05-06-2026 & Academic Council meeting on 20-06-2026



Aditya Nagar, ADB Road, Surampalem - 533 437

Department of Mining Engineering

Department Vision

To be a globally recognized center of excellence in Mining Engineering education fostering innovation, sustainable practices, and inclusive growth.

Department Mission

M1: Enhance mining education through transformative learning, expert faculty, and a vibrant research ecosystem.

M2: Develop cutting-edge laboratories and industry collaborations that promote innovation.

M3: Apply sustainable practices to address global challenges.

Program Educational Objectives (PEOS)

Graduates of the Program will

PEO 1: Excel as Mining Engineering professionals with innovation and leadership.

PEO 2: Create cutting-edge solutions for Mining Engineering problems.

PEO 3: Engage in lifelong learning in the evolving mining industry.

Program Specific Outcomes (PSOS)

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

PSO 1: Solve Mining & Mineral engineering problems.

PSO 2: Plan, manage, and ensure safety of mining operations.

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 Mining Engineering
B. Tech (Min.E) Program Curriculum - 2025
(Applicable for the batches admitted from A.Y 2025-26)

UG Programs Offered

- B. Tech in (Mining Engineering)
- B. Tech in (Mining Engineering) 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 Petroleum Technology
 - Minor degree in Agricultural Engineering
 - Minor degree in Entrepreneurship Development and Incubation
 - Minor degree in Quantum Technologies

Minor Stream offered in B. Tech (Mining Engineering)

- Minor Stream in Environment and Safety in Mining
- Minor Stream in Innovative Mining

Credit Division Category-wise

S. No.	Broad Category of Course	UGC	Credits
1	Major (Core) Courses (MCC)	80	80
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	10
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										
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501MA01	Linear Algebra & Calculus	FC	2		1	3	50	50	100	-
2501ME02	Engineering Mechanics	FC	3		1	4	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100		100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2		1	3	50	50	100	LAC
2501MN01	Introduction to Mechanical Engineering	FC	2		1	3	50	50	100	EM
2501MN02	Introduction to Mining Geology	FC	2		2	4	50	50	100	-
2501MN03	Development of Mineral Deposits	FC	3			3	50	50	100	-
2501MN04	Fundamental of Rock Mechanics	FC	3		2	5	50	50	100	-
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	-
2501MA06	Complex Variables & Statistical Methods	IC	3	1		4	50	50	100	-
2501MB02	Engineering Economics	IC	3			3	50	50	100	-
2501MN05	Mine Surveying	IC	3		2	5	50	50	100	-
2501MN06	Surface Mining	IC	3			3	50	50	100	DMD
2501MN07	Underground Coal Mining Technology	IC	3			3	50	50	100	DMD

2501MN08	Underground Metal Mining Technology	IC	3			3	50	50	100	DMD
2501MN09	Mineral Processing Technology	IC	2		2	4	50	50	100	-
2501MN10	Mine Hazards & Rescue	IC	3		1	4	50	50	100	-
2501MN11	Mine Environment & Ventilation Engineering	AC	2		2	4	50	50	100	-
2501MN12	Mine Machinery	AC	3			3	50	50	100	DMD, SM, UCMT, UMMT
2501MN13	Mine System Engineering	AC	3			3	50	50	100	SM
2501MN14	Mine Legislation & General Safety	AC	3			3	50	50	100	UCMT/UMMT
Total			58	2	20	80				

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	-
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	-
Total			4		6	10				

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EN01	Essential Cognitive Skills for Engineers	FC			1	1	100	-	100	-
2501EN02/ 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	-
2501MN47	Student Activity Based Learning	AC			2	2				
Total			2		7	9				

Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN15	Mine Water Pollution & Control	IC			2	2	50	50	100	-
2501MN16	Mine Automation	IC			1	1	100	-	100	-
2501MN17	Mine Planning	AC			2	2	50	50	100	-
2501MN18	Mine Automation & Virtual Reality	AC			2	2	50	50	100	-
2501MN19	Software Applications in Mining Engineering	AC			2	2	50	50	100	-
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
2501MN20	Summer Internship – I	IC			2	2	100		100	-
2501MN21	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
2501MN22	Full Semester Internship	AC			12	12	50	50	100	-
Total					12	12				

Mandatory Courses (MC)

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

Minor Stream: Environment and Safety in Mining

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN23	Sustainable Mining	FC	3			3	50	50	100	DMD
2501MN24	Drilling & Blasting	IC	3			3	50	50	100	DMD
2501MN25	Safety Practices in Mines	IC	3			3	50	50	100	UCMT
2501MN26	Environmental Impact Assessment	IC	3			3	50	50	100	SM
2501MN27	Mine Health & Safety Engineering	IC	3			3	50	50	100	SPM
2501MN28	Environmental Pollution & Control	IC	3			3	50	50	100	UCMT/UMMT
2501MN29	Industrial Safety	IC	3			3	50	50	100	
2501MN30	Waste Water Treatment & Recycling	IC	3			3	50	50	100	
2501MN31	Environment & Safety	IC	3			3	50	50	100	
2501MN32	Planning for Mine Closure & Reclamation	AC	3			3	50	50	100	SM
2501MN33	Safety Engineering	AC	2			2	50	50	100	MHSE
Total			32			32				

Minor Stream: Innovative Mining

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN34	Planning for Mining Projects	FC	3			3	50	50	100	DMD
2501MN35	Geo-Statistics	IC	3			3	50	50	100	DMD
2501MN36	Mineral Economics	IC	3			3	50	50	100	DMD
2501MN37	Advanced Exploration Techniques	IC	3			3	50	50	100	DMD
2501MN38	Advanced Surveying Technology	IC	3			3	50	50	100	MS
2501MN39	Geo Spatial Imaging & Geo- informatics	IC	3			3	50	50	100	
2501MN40	Remote Sensing Applications in Mining	IC	3			3	50	50	100	
2501MN41	Green Mining	IC	3			3	50	50	100	
2501MN42	Utilisation of Alternative Sources of Energy	IC	3			3	50	50	100	
2501MN43	Deep Sea Mining	AC	3			3	50	50	100	DMD
2501MN44	Space Mining Technology	AC	2			2	50	50	100	-
Total			32			32				

UNIVERSITY OPEN ELECTIVE COURSES (UEC)

Branch	Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Offered to	Pre-requisite
CE	2501CE66	Natural Disaster Management & Mitigation		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE81	Wastewater Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE82	Integrated Solid Waste Management for a Smart City		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE83	Watershed Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE53	Electric Power Generation, Transmission & Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	

EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE,ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE,ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE,ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME36	Sustainable Energy Systems	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ECE	2501EC97	Biomedical Electronics	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC98	Fundamentals of Wireless Communications	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	

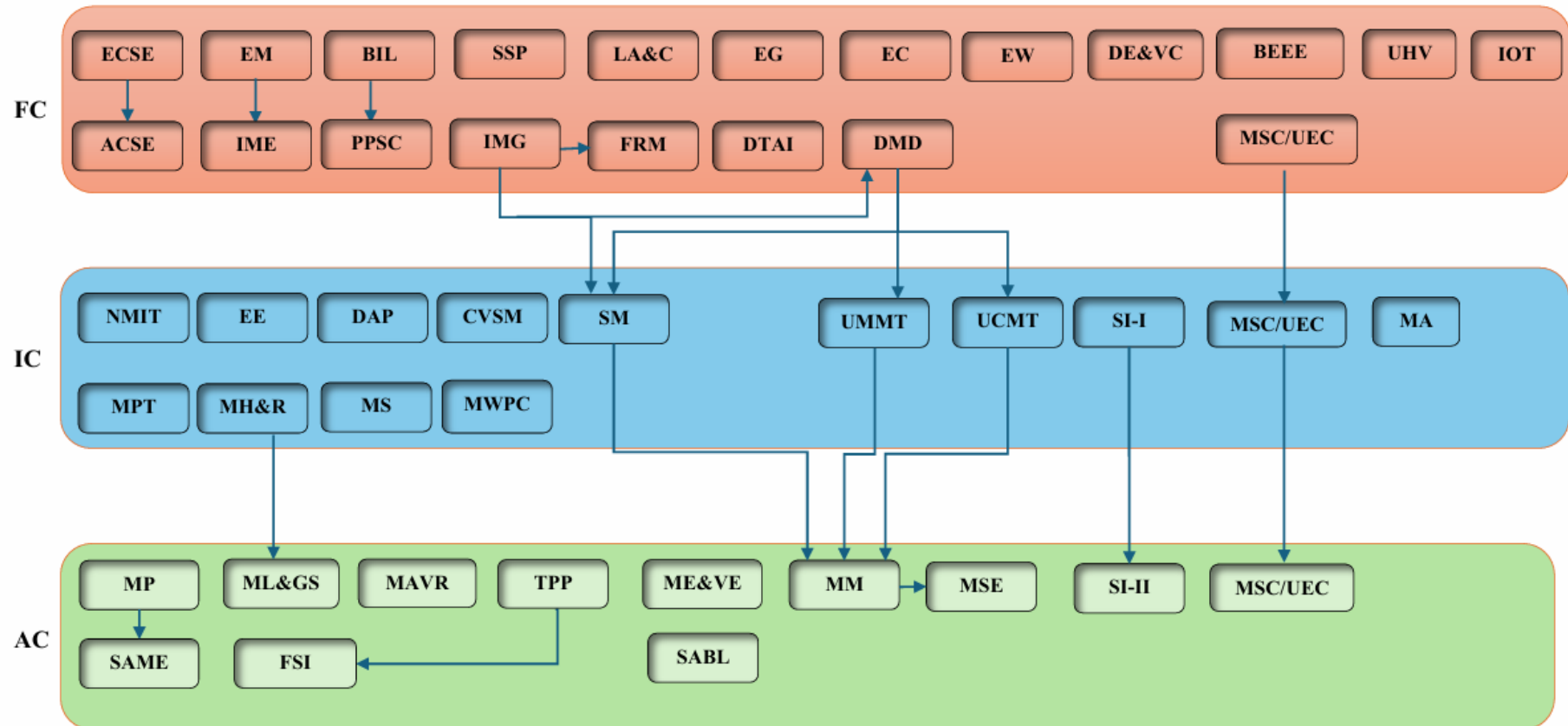
ECE	2501ECA3	Introduction to Quantum Computing	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	FC	2		2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2		2	4	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS
IT	2501CS07	Computer Networks	AC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2		1	3	50	50	CE, EEE, ECE, PT, Min.E	-
AI&ML	2501AI05	Machine Learning	AC	2		2	4	50	50	CE, ECE, PT, Min.E	DAUP
DS	2501CS34	Fundamental of Data Science	FC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS

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

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

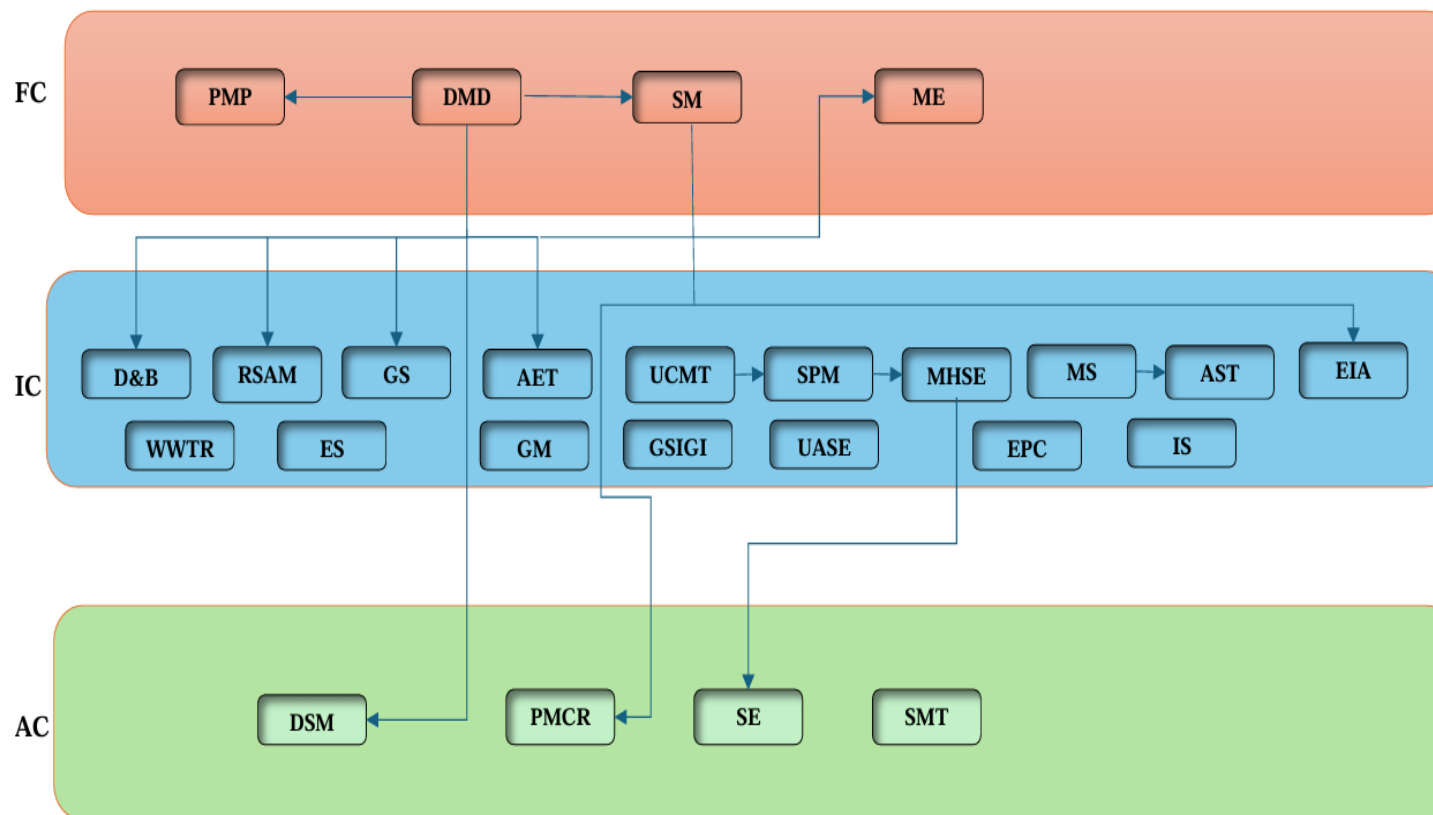
All the other courses are applicable to students admitted from the year 2025 onwards

B. Tech (Min.E) Program Curriculum Pre-requisite Flow Chart



FC- Foundation Courses		IC- Intermediate-level Courses		AC- Advanced Courses	
ECESE-	Essential Cognitive English Skills for Engineers	NMIT-	Numerical methods & Integral Transforms	MP-	Mine Planning
ACESE-	Advanced Cognitive English Skills for Engineers	MPT-	Mineral Processing Technology	SAME-	Software Applications in Mining Engineering
EM-	Engineering Mechanics	EE-	Engineering Economics	ML&GS-	Mine Legislation & General Safety
IME-	Introduction to Mechanical Engineering	MH&R-	Mine Hazards & Rescue	TPP-	Technical Paper Publication
BIL-	Business Intelligence Lab	DAP-	Data Analysis using Python	ME&VE-	Mine Environment & Ventilation Engineering
PPSC-	Programming for Problem Solving Using C	MS-	Mine Surveying	MM-	Mine Machinery
SSP-	Solid State Physics	CVSM-	Complex Variables & Statistical Methods	MSE-	Mine System Engineering
IMG-	Introduction to Mining Geology	MWPC	Mine Water Pollution & Control	MAVR-	Mine Automation & Virtual Reality
LA&C-	Linear Algebra & Calculus	SM-	Surface Mining	SI-II-	Summer Internship-II
FRM-	Fundamental of Rock Mechanics	UMMT-	Underground Metal Mining Technology	MSC-	Minor Stream Courses
IOT-	Internet of Things	UCMT-	Underground Coal Mining Technology	UEC-	University Elective Courses
EC-	Engineering Chemistry	SI-I-	Summer Internship-I	FSI-	Full Semester Internship
DMD-	Development of Mineral Deposits	MA-	Mine Automation	SABL-	Student Activity Based Learning
EW-	Engineering Workshop				
DTAI-	Design Thinking using AI				
DE&VC-	Differential Equations & Vector Calculus				
EG-	Engineering Graphics				
BEEE-	Basic Electrical & Electronics Engineering				
UHV-	Universal Human Values				

B. Tech (Min.E) Minor Stream Pre-requisite Flowchart



FC- Foundation Courses

PMP-	Planning for Mining Projects
DMD-	Development of Mineral Deposits
SM-	Sustainable Mining
ME-	Mineral Economics

IC- Intermediate-level Courses

D&B-	Drilling & Blasting
RSAM-	Remote Sensing Applications in Mining
GS-	Geo-Statistics
AET-	Advanced Exploration Techniques
UCMT-	Underground Coal Mining Technology
SPM-	Safety Practices in Mines
MHSE-	Mine Health & Safety Engineering
MS-	Mine Surveying
AST-	Advanced Surveying Technology
EIA-	Environmental Impact Assessment
WWTR-	Waste Water Treatment & Recycling
ES-	Environment & Safety
GM-	Green Mining
GSIGI-	Geo Spatial Imaging & Geo- informatics
UASE-	Utilisation of Alternative Sources of Energy
EPC-	Environmental Pollution & Control
IS-	Industrial Safety

AC- Advanced Courses

DSM-	Deep Sea Mining
PMCR-	Planning for Mine Closure & Reclamation
SE-	Safety Engineering
SMT-	Space Mining Technology

Suggestive Semester-wise Curriculum

I SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA01	Linear Algebra & Calculus	MCC	FC	2	1		3	3
2501PH01	Solid State Physics	MCC	FC	2		1	3	4
2501ME01	Engineering Graphics	MCC	FC	1		2	3	6
2501ME03	Engineering Workshop	MCC	FC			1	1	2
2501MN02	Introduction to Mining Geology	MCC	FC	2		2	4	6
2501IT01 / 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	MDC	FC			2	2	4
2501EN01	Essential Cognitive Skills For Engineers	AEC	FC			1	1	2
2501UC07	Design Thinking using AI	AEC	FC			1	1	2
Total				7	1	10	18	29

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
2501ME02	Engineering Mechanics	MCC	FC	2	1	1	4	5
2501EN02	Advanced Cognitive Skills for Engineers	AEC	FC			1	1	2
2501CS01/ 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	MDC	FC	2		2	4	6
2501EE01	Basic Electrical & Electronics Engineering	MDC	FC	2		2	4	6
2501UC08	Universal Human Values	AEC	FC	2			2	2
2501MN16	Mine Automation	SEC	IC			1	1	1
2501UC11	Employability Skills – I	VAC	FC			3	0	3
2501AC01	Environmental Science	MC	FC				0	2
Total				12	2	11	22	34

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
2501MN01	Introduction to Mechanical Engineering	MCC	FC	2		1	3	4
2501MB02	Engineering Economics	MCC	IC	3			3	3
2501MN03	Development of Mineral Deposits	MCC	FC	3			3	3
2501MN05	Mine Surveying	MCC	IC	2	1	2	5	7
2501CS02	Data Analysis using Python	VAC	IC			2	2	4
2501UC13	Employability Skills – II	VAC	FC			3	0	3
2501AC02	Constitution of India	MC	FC				0	2
Total				12	2	8	19	29

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
2501MN04	Fundamental of Rock Mechanics	MCC	FC	2	1	2	5	7
2501MN06	Surface Mining	MCC	IC	3			3	3
2501MN07	Underground Coal Mining Technology	MCC	IC	3			3	3
	Minor Stream Course-1/ University Open Elective Course-1	MSC/UEC	FC	3			3	3
	Minor Stream Course-2/ University Open Elective Course-2	MSC/UEC	IC/AC	3			3	3
2501MN17	Mine Planning	SEC	AC			2	2	4
2501CS04	Internet of Things	VAC	FC			1	1	2
2501UC14	Employability Skills – III	VAC	IC			3	0	3
2501AC03	Research Methodology	MC	FC				0	2
Total				16	2	8	23	35

V SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MN08	Underground Metal Mining Technology	MCC	IC	2	1		3	3
2501MN11	Mine Environment & Ventilation Engineering	MCC	AC	1	1	2	4	6
	Minor Stream Course-3/ University Open Elective Course-3	MSC/UEC	IC/AC	3			3	3
	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
2501MN18	Mine Automation & Virtual Reality	SEC	AC			2	2	4
2501UC15	Employability Skills – IV	VAC	IC			3	0	3
2501MN20	Summer Internship-I	SI	IC			2	2	4
2501AC04	Intellectual Property Rights & Patents	MC	FC				0	2
Total				12	2	9	20	31

VI SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MN09	Mineral Processing Technology	MCC	IC	2		2	4	6
2501MN12	Mine Machinery	MCC	AC	2	1	1	4	5
2501MN13	Mine System Engineering	MCC	AC	2	1		3	3
	Minor Stream Course-6/ University Open Elective Course-6	MSC/UEC	IC/AC	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
2501MN15	Mine Water Pollution & Control	SEC	IC			2	2	4
2501AC05	Indian Knowledge Systems	MC	FC				0	2
Total				15	2	5	22	29

VII SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MN10	Mine Hazards & Rescue	MCC	IC	2	1	1	4	5
2501MN14	Mine Legislation & General Safety	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	2			2	2
2501MN19	Software Applications in Mining Engineering	SEC	AC			2	2	4
2501MN21	Summer Internship - II	SI	AC			2	2	4
Total				12	2	5	19	24

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
2501MN47	Student Activity Based Learning	AEC	AC			2	2	4
2501MN22	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 Mining Engineering (offered to other branches students)

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

Minor Degree in Civil Engineering

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

Minor Degree in Electrical and Electronics Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE55	Operation &Control of Electric machines	FC	2			2	50	50	100	BEEE
2501EE56	Fundamentals of Power Electronics	FC	2			2	50	50	100	BEEE
2501EE13	Electrical Measurements & Instrumentation	FC	2	1	1	4	50	50	100	ENA-1/BEEE
2501EE53	Electric Power Generation, Transmission and Distribution Systems	IC	3			3	50	50	100	ENA-1/BEEE
2501EE34	Alternative Energy Sources (or) 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)	IC	3			3	50	50	100	SSP/ MP
2501ME78	Mechanics of Solids									
2501ME12	Heat Power Engineering (or)	IC	2	1		3	50	50	100	ETD
2501ME40	Refrigeration & Air Conditioning									
2501ME75	Production Technology	IC	3			3	50	50	100	EW
2501ME76	Metallurgy & Material Science	IC	3			3	50	50	100	SSP/ MP
2501ME79	Theory of Machines (or)	AC	3			3	50	50	100	SSP/ MP
2501ME80	Advanced Engineering Metrology									
	Total		18	2		20				

Minor Degree in Electronics and Communication Engineering

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

Minor Degree in Computer Science and Engineering

Course Code	Course Title	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS13	Operating Systems	IC	2		1	3	50	50	100	-
2501CS07	Computer Networks	IC	2		1	3	50	50	100	-
2501IT07	Agile Software Engineering	IC	2		1	3	50	50	100	PPSC
2501AI03	Data Mining	IC	2		1	3	50	50	100	-
2501CS08	Object Oriented Programming through C++ (or) Java Programming	IC	2		2	4	50	50	100	PPSC
2501IT06										
2501CS16	Introduction to MERN Stack Development(or) Information Security Analysis & Audit	IC			2	2	50	50	100	JP
2501CS30		IC	2			2	50	50	100	-
2501CS18	Advanced MERN Stack Development(or)	AC			2	2	50	50	100	IMSD
2501IT12	Flutter Fundamentals	AC			2	2	50	50	100	-
Total			12		8	20				

Minor Degree in Data Science

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501IT07	Agile Software Engineering	IC	2		1	3	50	50	100	PPSC
2501CS34	Fundamentals of Data Science	IC	2		1	3	50	50	100	PPSC
2501CS12	NoSQL Databases	IC	2			2	50	50	100	-
2501AI03	Data Mining	IC	2		1	3	50	50	100	-
2501CS37	Health Care Data Analytics	IC	2		1	3	50	50	100	PPSC
2501CS36	(or) Business Intelligence & Analytics									
2501AI04	Big Data Analytics (or)	AC	2		1	3	50	50	100	DM
2501AI48	Data Visualization Techniques									DAP
2501CS41	Social Network Analysis (or)	AC	2		1	3	50	50	100	-
2501CS40	Social Networks & Semantic Web									
	Total		14		6	20				

Minor Degree in Artificial Intelligence and Machine Learning

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501AI02	Artificial Intelligence	IC	2		1	3	50	50	100	DAP
2501AI05	Machine Learning	IC	2		2	4	50	50	100	DAP
2501AI15	AI Chatbots	IC	2			2	50	50	100	DAP
2501AI14	Soft Computing (or)	IC	2		1	3	50	50	100	AI
2501CS34	Fundamentals of Data Science		2		1	3	50	50	100	PPSC
2501AI47	Natural Language Processing and Text Analytics	AC	2		1	3	50	50	100	DAP
2501AI48	(or) Data Visualization Techniques									
2501AI16	Prompt Engineering and GenAI (or)	AC	2		1	3	50	50	100	ML
2501CS41	Social Network Analysis									
2501AI17	Federated Machine Learning	AC	2			2	50	50	100	ML
Total			14		6	20				

Minor Degree in Petroleum Technology

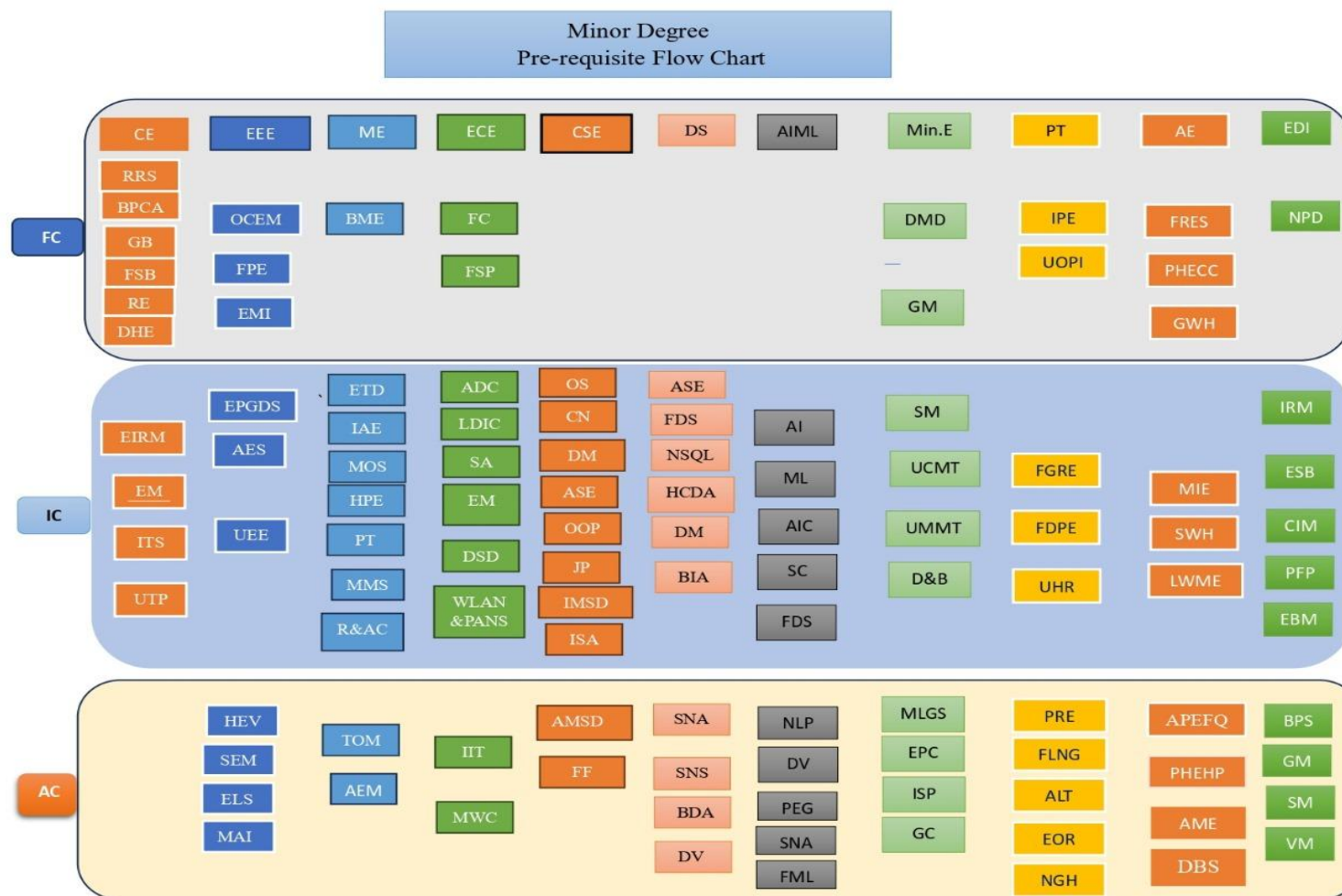
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PT27	Introduction to Petroleum Engineering	FC	3			3	50	50	100	-
2501PT35	Unit Operations in Petroleum Industry	FC	3			3	50	50	100	-
2501PT47	Fundamentals of Geology & Reservoir Engineering	IC	3			3	50	50	100	-
2501PT48	Fundamentals of Drilling & Production Engineering (or) Unconventional Hydrocarbon Resources	IC	3			3	50	50	100	-
2501PT16			1	1		2				
2501PT49	Natural Gas Hydrates (or)	AC	2			2	50	50	100	-
2501PT05	Fundamentals of Liquefied Natural Gas		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 Agricultural Engineering

Agricultural Engineering							Marks			Pre-requisite
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	
2501AE82	Fundamentals of Renewable Energy Sources	FC	3			3	50	50	100	-
2501AE83	Post-harvest Engineering of Cereal Crops	FC	3			3	50	50	100	-
2501AE84	Ground Water Hydrology	FC	3			3	50	50	100	-
2501AE85	Micro Irrigation Systems	IC	2			2	50	50	100	-
2501AE86	Surface Water Hydrology (OR)	IC	3			3	50	50	100	GWH
2501AE87	Land & Water Management Engineering									
2501AE88	Agricultural Process Engineering & Food Quality (OR)	AC	3			3	50	50	100	PHECC
2501AE89	Post-harvest Engineering for Horticultural Produce									
2501AE90	Agricultural & Machinery Equipment (or)	AC	3	0	0	3	50	50	100	FRES
2501AE91	Design of Bio-energy systems									
	Total		20			20				

Minor Degree in Quantum Technologies

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



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

BIA Business Intelligence & Analytics
HCDA Health Care Data Analysis

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
SM	Surface Mining	MLGS	Mine Legislation and General Safety
UCMT	Underground Coal Mining Technology	EPC	Environmental Pollution & Control
UMMT	Underground Metal Mining Technology	ISP	Industrial Safety Practices
DB	Drilling & Blasting	GC	Ground Control
FGRE	Fundamentals of Geology and Reservoir Engineering	PRE	Petroleum Refinery Engineering
FDPE	Fundamentals of Drilling and Production Engineering	FLNG	Fundamentals of Liquefied Natural Gas
UHR	Unconventional Hydrocarbon Resources	NGH	Natural Gas Hydrates
LWME	Land and Water Management	ALT	Artificial Lift Techniques
SWH	Surface Water Hydrology	EOR	Enhanced Oil Recovery
MIE	Micro Irrigation Systems	DBS	Design of Bio-Energy Systems
		PHEHP	Post-Harvest Engineering for Horticultural Produce
		AME	Agricultural Machinery and Equipment
		APEFQ	Agriculture Process Engineering and Food Quality
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		

AIML

Min.E

PT

Ag.E

EDC

DMD Development of Mineral Deposits

GM Green Mining

IPE Introduction to Petroleum Engineering

UOPI Unit operations in Petroleum Industry

GWH Ground Water Hydrology

PHEC Post-harvest Engineering of Cereal Crops

FRES Fundamentals of Renewable Energy Sources

NPD New Product Development

Major Core Courses (MCC)										
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501MA01	Linear Algebra & Calculus	FC	2		1	3	50	50	100	-
2501ME02	Engineering Mechanics	FC	3		1	4	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100		100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2		1	3	50	50	100	LAC
2501MN01	Introduction to Mechanical Engineering	FC	2		1	3	50	50	100	EM
2501MN02	Introduction to Mining Geology	FC	2		2	4	50	50	100	-
2501MN03	Development of Mineral Deposits	FC	3			3	50	50	100	-
2501MN04	Fundamental of Rock Mechanics	FC	3		2	5	50	50	100	-
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	-
2501MA06	Complex Variables & Statistical Methods	IC	3	1		4	50	50	100	-
2501MB02	Engineering Economics	IC	3			3	50	50	100	-
2501MN05	Mine Surveying	IC	3		2	5	50	50	100	-
2501MN06	Surface Mining	IC	3			3	50	50	100	DMD

2501MN07	Underground Coal Mining Technology	IC	3			3	50	50	100	DMD
2501MN08	Underground Metal Mining Technology	IC	3			3	50	50	100	DMD
2501MN09	Mineral Processing Technology	IC	2		2	4	50	50	100	-
2501MN10	Mine Hazards & Rescue	IC	3		1	4	50	50	100	-
2501MN11	Mine Environment & Ventilation Engineering	AC	2		2	4	50	50	100	-
2501MN12	Mine Machinery	AC	3			3	50	50	100	DMD, SM, UCMT, UMMT
2501MN13	Mine System Engineering	AC	3			3	50	50	100	SM
2501MN14	Mine Legislation & General Safety	AC	3			3	50	50	100	UCMT/UMMT
Total			58	2	20	80				

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

Course Code: 2501PH01

L T P C
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 behaviour of substances.
- CO5:** Summarize various types of electrical polarizations of dielectrics.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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:

- Determination of rigidity modulus of a material by using Torsional Pendulum.
- Determination of Young's Modulus of the material by method of single cantilever beam.
- Determination of Moment of Inertia of a Fly Wheel.
- 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:

- Determine the crystal structure of the sample using data.

UNIT – III

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

Practice:

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

UNIT – IV

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

Practice:

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

UNIT – V

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

Practice:

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

Text Books:

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

Reference Books:

1. Engineering Physics, M.R. Srinivasan, New Age international publishers, 2009. ISBN: 978-1848290501
2. Text book of Engineering Physics, S. O. Pillai, New Age international publishers 2012, ISBN: 9788122520753
3. Introduction to Solid State Physics, 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>

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, student will be able to:

- CO1:** Apply the knowledge of water treatment and specifications of potable water
- CO2:** Exemplify the principles of electrochemical cells and apply this knowledge to control corrosion
- CO3:** Summarize the essence of polymers and fuels – for sustainable energy solutions
- CO4:** Infer the preliminaries of engineering materials for industrial applications
- CO5:** Explore the fundamentals of Nano materials and integrate green chemistry for promoting sustainability

Mapping of Course Outcomes with Program Outcomes:

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

UNIT - I

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

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

Practice:

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

UNIT - II

Electrochemistry and Corrosion: Electrodes– electrochemical cell, Nernst equation, cell potential calculations.

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

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

Practice

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

UNIT - III

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

Compounding of plastics: Injection molding, and Extrusion molding.

Biodegradable polymers: Introduction and their requirements.

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

Practice

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

UNIT - IV

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

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

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

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

Practice

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

UNIT - V

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

Green Chemistry: Principles of Green Chemistry and applications of green chemistry.

Various green chemical approaches – Microwave synthesis, Bio catalyzed reaction (only explanation with examples).

Practice

1. Preparation of Nano particle by Green Synthesis method.

Text Books:

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

Reference Books:

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

Web Links:

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

Linear Algebra & Calculus
(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,CSE(DS),PT&Min.E)

Course Code: 2501MA01

L T P C
2 1 0 3

Course Outcomes:

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

- CO1:** Solve the system of Linear equations
- CO2:** Calculate Eigen values and Eigen vectors
- CO3:** Apply differential calculus for one and several variable functions
- CO4:** Calculate the Maximum value and Minimum value of a function of several variables
- CO5:** Compute areas and volumes using multiple integrals

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

Practice (Using any computational tool)

- Variables, arithmetic operations, elementary mathematical functions.
- Defining row vector, column vector, Arithmetic operations on matrices
- Finding transpose of a matrix, inverse of a matrix, determinant of a matrix
- Rank of a matrix, solving system of linear equations.

UNIT – II

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

Practice (Using any computational tool):

- Computing eigen values and eigen vectors, matrix diagonalization.

UNIT – III

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

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

Practice (Using any computational tool): Basics of plotting, Plot graphs of single variable functions.

UNIT – IV

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

Practice (Using any computational tool): Plot graphs of various multi variable functions.

UNIT – V

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

Practice (Using any computational tool): Plotting the region of Integration.

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

Text Books:

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

Reference Books:

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

Web Links:

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

Engineering Mechanics
(Common to CE, ME & Min.E)

Course Code: 2501ME02

L	T	P	C
2	1	1	4

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Force systems: Classification of Forces- Vectors and Tensors- Coplanar Concurrent Forces– Resultant–Moment of Force and its Application –Couple-Varignon's theorem- Resultant of Force Systems-Free-body diagrams and equilibrium.

Practice:

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

UNIT – II

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

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

Practice:

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

UNIT – III

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

Practice:

1. Finding the Moment of inertia of Compound pendulum

UNIT – IV

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

UNIT – V

Impulse-Momentum: Principle of Impulse and momentum.

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

Text Books:

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

Reference Books:

1. Engineering Mechanics-Statics and Dynamics , R.C.Hibbeler, 15th Edition, 2022, ISBN :9780137514725
2. Vector Mechanics for Engineers - Volume I ,Beer F.P. and Johnston E.R., Statics, Volume II -Dynamics, McGraw Hill, New York, ISBN 9789353166595

Web Links:

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

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

Course Code: 2501ME03

L T P C
0 0 1 1

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

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
-
1. To make a cross lap joint from the given wooden workpieces.

2. To make an open scoop using the given sheet metal.
3. To make a T-joint using given M.S pieces by arc welding.

Text Books:

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

Reference Books:

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

Web Links:

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

Engineering Graphics

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

Course Code: 2501ME01

L	T	P	C
1	0	2	3

Course Outcomes:

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

CO1: Apply the principles of engineering drawing to construct Engineering curves

CO2: Construct projections of points and lines.

CO3: Demonstrate visualization skills of projections of planes.

CO4: Demonstrate visualization skills of projections of solids and development of surfaces.

CO5: Construct isometric and orthographic views of simple solids.

Mapping of Course Outcomes with Program Outcomes:

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

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 Involute

- 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 Prism
- b) Development of Pyramid

11. Sections of Solides

- a) Prism
- b) Pyramid

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, 2025, ISBN : 9789385039706.
2. Engineering Drawing and Graphics , Venugopal, New Age Publications, 2nd edition, 2019, ISBN: 9788122515452.

Reference Books:

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

Web Links:

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

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

Semester: 2501MA02

L T P C
2 1 0 3

Course Outcomes:

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

- CO1:** Solve the linear differential equations of first order and apply in various engineering problems.
- CO2:** Solve the linear differential equations of higher order and apply in various engineering problems.
- CO3:** Solve the linear partial differential equations
- CO4:** Calculate the gradient, divergence and curl.
- CO5:** Compute work done, flux using vector integration

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

Practice(Using any computational tool): Solving the first order initial value problems using **odesolver** and plot the solution curves.

UNIT – II

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

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

Practice(Using any computational tool): Solving the second order initial value problems using **odesolver** and plot the solution curves

UNIT – III

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

UNIT – IV

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

Practice (Using any computational tool): Plotting of surfaces, 3D-plots, plotting vector fields

UNIT – V

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

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

Text Books:

1. Advanced Engineering Mathematics, E. Kreyszig, John Wiley & Sons, 10th Edition, 2018. ISBN 978-0470458365.
2. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44th 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, 11th Edition, 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/>

Introduction to Mechanical Engineering

Course Code: 2501MN01

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain different laws of thermodynamics.
- CO2:** Explain working principle of different engine.
- CO3:** Explain the concepts of Fluid kinematics and dynamics.
- CO4:** Explain the different manufacturing techniques.
- CO5:** Draw the velocity and acceleration diagrams analyzing machines and mechanisms.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Thermodynamics: Concept of thermodynamics, definitions of system, surroundings, state, process, cycle, zeroth, and first law of thermodynamics, properties of pure substances, energy analysis of closed systems and control volumes, applications of laws of thermodynamics.

UNIT – II

I. C. Engines: Classification - working principles, valve and port timing diagrams, - engine systems fuel, carburetor, fuel injection system, ignition, cooling and lubrication, principle of wankle engine, principles of supercharging and turbocharging.

Practice:

- Demonstration of valve time diagram for four stroke engine.
- Demonstration of cut section model of petrol and diesel engine.

UNIT – III

Fluid Mechanics: Introduction to fluid, properties of fluids- specific gravity, viscosity and its significance, surface tension, capillarity, and vapor pressure, atmospheric gauge, vacuum pressure-measurement of pressure, Pascal's law, hydrostatic law, Bernoulli's equation. Fluid kinematics: Flow types, Equation of continuity for one dimensional flow, Circulation and vorticity. Stream line, path line and streak lines and stream tube, Losses in pipe.

Practice:

1. Determination of loss of head due to minor losses in a pipeline.
2. Determination of loss of head due to major losses in a pipeline.
3. Determine the flow velocity of pitot tube.

UNIT – IV**Manufacturing Processes:**

Introduction to manufacturing techniques, casting, forging, forming, machining, welding, joining, powder metallurgy, plastic and composite manufacturing, introduction to computer numerical control (CNC) machines, additive manufacturing. Introduction to robotics - joints & links, configurations and applications of robotics.

Practice:

1. To design and manufacture a Wooden Pattern for a given Casting.
2. To prepare a Single Strap Butt Joint on the given work pieces using spot welding equipment.

UNIT – V**Machines & Mechanisms:**

Machines: Definition and significance of machines and mechanisms, History and evolution of mechanical systems, Applications.

Mechanisms: Types of mechanisms (linkages, cams, gears), Kinematic analysis of mechanisms, Velocity and acceleration diagrams, Gears and gear trains and applications.

Text Books:

1. Basic Mechanical Engineering, P.K. Nag, Tata McGraw Hill Education, 3rd Edition ISBN: 97870616266.
2. Fluid Mechanics and Hydraulic Machines, R. K. Rajput, 2nd edition. ISBN: 978817081042.
3. Manufacturing Engineering and Technology, S. Kalpakjian and S. Schmid, Pearson Education; 7th Edition, 2018. ISBN: 9780134290553.

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering, D.S. Kumar. ISBN: 9788189928468.
2. Manufacturing Science, A. Ghosh & A.K. Mallik, East West Press Pvt. Ltd Publication, 3rd Edition. ISBN: 978-8176710633.
3. Theory of Machines, S.S. Ratan, McGraw Hill Education India Private Limited, 4th Edition. ISBN: 9789352606859.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc24_me16/preview.
2. https://onlinecourses.nptel.ac.in/noc24_me51/preview.
3. <https://archive.nptel.ac.in/courses/113/106/113106098/>.

Introduction to Mining Geology

Course Code: 2501MN02

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Describe the fundamental principles of geology as applicable to mining engineering.
- CO2:** Demonstrate understanding of the classification and physical properties of minerals, rocks, and ores, as well as the distribution of mineral deposits.
- CO3:** Interpret geological maps to identify folds, faults, and other structural features.
- CO4:** Analyze geological formations and structures, such as folds, faults, and unconformities, to interpret their characteristics and significance in mining operations.
- CO5:** Create geological maps and profiles, as well as to propose strategies for mineral exploration and extraction.

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

Definition of Geology: Branches of Geology, Importance of Geology in Mining, Structure of earth; Mineral, rock, and ore; Weathering and Erosion.

Practice:

1. To Study different Physical properties of minerals and their identification.
2. To prepare a geological map and its profile.

UNIT – II

Definition of mineral – Classification of minerals – Physical properties of minerals –color, lusture, texture, grain size, hardness.

Practice:

1. To determine hardness of minerals using Mohr's scale of hardness.
2. To study crystallographic models of different minerals.

UNIT – III

Classification of Mineral deposits: Mineral resources, reserve classification, mineral distribution of India and World. Grade of ore and coal.

Practice:

1. To measure strike and dip of various outcrops in the field.
2. To draw the strike lines, measure the dip of the beds.

UNIT – IV

Petrology: Classification of rocks – igneous, sedimentary, and metamorphic origin, formation, structures, textures; Study of different types of igneous, sedimentary, and metamorphic rocks.

Practice:

1. To Study different Physical properties of igneous rocks.
2. To Study different Physical properties of sedimentary rocks.
3. To Study different Physical properties of metamorphic rocks.

UNIT – V

Structural Geology: Folds, faults, dykes/sills, joints, unconformity – types, characteristics, and their significance; Strike, dip, thickness of bedded deposits.

Practice:

1. To identify folds, faults in geological maps

Additional Practice:

1. To identify unconformity in geological maps.
2. To calculate true Thickness of the bed.

Text Books:

1. Engineering Geology, Parbin Singh, S.K. Kataria & Sons, 3rd Edition, ISBN: 978-93-5014-267-7.
2. Principles of Engineering Geology, Bangar, K.M., Standard Publishers Distributors, 6th Edition, 2020, ISBN: 978-8180141157.

Reference Books:

1. Structural Geology, P.B. Marland, prentice Hall of India Pvt.Ltd., 3rd Edition. ISBN: 978-812030590.
2. A Text Book of Geology, P.K. Mukherjee, The World Press Pvt.Ltd., 9th Edition. ISBN: 978-8187567547.

Web Links:

1. https://pubs.usgs.gov/of/203/ofr-03-210/IV_Geology.pdf
2. https://profiles.uonbi.ac.ke/cnyamai/files/lecture_1_mineralogy_and_crystallography-3_review.pdf
3. <http://www.d.umn.edu/~jgoodge/geol2312-1/Ch%201.pdf>

Development of Mineral Deposits

Course Code: 2501MN03

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Summarize different stages in the life of a mine
- CO2:** Choose a suitable location for opening to a deposit.
- CO3:** Explain Exploratory and Production Drilling
- CO4:** Categorize the use of explosives and blasting.
- CO5:** Summarize material handling and transportation in mining

Mapping of Course Outcomes with Program Outcomes:

CO/PO	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	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction to mining: Mining terminologies, Stages in the life of the mines- Prospecting, Exploration, Development, Exploitation, Reclamation, Brief overview of Surface & Underground Mining Methods.

UNIT – II

Access to mineral Deposits: Adits, shafts, incline - location, shape and size; Drilling, blasting and removal of debris. Methods of shaft sinking –conventional, mechanized and special methods; opening up of surface deposits.

UNIT – III

Exploratory and Production Drilling: Principles of drilling, Types of drill, Drill rods and drill bits – types and applications, Exploratory drilling - Drilling fluid; Production drilling – Rotary, Percussive, Rotary- percussive, pneumatic; Drill patterns.

UNIT – IV

Explosives and Blasting: Types of explosives, Properties of explosives, Detonators. Detonating cords, and detonating fuse and nonel detonator. Storage and transport of explosives, Mechanics of blasting, Primary and secondary blasting, Blast geometry and design, electrical and non electrical methods, delay blasting techniques, handling misfires.

UNIT – V

Material Handling and Transportation in Mines: LHD, SDL, shuttle car, AFC and belt conveyors; Raises, winzes, ore passes, ore chutes; shovels, dumpers, silo, bin, CHP, tippler.

Text Books:

1. Elements of Mining Technology, D.J.Deshmukh, Denett& Co., Nagpur Vol. I. ISBN: 978-8189904333.
2. Surface Mining, Dr T.N.Singh, Lovely Prakashan, Dhanbad , 2nd edition. ISBN: 978-8179561294.

Reference Books:

1. Indian Bureau of Mines, Minerals Year Book & other publications, Latest Edition.
2. Explosives and blasting techniques, G.K Pradhan, Latest edition. ISBN: 978-0470512275
3. Rock Blasting and Overbreak Control, Dr. Calvin Konya; Precision Blasting Services, Montville, Ohio 2nd edition. ISBN: 9780318198965.

Web Links:

1. <http://www.miningglobal.com/operations/gifs-5-stages-mining-life-cycle>
2. <https://www.minecationstandards.org/fileadmin/MAS/documents/nmas-national>
3. [stabdards/afghanistan/AMAS_07.04_Storage_Transportation_Handling_of_Explosives.Pdf](#)

Fundamental of Rock Mechanics

Course Code: 2501MN04

L T P C
3 0 2 5

Course Outcomes:

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

- CO1:** Prepare rock samples for stress and strain determination in laboratory testing
- CO2:** Evaluate the physical and mechanical properties of rocks
- CO3:** Utilize diverse measuring devices to accurately measure and analyze the load acting on rock
- CO4:** Analyze stress concentration around mine openings
- CO5:** Assess the failure criteria of rock materials within mining environments

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Rock Mechanics: Definition, scope of Rock Mechanics. Terminologies in rock mechanics. Rock mass classification- Bieniawski Classification, CMRI classification. Stress and Strain Behaviour of Rocks. Types of stress and strain, Analysis of stress and strain in two dimensions. Introduction to three dimensional stress analysis: Stress matrix, Cauchy's law, Stress invariants, Stress transformation, Determination of maximum shear stress, Octahedral stress, Compatibility equation.

Practice:

1. Preparation of rock sample.
2. Determination of porosity of rock samples.

UNIT – II

Physico-mechanical Properties of Rocks: Physical properties- Grain Size, Density, Porosity, Permeability, Moisture, Hardness, etc. Mechanical Properties- Strength properties of rocks: Compressive, Tensile and shear strength, Young's modulus, Poisson's ratio, Dynamic elastic properties. Index properties- Protodyakonov's index, point load index. Slake durability index.

Practice:

1. Determination of hardness of rocks by rebound hammer test.
2. Determination of uniaxial compressive strength of rocks.

UNIT – III

Rock Behaviour: Static Conditions- Deformability, Creep .Dynamic loading of rocks- Stress-strain behaviour. Measuring Instruments-Stress and Strain.

Practice:

1. Determination of tensile strength of rocks
2. Determination of shear strength of rocks.

UNIT – IV

Rock Stress: In-situ stresses and their estimation, Horizontal stress and vertical stress, Stresses around mine openings of different cross sections.

Practice:

1. Determination of moisture content and degree of saturation of given rock sample.
2. Determination of impact strength index of rock sample.

UNIT – V

Theories of Rock Failures: Theories of failure of rocks and their applications. Mohr's theory, Mohr-Coulomb failure criteria, Griffiths' theory, Different modes of failure of rocks.

Practice:

1. Determination of point load index of rocks.
2. Determination of slake-durability index rocks.

Additional Practice:

1. Strength analysis of Coal.
2. Strength comparison of soft and hard rock.
3. Determination of cohesion and friction angle using triaxial testing apparatus.

Text Books:

1. Introduction to rock mechanics, R.E Goodman, John Wiley and sons. ISBN: 978-0471393034.
2. Introduction to rock mechanics, V.S Vutukuri and K. Katsuyama, Industrial publishing & Consulting Inc, Tokyo. ISBN: 978-4-87195-026-4.

Reference Books:

1. Rock mechanics for underground mining, B.H. G Brady and E.T.Brown, George Allen and Unwin Ltd. ISBN: 978-0415411601.
2. Fundamentals of rock mechanics, J.C.Jeager and N.G.W.Cook, Chapman and Hall. ISBN: 978-0412298600.
3. Fundamentals and Applications of Rock Mechanics, Debasis Deb and Abiram Kumar Verma, PHI Publication. ISBN: 978-8120346294.

Web Links:

1. <https://home.iitk.ac.in/~sarv/New%20Folder/Presentation1.pdf>
2. Rock Mechanics for GeoEnergy Applications | GEOSTRATA Magazine | Vol 27, No 1 (ascelibrary.org)
3. Mechanical Strain and Elastic Moduli (Chapter 4) - Fundamentals of Rock Physics (cambridge.org)

Numerical Methods & Integral Transforms

(Common to EEE, Min. E & PT)

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

UNIT – I

Solution of Algebraic and Transcendental Equations and Interpolation:

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

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

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

UNIT – II

Numerical Differentiation, Integration and Solutions of Ordinary Differential Equations:

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

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

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

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

UNIT – III

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

Text Books:

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

Reference Books:

1. 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)

Course Code:2501MA06	L	T	P	C
	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	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	-	-
CO2	-	-
CO3	-	-
CO4	-	-
CO5	-	-

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

Sampling Theory:

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

Practice(Using any computational tool): Plotting of confidence intervals

UNIT – V

Tests of Hypothesis:

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

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

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

Text Books:

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

Reference Books:

1. Complex Variables and Applications, J.W. Brown and R.V. Churchill, 9th edition, McGraw 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>

Engineering Economics
(Common to ECE, Min.E, PT)

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	-	-	-	-	-	-	-	-	2	-	-
CO3	1	-	-	-	-	-	-	-	3	-	-
CO4	-	-	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	-	-	-	3	1	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 analysisDetermination 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 CoursesIndex)- 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/>

Mine Surveying

Course Code: 2501MN05

L	T	P	C
3	0	2	5

Course Outcomes:

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

- CO1:** Analyze different types of surveying methods.
- CO2:** Determine levels and Contours.
- CO3:** Apply modern instruments of surveying.
- CO4:** Evaluate the geodetic surveying GIS & GPS.
- CO5:** Estimate volumes of borrow pits and areas of fields

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

UNIT – I

Overview of Plane Surveying: Objectives and Principles of Surveying. Triangulation survey, Meridians, Azimuths and Bearings, declination, computation of angle.

Practice:

1. Measurement of distance using chains.
2. Measurement of bearing of sides using prismatic compass.

UNIT – II

Levelling: Types of levelling, traversing with theodolite, Stadia Tachometry. EDMs; Total station, GPS, Introduction to remote sensing.

Practice:

1. Simple leveling and differential levelling using dumpy level.
2. Measurement of horizontal and vertical angles using theodolite.

UNIT – III

Correlation Survey: Principles, Classification, Methods, Shaft Plumbing, Assumed Bearing, Weisbach Triangle, Co-planning, Weisbach quadrilateral, Problems on correlation survey etc. Measuring depth of shaft. Magnetic and gyroscopic orientation.

Practice:

1. Triangulation survey by theodolite.
2. Measure the height and distance using Tacheometer.

UNIT – IV

Curve Setting: Types of curves, simple and compound curves by linear and angular methods on surface and in the underground, Super elevation and transition curve, Characteristics and uses of contours.

Practice:

1. Distance measurement using Total station.
2. Measurement of horizontal angles using Total station.

UNIT – V

Problems in mine surveying: Dip, fault, bore hole and cross measure drift problems, Area from field notes, computation of areas along irregular boundaries and regular boundaries and volume of pits.

Practice:

1. Measurement of area using Total station.
2. Calculation of area using GPS.

Additional Practice:

1. Measurement of vertical angles using Total station
2. Radiation survey using plane table
3. Intersection survey using plane table
4. Study of mine plans.

Text Books:

1. Surveying, B.C.Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications (P) Ltd. Volume 3. ISBN: 9788131809569.
2. Mine Surveying, S Ghatak, Volume 3, ISBN: 9789382332887.

Reference Books:

1. Surveying, Dr.L.O.Punmia, Dr C.M.Kole, Khuli Khan KaAyojan (Hindi), CMPDIL, Ranchi, 1st edition. ISBN: 9788187566775.
2. Surveying and leveling, Kanetkar & Kulkarni, Volume I and II. ISBN: 9788189401237 & 9788189401244.

Web Links:

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

Surface Mining

Course Code: 2501MN06

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Analyze different surface mining methods
- CO2:** Design the layout of a large opencast mine
- CO3:** Design drilling and blasting for Surface mining
- CO4:** Choose the better excavation and loading equipments
- CO5:** Organize the transportation system

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Status and scope of surface mining- Applicability, Limitations and advantages and disadvantages. Methods of opening box cut, selection of site for box cut. Surface Mining Methods: Open pit Mining, Open cast Mining, Quarrying, High-wall Mining, Modern mining Methods. Placer Mining.

UNIT – II

Open Pit Layout and Design: Planning the layout and open pit mine with special reference to large mechanized mines. Optimum dimensions of open pit mines. Removal of over burden and disposal, Bench Design/Geometry, Design and stability slopes.

UNIT – III

Blast Design in Surface Mines: Drillability, mechanics of drilling, major types of drilling machines. Blasting: Basics of mechanics of blasting, principles of fragmentation. Blast design, Adverse impacts of blasting in surface mines. Controlled blasting techniques. Novel methods of blasting.

UNIT – IV

Excavation and Loading: Shovels, Dragline, Front-end loader. Non-Cyclic Surface Mining: Bucket Wheel Excavators and Continuous surface miners. Auxiliary Equipment: Stackers, Graders, Dozers, Ripper.

UNIT – V

Transport Equipment: Selection of mode of transport. Dumpers, Aerial ropeways-monocable and bicable types and their constructional details. Conveyor systems, ICC system, Slurry Transportation.

Text Books:

1. Surface Mining Technology, S. K. Das, Lovely Prakashan, Dhanbad. ISBN: 978-0873351087.
2. Surface Mining, G. B. Mishra, Dhanbad Publishers. ISBN: 978-0873351027.

Reference Books:

1. Opencast Mining unit operations, V.V.Rzhevsky, Mir Publisher's, Moscow. ISBN: 978-0412298600.
2. Open Pit Mine Planning and Design Crawford, T.john, American Institute of Mining, Metallurgical and Petroleum Engineers. ISBN: 978-0873352224.

Web Links:

1. <http://www.cienciaviva.pt/img/upload/Introduction%20to%20mining.pdf>
2. http://www.ilo.org/wcmsp5/groups/public/---ed_protect/---protrav/safework/documents/normativeinstrument/wcms_107828.pdf
3. <https://www.iitbhu.ac.in/faculty/min/rajesh-rai/NMEICTSlope/Pdf/03%20Types%20of%20slope%20failure.pdf>

Underground Coal Mining Technology

Course Code: 2501MN07

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of underground coal mining.
- CO2:** Explain the various mine development methods.
- CO3:** Explain the long wall mining method.
- CO4:** Analyze the various thick and deep seam mining methods.
- CO5:** Categorize the various modern mining methods.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Formation of coal deposits, structures associated with coal deposits, rank and grade of coal. Different coal mining methods: factors influencing choice of coal mining methods. Status of coal mining industry in India and global scenario.

UNIT – II

Bord and Pillar Mining: Applicability, limitations, advantages and disadvantages of Bord and pillar mining method. Development-Design of pillars and panel, supports. Depillaring-methods and sequence of operations, splitting and slicing of pillars, supports. Partial extraction techniques. Extraction of multi seams. Stowing Techniques. Mechanization- SDL, LHD, Continuous miners, belt conveyors, UDM etc. Case studies

UNIT – III

Longwall Mining: Applicability, limitations, merits and demerits, Longwall mining Methods- Advancing and Retreating, Thin and Thick seam. Longwall Development- Gate roads, longwall face. Face Mechanization, Shearer, Plough, AFC, Powered Supports. Sequence of operations- Cutting and conveying of coal from face. Case studies.

UNIT – IV

Thick Seam Mining: Applicability, limitations, and problems associated with thick seam mining, selection of mining method, caving and stowing methods. Different slicing methods- inclined Slicing, Horizontal Slicing, Diagonal Slicing, Transversely Inclined Slicing, Caving methods- Sublevel Caving Working Steep and Moderately Thick Seams- Blasting Gallery method, Room and Pillar method, Descending Shield method of Mining. Design of Supports, Case studies.

UNIT – V

Modern Coal Mining Methods: Horizon Mining, Hydraulic Mining, Underground Coal Gasification. Case studies.

Text Books:

1. Principles and Practices of Modern Coal Mining, R. D. Singh, New Age International. ISBN: 978-8122429705.
2. Modern Coal Mining Technology, S. K. Das, Lovely Prakashan Publishers, 2nd edition. ISBN: 978-81-7850-043-6.

Reference Books:

1. Underground Coal Mining Methods, J. G. Singh, BrajKalpa Publishers, Varnasi. ISBN: 81-7525-204-9.
2. Coal Mining, I.C.F. Statham, The Caxton Publishing Company Ltd. Inc, Vol. I, II, III and Vol. III. ISBN: 978-81-7850-043-9.
3. Winning and working coal, R. T. Deshmukh, D.J Deshmukh Vol 1 & 2. ISBN: 97-88-189904333.

Web Links:

1. <https://osme.co.in/wp-content/uploads/2023/01/UCMR-BAL-1.pdf>
2. https://www.digitalxplore.org/up_proc/pdf/340-151522605452-56.pdf

Underground Metal Mining Technology

Course Code: 2501MN08

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of metal mining
- CO2:** Analyze the various mine development methods.
- CO3:** Analyze the basics of stoping
- CO4:** Compare the various stoping methods.
- CO5:** Categorize the various special stoping methods.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Metal Mining: Terminologies in metal mining. Special Characteristics of Metalliferous deposit. Scope and limitations of underground metal mining. Access to deposits, Status of metal mining in India and World.

UNIT – II

Mine Developments: Factors affecting choice of level interval, Cross cuts, drive, shape and size of drive, shaft station, ore bin, ore pass and their position in relation to ore body and general scheme of its development. Division of mining area into working units and level pattern, dimensions of panels and blocks. Unit Operations in Metal Mining.

UNIT – III

Basics of Stopping: Stopping methods- applicability, limitations, merits and demerits. Selection of stopping methods. Stope design and production planning in various methods of stopping. Support design.

UNIT – IV

Stoping Methods: Supported and un-supported Stoping Methods, Caving methods. Description, application and design of stoping methods. Mechanisation of stopes.

UNIT – V

Novel Techniques: In-situ leaching, bio-mineral engineering, hydraulic mining, Extraction of remnant pillars, shaft pillars and contiguous reefs, their supporting system and special precautions during extraction.

Text Books:

1. Introductory Mining Engineering, H L Hartman, John Wiley and sons. ISBN: 978-0471811778.
2. Elements of Mining Technology, D.J.Deshmukh. Vol III. ISBN: 978-8184890700.

Reference Books:

1. Deep Mining, Jack Spalding, Mining Publications. ISBN: 978-0-903078-36-8.
2. Mineral Engineers Hand Book, Peele, Vol. I & II, ISBN: 978-0873352205 & 978-0873352212.
3. U/G Mining Method, Hustrulid, Society for Mining, Metallurgy & Exploration. ISBN: 978-0873352643.

Web Links:

1. <https://www.911metallurgist.com/methods-mining-metals/>
2. <https://www.greatmining.com/metals.html>

Mineral Processing Technology

Course Code: 2501MN09

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of mineral processing technology.
- CO2:** Categorize material by sieve analysis.
- CO3:** Select various mineral crushers
- CO4:** Choose the various mineral separators.
- CO5:** Analyze the mineral processing techniques

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Scope and objective of mineral processing. Liberation and Comminution: crushing, grinding, Laws of comminution.

Practice:

1. To do Sampling by Using Conning and quartering and John Riffle and calculation of error.
2. Determination of various sized product by using different Sieve shaker.

UNIT – II

Sizing- Laboratory sizing techniques and interpretation of sizing data, Industrial screen.

Practice:

1. Determination of average size reduction by Jaw crusher and study their theoretical and actual capacity
2. Determination of average size by sieving of crushed Ore sample in roller crusher
3. To study the effect of grinding with grinding time in Ball mill

UNIT – III

Mineral Concentration Methods: tabling, zigging, floatation, magnetic and heavy media separation; ore sorting; electric separation.

Practice:

1. To study the effect of grinding with frequency (RPM) in Ball mill.
2. Determination of Washability Curve by using Float -sink analysis.
3. Determination of Proximate analysis of coal.

UNIT – IV

Forth flotation: Theories, techniques, performance, selective flocculation and agglomeration.

Practice:

1. Perform the beneficiation of an Oxide ore pulp mix using Floatation Cell.
2. Perform the beneficiation of a sulphide ore pulp mix using Floatation cell.

UNIT – V

Coal preparation for coarse and fine coal. Washability curves and washability number. Dewatering devices. Drying and tailings disposal.

Practice:

1. Study of magnetic separator, and effect of magnetic field on efficiency of the process.
2. Perform the Jigging operation to detecting the rate of stratification.

Additional Practice:

1. Crushing of Coal in the Jaw Crusher, and Determination of average size by sieving
2. Determine the theoretical capacity and actual capacity of a roller crusher.
3. Compare the reduction ratio of an ore sample and the coal sample.

Text Books:

1. Principles of Mineral Dressing, A.M.Gaudin, TataMcGraw &Hill. ISBN: 978-74604311.
2. A text Book on Ore, R.H.Richard and C.E.Locky. ISBN: 978-70438090.

Reference Books:

1. Mineral Dressing Handbook, F.Taggart. ISBN: 978-0471033484.
2. Mineral Processing Technology, B. A.Wills, Willy & Sons. ISBN: 978-0750644505.

Web Links:

1. <https://www.britannica.com/technology/mineral-processing>
2. <http://met.solverlabs.com/library/articles/mineral-processing-introduction>
3. <http://www.nmlindia.org/mnp.html>
4. <http://ibm.nic.in/index.php?c=pages&m=index&id=81&mid=22090>

Mine Hazards & Rescue

Course Code: 2501MN10

L	T	P	C
3	0	1	4

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of Mine Fires
- CO2:** Examine the various causes of Mine Explosions.
- CO3:** Analyze the reasons of Inundation.
- CO4:** Summarize the dust and noise in mines
- CO5:** Explain the rescue procedures in mining.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Mine Fires: Causes of mines fires; spontaneous combustion - mechanism, factors affecting spontaneous combustion; detection, susceptibility indices and prevention of spontaneous heating; accidental fires – causes and prevention; dealing with mine fires - direct and indirect methods.

Practice:

1. Detection of Mine Gases.

UNIT – II

Mine Explosions: Firedamp and coal dust explosions – mechanisms, causes and prevention; stone-dust and water barriers; investigations after an explosion.

Practice:

1. Detection of Methane using flame safety lamp.

UNIT – III

Inundation: Causes and prevention; design of barriers; design and construction of water dams, shaft dams, emergency bulk heads; precautions and techniques of approaching old workings, safety boring apparatus, pattern of holes.

Practice:

1. Analysis of mine air by Orsat apparatus.

UNIT – IV

Rescue and Recovery: Classification of rescue equipments and their applications; rescue organization, rescue stations and rescue rooms; reopening and recovery of sealed of workings.

Practice:

1. Determination of Air pressure (Mine & Duct) by Inclined Manometer & Pitot tube.

UNIT – V

Dust and Noise in surface Mines: Airborne respirable dust – sources, sizes, effects, measurement, standards, prevention and control. Air quality Models-Box Model and Gaussian Model. Metreological aspects of Dust- Lpase Rate, Mixing Height, Atmosphpheric Stability.

Occupational noise-sources, effects, measurement- Sound Power, Sound Intensity, and Sound Pressure, Energy equivalent sound level (L_{eq}), Standards, Prevention and Control.

Practice:

1. Determination of Air quantity by Vane Anemometer.
2. Determination of Sound levels by Noise meter.

Text Books:

1. Mine Ventilation, Dr. G.B. Mishra. ISBN: 978-81-22402501.
2. Introduction to environmental Science and engineering by Gilberts and Masters. ISBN: 978-0131481930.

Reference Books:

1. Fires in coal Mines, L.C Kaku. ISBN: 978-8179561683.
2. Mine fire and spontaneous heating, S.P. Banarjee. ISBN: 978-9061915744.
3. Mine Ventilation, Penman. ISBN: 978-1-330-63568-1.

Web Links:

1. <https://nptel.ac.in/courses/12310602/MODULE%20%20I/Lecture%208.pdf>
2. <https://nptel.ac.in/courses/12310602/MODULE%20%20I/Lecture%209.pdf>

Mine Environment & Ventilation Engineering

Course Code: 2501MN11

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Outline various gases-origins, occurrence, physiological effects.
- CO2:** Identify mine climatic conditions by using various devices.
- CO3:** Analyze the necessity of mine ventilation systems.
- CO4:** Analyze the operation of mine fans and related laws.
- CO5:** Assess the ventilation planning, design and ventilation survey.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Mine Air: Composition of Atmospheric and mine air, Mine gases-Properties, sources, physiological effects, detection, monitoring and control. Methane layering, degasification of coal seams, Mine dust: Sources, Effects, Monitoring, & Control.

Practice:

1. Detection of Mine Gases.
2. Detection of Methane using flame safety lamp.
3. Analysis of mine air by Orsat apparatus.

UNIT – II

Mine Climate: Sources of heat in mines, effects of heat and humidity in mines, testing methods and devices: psychometry, kata thermometer, methods for improving of cooling power of mine air: Refrigeration and Air Conditioning Mine Illumination, Illumination standards, Design of illumination system in underground mines, flameproof enclosures.

Practice:

1. Determination of mine fan characteristics.
2. Detection of different gases by Gas Chromatograph.

UNIT – III

Ventilation Systems: Necessity of ventilation, different ventilation systems and its related calculations, factors affecting selection of ventilation system, Mechanism of airflow through mine openings, Laws of air flow, resistance of airways, equivalent orifice, Distribution of air flow and control devices. Natural ventilation: calculation of NVP.

Practice:

1. Determination of Relative humidity & cooling power of mine air.
2. Determination of Air quantity by Vane Anemometer.

UNIT – IV

Mechanical Ventilation: Different types of mine fans: Installation, operation details, applicability, limitations, efficiencies and characteristic. Factors affecting selection of mine fans, testing and output control of fans, operation of mine fans (series and parallel). Fan laws, drives, evasees, diffusers, booster fans. Auxiliary ventilation. Reversal of air currents and controlled recirculation.

Practice:

1. Determination of Air pressure (Mine & Duct) by Inclined Manometer & Pitot tube.
2. Analysis of mine air by Haldane apparatus.

UNIT – V

Ventilation Planning and Design: Ventilation survey: both quantity and pressure and related calculations. Mine ventilation design criteria and factors, Accessional, descensional, homotropical, antitropical Ventilation planning. Central and boundary ventilation systems – layouts and comparisons. Standard of ventilation. Calculation of air quantity and total head requirement for ventilating a mine, Ventilation network analysis.

Practice:

1. Illumination survey using Lux meter.
2. Determination index of flammability of coal dust.

Additional Practice:

1. Study of different types of ventilation control devices.
2. Study of IoT based gas monitoring techniques.
3. Study and uses of self-rescuer, Gas mask, smoke helmet.

Text Books:

1. Elements of Mining Technology, D. J. Deshmukh, Central Techno Publication, 9th Edition, Vol II. ISBN: 978-81-208-2547-5.
2. Mine Environment and Ventilation, G. B. Mishra, Oxford University Press. ISBN: 978-0198087714.

Reference Books:

1. Mine ventilation and air conditioning, Howard L. Hartman. Wiley International. ISBN: 978-0471216921.

2. Environmental Engineering in Mines, Vutukuri & Lama, Cambridge University Press. ISBN: 978-0521545519.
3. Mine Ventilation, S. Ghatak, Coalfield Publishers, Vol. – II. ISBN: 978-1578086795.

Web Links:

1. <https://archive.nptel.ac.in/courses/123/106/12310602/>

Mine Machinery

Course Code: 2501MN12

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Outline different types of machinery used in mines
- CO2:** Compare types of rope haulages and its safety appliances
- CO3:** Predict optimist conveyor system in mines.
- CO4:** Design winding system and its safety
- CO5:** Design drainage and pumping system in surface and underground mines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Elements of the transport system, classification and techno economic indices of transportation systems. Wire ropes –classification, construction, fields of application, rope capping and splicing; deterioration of rope in use and its prevention; testing of ropes, selection and maintenance, rope calculations.

Practice:

1. Identify and sketch the different types of wire ropes.
2. Sketch the different types of rope capping.

UNIT – II

Rope Haulages: Types of rope haulages gravity, direct, main & tail, endless, suitability of these haulages and their limitations, merits and demerits, safety appliances and rope haulage calculations; Underground man riding system.

Practice:

1. Sketch the direct rope haulage system and observe the types of motors & braking system used.

2. Sketch the endless rope haulage system and various attaching devices like small man clip.

UNIT – III

Conveyors: Various types of conveyors, Scraper chain conveyors, AFC's, belt conveyors, cable belt conveyor, shaking and vibrating conveyors, high angle conveying, electrical layouts. Numerical problems in conveyors.

Practice:

1. Sketch the tandem drive (Tensioning arrangement) system used in conveyor haulage system.

UNIT – IV

Mine Winders: Winding systems, principles of koepe and drum winders and their applications, mechanical braking of winders, safety devices in winding, overwind and over speed protection. Head gear and their design, cages and skips, suspension gear, shaft fittings and appliances – guides, keps, etc.,

Practice:

1. Draw the circuit diagram of signalling system used in Haulages.

UNIT – V

Mine Pumps: Centrifugal, Reciprocating, Submersible pumps. Numerical problems on Mine Pumps. Characteristics curves for centrifugal pumps.

Practice:

1. Sketch and know the principles of mine pumps.

Text Books:

1. Mine Winding and Transport, Walker, S.C, Elsevier. ISBN: 978-0-444-41717-1.
2. Elements of mining technology, D. J. Deshmukh, Vol. 3. ISBN: 978-8185930914.

Reference Books:

1. Heavy Earth Moving Machinery, Amitosh Dey, Lovely Prakashan Publications, Dhanbad. ISBN: 978-. 9380386423.
2. Mine Mechanisation and Automation, Alemgren G, Kumar U, and Vagenas N A.A, Balkema Publication. ISBN: 978-0419220100.

Web Links:

1. <http://mineportal.in/upload 20MACHINERY 243.pdf>
2. <http://gujaratmining.blogspot.com/2017/10/rope haulage notes.html>

Mine System Engineering

Course Code: 2501MN13

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Apply mathematical modelling to formulate real-world problems involving decision making.
- CO2:** Solve Linear programming problem, transportation and assignment problems.
- CO3:** Solve sequencing problem, replacement problem and inventory problem.
- CO4:** Apply game theory problems, queuing theory in decision making
- CO5:** Apply dynamic programming & simulation techniques in real-world problems.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction : Definition and Scope of Operations Research, Phases of Operations Research - Mathematical formulation of the problem, graphical solution. Linear Programming Problem Standard Form of LPP, Basic Feasible Solutions, Unrestricted Variables, Simplex Algorithm Artificial Variables, Big M Method, Two Phase Simplex Method, Degeneracy, Alternative Optimal, Unbounded Solutions, Infeasible Solutions, Primal And Dual Problems And Their Relations, Dual Simplex Method.

UNIT – II

Transportation Problem : Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model. Assignment Problem Hungarian method, optimal solution, unbalanced assignment matrix. Replacement: Introduction – replacement of items that deteriorate with time – when money value is not counted and counted – replacement of items that fail completely, group replacement.

UNIT – III

Inventory Control : Inventory-Factors Effecting Inventory-EOQ, ABC & VED analysis, Inventory Problems with and without Shortages, Price Breakups, Multi Item Deterministic Problems. Probabilistic Inventory Problems.

UNIT – IV

Queuing Theory : Queuing systems and their characteristics. M/M/1 : FCFS/ / M/M/2 : FCFS/, M/M/1 : FCFS/ /N queuing models, Case studies on mining. Project Management Techniques CPM, PERT Networks, Network analysis and Crashing, Case studies on mining.

UNIT – V

Production Scheduling: Simulation Techniques for Equipment selection and production scheduling Definition and applications- Monte Carlo simulation- Random numbers and random number generation, Case studies on mining.

Text Books:

1. Operations Research, S.D Sharma Kedarnath Ramnath & Co. ISBN: 978-8190701105.
2. Operations Research, KantiSwaroop, P.K. Gupta, Man Mohan, Sulthan Chand & Sons. ISBN: 978-81-8054-078-3.

Reference Books:

1. Operations Research, P.K.Gupta and D.S.Hira, S.Chand& Co., 7th Edition. ISBN: 978-9352538233.
2. Operations Research, Panneer Selvam, Prentice Hall of India. ISBN: 978-81-203-4212-0.
3. Operations Research, Richard Bronson, Schaum Series. ISBN: 978-71820825.

Web Links:

1. <http://ww2.informs.org/Resources/>
2. <http://www.mit.edu/~orc/>
3. <http://www.ieor.columbia.edu/>
4. <http://www.universalteacherpublications.com/univ/ebooks/or/Ch1/origin.htm>
5. <http://www.wolfram.com/solutions/OperationsResearch/>

Mine Legislation & General Safety

Course Code: 2501MN14

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Illustrate the general principle of mining laws and regulations
- CO2:** Compare the rules and regulation framed under CMR& MMR.
- CO3:** Explain the various mining rules and Indian electricity rules
- CO4:** Explain the Mineral concession rules and mine act
- CO5:** Explain the training rules and DGMS circular

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

General principles of mining laws, The Mines Act 1952, The mines & Minerals (Regulation & Development) Act 2015, Industrial dispute Act 1947.

UNIT – II

The Coal Mines Regulations 2017 and The Metalliferous Mines Regulations 2019.

UNIT – III

The Mines Rules 1955, Mine rescue rule 1985, Indian Electricity rule 1956.

UNIT – IV

The Mineral Concession Rules 2017, The Mineral Concession and Development Rules 2017.

UNIT – V

Introduction to Environmental Legislation in mines, Land Acquisition & Revenue:
Concepts: Related laws and regulations, Forest Conservation Act 1980.

Text Books:

1. Mines act, Mine Rules, CMR,MMR,MVTC, Mine Rescue Rules, DGMS.
2. Legislation in Indian Mines: A critical appraisal, Rakesh and S. D. Prasad, Mrs Asha Lata Varnasi, 5th edition, Vol I & II.

Reference Books:

1. Proceeding of the National Seminar on Policies, A. K. Ghosh, S. K. Ray and A. K. Patra, Statutes & Legislation in Mines, CIMFR, Dhanbad.
2. Mineral Concession Rules 1960, V. K. Malhotra, Malhotra Bros., Patna, Supplementary Edition.

Web Links:

1. <https://mines.gov.in/writereaddata/UploadFile/MMDR%20Act,1957.pdf>
2. <https://dgms.gov.in>.

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	-
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	-
Total			4		6	10				

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. Magnetisation Characteristics of DC shunt generator
2. Measurement of Power and Power factor using Single-phase wattmeter
3. Measurement of Resistance using Wheat stone bridge
4. Measurement of Earth Resistance using Megger.

UNIT-III

Energy Resources, Electricity Bill and Safety Measures

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

Practice:

1. Calculation of Electrical Energy for Domestic Premises

UNIT-IV

Semiconductor Devices

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

Practice:

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

UNIT-V

Basic Electronic Circuits

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

Digital Electronics

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, 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)

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

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice

1. Introduction to Excel

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

2. Data Analysis with Excel

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

3. Advanced Excel Features

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

4. Introduction to Power BI

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

5. Data Preparation in Power BI

- a. Introduction to Power Query for data transformation
- b. Cleaning, shaping, and filtering data in Power Query Editor

6. Data Preparation in Power BI

- a. Combining data from different sources
- b. Loading data into Power BI model.

7. Data 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 CO₂ Emissions Analytics Dashboard	Analyze global carbon dioxide emissions by country, region, and industry using Power BI. The dashboard presents emission trends, sector-wise contributions, historical comparisons, and sustainability indicators through Excel, interactive visualizations, and AI-generated insights.	https://ourworldindata.org/co2-and-greenhouse-gas-emissions
8	Olympics Performance Analytics Dashboard	Create a Power BI dashboard to evaluate Olympic Games performance by analyzing medal counts, athlete achievements, country rankings, sports categories, and historical participation. Excel and AI-powered visualizations are used to generate meaningful sports analytics and comparative insights.	https://www.kaggle.com/datasets/the-guardian/olympic-games
9	Netflix Content Analytics Dashboard	Develop an interactive dashboard to analyze Netflix's content library by genre, country, release year, ratings, duration, and content trends. Excel is used for preprocessing, while Power BI and AI insights help identify viewing patterns and content distribution across regions.	https://www.kaggle.com/datasets/shivamb/netflix-shows

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

		Microsoft Excel, Power BI, and AI-driven insights, the dashboard enables comparative analysis of tourism performance across countries and years.	
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)

Course Code: 2501CS01

L T P C
2 0 2 4

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

- CO1:** Demonstrate basics of computer, algorithm and flow chart for problem solving.
- CO2:** Make use of an appropriate control structures to solve given problems.
- CO3:** Solve complex problems using arrays and strings.
- CO4:** Develop modular programming using functions.
- 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/6698e2fbc6bd470f35b73d8>
<https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e>
 - c) find the frequency of each digit in the given string.
<https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true>
 - d) Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.
<https://maya.technicalhub.io/owl-program-details/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: Nth factorial using recursion.
- 4. Objective: Find the super digit of the integer.
- 5. Implement LCM
- 6. Objective: Calculate the Nth term of series.
<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>

UNIT – V

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

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

Practice:

- 1. Pointers

- a) Objective: learn to implement the basic functionalities of pointers in C.
<https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true>
 - b) Objective: Learn using Pointers with Arrays and Functions.
<https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true>
 - c) Objective: sort a given array of strings into lexicographically increasing order or into an order in which the string with the lowest length appears first.
<https://www.hackerrank.com/challenges/sorting-array-of-strings/problem?isFullScreen=true>
 - d) Find the sum of a 1D array using malloc().
 - e) Swap two numbers using functions and pointers - call by value and reference.
 - f) Objective: Dynamic Handling requests by a Librarian to place the books in the shelves.
<https://www.hackerrank.com/challenges/dynamic-array-in-c/problem?isFullScreen=true>
2. File handling concepts
- a) Write text into and read text from a file.
 - b) Write text into and read text from a binary file using fread() and fwrite().
 - c) Copy the contents of one file to another file.
 - d) Merge two files into the third file using command-line arguments
 - e) Find no. of lines, words and characters in a file.

Text Books:

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

Reference Books:

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

Web Links:

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

Additional Practice:

S.No .	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRAC TICECPP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/
17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/
24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/

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

53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/
58	Medium	Spiral Matrix	https://leetcode.com/problems/spiral-matrix/
59	Medium	Jump Game	https://leetcode.com/problems/jump-game/
60	Medium	Permutations	https://leetcode.com/problems/permutations/
61	Medium	Combination Sum	https://leetcode.com/problems/combination-sum/
62	Medium	Search in Rotated Sorted Array	https://leetcode.com/problems/search-in-rotated-sorted-array/
63	Medium	Group Anagrams	https://leetcode.com/problems/group-anagrams/
64	Medium	Sort Colors	https://leetcode.com/problems/sort-colors/
65	Medium	Subsets	https://leetcode.com/problems/subsets/
66	Medium	Reverse Linked List II	https://leetcode.com/problems/reverse-linked-list-ii/
67	Medium	Add Two Numbers II	https://leetcode.com/problems/add-two-numbers-ii/
68	Medium	Reorder List	https://leetcode.com/problems/reorder-list/
69	Medium	Linked List Cycle II	https://leetcode.com/problems/linked-list-cycle-ii/
70	Medium	K-th Largest Element in an Array	https://leetcode.com/problems/kth-largest-element-in-an-array/
71	Medium	Product of Array Except Self	https://leetcode.com/problems/product-of-array-except-self/
72	Medium	Word Search	https://leetcode.com/problems/word-search/
73	Medium	Unique Paths	https://leetcode.com/problems/unique-paths/
74	Medium	Minimum Path Sum	https://leetcode.com/problems/minimum-path-sum/
75	Medium	Temperature Converter - II	https://www.codechef.com/practice/course/c/LPCA_S03/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/permutation-s-of-strings/problem?isFullScreen=true

Maya Programs

S.No.	Problem Name	Maya Program Link
1	Can Cross the Bridge	https://maya.technicalhub.io/owl-program-details/6686308df56afec5c0c8e2dd
2	Hypotenuse	https://maya.technicalhub.io/owl-program-details/6686404ef56afec5c0c90135
3	Heron's Formula	https://maya.technicalhub.io/owl-program-details/66864474f56afec5c0c911f5
4	Loss Percentage	https://maya.technicalhub.io/owl-program-details/66864868f56afec5c0c91a4a
5	King Tours	https://maya.technicalhub.io/owl-program-details/66864c96f56afec5c0c921f1

6	Profit Percentage	https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694
7	Area and Perimeter of Square	https://maya.technicalhub.io/owl-program-details/6686546930bfd35127c869c
8	Volume of Sphere	https://maya.technicalhub.io/owl-program-details/6686565530bfd35127c8818
9	Required Points	https://maya.technicalhub.io/owl-program-details/66865b1130bfd35127c8a04
10	Instant Noodles	https://maya.technicalhub.io/owl-program-details/66865ddb30bfd35127c8c0a
11	Find Second Number	https://maya.technicalhub.io/owl-program-details/668660a530bfd35127c8cde
12	Kmph to Mps	https://maya.technicalhub.io/owl-program-details/668663ce30bfd35127c8dfb
13	Inches to Centimeters	https://maya.technicalhub.io/owl-program-details/6686665e30bfd35127c8f3a
14	Capacity	https://maya.technicalhub.io/owl-program-details/668678aa30bfd35127c95b9
15	Average of Two Numbers	https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6
16	Compound Interest	https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab
17	Average Weight	https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a
18	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1
19	Distance Between Two Points	https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a
20	Days into Years, Weeks	https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8
21	Convert Seconds to Hours, Minutes and Seconds	https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b
22	Hours and Minutes	https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673
23	Romeo and Juliet	https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b
24	Gross Salary of an Employee	https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682
25	Surface Area and Volume of a Cube	https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca
26	Area of Trapezium	https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e
27	Swap Two Numbers	https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55
28	Last Two Digits of a Given Year	https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90
29	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/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/66866c4a30bfd35127c90b4
32	String Copy	https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a
33	Recursive Digit Sum	https://www.hackerrank.com/challenges/recursive-digit-sum/problem

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

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

Course Code: 2601DS01

L	T	P	C
2	0	2	4

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

- CO1:** Demonstrate basics of computer, algorithm and flow chart for problem solving.
- CO2:** Make use of an appropriate control structures to solve given problems.
- CO3:** Solve complex problems using arrays and strings.
- CO4:** Develop modular programming using functions and dynamic memory allocation.
- CO5:** Develop programs using structures and file handling operations.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Programming and Problem Solving

Introduction to Programming Languages, Basics of a Computer Program- Algorithms, characteristics of algorithm, flowcharts, pseudo code.

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

Practice 1:

1. Explore different platforms
 - a. Basic linux environment and its editors like Vi, Vim & Emacs etc.
 - b. Exposure to turbo C, gcc.
 - c. Explore to hacker rank or any other Online coding platform and compiler environment.
 - d. “Hello world” in C.
<https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B>
 - e. Objective: Learn about the syntax of reading from stdin and writing to stdout.
<https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true>
 - f. Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.

2. Basics and Operators

- a. Sum and Difference of 2 numbers.

Objective: Learn int and float data types.

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

- b. Playing with Characters.

Objective: Learn how to take a character, a string and a sentence as input in C.

<https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true>

- c. Bitwise Operators

Objective: Learn how to work with bits (0,1) and bitwise operators.

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

- d. Conversion of Fahrenheit to Celsius and vice versa.

<https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30>

- e. Distance travelled by an object.

- f. Calculate Simple interest and compound interest.

3. Operators and Expressions, Variables and Type conversions.

- a. Evaluate the following expressions

i. $a/b * c - b + a * d / 3$

ii. $j = (i++) + (++i)$

- b. Square root of a given number.

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

https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com

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

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

UNIT – II

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

Practice:

1. Conditional Statements

- a. Objective: Understand if and else Conditional statements in C.

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

- b. Roots of a Quadratic Equation.

- c. Generate electricity bill.

- d. Simulate a calculator using switch case.

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

2. Loops

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

- b. Sum of the digits of a 5-digit number.

Objective: Learn the usage of while loop and usage of operators - % and /.

<https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true>

- c. Given number is a prime or not. (Also Prime numbers between a given range.)

- d. Armstrong Number or not.

- e. Palindrome or not.

- f. Objective: Print a pattern of numbers using Loops.

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

- g. Construct a Pyramid pattern.

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

UNIT – III

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

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

Practice:

1. 1-Dimensional Arrays
 - a. Objective: Print the sum and free the memory where the array is stored.
<https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true>
 - b. Objective: Working with indices in array.
Search an element in array .
 - c. Find min and max elements in array.
 - d. Insert an element into array.
 - e. Eliminate duplicate elements from array.
 - f. Sorting of elements in an array
2. 2-Dimensional Arrays
 - a) Sum of two 2-D arrays.
 - b) Multiplication of two 2-D arrays.
 - c) Transpose of a Matrix.
 - d) Trace of a Matrix.
 - e) Lower Triangular Matrix.
3. 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: Nth factorial using recursion.
 - d. Objective: Find the super digit of the integer.
 - e. Implement LCM
 - f. Objective: Calculate the Nth term of series.
<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>
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/INTTEST
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=CHFARRP
48	Medium	Add Two Numbers	https://leetcode.com/problems/add-two-numbers/
49	Medium	Longest Substring Without Repeating Characters	https://leetcode.com/problems/longest-substring-without-repeating-characters/
50	Medium	Longest Palindromic Substring	https://leetcode.com/problems/longest-palindromic-substring/
51	Medium	3Sum	https://leetcode.com/problems/3sum/
52	Medium	Container With Most Water	https://leetcode.com/problems/container-with-most-water/
53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/

58	Medium	Spiral Matrix	https://leetcode.com/problems/spiral-matrix/
59	Medium	Jump Game	https://leetcode.com/problems/jump-game/
60	Medium	Permutations	https://leetcode.com/problems/permutations/
61	Medium	Combination Sum	https://leetcode.com/problems/combination-sum/
62	Medium	Search in Rotated Sorted Array	https://leetcode.com/problems/search-in-rotated-sorted-array/
63	Medium	Group Anagrams	https://leetcode.com/problems/group-anagrams/
64	Medium	Sort Colors	https://leetcode.com/problems/sort-colors/
65	Medium	Subsets	https://leetcode.com/problems/subsets/
66	Medium	Reverse Linked List II	https://leetcode.com/problems/reverse-linked-list-ii/
67	Medium	Add Two Numbers II	https://leetcode.com/problems/add-two-numbers-ii/
68	Medium	Reorder List	https://leetcode.com/problems/reorder-list/
69	Medium	Linked List Cycle II	https://leetcode.com/problems/linked-list-cycle-ii/
70	Medium	K-th Largest Element in an Array	https://leetcode.com/problems/kth-largest-element-in-an-array/
71	Medium	Product of Array Except Self	https://leetcode.com/problems/product-of-array-except-self/
72	Medium	Word Search	https://leetcode.com/problems/word-search/
73	Medium	Unique Paths	https://leetcode.com/problems/unique-paths/
74	Medium	Minimum Path Sum	https://leetcode.com/problems/minimum-path-sum/
75	Medium	Temperature Converter - II	https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B
76	Medium	Reverse	https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true
77	Medium	Sentence in a new line	https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true
78	Hard	Median of Two Sorted Arrays	https://leetcode.com/problems/median-of-two-sorted-arrays/
79	Hard	Regular Expression Matching	https://leetcode.com/problems/regular-expression-matching/
80	Hard	Wildcard Matching	https://leetcode.com/problems/wildcard-matching/
81	Hard	Trapping Rain Water	https://leetcode.com/problems/trapping-rain-water/
82	Hard	First Missing Positive	https://leetcode.com/problems/first-missing-positive/
83	Hard	Longest Valid Parentheses	https://leetcode.com/problems/longest-valid-parentheses/
84	Hard	Merge k Sorted Lists	https://leetcode.com/problems/merge-k-sorted-lists/
85	Hard	Reverse Nodes in k-Group	https://leetcode.com/problems/reverse-nodes-in-k-group/description/

86	Hard	Sudoku Solver	https://leetcode.com/problems/sudoku-solver/
87	Hard	N-Queens	https://leetcode.com/problems/n-queens/description/
88	Hard	Edit Distance	https://leetcode.com/problems/edit-distance/
89	Hard	Word Ladder II	https://leetcode.com/problems/word-ladder-ii/
90	Hard	Maximal Rectangle	https://leetcode.com/problems/maximal-rectangle/
91	Hard	Binary Tree Maximum Path Sum	https://leetcode.com/problems/binary-tree-maximum-path-sum/
92	Hard	Serialize and Deserialize Binary Tree	https://leetcode.com/problems/serialize-and-deserialize-binary-tree/
93	Hard	Variadic functions in C	https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true
94	Hard	Small Triangles, Large Triangles	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true
95	Hard	Permutations of Strings	https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true

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

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	-
2501MN47	Student Activity Based Learning	AC			2	2				
Total			2		7	9				

Essential Cognitive Skills for Engineers

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

Course Code: 2501EN01

L	T	P	C
0	0	1	1

Course Outcomes:

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

- CO1: Recognize the different aspects of the English language proficiency with emphasis on LSRW skills.
- CO2: Apply communication skills through various language learning activities.
- CO3: Analyze the English speech sounds, stress, intonation and syllable division for better listening and speaking comprehension.
- CO4: Enable them to learn and apply fundamentals of English grammar concepts for improved language
- CO5: Make use of various types of vocabulary in different academic and professional careers

Mapping of Course Outcomes with Program Outcomes:

CO/PO	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: <i>Protector of the sea and the woman who reinvented children's TV</i> , Interviews: <i>30-day challenge</i> , Article: <i>Tech free!</i>
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

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

Unit – 3 Talent A/B/C/D

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

Unit – 4 Life Lessons A/B/C/D

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

Unit – 5 Chance A/B/C/D

Listening	Monologue: What are your chances?, Conversation: Talking about work, Money problems, News reports: environmental problems
Speaking	Discussing possible future events, Role Play: job interview, Explaining and responding to an idea for a café, Giving opinions on environmental problems

Reading	Quiz: <i>Are you an optimist or a pessimist?</i> ; Article: <i>Why we think we're going to have a long and happy life</i> , Quiz: <i>The unknown continent</i> ; Article: <i>Cooking in Antarctica</i> , Essay about protecting the environment
Writing	For and against essay, Arguing for and against an idea
Grammar	Future probability, Future perfect and future continuous
Vocabulary	Adjectives describing attitude, The natural world
Pronunciation	Sound and spelling : <i>th</i> , Intonation groups

Text Book:

- Cambridge Empower – Second Edition B2 Level - Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis – Jones. 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 about four tourist destinations; Website: <i>Where to go?</i>
Writing	Travel blog, Using descriptive language
Grammar	Infinitives and <i>-ing</i> forms
Vocabulary	Travel and tourism, Describing changes
Pronunciation	Consonant clusters, Consonant sounds

Unit – 2 City living A/B/C/D

Listening	Interview: ‘Smart’ cities: Two monologues talking about ‘smart’ cities, Two monologues: house renovations, Flat hunting, Interviews about a new shopping centre
Speaking	Discussing good and bad points about a city
Reading	Article: <i>Quick-slow down!</i> , Article: <i>Who puts the ‘real’ in reality</i> TV? Email: Complaining about an important issue.
Writing	Email of complaint, Using formal language
Grammar	<i>Too/enough; so/such</i> , Causative <i>have/get</i>
Vocabulary	Describing life in cities, Film and TV; Houses
Pronunciation	Sound and spelling: o, Stress in compound nouns

Unit – 3 Dilemmas A/B/C/D

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

Unit – 4 Discoveries A/B/C/D

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

Unit – 5 Possibilities A/B/C/D

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

Text Book:

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

Suggested Software:

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

Reference Books:

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

Web links:

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

Design Thinking using AI

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

Course Code:2501UC07

L	T	P	C
0	0	1	1

Course Outcomes:

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

- CO1:** Appreciate various design process procedure.
- CO2:** Generate and develop design ideas through different technique.
- CO3:** Identify the significance of reverse Engineering to Understand products.
- CO4:** Draw technical drawing for design ideas.
- CO5:** Illustrate design teams to create feasible and user-focused solutions to complex problems in design.

Mapping of Course Outcomes with Program Outcomes:

CO/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
2501MN15	Mine Water Pollution & Control	IC			2	2	50	50	100	-
2501MN16	Mine Automation	IC			1	1	100	-	100	-
2501MN17	Mine Planning	AC			2	2	50	50	100	-
2501MN18	Mine Automation & Virtual Reality	AC			2	2	50	50	100	-
2501MN19	Software Applications in Mining Engineering	AC			2	2	50	50	100	-
Total					9	9				

Mine Water Pollution & Control

Course Code: 2501MN15

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Describe the composition of various water samples
- CO2:** Measure pH and electrical conductivity of mine water samples
- CO3:** Determine acidity and alkalinity of a water sample
- CO4:** Analyse Total hardness of a water sample
- CO5:** Determine Na, K and Ca ions in a water sample

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	1	1	1
CO2	3	2	-	-	-	-	-	-	1	1	1
CO3	3	2	-	-	-	-	-	-	1	1	1
CO4	3	2	-	-	-	-	-	-	1	1	1
CO5	3	2	-	-	-	-	-	-	1	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. Determination of DO and BOD of a water sample.
2. Determination of pH and conductivity of a water sample.
3. Determination of acidity and alkalinity of a water sample.
4. Determination of Total Suspended Solids (TSS).
5. Assessment of Total Dissolved Solids (TDS).
6. Determination of Turbidity of a water sample.
7. Determination of COD of a water sample.
8. Determination of Total hardness of a water sample.
9. Determination of Carbonate hardness of a water sample.
10. Determination of Ultimate BOD.
11. Detection of Acid Mine Drainage (AMD) Parameters.

Additional Practice:

1. Determination of sulphate concentration in water.
2. Determination of Na, K and Ca ions in a water sample using flame photometer.

Text Books:

1. Standard Methods for the Examination of Water and Wastewater, Eugene W. Rice, Rodger B. Baird, American Public Health Association (APHA), 23rd Edition, 2022. ISBN Number: 978-0875532993.
2. Environmental Chemistry, Stanley E. Manahan, CRC Press, 10th Edition, ISBN: 978-1498776949.

Reference Books:

1. Water Quality & Treatment: A Handbook on Drinking Water, American Water Works Association (AWWA), McGraw-Hill Education, 6th Edition, ISBN: 978-0071630115.
2. Water Quality Assessments: A Guide to Use of Biota, Sediments and Water in Environmental Monitoring, Deborah V. Chapman, E & FN Spon (an imprint of Chapman & Hall), 2nd Edition, ISBN: 978-0419215905.

Web Links:

1. https://www.whitman.edu/chemistry/edusolns_software/BODBackground.pdf
2. <https://www.ijnrd.org/papers/IJNRD2208157.pdf>

Mine Automation

Course Code: 2501MN16

L	T	P	C
0	0	1	1

Course Outcomes:

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

- CO1:** Apply the Principles and Strategies of Automation and enhancement of Productivity
- CO2:** Classify Essential Elements of an Automated System
- CO3:** Apply Automated Communication and Tracking Technologies: Image Processing
- CO4:** Apply Mine Safety Applications, Mining operation simulations
- CO5:** Analyze Virtual Reality Applications

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

- Introduction to Automation, Principles and Strategies of Automation and enhancement of Productivity.
- Essential Elements of an Automated System.
- Autonomous Mining System I: Autonomous Haulage Systems.
- Autonomous Mining System II: Automated Drilling System.
- Autonomous Mining System III: Fleet Management System: TDS.
- Mine Robotics: Mining Remote Operations & Control.
- Radar Systems, RFID in Mining Engineering.
- Geo-fencing, CCD camera in Mining for safety and management.
- Global Navigational Satellite System in Mining production planning and efficient control of the machine.
- Automated Communication and Tracking Technologies: Image Processing.
- Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations – Part 1.

Additional Practice:

1. Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations – Part 2.
2. Virtual Reality Applications: Mining Equipment Concept development, Mine Safety Applications, Mining operation simulations – Part 3.

Text Books:

1. The elements of statistical learning, Hastie, Trevor, et al. Springer, New York, Vol. 2. ISBN: 978-0387848570.
2. Applied statistics and probability for engineers. Montgomery, Douglas C., and George C. Runger, John Wiley & Sons. ISBN: 978-1119723456.

Reference Books:

1. Mine Mechanization & Automation, G. Almgren, U. Kumar, N. Vagenas, 1st Edition. ISBN: 978-1402075355.
2. Automation in Mining, Mineral and Metal Processing, J. O'Shea M. Polis, Proceedings of The 3rd Ifac Symposium, Montreal, Canada. ISBN: 978-0080261645.
3. A General Introduction to Data Analytics, Joao Moreira, Andre Carvalho, Tomás Horvath, Wiley, 2019. ISBN: 978-1119467168.

Web Links:

1. <https://www.identecsolutions.com/news/rfid-in-mining>
2. <https://www.unoosa.org/documents/pdf/icg/ISWI/IJSWS12-326.pdf>

Mine Planning

Course Code: 2501MN17

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Apply Traditional Approaches to Reserve Estimation and Tonnage Factor
- CO2:** Determine Average Grade of Ore in Vertical and Horizontal Sections
- CO3:** Implement Advanced Weighting Techniques for Grade Estimation
- CO4:** Determine Lease Boundaries Using Bearings, Distance, and Coordinates
- CO5:** Create and Utilize a Geological Database for Drill Hole Data

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

- Traditional Approaches to Reserve Estimation Tonnage factor.
- Determination of average grade of ore in a vertical section.
- Determination of average grade of ore in a horizontal section- Triangular method.
- Determination of average grade of ore in a horizontal section- Polygonal method.
- Constant distance weighting technique.
- Determination of average grade of ore in a horizontal section- Inverse distance weighting technique.
- Determination lease boundaries using bearings and distance.
- Determination of lease boundaries using co-ordinates.
- Creation of Geological Data Base.
- Generation and displaying of drill holes.

Additional Practice:

- Creation of 3-D Block Model.
- Calculation of volume and tonnage using string file.

Text Books:

1. Introductory Mining Engineering, Howard L. Hartman and Jan M. Mutmanský, John Wiley & Sons, 2nd Edition, ISBN: 978-0471348511.
2. Ore Reserve Estimation and the Geostatistical Method, M. David, Elsevier Scientific Publishing Company, ISBN: 978-0444415143.

Reference Books:

1. Geological Modelling and Mine Planning with Surpac and Whittle, Sukumar Bandopadhyay, CRC Press (Taylor & Francis Group), 1st Edition, ISBN: 978-1138749927.
2. Surface Mining Technology: Progress and Prospects, Ajoy K. Ghose, CRC Press, Taylor & Francis Group, 1st Edition, 2022, ISBN: 9781032119333.

Web Links:

1. <https://geologyhub.com/ore-reserve-estimation-methods/>
2. <https://www.911metallurgist.com/ore-reserve-estimation-methods/>

Mine Automation & Virtual Reality

Course Code: 2501MN18

L T P C
0 0 2 2

Course Outcomes:

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

- CO1:** Apply Psychrometric Principles
- CO2:** Evaluate Duct Flow Characteristics
- CO3:** Validate Measurement Instruments
- CO4:** Calculate Frictional and Drag Coefficients
- CO5:** Interpret Relationships in Ventilation Systems

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

1. Use of Assmann Psychrometer and estimation of Psychrometer properties.
2. Determination of method factor of a duct.
3. Performance Evaluation of Mine Evasee Present in a Ventilation System
4. Calibration of orifice plates.
5. Calibration of Inclined Tube Manometer using Askania Minimeter.
6. Determination of Frictional Co-efficient of Mine Airways.
7. Precise Traversing in a Duct using Pitot Tube.
8. Establishment of the Relationship between Kata Cooling Power and Air Velocity.
9. Determination of Shock Pressure Loss in Presence of Tub and Estimation of Drag coefficient.
10. Fan Rating Test.

Additional Practice:

1. Determination of Air pressure (Mine & Duct) by Inclined Manometer.
2. Determination of Air pressure (Mine & Duct) by Pitot tube.

Text Books:

1. Elements of Mining Technology, D. J. Deshmukh, Central Techno Publication, 9th Edition, Vol II. ISBN: 978-8185213197.
2. Mine Environment and Ventilation, G. B. Mishra, Oxford University Press. ISBN: 978-0198088956.

Reference Books:

1. Mine ventilation and air conditioning, Howard L. Hartman. Wiley International. ISBN: 978-0471648557.
2. Environmental Engineering in Mines, Vutukuri & Lama, Cambridge University Press, Cambridge. ISBN: 978-0521476637.
3. Legislation in Indian mines a critical appraisal, Prasad and Rakesh, Vol. I & Vol. II. ISBN: 978-0521476735.

Web Links:

1. <https://mv-iitkgp.vlabs.ac.in/exp/pitot-tube/procedure.html>
2. <https://mv-iitkgp.vlabs.ac.in/exp/ventilation-system/theory.html>

Software Applications in Mining Engineering

Course Code: 2501MN19

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Describe different mine planning software.
- CO2:** Explain about DATAMINE software.
- CO3:** Explain about Surpac software
- CO4:** Explain about blasting software
- CO5:** Explain about Mine Design software

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	3	-	1	-	-	-	-	1	1	1
CO2	2	3	-	1	-	-	-	-	1	1	1
CO3	2	3	-	1	-	-	-	-	1	1	1
CO4	2	3	-	1	-	-	-	-	1	1	1
CO5	2	3	-	1	-	-	-	-	1	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 Mine Planning Process and Application of Computer Technology in Mine Planning.
2. Computer Aided Mine Planning and Design Process with SURPAC.
3. To create Geological Database in SURPAC and Import of Geological Data.
4. To visualize the Drill Hole and charge distribution using O-pitblast software.
5. To Predict the surface subsidence over underground coal mining workings using ANSYS.
6. To perform Stress analysis in stability of pillar in coal mines using ANSYS and Flow Fluid.
7. To Study strata support behavior in underground mine using ANSYS.
8. To analyse Slope stability of benches using FLAC/ FLAC 3D software.
9. To optimize blast parameters using O-pitblast software.
10. To determine fragmentation size using FRAGLYST 4.0 software.
11. To prepare LULC maps for mine area.

Additional Practice:

12. To prepare NDVI maps for mining area.

13. To design mine plan using DATAMINE.
14. To analyse Slope stability of benches using GALENA.

Text Books:

1. Open Pit Mine Planning & Design, W. Hustrulid and M. Kuchta. ISBN: 978-0415403455.
2. Application of the Computers and Operation Research in the Mineral Industry, Bandopadhyay, S. SME Publication , Proceedings of the 30th international Symposium. ISBN: 978-0873352224.

Reference Books:

1. Computers in Mineral Industry, Mozumdar, B.K., Ramani, R.V. and Samaddar, A.B, CRC Press, 1st Edition. ISBN: 978-0849301650.
2. Tutorials on mine planning software SURPAC, Minex, Datamine.

Web Links:

1. https://www.researchgate.net/publication/341793185_Manual_National_Land_Use_Land_Cover_Mapping_using_Multi-temporal_Satellite_Data
2. <https://support.esri.com/en-us/knowledge-base/how-to-create-an-ndvi-map-in-arcgis-pro-000030690>
3. <https://downloads.o-pitblast.com/files/manual/O-Pitblast%20Manual%20v.3.0.pdf>

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)

Course Code: 2501CS02

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Make use of 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, Neethumol Sabu, Charulatha Publications ISBN: 978-93-5577-695-6
4. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Wes McKinney, O'Reilly Media, ISBN: 978-1491957660

Web Links:

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

Internet of Things

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

Course Code: 2501CS04

L	T	P	C
0	0	1	1

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

Practice:

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

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

Additional Practice (Any 2 from the following)

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

Reference Books:

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

Web Links:

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

Employability Skills- I

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

L	T	P	C
0	0	3	0

Course Code: 2501UC11

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

Aptitude:

Problems on Ages, Partnership, Percentages, Profit and Loss

Reasoning:

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

Verbal:

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

Text Books:

1. Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND.
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)

Course Code: 2501UC14

L T P C
0 0 3 0

Course Outcomes:

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

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

Mapping with Program Outcomes:

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

1. Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND.
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	-		2	-	-	-	-	-	-
CO2	3	3	-		2	-	-	-	-	-	-
CO3	-	3	-	2	2	-	-	-	-	-	-
CO4	-	3	-	2	2	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	2	2	-	2

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

1. Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND.
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
0 0 3 1

Course Code: 2501UC16

Course Outcomes:

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

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

Mapping with Program Outcomes:

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

1. Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND.
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)

Course Code: 2501AC01

L	T	P	C
2	0	0	0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Multidisciplinary Nature of Environmental Studies:

Definition, Scope and Importance, Need for Public Awareness.

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

UNIT – II

Ecosystem, Biodiversity and Its Conservation:

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

Biodiversity And Its Conservation: Definition: genetic, species and ecosystem diversity – 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)

Course Code: 2501AC02

L	T	P	C
2	0	0	0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Indian Constitution:

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

UNIT – II

Union Government and its Administration Structure of the Indian Union:

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

UNIT – III

State Government and its Administration Governor:

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

UNIT – IV

Local Administration:

District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation 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)

Course Code: 2501AC03

L	T	P	C
2	0	0	0

Course Outcomes:

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

- CO1:** Explain the characteristics and process of research.
- CO2:** Select the research problem by applying problem identification techniques.
- CO3:** Formulate and execute research design process.
- CO4:** Report the results of research process adhering to professional ethics.
- CO5:** Analyze the results of research using statistical measures of central tendency

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Meaning of Research:

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

UNIT – II

Identification of Research Problem :

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

UNIT – III

Research Design :

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

UNIT – IV

Interpretation and Report Writing:

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

UNIT – V

Statistical Techniques and Tools :

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

Text Books:

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

Reference Books:

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

Web Links:

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

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

Course Code: 2501AC04

L T P C
2 0 0 0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Text Books:

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

Reference Books:

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

Web Links:

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

Indian Knowledge Systems (IKS)
(CE, EEE, ME, ECE, CSE, IT, AIML, CSE(DS), PT, Min. E)

Course Code: 2501AC05

L T P C
2 0 0 0

Course Outcomes:

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

- CO1:** Describe the foundations and scope of Indian Knowledge Systems.
- CO2:** Recognize major Indian contributions to knowledge, science, and culture.
- CO3:** Appreciate ethical values and sustainability rooted in Indian traditions.
- CO4:** Relate traditional knowledge to contemporary societal and technological needs.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Foundations of Indian Knowledge Systems

Meaning, scope, and importance of IKS. Sources of IKS: Vedas, Upanishads, Itihasas, Puranas, Shastras. Traditional Knowledge, Indigenous Knowledge, and Western Knowledge – comparison. Gurukula system and knowledge transmission traditions

UNIT – II

Indian Civilization and Philosophical Traditions

Overview of ancient Indian civilization (Indus Valley, Maurya, Gupta). Indian philosophical schools and ethical values. Epics: Ramayana and Mahabharata – cultural and moral significance. Religious traditions: Hinduism, Buddhism, Jainism, Sikhism

UNIT – III

Arts, Architecture and Cultural Expressions

Temple architecture: Nagara, Dravidian, Vesara. Mughal architecture and monuments. Indian classical dance forms and music traditions. Handicrafts, sculpture, painting, and iconography

UNIT – IV

Traditional Knowledge in Health, Environment and Sustainability

Ayurveda and Yoga – holistic health systems. Traditional agriculture and food practices. Water conservation methods and environmental ethics. Biodiversity conservation and sustainable living

UNIT – V

Traditional Knowledge and Contemporary Relevance

Protection of Traditional Knowledge. Traditional Knowledge (TK) and Intellectual Property Rights (overview). Role of government and national initiatives. Relevance of IKS to engineering, innovation, and entrepreneurship

Text Books:

1. **Indian Knowledge Systems**, Kapil Kapoor & Avadhesh Kumar Singh, D.K. Printworld (India) Pvt. Ltd., New Delhi. ISBN: 9788124608177.
2. **Indian Philosophy – Volume I & II**, S. Radhakrishnan, Oxford University Press, New Delhi. ISBN: 9780195698418.
3. **Science and Technology in Ancient India**, O.P. Jaggi, Atma Ram & Sons, Delhi. ISBN: 9788185694085.
4. **Indian Heritage and Culture**, Madhukar K. Bhagat, McGraw Hill Education (India). ISBN: 9789332901476.
5. **Traditional Knowledge System in India**, Yogendra K. Malik, Pearson Education India. ISBN: 9788131762219.

Reference Books:

1. **Ancient Indian Science and Technology**, Debiprasad Chattopadhyaya, History of Science, Philosophy and Culture in Indian Civilization Series. ISBN: 9788187586098.
2. **Indian Culture and Heritage**, Nitin Singhania, McGraw Hill Education. ISBN: 9789353161132.
3. **Knowledge Traditions of India**, Bhu Dev Sharma, Indian Council of Philosophical Research (ICPR). ISBN: 9788185636306.

Web Links:

1. <https://iks.aicte-india.org/>
2. <https://www.education.gov.in/iks>

Minor Stream: Environment and Safety in Mining

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN23	Sustainable Mining	FC	3			3	50	50	100	DMD
2501MN24	Drilling & Blasting	IC	3			3	50	50	100	DMD
2501MN25	Safety Practices in Mines	IC	3			3	50	50	100	UCMT
2501MN26	Environmental Impact Assessment	IC	3			3	50	50	100	SM
2501MN27	Mine Health & Safety Engineering	IC	3			3	50	50	100	SPM
2501MN28	Environmental Pollution & Control	IC	3			3	50	50	100	UCMT/UMMT
2501MN29	Industrial Safety	IC	3			3	50	50	100	-
2501MN30	Waste Water Treatment & Recycling	IC	3			3	50	50	100	-
2501MN31	Environment & Safety	IC	3			3	50	50	100	-
2501MN32	Planning for Mine Closure & Reclamation	AC	3			3	50	50	100	SM
2501MN33	Safety Engineering	AC	2			2	50	50	100	MHSE
Total			32			32				

Sustainable Mining

Course Code: 2501MN23

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Analyze different stages in the EIA
- CO2:** Analyze the participation of public and NGO'S in environmental decision making.
- CO3:** Analyze the special methods and components of EIA.
- CO4:** Generate the awareness of assessment of impacts air, water, soil, noise biological, socio & cultural environments.
- CO5:** Analyze the Case studies related to the Mining sectors.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Foundations of Sustainable Mining :Concept of Sustainable Development for Mining Industry, Overview of Current Mining Practices and Their Impact on Sustainability, Legislative Measures for Sustainable Development: MMDR Act, Star Rating of Indian Mines (Coal & Non-coal), Milos Statement on Sustainable Mineral Industry.

UNIT – II

Current Practices and Policies :International Sustainability Reporting and Tools for Measurement, National Mineral Policies in Mineral Based Countries, Indian National Mineral Policy: Historical Development and Sustainable Practices, Lease Issues, Auctions, and their Impact on Sustainability.

UNIT – III

Sustainable Mining Technologies and Techniques :Overview of Clean Coal Technologies: Coal beneficiation, Coal Bed Methane, Underground Coal Gasification, Metal Recovery Techniques: Leaching of Old Dumps, Recycling of Metals, CO2 Sequestration - Reducing Emissions through Technology.

UNIT – IV

Best Practices and Innovations: Case Studies on Best Mining Practices for Sustainability, Innovative Techniques and Technologies in Sustainable Mining, Benefits of Sustainability for mineral development in India.

UNIT – V

Environmental and Social Initiatives for Sustainable Mining: Environmental Responsibility and Corporate Social Responsibility, District Mineral Fund: Collection, Utilization, and Impact, Integration of Artificial Intelligence in Mining Industries for Sustainable Practices

Text Books:

1. Advances in Productive, Safe, and Responsible Coal Published, Joseph Hirschi, Elsevier Ltd, 2019. ISBN: 9780128171057.
2. Capacity building in Geosciences and Sustainable Development, Mukherjee, Saumitra, Min. of Mines. ISBN: 978-8190191601.

Reference Books:

1. Annual Report of Ministry of Coal, Ministry of Mines, MoEF & Climate Change. National Seminar on Sustainable Development in Mineral & Earth Resources, New Delhi, The Indian Mining & Engineering Journal, Bhubaneswar & AKS University, Satna.

Web Links:

1. https://sdimi.org/wp-content/uploads/2021/11/SDIMI2003_milos_decl_org.pdf
2. <https://www.sciencedirect.com/science/article/abs/pii/S0969698914001143>

Drilling & Blasting

Course Code: 2501MN24

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Differentiate between types of drilling machines.
- CO2:** Identify and classify explosives
- CO3:** Analyze problems associated with open cast blasting and mitigation.
- CO4:** Analyze problems associated with underground blasting and mitigation.
- CO5:** Assess blasting in metal mines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Drilling: Drillability, mechanics of drilling, major types of drilling machines, Principles of drilling, Types of drill, Drill rods and drill bits -Types and applications, Exploratory and Production Drilling.

UNIT – II

Explosives and Blasting Accessories: Mechanism of blasting, Explosives- types and properties. Selection of explosives, Handling, and storage of explosives. Types of initiating systems – Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders. Blast Design in Surface and Underground Mines.

UNIT – III

Drilling and Blasting in Surface Mines: Factors affecting blasting, Blast design - estimation of burden and spacing, estimation of charge requirement; Initiation patterns; secondary blasting – pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure.

UNIT – IV

Drilling and Blasting in Underground Coal Mines: Blast hole patterns and their applicability, blasting-off-solid, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns.

UNIT – V

Drilling and Blasting in Underground Metal mines: Blast hole patterns and their applicability, blast design for horizontal drivage, long hole blasting, vertical crater retreat blasting.

Text Books:

1. Principle of rock drilling, B. Misra, U.M. Rao Karanam, Taylor & Francis, CRC Press. ISBN: 9781138033646.
2. Drilling & Blasting Minetech, Pradhan G.K., Ghose A.K., Bhubaneswar, India: Mintech. ISBN: 9789383183039.

Reference Books:

1. Elements of Mining Technology, DJ Deshmukh, Denett, First Edition, Vol. 1. ISBN: 978-81-89940-02-7.
2. Surface mining, GB Mishra, Dhanbad, Vol.1. ISBN: 978-0873351027.

Web Links:

1. <https://archive.nptel.ac.in/courses/123/105/123105003/>
2. <https://www.rpmdrilling.co.za/blast-hole-drilling-process/>
3. www.railsystem.net/drill-and-blast-method/

Safety Practices in Mines

Course Code: 2501MN25

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe about M.V.T.R training course.
- CO2:** Analyze safety operating procedures of mine machinery.
- CO3:** Analyze safe act and safe environment.
- CO4:** Use safety appliances
- CO5:** Apply safety audit 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	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-
CO5	2	3	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

Training Programmes: Basic training course, Refresher training course and Special training courses as per M.V.T.R. 1966

UNIT – II

S.O.P : Safe operating procedures for dumper, shovel, drills and dozers, Safe operating procedures at working face and dumps.

UNIT – III

Safe Act and Safe Environment: Unsafe act and unsafe environment, Accident analysis, Near-miss analysis, Heinrich and Pearson Triangle for mine accident.

UNIT – IV

Safety appliances: Safety appliances with respect to mine gasses and inundation, Rescue apparatus, Automatic fire suppression, fire extinguishers, and Protective equipment for miners.

UNIT – V

Safety Awareness: Safety audit methods, Safety record management and recent trends in development of safety engineering approaches. Safety Management Plan.

Text Books:

1. Safety at work, Ridley .J& C Channing, Butter worth, Oxford. ISBN: 978-0750654936.
2. Introduction of system safety engineering, Rodgers. W.P, John Wiley & Sons Inc, New York. ISBN: 0471720020.

Reference Books:

1. Introductory Mining Engineering, Howard L. Hartman, Jan M. Mutmanský. ISBN: 978-0471348511.
2. Safety in Mines Research, Green A. R, A. R. Balkena, Rotterdam. ISBN: 978-9061915075.
3. Mine vocational Training rules 1966.

Web Links:

1. <https://arlweb.msha.gov/Fatals/AccidentClassifications.asp>
2. https://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_Risk_Assessment/

Environmental Impact Assessment

Course Code: 2501MN26

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Analyze different stages in the EIA.
- CO2:** Analyze the participation of public and NGO'S in environmental decision making
- CO3:** Analyze the special methods and components of EIA.
- CO4:** Generate the awareness of assessment of impacts air, water, soil, noise biological, socio & cultural environments
- CO5:** Analyze the Case studies related to the Mining sectors.

Mapping of Course Outcomes with Program Outcomes:

CO/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	3	-
CO2	3	-
CO3	3	-
CO4	3	-
CO5	3	-

UNIT – I

Introduction: Environment and Forest Clearance-Legal and regulatory aspects. Environmental Impact Assessment (EIA) - Environmental Impact Statement, Environmental management plan. Contribution of greenhouse gasses from mining causing climate change.

UNIT – II

Components and Methods: Components of EIA - Processes - Screening - Scoping - Setting - Analysis - mitigation. Matrices – (Leopold matrix, Battle Environment Evaluation Systems (BEES)) Networks - Checklists - Connections and combination of processes - Cost benefit analysis - Analysis of alternatives - Software packages for EIA- Expert systems in EIA.

UNIT – III

Prediction, Assessment of Impacts and Reporting: Prediction tools for EIA - Mathematical modeling for impact prediction - Assessment of impacts - Air - Water - soil - noise - biological - socio - cultural environment .Mine closure planning-progressive and final mine closure planning, closure risk assessment.

UNIT – IV

Societal Impact Assessment: Cross sectorial issues and terms of reference in EIA - Participation of Public and Non - Governmental Organizations in environmental decision making. Rehabilitation and Resettlement of PAP. Socio-economic impact assessment.

UNIT – V

Case Studies: Case studies on EIA and EMP of Mining projects.

Text Books:

1. Environmental Impact Assessment - Practical solutions to recurrent problems, Lawrence D.P, Wiley –Inter science, New Jersey. ISBN: 978-0471290472.
2. Hand book of Environmental Impact Assessment, Petts, J. Blackwell Science London, Vol - I and II. ISBN: 978-0632042604. & 978-0632042611.

Reference Books:

1. Environmental Impact Assessment, R.R.Barthwal. ISBN: 978-0074622687.
2. Environmental Impact Assessment, N.S.Ramman. ISBN: 978-0632042602.

Web Links:

1. <https://www.cbd.int/impact/whatis.shtml>
2. https://www.sciencedaily.com/terms/environmental_impact_assessment.htm
3. <https://www.gdrc.org/sustdev/concepts/08-eia.html>
4. <https://www.journals.elsevier.com/environmental-impact-assessment-review>

Mine Health & Safety Engineering

Course Code: 2501MN27

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the different health hazards and its prevention in mining industries.
- CO2:** Distinguish the mine accidents occurring in surface and underground mining area.
- CO3:** Illustrate the various approaches towards safety risk assessment.
- CO4:** Discuss the safety planning and safety management systems
- CO5:** Analyze the innovations in mine safety engineering.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Occupational health hazards in mines: Pneumoconiosis, Gas Poisoning, Radiation, noise induced hearing loss (NIHL), Metal Toxicity, Prevention of health hazards in mines.

UNIT – II

Mine accidents: Classification, Genesis, Analysis & Prevention in Surface & Underground mines.

UNIT – III

Safety Risk Assessment: Hazard identification, analysis and evaluation, control. Qualitative & Quantitative approaches FTA, ETA, HAZOP, FMEA, WRAC etc., Formulation of safety management plan

UNIT – IV

Behaviors Based Safety & Safety Culture. Ergonomics & Mine Safety. OHS Structure for different mining companies.

UNIT – V

Safety audits, Innovations in Mine Safety Engineering. Case Studies.

Text Books:

1. Safety at work; Ridley .J& C Channing; Butter worth, Oxford. ISBN: 978-0408031014.
2. Introduction of system safety engineering, Rodgers. W.P, John Wiley & Sons Inc, New York. ISBN: 978-0471066077.

Reference Books:

1. Introductory Mining Engineering, Howard L. Hartman, Jan M. Mutmanský. ISBN: 978-0471297107.
2. Safety in Mines Research: Greem A. R, A. R. Balkena, Rotterdam. ISBN: 978-9061919680.

Web Links:

1. <https://arlweb.msha.gov/Fatals/AccidentClassifications.asp>
2. https://www.hsa.ie/eng/Topics/Managing_Health_and_Safety/Safety_Statement_and_Risk_Assessment/

Environmental Pollution & Control

Course Code: 2501MN28

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Illustrate the fundamentals of environmental issues in mining
- CO2:** Examine the various causes of water pollution.
- CO3:** Analyze the various causes of air pollution.
- CO4:** Analyze the methods for mine reclamation
- CO5:** Assess environmental impact due to mining.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Air Pollution: Atmospheric science; Sources of air pollution in mines; Effect of air pollution and preventive measures; Ozone layer and greenhouse effect; Dispersion model.

UNIT – II

Water Pollution: Sources of water pollution; Effect and preventive measures of water pollution; Ground water and its contamination; Water pollution modeling - biological oxygen demand and chemical oxygen demand; Acid mine drainage; Waste water treatment.

UNIT – III

Noise Pollution: Terminologies associated with noise; Sources and effects of noise; Measurement of noise; Noise standard and guidelines; Noise control strategies.

UNIT – IV

Land Reclamation and Rehabilitation: Causes of land degradation; Land reclamation method- Rehabilitation, Reclamation, Restoration; Factor affecting the land restoration; Land reclamation planning.

UNIT – V

Socio-Economic Impact Assessment: Socio-economic impact of mining, Quality of life index.

Text Books:

1. Environmental Pollution and Control, Peirce J. Jeffrey, Elsevier Science & Technology, Fourth Edition, 2018. ISBN: 978-0128125428.
2. Principle and practices of modern coal mining, R.D. Singh, New Age International. ISBN: 978-8122501646.

Reference Books:

1. Ground Control, Peng, S.S. Wiley Publications, New York. ISBN: 978-0471775410.
2. Open pit mine planning and Design, W. Hustrulid and M. Kuchta, A. A. Balkema Rotterdam, 1st edition, Vol – I. ISBN: 978-9056990736.
3. Surface Mining, G. B. Mishra, Lovely Prakashan Dhanbad, 1st edition. ISBN: 978-81-85500-42-6.

Web Links:

1. <https://miningandblasting.wordpress.com/2011/08/30/mine-planning-and-scheduling-smart-practice>
2. https://onlinecourses.nptel.ac.in/noc22_ce22/preview

Industrial Safety

Course Code: 2501MN29

L T P C
3 0 0 3

Course Outcomes:

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

CO1: Evaluate the effectiveness of different safety engineering methods in mitigating risks.

CO2: Analyze the impact of ergonomic practices on productivity and job satisfaction.

CO3: Describe Importance of Industrial safety.

CO4: apply regulatory standards and best practices related to the use of personal protective equipment.

CO5: Analyze the common characteristics and patterns associated with different types of accidents.

Mapping of Course Outcomes with Program Outcomes:

CO/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 industrial safety

Safety scenario in national and international arena, Overview of safety engineering principles, identification of safety issues in different industries and their remedial measures, general safety practices.

UNIT – II

Ergonomics

Ergonomics – Importance, Types of ergonomics – physical, cognitive, and organizational. Ergonomics Hazards – Musculoskeletal Disorders and Cumulative Trauma Disorders, ergonomics case studies. Whole Body Vibration, Hand Arm Vibration, Foot Transmitted Vibrations.

UNIT – III

Industrial Health and Hygiene

Occupational health hazard & classification of health hazards, Occupational health and hygiene surveillance, legislative measures and prevention of health hazards.

UNIT – IV

Personal Protective Equipment

Types of personal protective equipment and their usages- head protection, eye and face protection, respiratory and hearing protection.

UNIT – V

Accident Prevention Techniques

Types of accidents, causes of accidents- unsafe acts and conditions, human factors, mechanical failures, environmental factors. accident investigation and prevention.

Text Books:

1. The Factories Act with amendments, Govt. of India Publications, DGFASLI, Mumbai. ISBN: 978-9352471010.
2. Loss of prevention in Process Industries, Frank P Lees, Butterworth- Heinemann Ltd., Vol. 1 and 2. ISBN: 978-0750633016 & 978-0750633023.

Reference Books:

1. Accident Prevention Manual – NSC, Chicago. ISBN: 978-1118240295.
2. Occupational safety Manual BHEL, Trichy, ISBN: 978-81-73190163.
3. Safety Management, John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi. ISBN: 978-8173190162.

Web Links:

1. <https://environmentclearance.nic.in/writereaddata/online/RiskAssessment/070920177YH10QMZRiskAssessment.pdf>
2. <https://www.lightguidesys.com/resource-center/blog/what-is-ergonomics/#:~:text=There%20are%20three%20types%20of,physical%2C%20cognitive%2C%20and%20organizational.>
3. https://www.ccohs.ca/oshanswers/chemicals/whmis_ghs/hazard_classes.html
4. <https://www.anbusafety.com/mining-ppe-2/>

Waste Water Treatment & Recycling

Course Code: 2501MN30

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Analyze about Wastewater Generation.
- CO2:** Explain about the Sources and Types of Waste water
- CO3:** Analyze Waste water Characteristics.
- CO4:** Analyze Secondary Treatment Processes of waste water.
- CO5:** Assess Wastewater Treatment 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	2	-	1	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Introduction to wastewater, Wastewater Generation and Characteristics, Natural Attenuation of Pollutants in Wastewater, Treatment Philosophy, Objectives of wastewater treatment, Preliminary and Primary Treatment Processes, Secondary Treatment Processes, Secondary Treatment Processes-Anaerobic, Sludge Management, Tertiary (Advanced) Treatment Processes, Current Treatment Approaches, Wastewater Recycling: Scope and demands, Technology Selection and Decision Making. Acid Mine Drainage.

UNIT – II

Sources and Types of Wastewater Pollutants in Wastewater: Point and Non-point Sources, Wastewater Management: Concept of Treatment and Recycling, Issues and Challenges, Wastewater Generation and Quantity Estimation, Quantity Estimation of Sewage, Population Forecasting Methods, Quantity Estimation of Sewage Flow, Sewage Quantity Estimation: Practice Problems.

UNIT – III

Wastewater Characteristics: Quality Parameters, Practice Problems, Terrace - Introduction, Bench Terraces, Problems on Bench Terraces, Broad-base Terraces, Problems on Broad-base Terraces, Mass Balance: Application in Specific Cases, Mass Balance in Reactors: Application and Practice Problems.

UNIT – IV

Secondary Treatment Processes: Introduction to Biological Treatment of Waste water Biological Treatment of Wastewater: Microbial Growth and its Kinetics, Activated Sludge Process, Sludge Stabilization and Conditioning, Dewatering, Hibernization, Disposal/Reuse. Tertiary (Advanced) Treatment of Waste water: Nutrients Removal, Adsorption and Ion Exchange, Disinfection and Chemical Treatments.

UNIT – V

Wastewater Treatment Systems: Options and Conventional Approach, Alternate Wastewater Treatment Systems; Integrated Systems: Wetlands, SBR and SBBR, MBR and MBBR, Wastewater Reuse and Recycling: Challenges, Risks and Research Trends, Decision Making in Wastewater Reuse and Recycling, Wastewater Reuse and Recycling: Public Acceptance for Recycled Water Use, Global Practices and Case Studies

Text Books:

1. Wastewater Engineering, Metcalf and Eddy, McGraw-Hill. ISBN: 978-0073401188.
2. Environmental Engineering, Peavy, Rowe and Tchobanoglous, McGraw-Hill. ISBN: 978-0071002556.

Reference Books:

1. Water Quality Engineering: Physical / Chemical Treatment Processes, Lawler and Benjamin, John Wiley & Sons. ISBN: 978-0470177922.
2. Unit Operations and Processes in Environmental Engineering, Reynolds and Richards, CL Engineering. ISBN: 978-0133049605.

Web Links:

1. <https://water.unl.edu/article/wastewater/wastewater-what-it>
2. https://afrosai-e.org.za/wp-content/uploads/2021/05/PA-Report-Management-of-Wastewater-Treatment_Botswana.2020.pdf

Environment & Safety

Course Code: 2501MN31

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1** Assess the scope of environmental and safety issues in mining
- CO2** Describe the principles and procedures involved in conducting an EIA
- CO3** Apply effective waste management techniques in mining
- CO4** Identify occupational health hazards in mining and implement prevention strategies
- CO5** Apply the principles and practices of sustainable mining

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Environmental and Safety Issues in Mining: Overview of environmental and safety challenges in mining, Historical context and evolution of mining practices, Key regulations and standards in mining safety and environmental protection.

UNIT – II

Environmental Impact Assessment (EIA) and Monitoring: Principles and procedures of Environmental Impact Assessment (EIA), Baseline studies and environmental monitoring, Mitigation measures and best practices.

UNIT – III

Waste Management and Pollution Control in Mining: Types of waste generated by mining activities, Waste management techniques (tailings, waste rock, slag), Pollution control measures (air, water, soil).

UNIT – IV

Health and Safety in Mining Operations: Occupational health hazards in mining, Safety management systems and risk assessment, Emergency response and disaster management.

UNIT – V

Sustainable Mining Practices and Future Trends: Principles of sustainable mining, Rehabilitation and reclamation of mine sites, Emerging technologies and future trends in mining safety and environmental protection.

Text Books:

1. Mine Health and Safety Management. Karmi's, M. SME. ISBN: 978-0873353861.
2. Introduction to Mine Health and Safety Management. McAree, P. R, University of Queensland. ISBN: 978-0- 87335-200-0.

Reference Books:

1. Mineral Processing Technology: An Introduction to the Practical Aspects of Ore Treatment and Mineral Recovery. Wills, B. A., & Finch, J, Wills' Butterworth-Heinemann. ISBN: 978-0080970530.
2. Mining Waste Management and Environmental Sustainability. Awasthi, A., CRC Press. ISBN: 9780367331166.

Web Links:

1. <https://www.icmm.com/en-gb/our-principles>
2. <https://www.sgu.se/en/itp308/knowledge-platform/4-mining-waste/>

Planning for Mine Closure & Reclamation

Course Code: 2501MN32

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe about strategies for mine reclamation and closure planning.
- CO2:** Analyze challenges of mine closure
- CO3:** Analyze Socio- economic Aspects of Mine closure
- CO4:** Analyze financial provisions
- CO5:** Assess best practices in mine closure planning.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Principles and strategies for mine reclamation and closure planning. Land Reclamation: Issues of land degradation due to mining activities, environmental factors affecting revegetation in the mine site.

UNIT – II

Challenges of mine closure: Societal and environmental Issues in implementation of mine closure and reclamation planning. EIA and EMP, Environmental laws and standards, Preparation of EMP for various mineral industries.

UNIT – III

Socio-economic aspects: Systems approach for mine closure & reclamation, development of closure plan, Socio- economic Aspects of Mine closure and reclamation.

UNIT – IV

Financial provisions: Mine closure and reclamation risk assessment, financial provisions for reclamation and closure in India, District mineral fund, Introduction to the Functioning of Escrow Account.

UNIT – V

Case Studies: Technological and biological reclamation of waste dumps, best practices in mine closure planning. Technologies to monitor reclamation and closure activities.

Text Books:

1. Handbook of Environmental Management and Technology, G. Burke, B. R. Singh and L. Theodore, Wiley-Interscience, 2nd edition. ISBN: 978-0471656782.
2. Mine Waste Management, P. G. Hutchison, and R. D. Ellison, CRC Press, 1st edition. ISBN: 978-0367336438.

Reference Books:

1. Environmental Engineering, McGraw- H. S. Peavy, D. R. Rowe and G. Tshibangu's, Hill Publishing Co; 7th Rev Ed edition. ISBN: 978-0073401182.
2. Mining Environment Management Manual, N. C Saxena, Scientific Publishers (India). ISBN: 9788172333669.
3. Environmental Management: Principles and Practice (Routledge Environmental Management Series), C. J. Barrow, Routledge, 1st edition. ISBN: 978-0415185227.

Web Links:

1. <https://miningandblasting.wordpress.com/2011/10/01/challenges-in-mine-planning-and-scheduling>
2. <https://fipr.floridapoly.edu/about-us/phosphate-primer/reclamation-strategies-and-stages.php>

Safety Engineering

Course Code: 2501MN33

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Describe classification of accidents
- CO2:** Explain methods for analyzing accidents
- CO3:** Describe Risk Assessment and Safety Management
- CO4:** Apply Human Factors and Behavioural Aspects in Safety
- CO5:** Analyze Crisis Management and Economic Aspects of Safety

Mapping of Course Outcomes with Program Outcomes:

CO/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	-	-	1	-	-	-	-	-	-	-
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	2	-

UNIT – I

Overview of safety engineering principles, Classification of Accidents, Examples and case studies, Causes of Accidents-Human factors, Mechanical failures, Environmental factors.

UNIT – II

Accident Prevention and Analysis-Causes & Prevention of Various Types of Accidents, identifying root causes, Prevention strategies and best practices, Accident Analysis and Control- Methods for analyzing accidents, Control measures to mitigate accidents, Accidental Enquiry, Significance of accident investigations, Steps to prepare an accident enquiry report.

UNIT – III

Risk Assessment and Safety Management- Risk Assessment, Techniques for assessing risk, Risk management processes, Safety Management and Organization, Organizational roles in safety management, Techniques Used in Safety Analysis, Tools and methodologies for safety analysis, Application of safety techniques in various industries.

UNIT – IV

Human Factors and Behavioural Aspects in Safety, Aspects of Human Behavior in Accidents, Psychological and social factors, Human Behavioural Approach in Safety, Training and development for safety awareness, Behavioural safety programs, Workers Participation for Promotion of Safety, Importance of worker involvement, Strategies to enhance participation.

UNIT – V

Crisis Management and Economic Aspects of Safety- Crisis Management and Its Role in Safety Planning for crisis scenarios, Role of crisis management in ensuring safety. Accidents Costs- Direct and indirect costs of accidents, Economic impact analysis, Concepts of ZAP & MAP Implementation and benefits.

Text Books:

- 1 Legislation in Indian mines- A critical appraisal , Rakesh & Prasad, Ashalatha. ISBN: 978-81-908799-0-0.
- 2 Safety at Work; Ridley, J & Channing, J. Butterworth-Heinemann, Oxford. ISBN: 978-0750622826.

Reference Books:

- 1 Introduction to System Safety Engineering, Rodgers, W.P. John Wiley & Sons Inc. ISBN: 978-0471025790.
- 2 Safety in Mines Research; Green, A.R.; A.A. Balkena; Rotterdam. ISBN: 0-415-06943-7.

Web Links:

- 1 [https://www.dgms.gov.in/writereaddata/Content/User%20\(External\)%20Manual%20of%20Accident%20Module%20\(1\).pdf](https://www.dgms.gov.in/writereaddata/Content/User%20(External)%20Manual%20of%20Accident%20Module%20(1).pdf)
- 2 <https://www.zehntech.com/7-benefits-of-using-zap-tool-for-security-testing/>
- 3 <https://www.hse-network.com/behavioural-safety-approaches-to-hse-management/#:~:text=The%20definition%20of%20behavioural%20safety,the%20cause%20of%20the%20incident.>

Minor Stream: Innovative Mining

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MN34	Planning for Mining Projects	FC	3			3	50	50	100	DMD
2501MN35	Geo-Statistics	IC	3			3	50	50	100	DMD
2501MN36	Mineral Economics	IC	3			3	50	50	100	DMD
2501MN37	Advanced Exploration Techniques	IC	3			3	50	50	100	DMD
2501MN38	Advanced Surveying Technology	IC	3			3	50	50	100	MS
2501MN39	Geo Spatial Imaging & Geo-informatics	IC	3			3	50	50	100	-
2501MN40	Remote Sensing Applications in Mining	IC	3			3	50	50	100	-
2501MN41	Green Mining	IC	3			3	50	50	100	-
2501MN42	Utilisation of Alternative Sources of Energy	IC	3			3	50	50	100	-
2501MN43	Deep Sea Mining	AC	3			3	50	50	100	DMD
2501MN44	Space Mining Technology	AC	2			2	50	50	100	-
Total			32			32				

Planning for Mining Projects

Course Code: 2501MN34

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Prepare feasibility report
- CO2:** Design open pit slope angels & ultimate pit limit
- CO3:** Select transport and dumping systems.
- CO4:** Examine stability analysis.
- CO5:** Explain transition of underground to opencast mines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Preliminary Investigations: Stages of planning, Unit operations, Techno economic feasibility studies.

UNIT – II

Production planning and scheduling, Estimation of mine life, Ultimate pit limit, Equipment selection, Development & extraction phases in surface mining.

UNIT – III

Transport and Material Handling , Design of haul roads, Transport and dumping systems, Ore blending.

UNIT – IV

Design of slopes, Design of rock slope and waste dump- factors affecting slopes, types of slope failure, slope stability analysis.

UNIT – V

Other Mining Technique, Beach sand and placer mining, Transition of underground to opencast mines and vice versa.

Text Books:

1. Opencast Mining, R. T. Desmukh, Lovely prakashan Dhanbad, 1st edition. ISI 9788189904333.
2. Open Cast Mining Unit Operations, Rzhovsky, V.V., Mir publishers. ISI 9788189904212.

Reference Books:

1. Ground Control, Peng, S.S. Wiley Publications, New York. ISBN: 978-0471389303
2. Open pit mine planning and Design, W. Hustrulid and M. Kuchta A. A. Balke Rotterdam, 1st edition, , Vol – I. ISBN: 978-0415374104.
3. Surface Mining, G. B. Mishra, Lovely Prakashan Dhanbad, 1st edition. ISBN: 978-85881-79-6.

Web Links:

1. <https://www.scribd.com/document/335051910/Mine-Planning-and-Scheduling-Sma>
Practices-Mining-and-Blasting
2. <https://www.911metallurgist.com/ultimate-pit-limit/>
3. <https://www.cdc.gov/niosh/mining/userfiles/works/pdfs/ic8758.pdf>

Geo-Statistics

Course Code: 2501MN35

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Interpret key statistical measures
- CO2:** Apply various probability distribution functions
- CO3:** Solve problems involving advanced probability theories
- CO4:** Apply appropriate sampling methods
- CO5:** Apply various reserve estimation techniques in both vertical and horizontal sections

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Statistics: Arithmetic mean; Median; Mode; Standard deviation; Mean deviation or the average deviation; coefficient of variance; coefficient of correlation; Rank correlation.

UNIT – II

Introduction to Probability: Probability distribution function; Normal distribution function; Poisson distribution function; Exponential distribution; Expectation of a variance.

UNIT – III

Theories of Probability: Additional theory of probability; Theorem of total probability for compound events; Bay's theorem; Mean square error.

UNIT – IV

Sampling: Type of sampling, Methods of sampling- grab sampling, channel sampling, chip sampling, face sampling, bulk sampling, drill hole sampling, Error in sampling.

UNIT – V

Reserve Estimation Techniques: Determination of average grade of ore in a vertical section, Determination of average grade of ore in a horizontal section- Triangular method, Determination of average grade of ore in a horizontal section- Polygonal method.

Text Books:

1. Introduction to the Practice of Statistics, David S. Moore, George P. McCabe, Bruce A. Craig, W.H. Freeman & Company, 9th Edition, 2020, ISBN: 978-1319013387.
2. Introduction to Probability, Joseph K. Blitzstein and Jessica Hwang, CRC Press, 2nd Edition, 2019, ISBN: 978-1138369915.

Reference Books:

1. Principles of Sampling and Analysis, J. Chrismer, Springer, 1st Edition, 2023, ISBN: 978-3030543487.
2. Reserve Estimation Techniques for Mining, A.K. Gorai, CRC Press, 1st Edition, 2021, ISBN: 9780367331834.

Web Links:

1. <https://www.investopedia.com/terms/c/correlationcoefficient.asp>
2. <https://dspmuranchi.ac.in/pdf/Blog/SAMPLING%20METHODS-%20ROCK,%20SOIL,%20SEDIMENT,%20VEGETATION,%20VAPOUR.pdf>

Mineral Economics

Course Code: 2501MN36

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe importance of strategic minerals.
- CO2:** Classify grading and pricing of minerals.
- CO3:** Estimate total reserve of minerals.
- CO4:** Estimate Internal Rate of Return and Net Present Value
- CO5:** Assess organizational and financial project management.

Mapping of Course Outcomes with Program Outcomes:

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

General Economic importance of the mineral industry; Risky nature of the mining industry; Demand and Supply analysis, National mineral policy; Mineral price and pricing International monetary system, Factors affecting mineral price, kinds of price quotation, Mineral price index, Mineral prices.

UNIT – II

Mineral Resource/Reserve Concept, classification and estimation of reserves. Applications of Geostatistics. Mineral inventory concept, characteristic features, composition and economic significance; Estimation of life index. Demand analysis and Market survey Meaning and law of demand; methodology of demand analysis, Market survey

UNIT – III

Conservation of mineral resources – Means of conservation and limitations in the scope of Conservation. Sampling Definition, purpose and scope, Preparation of samples, methods and computations; Application of statistical methods in sampling Loss of mineral in mining - Classification and incorporation of losses, co-efficient of completeness of mineral extraction, Dilution and recovery.

UNIT – IV

Mine valuation Basic concept, Earlier approaches to mine valuation, recent approaches to evaluation Investment appraisal Elements of investment appraisal, Static methods of investment appraisal, Dynamic methods of appraisal, discounted cash flow analysis Mining costs Capital and operating costs; Factors affecting operating cost; Methods of estimating future costs; Standard cost and forecast; Budget and budgetary control.

UNIT – V

Mine finance Capital generation for mining companies Mineral taxation system Theory of taxation on minerals, Mineral tax designing, Types of mineral taxes, Taxes affecting mineral sector, Internal and external trade Taxes and duties; Imports and exports; International investment and trade in mineral materials & products.

Text Books:

1. minerals deposit evaluation: A practical approach, Alwyn E. Annels. ISBN: 978-0750626124.
2. Mine and mineral economics, Deshmukh R.T, Emdee publishers. ISBN: 978-8177431220.

Reference Books:

1. Industrial engineering and management, O.P.Khanna, Dhanpat Rai, Delhi. ISBN: 978-81-7079-078-0.
2. courses in mining geology, R.N.P. Arogyaswami, Oxford and IBH. 2nd Edition. ISBN: 978-8120408815.

Web Links:

1. <https://redstagfulfillment.com/what-is-demand-forecasting/>
2. <https://corporatefinanceinstitute.com/resources/valuation/discounted-cash-flow-dcf/>
3. <https://www.fedmin.com/fedmin/taxation.pdf>

Advanced Exploration Techniques

Course Code: 2501MN37

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Apply knowledge on various geophysical and geochemical prospecting techniques
- CO2:** Choose the proper techniques of exploration and estimation of the reserves.
- CO3:** Apply knowledge of different mineral processing techniques.
- CO4:** Analyze the methods of preparation of feasibility reports and its evaluation techniques.
- CO5:** Study the prefeasibility and feasibility reports and its evaluation 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	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-
CO5	2	3	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

Exploration Geochemistry, Field Procedure, Analytical Methods, Mineral Exploration - Triangulation, Establishment of Local Base from National Grid Base- - Exploration Strategy, Groups and their role, Strategy and structure of the exploration group, government policies Exploration investment decision, exploration targets.

UNIT – II

Electrical Methods: Scope of exploration geophysics – physical properties of the earth – Electrical methods – SP, IP, EM and Resistivity - methods of electrode arrangement – field methods resistivity, self-potential methods- interpretation -application in mineral prospecting – groundwater targeting, electrical logging methods in oil exploration.

UNIT – III

Magnetic and Gravity Methods — types of magnetometer-field survey – anomaly - interpretation and prospecting. Magnetic methods – principle - field procedure – magnetometers – interpretation of magnetic data – size and shape of bodies – correction of magnetic data - applications - airborne geophysical surveys.

UNIT – IV

Practice of semi-variogram modelling; practice of kriging - steps and procedure. Ordinary Kriging: definition, point/block estimation procedures, techniques of semi-variogram model fitting; Geo-statistical evaluation scheme; Effect of Nugget variance on kriged weights.

UNIT – V

Integrating Surface/ Underground mapping Drilling Sampling to evolve a 3D Model - Fold/Fault Interpretation from Maps and Bore hole Data - GIS Applications in mining and Mineral Projects. Evaluation of exploration and development projects, study of typical pre-feasibility and feasibility reports.

Text Books:

1. Aspects of Ore Treatment and Mineral Recovery, Butterworth-Heinemann, 8th Edition. ISBN: 978-0750625396.
2. Prospecting manual, Chaussier, J.B., and Mores, J Mineral North Oxford Academic press. ISBN: 978-0195041440.

Reference Books:

1. Geochemistry, Arthur Brownlow, Pearson Education, INC., Australia. ISBN: 978-0131495105.
2. Principles and applications of Geochemistry, Faure, G, Pearson Education, INC. ISBN: 978-0130142715.
3. Essentials of Geochemistry, John V. Walther, Jones and Bartlett Publishers, Boston. ISBN: 978-0763753146.

Web Links:

1. <https://www.sciencedirect.com/science/article/abs/pii/S0016714268900136>
2. <https://www.esri.com/en-us/industries/mining/overview>

Advanced Surveying Technology

Course Code: 2501MN38

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Analyze the base line measurement and triangulation work.
- CO2:** Determine different types of hydro graphic surveying.
- CO3:** Explain the basic principles of photogrammetric surveying.
- CO4:** Analyze the correction in astronomical observations.
- CO5:** Apply modern instruments of surveying total station and GPS

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Geodetic Surveying: Definition, importance, triangulation system, order of triangulation, size and shape of triangulation, strength of figure criterion, triangulation fieldwork, base line measurement- tape corrections, problems in baseline measurement, measurement of angles.

UNIT – II

Hydrographic Surveying: Tides-lunar tides, solar tides, spring and neap tides, measurement of tides- shore lines, soundings, sounding equipment's, depth surveys, river and marine surveys.

UNIT – III

Photogrammetric Surveying: Basic principles, -photo theodolite, horizontal and vertical angles from terrestrial photographs, elevation of a point by photographic measurement, determination of focal length of the lens, applications of surveying.

UNIT – IV

Astronomical Surveying: Spherical Trigonometry, latitude and longitude, solar system, astronomical teams, coordinate systems-altitude, azimuth system, declination, hour angle system, time and astronomical work-sidereal time, apparent solar time, mean solar time, standard time, standard time, application of astronomy in surveying, corrections to astronomical observations.

UNIT – V

Total stations: Importance, measurement of horizontal angles, vertical angles, horizontal distance, slope distance, height of object-remote elevation measurement (REM).

Global Positioning System: Principles of GPS, components of GPS, types of GPS, applications of GPS, sources of error GPS and limitations.

Text Books:

1. Surveying and Levelling, R. Subramanian, Oxford University Press, New Delhi. ISBN: 978-0198080422.
2. A text book of Surveying, C. Venkatramaiah, University Press, New Delhi. ISBN: 978-8173712777.

Reference Books:

1. Remote Sensing and its Applications, L A R Narayan, Universities Press, New Delhi. ISBN: 978-8173714184.
2. Geographical Information Science, Narayan Panigrahi, Universities Press, New Delhi. ISBN: 978-8173716583.

Web Links:

1. <https://www.rasasurvey.com/advanced-technologies/>
2. <https://appliedtechnology.santarosa.edu/surveying-technology>
3. <https://www.alifewithoutlimits.com.au/about-surveying/technology/>

Geo Spatial Imaging & Geo- Informatics

Course Code: 2501MN39

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe importance of remote sensing
- CO2:** Outline different remote sensing techniques
- CO3:** Describe importance of GIS
- CO4:** Analyze GIS functions
- CO5:** Assess applications of RS & GIS

Mapping of Course Outcomes with Program Outcomes:

CO/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	1	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Remote Sensing: Introduction to Remote Sensing: History, Energy Sources, Sensor Systems, land sat, spot, IRS etc. Satellites, Applications of Remote Sensing: Topographic Mapping, Resource Mapping, Environmental Monitoring, Real Property Boundary Determination. Active and Passive sources.

UNIT – II

Remote Sensing Techniques and Digital Image Processing: Sensors and Platforms in Remote Sensing, Digital Image Processing Techniques Introduction to Digital Elevation Modelling (DEM).

UNIT – III

Geographic Information Systems (GIS) Basics: Introduction to GIS: Overview, Components, and Applications, Data Structures in Thematic Maps: Raster vs Vector Data Models, Database Management for GIS and Data Input/Output.

UNIT – IV

Advanced GIS Analysis Functions: Overview of GIS Analysis Functions: Organization, Classification, and Maintenance of Spatial Data, Integrated Analysis of Spatial and Non-spatial Data.

UNIT – V

Applications and Implementation of GIS: Environmental Resource Mapping and Land Development Applications, Applications of GIS in Surface Mining, Road Construction, and Land Development, Hands on Exercise on Image Processing and GIS Packages.

Text Books:

1. Remote sensing and its applications, LRA Narayana, University press. ISBN: 978-8173717068.
2. Principles of Geophysical information systems, Peter A Burragh and Racheal A. MC Donnell, Oxford publishers. ISBN: 978-0198556508.

Reference Books:

1. Concepts and techniques of GIS, C. P. Lo Albert, K. W Yonng, Prentice Hall (India) publication. ISBN: 978-0131496517.
2. Remote sensing and Geographical information systems, M. Anji Reddy, JNTU Hyderabad, B.S Publications. ISBN: 978-81-7436-533-6.
3. Introductory Digital Image Processing, John, R. Jensen, Prentice Hall, New Jersey, 3rd edition. ISBN: 978-0134058404.

Web Links:

1. <https://www.esri.com/en-us/what-is-gis/overview>
2. <https://www.esri.com/content/dam/esrisites/en-us/media/pdf/teach-with-gis/raster-faster.pdf>
3. <https://www.polosoftech.com/industries/gis-mining/>

Remote Sensing Applications in Mining

Course Code: 2501MN40

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the principles of remote sensing
- CO2:** Explain the data acquisition process for remote sensing in mining
- CO3:** Apply image classification techniques to remote sensing data
- CO4:** Implement change detection techniques to analyze temporal data
- CO5:** Explain future trends and identify emerging technologies in remote sensing

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Remote Sensing in Mining: Overview of remote sensing technologies, Historical development and evolution of remote sensing in mining, Types of remote sensing data (optical, radar, LiDAR, thermal, hyperspectral).

UNIT – II

Data Acquisition and Processing: Satellite and airborne remote sensing platforms, Sensors and their characteristics, Data acquisition techniques, Preprocessing techniques (radiometric, geometric, and atmospheric corrections).

UNIT – III

Remote Sensing Techniques for Mineral Exploration: Spectral signatures of minerals, Hyperspectral remote sensing in mineral exploration, Image classification techniques (supervised and unsupervised), Case studies of mineral exploration using remote sensing.

UNIT – IV

Monitoring and Environmental Impact Assessment: Monitoring mining activities using remote sensing, assessing environmental impacts (deforestation, land degradation, water pollution), Change detection techniques, Legal and regulatory frameworks.

UNIT – V

Advanced Applications and Future Trends: Integrating remote sensing with GIS for mining applications, Advances in sensor technology, Future trends and emerging technologies.

Text Books:

1. Remote Sensing of the Environment: An Earth Resource Perspective, Jensen, J. R.. Pearson. ISBN: 978-0134550229.
2. Remote Sensing Handbook. Thenkabail, P. S. CRC Press. ISBN: 9780367337853.

Reference Books:

1. Remote Sensing for Environmental Monitoring, GIS Applications, and Geology. Zorn, M, MDPI. ISBN: 978-3-0365-5475-2.
2. Geographic Information Systems and Science. Li, D, Wiley. ISBN: 978-0470016783.

Web Links:

1. https://www.jstage.jst.go.jp/article/jmps/99/3/99_3_83/_pdf/-char/en
2. <https://egyankosh.ac.in/bitstream/123456789/39531/1/Unit-3.pdf>

Green Mining

Course Code: 2501MN41

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the importance of green mining.
- CO2:** Plan and scheduling of activities related to mine waste management.
- CO3:** Analyze the impact of water pollution due to mining.
- CO4:** Distinguish progressive and final mine closure planning
- CO5:** Explain the usage of renewable energy in mines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Footprint Reduction: Importance of green mining, Sustainable project management, Corporate social responsibility for industrial sustainability, Environment Friendly Mining Equipment's, Clean development mechanism (CDM), CCUS technology, Application of Bio Fuels.

UNIT – II

Mine Waste Management: Types of mine waste Overburden, Tailings and other wastes. Tailings dams – types, construction and design, Characterization, disposal, management of different types of mining waste.

UNIT – III

Mine Water: Sources of pollution, Effect of mining on water bodies, Treatment of mine water, Water conservation initiatives in mines, zero waste water discharge.

UNIT – IV

Mine Closure Planning: Progressive and final mine closure planning, structure of mine closure report, Legislative provisions on mine closure planning.

UNIT – V

Renewable Energy: Usage of renewable energy in mines- Solar and Wind Energy; Application and limitation.

Text Books:

1. Green Mining: The Way Forward, Anil Jha, Das Gupta Co Pvt Ltd Publication, 2019. ISBN: 978-8194161424.
2. Sustainable Mining Practices, A.K. Gorai and D. Nimaje, Narosa Publishing House. ISBN: 9788184876048.

Reference Books:

1. Mining and Environmental Sustainability, G. S. Roonwal, ASTRAL Publication. ISBN: 9789351247591.
2. Advances in Productive, Safe, and Responsible Coal Mining, Joseph Hirschi, Elsevier Ltd, 2019. ISBN: 9780128156263.

Web Links:

1. <https://www.mdpi.com/books/pdfview/book/3216>
2. <https://web.mit.edu/12.000/www/m2016/finalwebsite/solutions/greenmining.html>
3. <https://www.sciencedirect.com/science/article/pii/S187661021200077X>
4. Oxford scientists show how green mining could pave the way to net zero and provide the metals we need for a sustainable future | University of Oxford
5. Green Mining (mdpi.com)

Utilisation of Alternative Sources of Energy

Course Code: 2501MN42

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Solar Radiation and its measurement:

Solar angles, Sun path diagrams, Radiation, extraterrestrial characteristics, Measurement of solar radiation, Solar energy measuring instruments, Pyranometer, Pyrliometer, 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, evacuated tubular collectors, concentrator collectors, classification, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus, Heliostats.

UNIT – III

Solar Thermal Technologies:

Principle of working, types, design, and operation of, Solar heating and cooling systems, Thermal Energy storage systems, Solar Desalination, Solar cooker: domestic, community, 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.

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.

Text Books:

1. Solar Energy, Sukhatme S P, Nayak J K Tata Mc Graw Hill, 4th Edition. ISBN: 978-0074624771.
2. Solar Energy, Fundamentals Design, Modelling and Applications, Tiwari G. N, Narosa, New Delhi, 5th Edition. ISBN: 978-81-8487-806-7.

Reference Books:

1. Principles of Solar Engineering, D. Yogi Goswami, CRC Press, Taylor and Francis group, New York, 3rd Edition. ISBN: 978-0367330406.
2. Solar Engineering of Thermal Process, Duffie. J.A and Beckman. W.A, Wiley, Canada, 4th Edition. ISBN: 978-1118976017.
3. Solar Energy: Fundamental and Application, Garg H P, Prakash S, Tata Mc Grow Hill, 1st edition. ISBN: 978-0074624708.

Web Links:

1. <https://nptel.ac.in/courses/112105051>
2. <https://nptel.ac.in/content/storage2/courses/112105050/m111.pdf>

Deep Sea Mining

Course Code: 2501MN43

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain about marine environment profile of sea.
- CO2:** Analyse profile of sea.
- CO3:** Examine marine sediments and continental slope.
- CO4:** Choose methods of off shore exploration of oil and gas.
- CO5:** Explain deep sea bed mining.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Introduction to Marine environment, Characteristics of the ocean floor, Environmental impact of ocean mining.

UNIT – II

Profile of the sea: Shelf, slope and rise, nature of the deposits.

UNIT – III

Marine Deposit: Mineralogical studies of marine sediments and continental slope, Continental shelf and deep sea bed mineral resources, Exploration systems of dissolved and un dissolved mineral deposits; Poly metallic manganese nodules.

UNIT – IV

Offshore exploration: Offshore exploration of oil and gas and subsea systems

UNIT – V

Legal Issue of Deep Sea Mining: Legal Aspects of Ocean Floor Mining Deep sea bed Mining, Economic & Technologies, Law of the sea bed authority, legal considerations in ocean mining.

Text Books:

1. Introductory Mining Engineering, Hartman H.L, Willey Eastern. ISBN: 978-0471812205.
2. Issues of Marine Mining, Metals fom sea bed, Manjula R.Shyam. ISBN: 978-8193299838.

Reference Books:

1. Deep-Sea Mining: Resource Potential, Technical and Environmental Considerations, Rahul Sharma, Springer International Publishing. ISBN: 978-3-030-28831-0.
2. Environmental Issues of Deep-Sea Mining Impacts, Consequences and Policy Perspectives by Rahul Sharma, Springer International Publishing, 2019. ISBN: 978-3-030-22386-4.
3. Deep Sea Mining and the Law of the Sea, Alexandra, Springer, Netherlands. ISBN: 978-94-017-8556-0.

Web Links:

1. <https://education.nationalgeographic.org/resource/marine-ecosystems/>
2. <https://www.noaa.gov/education/resource-collections/ocean-coasts/ocean-floor-features>

Space Mining Technology

Course Code: 2501MN44

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Describe about Space mining operations.
- CO2:** Analyze the challenges of Moon mining
- CO3:** Illustrate about Space Mining Excavation
- CO4:** Analyze the Economic and legal considerations in space mining
- CO5:** Explain the Environmental impacts of space mining

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

Overview of Space mining operations, Space environment, Importance of space mining, unit operations-excavation and logistics support.

UNIT – II

Moon mining:

Types of minable minerals, technologies for moon mining, Asteroid selection and Types: Types of minable minerals, technological scope for asteroid mining.

UNIT – III

Space Mining Excavation:

Space shuttles and Technology, Different excavation techniques, Surface Mining, Shaft Mining, Magnetic rakes, Heating, Mond process, Self-replicating Machine.

UNIT – IV

Economic and legal considerations in space mining:

Economics for the space mining process, Scarcity of the minerals and financial feasibility of the space mining. Regulation and Safety related to space mining.

UNIT – V

Impacts of space mining: Challenges and Opportunities, case studies.

Text Books:

1. Mining the Sky: Untold Riches from the Asteroids, Comets, And Planets, John Lewis. ISBN: 978-0201309602.
2. Mankind Beyond Earth: The History, Science, and Future of Human Space Exploration, Claude A. Piantadosi, Columbia University Press. ISBN: 978-0231181196.

Reference Books:

1. The Technical and Economic Feasibility of Mining the Near-Earth Asteroids, M. J. Sonter. ISBN: 978-0849318681.
2. The Future of Space Mining, Michael Booth. ISBN: 978-0992811920.

Web Links:

1. <https://www.qil-qdi.org/regulation-space-resource-rights-meeting-needs-states-private-parties/>
2. http://www.absoluteastronomy.com/topics/Asteroid_belt.

UNIVERSITY ELECTIVE COURSES

Branch	Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Offered to	Pre-requisite
CE	2501CE66	Natural Disaster Management & Mitigation		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE81	Wastewater Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE82	Integrated Solid Waste Management for a Smart City		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE83	Watershed Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE53	Electric Power Generation, Transmission & Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME36	Sustainable Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ECE	2501EC97	Biomedical Electronics	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	

ECE	2501EC98	Fundamentals of Wireless Communications	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA3	Introduction to Quantum Computing	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/2601DS02	Data Structures* / Data Structures using C++#	FC	2		2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2		2	4	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS
IT	2501CS07	Computer Networks	AC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2		1	3	50	50	CE, EEE, ECE, PT, Min.E	-
AI&ML	2501AI05	Machine Learning	AC	2		2	4	50	50	CE, ECE, PT, Min.E	DAUP
DS	2501CS34	Fundamental of Data Science	FC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS

Natural Disaster Management & Mitigation

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

Course Code: 2501CE66

L	T	P	C
3	0	0	3

Course Outcomes:

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

CO1: Explain the aspects of disaster management and adopt remedial measures.

CO2: Explain disaster risk assessment and coping measures.

CO3: Explain the vulnerability conditions.

CO4: Assess the impact of hazards on structures.

CO5: Adopt the rehabilitation procedures.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction Concept of Disaster Management. Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels.

UNIT – II

Overview of Disaster Situations:

Overview of Disaster Situations in India Vulnerability of profile of India and Vulnerability mapping including disaster – prone areas, communities, places. Disaster preparedness – ways and means; skills and strategies; rescue, relief reconstruction. Case Studies: Lessons and Experiences from Various Important Disasters in India and Biological disasters – SARS-spread and transmissions -pandemic, endemic and epidemic.

UNIT – III

Flood:

Flood and Drought Disaster Raising flood damage, assessing flood risk, flood hazard assessment, flood impact assessment, flood risk reduction options. Drought and development, relief management and prevention, drought mitigation and management-integrating technology and people.

UNIT – IV

Overview of Disaster Situations:

Landslide and Earthquake Disaster Land slide hazards zonation mapping and geo environmental problems associated with the occurrence of landslides. The use of electrical resistivity method in the study of landslide. Causes and effects of earthquakes. Secondary effects. Criteria for earthquake resistant design.

UNIT – V

Cyclone and Fire Disaster:

Cyclone and Fire Disaster Cyclone occurrence and hazards. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Types of fire. Fire safety and firefighting method, fire detectors, fire extinguishers. Rehabilitation: Rehabilitation programmes, Management of Relief Camp.

Text Books

1. Disaster Management, RB Singh (Ed), Rawat Publications. (ISBN: 13-978-8131600337).
2. Disaster Management Future Challenges and Opportunities, Jagbir Singh, I.K International publishing house. (ISBN: 13-978-8189866464).

Reference Books:

1. Natural Hazards in the Urban habitat by Iyengar, CBRI, Tata McGraw Hill. (ISBN:13-9780074631881).
2. Natural Disaster management, Jon Ingleton (Ed), Tulor Rose. (ISBN:13-978-0953614011).
3. Anthropology of Disaster management, Sachindra Narayan, Gyan Publishing house. (ISBN: 13-978-8121206839).

Web Links:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/dm%20notes.pdf

Waste Water Management

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

Course Code: 2501CE81

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the importance of sanitation and wastewater management.
- CO2:** Explain the various methods of sewage flow estimation and pumping systems.
- CO3:** Identify the various characteristics of sewage and the treatment system.
- CO4:** Outline the various secondary treatment technologies for waste water
- CO5:** Explain the different tertiary and effluent disposal methods.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction to sanitation–systems of sanitation–relative merits and demerits –need for waste water management–basic terminology in waste water–generation of waste water–types – collection and conveyance of waste water– classification of sewerage systems.

UNIT – II

Sewage Flow and Pumping:

Estimation of sewage flow and storm water drainage–fluctuations. Types of sewers– hydraulics of sewers– appurtenances in sewerage. Pumping of waste water:pumping stations–location–components– types of pumps and their suitability with regards to waste waters.

UNIT – IV

Secondary Treatment:

Aerobic and anaerobic treatment process-comparison. Aerobic units: Activated sludge process, principles, modifications of activated sludge processes–Oxidation ponds–Trickling filters– Rotating biological contactors. Anaerobic units: UASB Reactor, principle and working.

UNIT – V

Tertiary Treatment and Disposal:

Removal of Nutrients–Nitrification and Denitrification–Ion exchange–membrane processes –MF, UF, NF, RO. Disposal of sewage–Methods of disposal–Effluent Standards. Need, Scope and demand for waste water recycling.

Text Books:

1. Wastewater Engineering: Treatment and Resource Recovery, Metcalf & Eddy, McGraw-Hill, New York, 5th Edition. (ISBN: 13-978-0073401188).
2. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill , 2018. (ISBN: 13-978-0070495395).

Reference Books:

1. Environmental Engineering-II: Sewage disposal and Air pollution Engineering, Garg & S.K., Khanna Publications. (ISBN:978-81-7409-230-4)
2. Environmental Engineering by D. Srinivasan, PHI Learning private Limited, New Delhi. (ISBN:13-9788120336001)
3. Elements of Environmental Engineering, K.N. Duggal, S.Chand& Company Ltd. New Delhi. (ISBN: 13-978-8121915472).
4. Wastewater Treatment for pollution control and Reuse, Soli J Areivala, Sham R Asolekar, Mc- GrawHill, New Delhi. (ISBN:9780070620995).

Web Links:

1. https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf
2. <http://www.civil.iitm.ac.in/dwwm/sites/default/files/presentations>
3. https://www.researchgate.net/publication/221911472_Wastewater_Management

Integrated Solid Waste Management for A Smart City

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

Course Code: 2501CE83

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the objectives and characteristics of watershed management.
- CO2:** Classify the types of soil erosion and control methods.
- CO3:** Explain different water harvesting techniques.
- CO4:** Organize the land and drought management techniques.
- CO5:** Create hydrological models

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction - Concept of watershed development – objectives of watershed development – need for watershed development - integrated and multidisciplinary approach for watershed management. Characteristics of Watershed: Size – shape – physiography – slope – climate – drainage – land use – vegetation – geology and soils – hydrology and hydrogeology – socio-economic characteristics – Application of artificial intelligence technology for identification of watershed characteristics.

UNIT – II

Principles of Erosion: Types and causes of erosion – factors affecting erosion– estimation of soil loss due to erosion- Universal soil loss equation. Measures to Control Erosion: Contour techniques – ploughing – furrowing – trenching – bunding – terracing – gully control – check dams – rock-fill dams – brushwood dam – Gabion.

UNIT – III

Water Harvesting: Techniques of rainwater harvesting – rainwater harvesting from rooftop – surface flow harvesting – subsurface flow harvesting – stop dams – farm ponds and dugout ponds – percolation tanks.

UNIT – IV

Land Management: Land use and Land capability classification – management of forest – agricultural – grassland and wild land land grading operation –reclamation of saline and alkaline soils. Drought Management: Drought assessment and classification – drought analysis techniques – drought mitigation planning.

UNIT – V

Beyond BIM - Emerging Trends

Watershed Modelling: Data of watershed for modelling – application and comparison of watershed models – model calibration and validation – advances of watershed models.

Text Books:

1. Watershed Management, Das MM and M.D Saikia, PHI Learning Pvt. Ltd.(ISBN:13-978-8120346765).
2. Land and Water Management, Murthy.VVN, Kalyani Publications. (ISBN: 13-978-9327214659)

Reference Books:

1. Water Resource Engineering, Wurbs R A and James R A, Prentice Hall Publishers. (ISBN: 13-978-8120321519).
2. Watershed Hydrology, Black P E, Prentice Hall. (ISBN: 13-978-1575040271).
3. Watershed Management, Murthy J V S, New Age International Publishers. (ISBN:13-978-8122435184).

Web Links:

1. https://www.ct.gov/deep/cwp/view.asp?a=2719&q=325622&depNav_GID=1654
2. http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershedmgt.html
3. <https://yourstory.com/2017/11/watershed-management/>

Electric Power Generation, Transmission & Distribution Systems

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

Course Code: 2501EE53

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Identify the different components of various power plants.
- CO2:** Analyze the performance of short, medium and long transmission lines.
- CO3:** Identify various factors related to sag and corona.
- CO4:** Distinguish between AC/ DC distribution systems and also estimate voltage drops of distribution systems.
- CO5:** Analyze the different economic factors of power generation and tariffs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11
CO1	3	1	-	-	-	2	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-
CO3	2	1	3	-	-	1	-	-	-	-	-
CO4	2	3	1	-	-	1	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-

UNIT – I

Power Stations: Principle of power generation, site selection and layout of Thermal, Nuclear, Hydro power plant, Components of Thermal and Nuclear power plant

UNIT – II

Performance of Transmission Lines: Classification of Transmission Lines –Short, medium, long and their model representations –End condenser method, Nominal-T–Nominal-Pie, and A, B, C, D Constants, Surge Impedance and SIL of Long Lines.

UNIT – III

Corona and Sag: Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss –Radio Interference. Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor

UNIT – IV

Distribution Systems: Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations: DC distributors for following cases - radial DC distributor fed at one end and at both ends (equal / unequal voltages), ring main distributor, stepped distributor and AC distribution, comparison of DC and AC distribution.

UNIT – V

Economic Aspects of Power Generation and Tariff Methods: Types of load, Load curve, load duration and integrated load duration curves, Important terms and factors in Load Curve. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs, Characteristics and types of Tariff.

Text Books:

1. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar & A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd (ISBN: 978817700207).
2. Generation, Distribution & Utilization of Electric Energy by C. L. Wadhawa, Newage International (P) Limited, Publishers (ISBN: 9789393159175).

Reference Books:

1. Principles of Power System by V. K. Mehta & Rohit Mehta, S Chand & Company Limited, Publishers (ISBN: 9788121924962).
2. Electrical Power Distribution Systems by V. Kamaraju, Tata McGraw Hill, New Delhi (ISBN: 978070151413).

Web Links:

1. <https://www.slideshare.net/ntpc-project-korbasuper-themal-power-plant>
2. <https://www.euronuclear.org/1-information/energy-uses.html>
3. <https://www.slideshare.net/9anku/electrical-distribution-system>

Electric Energy Storage Systems
(CE,ME,ECE,CSE,IT,AIML,CSE(DS), PT, Min.E.)

L T P C

Course Code:2501EE36

3 0 0 3

Course Outcomes:

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

- CO1** Analyze the characteristics of electrical energy storage technologies.
- CO2** Analyze the needs for electrical energy storage.
- CO3** Analyze the needs for electrical energy storage.
- CO4** Understand the various types of electrical energy storage systems.
- CO5** Identify various real time applications of energy storage systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Electrical Energy Storage (EES) Technologies: Characteristics of electricity, Electricity & the roles of EES, High generation cost during peak-demand periods, Need for continuous & flexible supply, Long distance between generation & consumption, Congestion in power grids, Transmission by cable.

UNIT – II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT – III

Features of Energy Storage Systems: Classification of EES systems, Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H₂), Synthetic natural gas (SNG).

UNIT – IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, Standards for EES, Technical comparison of EES technologies.

UNIT – V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management & control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems & distributed generation (Virtual Power Plant), Battery SCADA aggregation of many dispersed batteries.

Text Books:

1. Energy Storage Benefits & Market Analysis, by James M. Eyer, Joseph J. Iannucci & Garth P. Corey Sandia National Laboratories.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Boks:

1. Energy Storage for the Electricity Grid: Benefits & Market Potential Assessment Guide, Jim Eyer, Garth Corey, Sandia National Laboratories.
2. Energy Storage by Mullick & Garg (ISBN: 9789027719300)

Web Links:

1. <https://nptel.ac.in/courses/112/105/112105221/>
2. <https://nptel.ac.in/courses/112/107/112107283/>
3. <https://nptel.ac.in/content/storage2/courses/10810309>

Electrical Safety

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

Course Code: 2501EE43

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO 1:** Describe electrical hazards & safety equipment.
- CO 2:** Analyze & apply various grounding & bonding techniques
- CO 3:** Select appropriate safety method for low, medium equipment's & high voltage equipment.
- CO 4:** Participate in a safety team & Carry out proper maintenance of electrical equipment by understanding various standards.
- CO 5:** Analyze the safety method for high voltage equipment's.

Mapping of course outcomes with program outcomes:

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

UNIT-I:

Hazards of Electricity & Electrical Safety Equipment: Primary & secondary hazards- arc, blast, shocks causes & effects-safety equipment flash & thermal protection, head & eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers & signs, safety tags, locking devices-voltage measuring instruments- proximity & contact testers-safety electrical one line diagram-electrician's safety kit.

UNIT-II:

Grounding of Electrical Systems & Equipment: General requirements for grounding & bonding-definitions grounding of electrical equipment-bonding of electrically conducting materials & other equipment connection of grounding & bonding equipment- system grounding- purpose of system grounding-grounding electrode system- grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage & high voltage systems.

UNIT-III:

Safety Procedures & Methods: The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation & approach distances-calculating the required level of arc protection-safety equipment, procedure for low, medium & high voltage systems- the one-minute safety audit

UNIT-IV:

Safety Management & Organizing Structure: Electrical safety program structure, development-company safety team- safety policy program implementation- employee electrical safety teams-safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation.

UNIT-V:

Electrical Maintenance & Legal Safety Requirements & Standards: Safety related case for electrical maintenance- reliability centred maintenance (RCM) - eight step maintenance program-frequency of maintenance- maintenance requirement for specific equipment & location- regulatory bodies- national electrical safety code standard for electrical safety in work place- occupational safety & health administration standards, Indian Electricity Acts related to Electrical Safety

Text Books:

1. 'Electrical Safety Handbook' by John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, McGraw-Hill Education, 4th Edition (ISBN: 978071745130)
2. "Electric Safety Practice & Standards", Khaled Ismail, CRC Press, Taylor & Francis (ISBN: 9781138073999).

Reference Books

1. 'Electrical Safety- a guide to the causes & prevention of electric hazards', Maxwell Adams.J, The Institution of Electric Engineers, IET (ISBN: 9780852968062).
2. 'Electrical Safety in the Workplace', Ray A. Jones, Jane G. Jones, Jones & Bartlett Learning (ISBN: 9780877655800).

Web Links:

1. <http://nptel.ac.in/courses/103106071/5>
2. <https://www.electricalsafetyfirst.org.uk>

Hybrid & Electric Vehicles

(CE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code:2501EE54

L	T	P	C
3	0	0	3

Course Outcomes:

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

CO1: Describe the History of Hybrid Electric vehicles

CO2: Classify the various electric drivetrain topologies

CO3: Articulate the Energy Storage Requirements in Hybrid & Electric Vehicles

CO4: Illustrate the Charging Infrastructure

CO5: Evaluate Energy Management Strategies used in hybrid & electric vehicle

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction to Hybrid Electric Vehicles: History of hybrid & electric vehicles, social & environmental importance of hybrid & electric vehicles, impact of modern drive-trains on energy supplies-Challenges & Key Technologies of EVs – Challenges for EV Industry in India

UNIT – II

Electric Drive-trains:

Basic concept of electric traction - introduction to various electric drivetrain topologies - Power flow control in electric drive-train topologies - fuel efficiency analysis

Electric Propulsion unit:

Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, configuration and control of Induction Motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency

UNIT – III

Energy Storage:

Introduction to Energy Storage Requirements in Hybrid & Electric Vehicles -Battery based energy storage & its analysis - Fuel Cell based energy storage & its analysis - Super Capacitor based energy storage- Flywheel based energy storage & its analysis.

UNIT – IV

Sizing the drive system:

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT – V

Energy Management Strategies

Introduction to Energy Management Strategies used in hybrid & electric vehicle, Classification of different Energy Management strategies - Comparison of different Energy Management Strategies - Implementation issues of energy strategies - Effect of charging infrastructure on grid protection & control.

Text Books:

1. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley-Blackwell (ISBN: 9781119942733).
2. Energy Management Strategies for Electric & Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer (ISBN: 9781493955237).

Reference Books:

1. Electric Vehicle Battery Systems, Sandeep Dhameja, Elsevier (ISBN: 9780750699167).
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press (ISBN: 9781138072855).
3. Hybrid electric Vehicles Principles & applications with practical perspectives, Chris Mi, M. Abul Masrur, D. Wenzhong Gao, A Dearborn, John Wiley & Sons Ltd (ISBN: 9781118970560).

Solar Energy Systems
(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501ME37

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the concept of solar radiation and its measurement
- CO2:** Describe the working principle of different types of collectors and its types
- CO3:** Explain the various solar thermal energy technologies and their applications
- CO4:** Analyze the various solar PV cell materials and conversion techniques.
- CO5:** Apply solar passive building techniques for cooling and heating applications.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Solar Radiation and its measurement: Solar angles, Sun path diagrams, Radiation, extra terrestrial characteristics, Solar energy measuring instruments: Pyranometer, Pyrliometer, Sunshine recorder. Estimation of average solar radiation and estimation on horizontal and tilted surfaces

UNIT – II

Solar Collectors for Industrial process heat: Flat plate collector, Materials for flat plate collector and their properties, classification, evacuated tubular collectors, concentrator collectors, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus, Heliostats.

UNIT – III

Solar Thermal Technologies: Working principle, types, design, and operation, Solar heating and cooling systems, Thermal Energy storage systems, Solar Desalination, Solar cooker, Solar Pond, Solar drying, Solar chimney, Solar water disinfection (SODIS), Solar furnaces.

UNIT – IV

Solar Cells: Semiconductor materials, Doping, PN junction and characteristics, Photovoltaic effect, Photovoltaic material, Parameters of solar cells, Effects of cell temperature on cell efficiency, Types of solar cells, Solar modules and arrays, Solar cell power plant, Silicon, thin film and polymer processing, Silicon wafer based solar cells, Hybrid organic- inorganic solar cells.

UNIT – V

Solar Passive Architecture: Thermal comfort, bioclimatic classification. Passive heating concepts: direct heat gain, indirect heat gain, isolated gain and sunspaces
Passive cooling concepts: evaporative cooling, Radiative cooling, shading - paints and cavity walls for cooling, roof radiation traps, thermal comfort.

Text Books:

1. Solar Energy-Principles of Thermal Collection and Storage, S P Sukhatme & J K Nayak, McGraw Hill Education, 3rd Edition, 2009, ISBN : 9780070142961.
2. Principles of Solar Engineering, D.Yogi Goswami, Frank Kreith and Jan F. Kreider Taylor and Francis, 2nd Edition, 2000, ISBN : 9781560327141.

Reference Books:

1. Solar Energy- Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa publishing house. 1st Edition, 2002, ISBN : 9780849325093.
2. Solar Energy and Non-conventional Energy Sources, Domkundwar, Dhanpat Rai & Co, (P) Ltd., 2nd Edition, ASIN : B0BQWR83GF

Web Links:

1. <https://archive.nptel.ac.in/courses/115/103/115103123/>
2. <https://www.nrel.gov/research/re-solar.html>

Industry 5.0 for Engineers

(CE,EEE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code: 2501ME58

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the basic concept of Industry 5.0.
- CO2:** Explain the concepts of Industrial IOT, IOS and Predictive Analytics
- CO3:** Explain the cyber physical systems and AI technologies
- CO4:** Analyse the applications of Industry 5.0 in various sectors
- CO5:** Analyse case studies on automation and healthcare services

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Industry 5.0: Introduction of Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes.

UNIT – II

Importance of Internet of Things (IOTs): Introduction to Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Services, Fundamental of Predictive Analytics, Smart Logistics, Smart Devices and Products.

UNIT – III

Technology Evolution: Basics of cyber Physical Systems, Process Automations and Collaborative robots, Fundamental to artificial Intelligence, Mobile Computing, Cyber Security, Ethical technology, Responsive and distributed supply chain system, Human-centric and Value-oriented approaches.

UNIT – IV

Technology Implementation and Case Studies: 3D printing, Solar energy sector, Healthcare sector, Maintain records related to education, finance, clean bioenergy generation and Intelligent NextG Wireless Networks.

UNIT – V

Case studies on CNC/NC automation - Benefits, challenges, and industry applications. In-house, Healthcare services-Examples of innovations improving patient care and operational efficiency.

Text Books:

1. Uthayan Elangovan, Industry 5.0, “The Future of the Industrial Economy”, First Edition, Taylor & Francis, ISBN: 978-1-032-04127-8, 2022.
2. Alessandro Massaro, “Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances”, Wiley-IEEE Press, 2021, ISBN: 2021028944.

Reference Books:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016.
2. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
3. Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, “The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0”, Industrial Press Inc., U.S. ISBN 0831136367, Nov 2021.
4. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, “Healthcare 4.0 Next Generation Processes with the Latest Technologies”, Palgrave Pivot, 2019, ISBN 978-981-13-8113-3.

Web Links:

1. <http://www.mqtt.org/>
2. <https://opcfoundation.org/about/opc-technologies/opc-ua/>
3. <https://www.etherncat.org/default.htm>

Organizational Behaviour
(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501ME73

L P T C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the roles, approaches of organizational behaviour models.
- CO2:** Summarize the behaviour of individuals and groups in organizations in terms of organizational behaviour.
- CO3:** Illustrate various stress and emotional organizational behaviour concepts, models and theories to real life management situations.
- CO4:** Analyze the functions of organizational communication and culture for effective communication and managing cultural diversity
- CO5:** Organize different groups and teams in the organization for better results.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Organizational Behaviour: Concept of Organizational Behaviour (OB)- Importance of Organizational Behaviour- Key Elements of Organizational Behaviour, Role of Managers in OB- Interpersonal Roles-Informational Roles- Decisional Roles, Approaches to Organizational Behaviour

UNIT – II

Interpersonal Behaviour: Nature and meaning of Interpersonal Behaviour, Concept of Self, Transaction Analysis (TA), Benefits and uses of Transactional Analysis, Johari Window Model

Personality: Definition and Meaning of Personality - Importance of Personality, Determinants of Personality, Theories of Personality, Personality Traits Influencing OB.

UNIT – III

Emotions: Nature and Meaning of Emotions - Characteristics of Emotions, Theories of Emotions, Emotions in the Context of OB. Organizational Stress: Definition and Meaning, Sources of Stress, Types of Stress, Impact of Stress on Organizations, Stress Management Techniques.

UNIT – IV

Organizational Communication: Meaning and Importance of Communication, Functions, process, types, Interpersonal Communication, Organizational Communication, Tips for Effective Communication.

Organization Culture: Meaning and Nature of Organization Culture – Origin of Organization Culture, Functions of Organization Culture, Types of Culture, Creating and Maintaining Organization Culture, Managing Cultural Diversity

UNIT – V

Groups and Teams: Meaning and Importance of Groups, Reasons for Group Formation, Types of Groups, Stages of Group Development, Meaning and Importance of Teams, Types of Teams, Creating an Effective Team.

Text Books:

1. Organizational Behaviour, K. Ashwathappa, Himalaya Publishing House, ISBN-13. 978-8184889390.
2. Management and Organizational Behaviour - (Text and Cases), Dr.P.Subba Rao and Prof. N.Sambasiva Rao, Himalaya Publishing House, Mumbai, ISBN: 978-93-5025-951-2.

Reference Books:

1. Understanding Organisational Behaviour, Udai Pareek, Oxford Higher Education, 2nd Edition, ISBN-13: 978-0195690866
2. Mc Shane & Von Glinov, Organisational Behaviour, Tata McGraw Hill, 4th Edition, ISBN-13, 978-1259927676.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg51/preview
2. <https://www.udemy.com/course/organisational-behaviour/>

Sustainable Energy Systems
(CE,EEE,ECE,CSE,IT,AIIML,CSE(DS), PT, Min.E.)

Course Code: 2501ME36

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Demonstrate the various components of solar thermal energy systems.
- CO2:** Describe the working of Wind turbines.
- CO3:** Explain the principle and working of Biomass and Geothermal Energy systems
- CO4:** Explain the Ocean, Tidal, Wave and hydro energy conversion systems.
- CO5:** Illustrate working of hybrid energy systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Renewable energy sources: Energy demand and availability, energy crisis, renewable and non-renewable energy resources, environmental impact of conventional energy usage.

Solar Energy: Overview of the fundamental physics of solar radiation. Solar energy collectors.

Solar energy storage: Stratified storage, well mixed storage, comparison, Hot water system, solar ponds, non-convective solar pond, extraction of thermal energy and application of solar ponds.

Solar PV systems and its applications. Solar cell, module, and array.

UNIT – II

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for windfarms. Horizontal and vertical axis wind mills, Wind farms- offshore, Onshore, various methods of control, and Environmental issues – Applications.

UNIT – III

Biomass: Bio-resources, Conversion process, Biomass gasifier - Types of biomass gasifiers, Biodiesel production – Ethanol production -Applications.

Geothermal Energy: Origin and types of geothermal energy and utilisation, Power generation from Geothermal energy, Environmental impact.

UNIT – IV

Ocean, Wave & Tidal Energy: Introduction - Resource Assessment - Power generation through OTEC systems. Wave and Tidal energy- Working principle, Availability, and energy conversion systems.

Mini & Micro Hydropower: Introduction, Power from water, System components of Mini and Micro Hydropower, Micro Hydropower plant in India, Potential Hydropower plant projects identified in India.

UNIT – V

Hybrid Energy Systems: Systems for processes and power applications – solar – wind – Biomass hybrid technologies

Fuel cell: Working principle- types - construction and applications. Solar – Fuel cell hybrid systems.

Text Books:

1. Renewable Energy: Power for a Sustainable Future, Boyle, G, Oxford University Press, 3rd Edition, 2012, ISBN : 9780199681273.
2. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, 6th edition, ISBN : 9788174090737.

Reference Books:

1. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 3rd edition, 2015, ISBN : 9780415584388.
2. Non-Conventional Energy Resources, B H Khan, TMH Publishers, 3rd Edition, 2017, ISBN : 9789352601882.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2. <https://www.energy.gov/eere/renewable-energy>

Biomedical Electronics
(CE,EEE,ME,CSE,IT,DS,AIIML,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,AI ML,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 techinques.
- CO3:** Compare multiple access techniques used in wireless communication systems.
- CO4:** Explain the architecture and standards of WPAN, WLAN, and WMAN technologies.
- CO5:** Compare cellular generations and LTE network architecture for modern mobile communications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Overview of Wireless Communication:

History of wireless communication, Current Wireless Systems: Cellular Telephone Systems, Generations, Cordless Phones, Wireless LANs, Wide Area Wireless Data Services, Broadband Wireless Access, Paging systems, Satellite Networks, Bluetooth, ZigBee, Ultra-wideband Radios. The Wireless Spectrum: Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, Standards.

UNIT – II

Modulation for Wireless Communication:

Need for Modulation, Analog Modulation, Amplitude modulation, Double sideband Supressed carrier, single sideband supressed carrier, Angle modulation, Digital modulation: Amplitude Shift Keying, Frequency Shift Keying Techniques, Phase-Shift Keying Techniques,BPSK and QPSK. Multicarrier-Modulation, Orthogonal Frequency Division Multiplexing.

UNIT – III

Multiple Access Techniques:

Contention-free multiple access schemes, Frequency-Division Multiple Access (FDMA), Time-Division Multiple Access (TDMA), Code-Division Multiple Access (CDMA), Space-division, contention-based multiple access schemes (ALOHA and CSMA).

UNIT – IV

Wireless Personal Area Networks:

Bluetooth, UWB and ZigBee, wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), wireless metropolitan area networks (WiMAX).

UNIT – V

Wireless Mobile Networks and Applications:

Principles of Cellular Networks, First- Generation Analog, Second- Generation TDMA, CDMA, Third- Generation Systems, Fourth Generation Systems, LTE Architecture, Evolved Packet Core, LTE Resource Management.

Text Books:

1. Wireless communications- Goldsmith Andrea, Cambridge university press, 2005, ISBN: 9780511841224.
2. Wireless communication networks and systems-Cory Beard, and William Stallings, Pearson education (Global Edition), 2015, ISBN: 978-1292108728

Reference Books:

1. Wireless Communication the Fundamental and Advanced Concepts-Sanjay Kumar River Publishers, Denmark, 2015 ISBN: 9781000795325
2. Wireless communications: Principles and Practice, 2nd Edition, Theodore S. Rappaport, Pearson education, 2010.
3. Fundamentals of wireless communication.- Tse, David, and Pramod Viswanath. Cambridge university press, 2005.

Web Links:

1. <https://nptel.ac.in/courses/106106167> by Prof. David Koilpillai, IIT Madras
2. <https://nptel.ac.in/courses/117104115> by Aditya K. Jagannatham, IIT Kanpur

Principles Of Embedded Systems
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501EC99	3	0	0	3

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

- CO1:** Summarize the building blocks of an embedded system.
- CO2:** Interpret the hardware modules required to design an embedded system.
- CO3:** Infer the firmware design approaches for an embedded system.
- CO4:** Illustrate the hardware integration with firmware.
- CO5:** Outline the process of embedded system development and choose the tools for embedded system implementation and testing.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Embedded system-Definition, History of Embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system, core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT – II

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, multi processors architectures.

UNIT – III

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, Interrupt sources, ISR concept, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C.

UNIT – IV

RealTime Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

Hardware Software Co-Design:

Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT – V

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation and Testing: The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine.

Text Books:

1. Introduction to Embedded Systems, Shibu.K.V, Tata McGraw Hill Education Private Limited, 2nd Edition, 2016.
2. Embedded Systems – SoC, IoT, AI and Real-Time Systems, Raj Kamal, McGraw Hill Education India 4th Edition, 2020.

Reference Books:

1. Embedded System Design, Frank Vahid and Tony Givargis, John Wiley Publications, 2013.
2. Hardware Software Co-Design Principles and Practice, J.Staunstrup, Springer Publications, 2013
3. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, 3rd Edition, 2013.

Web Links:

1. <https://www.coursera.org/learn/introduction-embedded-systems>
2. <https://www.linkedin.com/learning/introduction-to-embedded-systems-with-rust>
3. <https://www.udemy.com/course/embedded-systems-and-microcontrollers/>

Electronics For Health Care
(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA0	3	0	0	3

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

CO1: Know about health care data and its conversion to information and to knowledge.

CO2: Acquire knowledge on (Electronic Health Records) EHRs and their Implementation.

CO3: Understand the working of electronic devices used for the patient monitoring.

CO4: Know the concepts of Telemedicine and therapeutic devices used inside the human body.

CO5: Understand and analyse the working principles, design, and clinical applications of therapeutic devices.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I:

Health care data, Information and Knowledge: Definitions and Concepts, Converting Data to Information to Knowledge, Clinical Data Warehouses, what makes Health Informatics Difficult, Why Health IT fails Sometimes, Terminology of Analytics, Challenges to Data Analytics, Research and application of analytics, Role of Informatics in analytics.

UNIT-II:

Electronic Health Records: Introduction, Need for Electronic Health Records, Institute of Medicine's Vision for EHRs, Electronic Health Record Key Component, Electronic Prescribing, Electronic Health Record Adoption, Electronic Health Record Adoption and Meaningful use Challenges, Electronic Health Record Examples, Logical Steps to Selecting and Implementing an HER.

UNIT-III:

Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors, Measurement of Heart Rate, Measurement of Pulse Rate, Blood Pressure Measurement, Measurement of Temperature, Measurement of Respiration Rate, Catheterization Laboratory Instrumentation.

UNIT-IV:

Biomedical Telemetry and Telemedicine: Wireless Telemetry, Single Channel Telemetry Systems, Multi-channel Wireless Telemetry Systems, Multi-patient Telemetry, Implantable Telemetry Systems, Transmission of Analog Physiological Signals, Over Telephone, Telemedicine.

UNIT-V:

Therapeutic Devices: Need for Cardiac Pacemaker, Implantable Pacemakers, DC Defibrillator, Electronics in the Anaesthetic Machine.

Text Books:

1. Robret E. Hoyt MD FACP “Health Informatics” sixth edition 2007.
2. R. S. Kandpur “Biomedical Instrumentation Technology and Applications” second edition Tata McGraw-Hill.

Reference Books:

1. Edward H. Shortliffe, James J.Cimino “Biomedical Informatics, Computer applications in Health care and Biomedicine” third edition Springer.
2. G.V.R.K. Acharyulu, Bhimaraya Metri, L. Kalyan Viswanath REDDY “Health care and Hospital Management Contemporary Issues and Strategies”.

Web Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge25.
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs82.
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_bt09.

Basics of VLSI Design

(CE,EEE,ME,CSE,IT,DS,AIIML,PT,Min.E, Ag.E)

Course Code: 2501ECA1

L	T	P	C
3	0	0	3

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

- CO1:** Outline the fundamental concepts related to MOS and Bi-CMOS Circuits fabrication.
- CO2:** Analyze the electrical properties of MOS and Bi-CMOS Circuits.
- CO3:** Make use of design rules for developing stick and layout diagrams.
- CO4:** Interpret the issues related to subsystem design.
- CO5:** Interpret FPGA and ASIC design approaches for semi-custom design.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, Bi-CMOS Technology, Comparison between CMOS and Bipolar technologies.

UNIT – II

Basic Electrical Properties of MOS and Bi-CMOS Circuits: I_{ds} versus V_{ds} Relationships, Threshold Voltage, MOS transistor Trans-conductance, Output Conductance and Figure of Merit, The Pass transistor, NMOS Inverter, Alternative forms of the pull-up, The CMOS Inverter, Bi- CMOS Inverter, Transistor switches, Schematics of Inverter, NAND, NOR gates using NMOS, PMOS, and CMOS technologies.

UNIT – III

MOS Circuit Design Processes: MOS Layers, Design Rules, General observations of design rules, $2\mu\text{m}$ Double Metal, Double Poly, CMOS rules, $1.2\mu\text{m}$ Double Metal,

Double Poly CMOS rules, Stick Diagrams, Layout Diagrams of NAND and NOR gates and CMOS inverter.

UNIT – IV

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances.

UNIT – V

IC Design: PLAs, PLDs, FPGA, ASIC, Selection of an Appropriate Integrated Circuit.

FPGA Design Process: Architectures of Popular FPGAs, Choosing an FPGA, FPGA Design Process, FPGA Families of Different Vendors, FPGA Design Examples.

Text Books:

1. Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell, Sholeh Eshraghian, Prentice-Hall of India Private Limited, ISBN: 978-8120327726
2. VLSI Design, Black Book by Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc, ISBN: 978-9350048047

Reference Books:

1. CMOS Digital Integrated Circuits Analysis & Design, Sung-Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw-Hill, 3rd Edition, ISBN: 978-0072460537
2. Modern VLSI Design-Wolf Wayne, Pearson Edition, 3rd Edition, ISBN: 978-0130619709
3. VLSI Design, K. LalKishore, V.S.V.Prabhakar, I.K. International Publishing House Private Limited, 1st Edition, ISBN: 978-9380026671

Web Links:

1. NPTEL – VLSI Physical Design- <https://nptel.ac.in/courses/106105161>
2. NPTEL – Advanced VLSI Design <https://nptel.ac.in/courses/117/101/117101004>.

System on Chip Design

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA2	3	0	0	3

Course Outcomes:

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

- CO1:** Explain all the building blocks of SoC.
- CO2:** Classify the concept of processors and instruction handling.
- CO3:** Analyze vector, VLIW and superscalar processors.
- CO4:** Develop a Memory as part of SoC.
- CO5:** Illustrate the concepts of interconnect optimization and configuration in SoC.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to the System Approach:

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT – II

Processors:

Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers:minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT – III

Memory Design for SOC:

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

UNIT – IV

Interconnect Customization:

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor.

UNIT – V

Interconnect Configuration:

Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

Text Books:

1. Computer System Design System-on-Chip, Michael J. Flynn and Wayne Luk, Wiley India Pvt. Ltd, ISBN: 978-0470643365.
2. ARM System on Chip Architecture, Steve Furber, Addison Wesley Professional, 2nd Edition, ISBN : 9780201675191 .

Reference Books:

1. Design of System on a Chip: Devices and Components, Ricardo Reis, Springer 1st Edition, ISBN: 978-1441954541.
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology), Jason Andrews, Newnes, BK and CDROM, ISBN: 978-0750677301.
3. System on Chip Verification–Methodologies and Techniques, Prakash Rashinkar, Peter Paterson and Leena Singh L, Kluwer Academic Publishers, ISBN: 978-0792372790.

Web Links:

1. <https://www.peterindia.net/System-On-ChipLinks.html>
2. <https://www.ieee-socc.org/>
3. <http://nptel.ac.in/courses/108102045/10> (Prof. Santanu Chaudhary, IIT Delhi)

Introduction to Quantum Computing

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501ECA3	3	0	0	3

Course Outcomes:

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

- CO1:** Understand the fundamentals of quantum computing and qubits.
- CO2:** Build simple quantum circuits.
- CO3:** Analyze quantum circuits and algorithms.
- CO4:** Identify different quantum hardware technologies and their challenges.
- CO5:** Outline real time applications of quantum computing in various fields

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamentals of Quantum Computing:

Evolution from Classical Computing to Quantum Computing, Need for Quantum Computing, Classical Bits vs Qubits, Principles of Quantum Mechanics for Computing, Superposition and Measurement, Quantum States and Bloch Sphere Representation, Introduction to Quantum Gates, Quantum Computing Platforms and Ecosystem.

UNIT – II

Quantum Circuits and Computing Concepts:

Quantum Circuit Model, Single Qubit and Multi-Qubit Systems, Common Quantum Gates: Pauli, Hadamard, Phase, CNOT, Quantum Entanglement, Quantum Parallelism, Quantum Teleportation (Conceptual Understanding), Basic Quantum Circuit Design, Introduction to Quantum Simulators.

UNIT – III

Quantum Algorithms:

Introduction to Quantum Algorithms, Deutsch–Jozsa Algorithm, Grover’s Search Algorithm, Shor’s Factorization Algorithm (Overview), Quantum Fourier Transform (Basic Idea), Quantum Speedup and Computational Advantage, Hybrid Quantum-Classical Computing, Introduction to Quantum Machine Learning.

UNIT – IV

Quantum Hardware and Programming:

Overview of Quantum Hardware Technologies: Superconducting Qubits, Trapped Ion Systems, Photonic Quantum Computing. Noise and Decoherence, Quantum Error Correction (Basic Concepts), Introduction to NISQ Devices, Basics of Quantum Programming using Python and Qiskit, Introduction to IBM Quantum Experience.

UNIT – V

Applications of Quantum Computing:

Quantum Cryptography and Cybersecurity, Quantum Computing in Healthcare and Drug Discovery, Optimization Problems and Smart Systems, Quantum in Finance & Logistics, Quantum computing for Industrial Applications and Future Scope, Ethical and Societal Impact of Quantum Technologies.

Text Books:

1. Quantum Computation and Quantum Information – Michael A. Nielsen & Isaac L. Chuang.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, First Edition, 2011.

Reference Books:

1. **Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia**, Programming Quantum Computers: Essential Algorithms and Code Samples, O'Reilly Media, First Edition, 2019.

Web Links:

1. https://quantum.cloud.ibm.com/?utm_source=chatgpt.com
2. <https://quantum.cloud.ibm.com/docs/en/guides>

Data Structures

(CE, ME, PT, Min.E.)

L T P C

Course Code: 2501CS03

2 0 2 4

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

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

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

Practice:

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

UNIT – II

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures.

Sorting Techniques: Quick sort, Merge sort, Radix sort

Practice:

1. Implement Merge sort using arrays.
<https://www.hackerrank.com/contests/hw1/challenges/merge-sort>
2. Implement Quick sort using arrays
<https://www.hackerrank.com/challenges/quicksort1/problem>

3. Implement Radix Sort using arrays
https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm_source

UNIT – III

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

Practice:

1. Single Linked List: Perform different operations in single linked list.
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source

UNIT – IV

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

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

Practice:

1. Stack and its operations using arrays and Linked List
<https://www.hackerrank.com/challenges/balanced-brackets/problem>
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List
<https://leetcode.com/problems/implement-queue-using-stacks/description/>
https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
<https://leetcode.com/problems/design-circular-queue/description/>

UNIT – V

Non-linear Data Structures:

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

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

Practice:

1. Implement Binary search tree (BST).
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
2. Implement Binary search Tree (BST) Traversals.
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>
3. Graph Traversal using Breadth First Search (BFS)
<https://www.hackerrank.com/challenges/bfsshortreach/problem>
4. Graph Traversal using Depth First Search (DFS)
<https://leetcode.com/problems/number-of-islands/description/>

Text Books:

1. Data Structures using C, Rema Theraja, Oxford University Press, 3rd Edition. ISBN: 978-9354979453
2. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, ISBN: 978-0716782506
3. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407
4. Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition. ISBN: 978-0198099307

Web Links:

1. <https://nptel.ac.in/courses/106102064>
2. <https://archive.nptel.ac.in/courses/106/105/106105225/>
3. <https://www.udemy.com/topic/data-structures/>
4. <https://www.coursera.org/specializations/data-structures-algorithms>
5. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Structs and enums	https://www.hackerrank.com/challenges/too-high-boxes/problem
2	Easy	Structs and enums	https://www.codechef.com/problems/HS08TEST?tab=statement
3	Medium	Structs and enums	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem
4	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
5	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
6	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
7	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
8	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
9	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
10	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
11	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/

12	Medium	Stack 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:

- Find the roots of a quadratic equation.
- Find factorial of a given number using recursion
- Palindrome Number
<https://leetcode.com/problems/palindrome-number/description/>
- Class and Objects
<https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true>
- Program to illustrate the use of Constructors and Destructors.

6. C++ Class Templates

<https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true>

UNIT – II

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

Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.

Linked Lists: Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

Practice:

1. Single Linked List: Perform different operations in single linked list.
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source
4. Reversing a Linked List

UNIT – III

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

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

Practice:

1. Stack and its operations using arrays and Linked List
<https://www.hackerrank.com/challenges/balanced-brackets/problem>
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List
<https://leetcode.com/problems/implement-queue-using-stacks/description/>
https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
<https://leetcode.com/problems/design-circular-queue/description/>

UNIT – IV

Trees: Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.

Binary Search Trees – Definition, Operations: Searching, Insertion, Deletion.

Practice:

1. Implement Binary search tree (BST).

<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>

<https://leetcode.com/problems/delete-node-in-a-bst/description/>

2. Implement Binary search Tree (BST) Traversals.

<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>

<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>

<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>

UNIT – V

Graphs: Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjacency list, Graph Traversals (BFS & DFS), Bi-Connected Components.

Practice:

1. Graph Traversal using Breadth First Search (BFS)

<https://www.hackerrank.com/challenges/bfsshortreach/problem>

2. Graph Traversal using Depth First Search (DFS)

<https://leetcode.com/problems/number-of-islands/description/>

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
2. Fundamentals of Data Structures in C++, Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, ISBN: 81-7515-278-8
3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition, ISBN : 9780133522884.
2. Object oriented programming in C++, Joyce Farrell, Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek, Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

Web Links:

1. <http://nptel.ac.in/courses/106105151/>
2. <https://nptel.ac.in/courses/106102064>
3. <https://archive.nptel.ac.in/courses/106/105/106105225/>
4. <https://www.udemy.com/topic/data-structures/>
5. <https://www.coursera.org/specializations/data-structures-algorithms>
6. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
2	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
3	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
4	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
5	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
6	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
7	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
8	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
9	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
10	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
11	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
12	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Code chef	Hacker rank	Leet code	Geek for Geeks
Unit-1	3	0	2	1	0
Unit-2	0	1	3	2	0
Unit-3	0	0	1	5	0
Unit-4	0	0	3	2	0
Unit-5	0	0	1	1	0
Additional Practice	0	0	3	8	1
Total	3	1	13	19	1

Operating Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

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

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

Practice:

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

UNIT – II

Process Concept: Process scheduling, Operations on processes, Inter-process communication.

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

Multithreaded Programming: Multithreading models, Thread libraries, Threading issues

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

Practice:

1. Simulate the following CPU scheduling algorithms: FCFS and SJF
2. Simulate the following CPU scheduling algorithms: Priority and Round Robin

UNIT – III

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

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

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

Practice:

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

UNIT – IV

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.

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

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

Practice:

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

UNIT – V

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

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

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

Practice:

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

Text Books:

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

Reference Books:

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

Web Links:

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

Database Management Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

Course Code: 2501IT05

L	T	P	C
2	0	2	4

Course Outcomes:

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

- 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 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(uptable and nonuptable), 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.)

Course Code: 2501CS07

L	T	P	C
2	0	1	3

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

Practice:

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

UNIT – II

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

Practice:

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

UNIT – III

Media Access Control: Random Access: ALOHA, Carrier sense multiple access (CSMA), CSMA with Collision Detection, CSMA with Collision Avoidance, Controlled Access: Reservation, Polling, Token Passing, Channelization: frequency division multiple Access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA).

Practice:

1. Write a Program to implement Sliding window protocols

UNIT – IV

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

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

Traffic Control Algorithm: Leaky bucket & Token bucket.

Practice:

1. Programs to implement 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, Atul Kahate, McGraw-Hill Education (India) Pvt Limited, 2nd Edition. ISBN: 978-0-07-123110-7
- 2 Computer Networks, Mayank Dave, CENGAGE India, 6th Edition ISBN: 978-8131509869

Web Links:

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

Artificial Intelligence

(CE, EEE, ECE, PT, Min.E.)

Course Code: 2501AI02

L	T	P	C
2	0	1	3

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

- CO1:** Illustrate the foundations, history, and applications of Artificial Intelligence using modern tools
- CO2:** Develop AI-based problem-solving models using Python
- CO3:** Implement search and optimization algorithms using Python libraries
- CO4:** Apply knowledge representation techniques using Python frameworks
- CO5:** Design simple intelligent systems and expert systems using Python

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit - I

Introduction to AI & Python Foundations

What is AI? Foundations and History of AI, AI Applications in real-world systems, Intelligent Agents and Environment, Rationality and Types of Agents, Fundamentals of Python for AI applications.

Practice (Python-based):

1. Implement simple AI agent (e.g., vacuum cleaner agent simulation)
2. Rule-Based AI Agent (Weather Decision Agent)

Unit – II

Problem Solving & Search Algorithms

Problem formulation and state space representation, Control strategies, Search strategies, Uninformed Search: BFS, DFS, Uniform Cost Search, Informed Search: Greedy, A* Algorithm, Heuristics and evaluation functions.

Practice (Python):

1. Implement DFS algorithm for Water Jug Problem
2. Solve Tic-Tac-Toe using BFS search strategy.
3. Implement A* Algorithm for pathfinding (e.g., grid navigation)

Unit – III

Optimization & Game Playing

Problem graphs, Matching, Indexing, Local Search Algorithms: Hill Climbing, Simulated Annealing, Optimization Problems, Searching with Nondeterministic Actions, Constraint Satisfaction Problems (CSP), Game Playing: Minimax Algorithm, Alpha-Beta Pruning

Practice (Python):

1. Solve 8-Puzzle using Hill Climbing
2. Implement Travelling Salesman Problem (TSP) using heuristic approach

Unit – IV

Knowledge Representation

Knowledge Representation Techniques, Propositional Logic & Predicate Logic, Inference & Resolution, Semantic Networks and Frames, Representation of knowledge through Planning generation Systems-K Strips Strategic explanations Why, why not and how explanations.

Practice (Python):

1. a) Implement Predicate Logic using Python (SymPy / logic module)
b) Develop a Semantic Network (e.g., Animals or Transport)
2. Create a Frame-based system (Restaurant domain)

Unit – V

Expert Systems & Modern AI Applications

Expert Systems Architecture, Knowledge Acquisition & Representation, Meta knowledge, Rule-based Systems, Ethics in AI, Typical expert systems – EMYCIN, DART, XOON, Expert systems shells.

Practice (Python):

1. Build a Travel Recommendation Expert System
2. Develop a Student Career Guidance System

Text Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig (need to add details)
2. Artificial Intelligence: Foundations of Computational Agents – Poole & Mackworth

Reference Books

1. Artificial Intelligence with Python – Prateek Joshi
2. Hands-On Machine Learning with Scikit-Learn & TensorFlow – Aurélien Géron
3. Python AI Projects for Beginners – Prateek Joshi

Web Resources

1. <https://docs.python.org>
2. <https://nptel.ac.in/courses/106105077>
3. <https://nptel.ac.in/courses/106106126>

Machine Learning
(CE, ECE, PT, Min.E.)

Course Code: 2501AI05

L	T	P	C
2	0	2	4

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2			2	2		1	1		
CO2	2	2	3		2	2		1	1		
CO3	3	2	3		2			1	1		2
CO4	3	2	3		2			1	1		
CO5	2	2	2		2			1	1		2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

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

Practice :

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

UNIT – II

Supervised Learning(Regression/Classification):Basic Methods:

Concept Learning: General-to-Specific Hypotheses Ordering, Find-S and Candidate Elimination Algorithm, Version Space, and Inductive Bias.

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

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

Practice :

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

UNIT – III

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

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

Practice :

1. Exercises to solve the real-world problems using Linear Regression
2. Exercises to solve the real-world problems using Logistic Regression
3. Consider Patient Dataset. Apply linear classification technique(SVM) to identify the rate of 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 to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
2. Apply EM algorithm to cluster a Heart Disease Data Set. Use the same data set for clustering using kMeans algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

Corner Stone Project:

PROJECT 1: Intelligent Loan Risk Assessment System (End-to-End ML Pipeline)

Project Implementation, Documentation and Viva Voce

• Implementation mainly focuses on

- Collecting and integrating multiple datasets (loan + financial history)
- Advanced preprocessing (missing values, outliers, feature engineering)
- Implementing multiple models (Logistic Regression, Random Forest, XGBoost)
- Handling imbalanced data (SMOTE / resampling techniques)
- Model evaluation using ROC-AUC, F1-score, cross-validation
- Building a simple UI (Streamlit/Web app) for predictions
- Model comparison and optimization

• Documentation must contain

- Objective & real-world problem definition
- Dataset merging and preprocessing pipeline
- Feature engineering techniques
- Model comparison and evaluation metrics
- System architecture diagram
- Screenshots (UI + outputs)
- Enhancements (hyperparameter tuning, deployment)

PROJECT 2: Smart Disease Prediction System with Model Ensemble

• Implementation mainly focuses on

- Using medical datasets (heart disease/diabetes/multi-disease)
- Data preprocessing and feature selection
- Applying multiple classifiers (SVM, kNN, Random Forest, Gradient Boosting)

- Ensemble learning (Voting / Stacking models)
- Model evaluation using confusion matrix, ROC curves
- Explainability (feature importance / SHAP basics)
- Web-based prediction interface
- **Documentation must contain**
 - Objective
 - Dataset and preprocessing steps
 - Model architecture and ensemble approach
 - Evaluation metrics and comparison
 - Screenshots (prediction system)
 - Enhancements (multi-disease prediction)

PROJECT 3: Real-Time Sentiment Analysis System with Web Scraping

- **Implementation mainly focuses on**
 - Scraping live data (Twitter/news using APIs or scraping tools)
 - Text preprocessing (stopwords, stemming, vectorization – TF-IDF)
 - Training models (Naïve Bayes, Logistic Regression, LSTM optional)
 - Real-time sentiment prediction
 - Visualization dashboard (charts for sentiment trends)
 - Handling large-scale streaming data
- **Documentation must contain**
 - Objective
 - Data collection methodology (APIs/web scraping)
 - NLP preprocessing pipeline
 - Model building and evaluation
 - Dashboard explanation
 - Screenshots
 - Enhancements (real-time alerts, topic modeling)

PROJECT 4: Heart Disease Prediction using SVM

- **Implementation mainly focuses on**
 - Loading patient dataset
 - Applying Support Vector Machine (SVM)
 - Data preprocessing and feature scaling
 - Classification of patients (disease/no disease)
 - Model evaluation using confusion matrix
- **Documentation must contain**
 - Objective
 - Dataset description
 - SVM working principle
 - Evaluation metrics
 - Output results
 - Screenshots
 - Enhancements (kernel comparison)

PROJECT 5: Customer Segmentation using Clustering

- **Implementation mainly focuses on**
 - Loading customer dataset
 - Applying K-Means clustering
 - Identifying groups based on features
 - Visualizing clusters using plots
 - Comparing clustering results
- **Documentation must contain**

- Objective
- Dataset details
- Clustering technique explanation
- Cluster visualization
- Results interpretation
- Screenshots
- Enhancements (DBSCAN comparison)

PROJECT 6: Fake News Detection System using Machine Learning

- **Implementation mainly focuses on**
 - Dataset collection (news datasets / scraping)
 - Text preprocessing (tokenization, TF-IDF, n-grams)
 - Applying classification models (Logistic Regression, SVM, Random Forest)
 - Model evaluation using precision, recall, F1-score
 - Comparing multiple models
 - Building a simple interface for prediction
- **Documentation must contain**
 - Objective
 - Dataset description
 - NLP pipeline
 - Model comparison
 - Evaluation metrics
 - Screenshots
 - Enhancements (deep learning models)

PROJECT 7: Sentiment Analysis using Ensemble Learning

- **Implementation mainly focuses on**
 - Collecting dataset (Twitter/Kaggle)
 - Text preprocessing
 - Applying Bagging and Boosting techniques
 - Training ensemble models (Random Forest / AdaBoost)
 - Predicting sentiment (positive/negative)
- **Documentation must contain**
 - Objective
 - Dataset source
 - Preprocessing steps
 - Ensemble methods explanation
 - Performance comparison
 - Screenshots
 - Enhancements (real-time data analysis)

PROJECT 8: Model Evaluation and Comparison System

- **Implementation mainly focuses on**
 - Implementing multiple models (kNN, SVM, Regression)
 - Performing cross-validation
 - Calculating accuracy, precision, recall, F1-score
 - Comparing model performance
 - Visualizing results using graphs
- **Documentation must contain**
 - Objective
 - Models used
 - Evaluation metrics explanation
 - Comparison results
 - Graphs and charts

- Screenshots
- Enhancements (hyperparameter tuning)

Text Books:

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

Reference Books:

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

Web Links:

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

Note:

- Students must submit the Certificate of Completion offered by any Industry.
- The capstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The SEE – Lab shall be evaluated for 50 marks based on project implementation, oral presentation, 10-minute video presentation, and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.

Fundamentals of Data Science

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

Course Code: 2501CS34

L	T	P	C
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/>

