

B.TECH. PROGRAM CURRICULUM - 2025

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

Version 2.0

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



A D I T Y A
U N I V E R S I T Y

Aditya Nagar, ADB Road, Surampalem - 533 437



Department of Mechanical Engineering**VISION:**

To be a globally recognized pioneer in Mechanical Engineering by promoting Excellence in Education, fostering Innovative Research, and delivering Sustainable Solutions to address global challenges.

MISSION

M1: Ensure educational excellence through infrastructure supporting industry-aligned design and development.

M2: Develop innovative research ecosystem through collaborations with industry and academia.

M3: Integrate Leadership and Teamwork Capabilities for solving inclusive community challenges.

PROGRAM EDUCATIONAL OUTCOMES:

Graduates of the Program will

PEO 1: Excel in careers or entrepreneurship by applying mechanical engineering knowledge with innovation and responsibility.

PEO 2: Pursue higher education, interdisciplinary research, and contribute to sustainable development.

PEO 3: Engage in lifelong learning and adapt to emerging technologies for professional growth

PROGRAM SPECIFIC OUTCOMES:

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

PSO 1: Design and develop components for enhancement of manufacturing processes with modern engineering tools.

PSO 2: Create sustainable energy systems effectively for a variety of technical applications.

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 Mechanical Engineering

B. Tech (ME) Program Curriculum – 2025

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

UG Programs Offered

- B. Tech in (Mechanical Engineering)
- B. Tech in (Mechanical Engineering) with
 - Minor degree in Civil Engineering
 - Minor degree in Electrical and Electronics Engineering
 - Minor degree in Electronics and Communication Engineering
 - Minor degree in Computer Science and Engineering
 - Minor degree in Data Science
 - Minor degree in Artificial Intelligence and Machine Learning
 - Minor degree in Petroleum Technology
 - Minor degree in Mining Engineering
 - Minor degree in Agricultural Engineering
 - Minor degree in Entrepreneurship Development and Incubation
 - Minor degree in Quantum Technologies

Minor Streams offered in B. Tech (Mechanical Engineering)

- Minor Stream in Automation & Robotics
 - Minor Stream in Thermal Engineering
 - Minor Stream in Automotive Engineering
 - Minor Stream in Design and Manufacturing
 - Minor Stream in Advanced Specialization on Electric Vehicles
- Industry Integrated Program- L & T

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)	9	11
4	Ability Enhancement Courses (AEC)	8	9
5	Skill Enhancement Courses (SEC)	9	6
6	Value Added Courses (VAC)	6-8	6
7	Summer Internship (SI)	2-4	4
8	Full Semester Internship (PROJ)	12	12
9	Mandatory Course (MC)	0	0
Total Credits to be earned for B. Tech Degree		160	160

Foundation Courses – FC

Intermediate-level Courses - IC

Advanced Courses – AC

Major Core Courses (MCC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100	-	100	-
2501ME02	Engineering Mechanics	FC	2	1	1	4	50	50	100	-
2501ME04	Engineering Thermodynamics	IC	2	1		3	50	50	100	SSP/ MP
2501MA03	Integral Transforms & Applications of Partial Differential Equations	IC	2	1		3	50	50	100	LAC
2501MA04	Numerical Methods & Statistical Techniques	IC	2	1		3	50	50	100	ITAPDE
2501ME05	Fluid Mechanics & Hydraulic Machines	IC	2	1	1	4	50	50	100	SSP
2501ME06	Material Science and Deformation	IC	2		2	4	50	50	100	EC
2501ME07	Manufacturing Process-I	IC	2		2	4	50	50	100	EW
2501ME08	Automobile Engineering	IC	3		1	4	50	50	100	SSP
2501ME09	Kinematics of Machinery	IC	2	1	1	4	50	50	100	EM
2501ME10	Internal Combustion Engine	IC	2		2	4	50	50	100	ETD
2501ME11	Manufacturing Process-II	IC	2		2	4	50	50	100	MP – I
2501ME12	Heat Power Engineering	IC	2	1		3	50	50	100	ETD
2501ME13	Machine Design	IC	2	1		3	50	50	100	EG
2501ME14	Computer Aided Machine Drawing (CAMD)	IC			3	3	50	50	100	EG

2501MB01	Engineering Economics & Management	IC	2			2	50	50	100	-
2501ME15	Mechatronics	IC	2		2	4	50	50	100	MP-I
2501ME16	Heat Transfer	AC	2		2	4	50	50	100	HPE
2501ME17	Dynamics of Machinery	AC	2		2	4	50	50	100	KOM
Total			44	10	26	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	-
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	FC	2		2	4	50	50	100	-
2501ME18	Operations Research	IC	2	1		3	50	50	100	-
Total			6	1	4	11				

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Prerequisite
2501EN01	Essential Cognitive Skills for Engineers	FC			1	1	100	-	100	-
2501EN02	Advanced Cognitive Skills for Engineers	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	-
2501ME91	Student Activity Based Learning	AC				2	100	-	100	-
Total			2		5	9				

Skill Enhancement Courses (SEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME19	Digital Manufacturing Lab	IC			2	2	50	50	100	-
2501ME20	Analysis & Simulation Lab	AC			2	2	50	50	100	-
2501AI01	Artificial Intelligence & Machine Learning Lab	AC			2	2	50	50	100	-
Total			-	-	6	6				

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	FC			2	2	50	50	100	-
2501CS04	Internet of Things	FC			1	1	50	50	100	-
2501CS02	Data Analysis using Python	IC			2	2	50	50	100	PPSC
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					20	6				

Summer Internships (SI)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME21	Summer Internship - I	IC			2	2	100	-	100	-
2501ME22	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
2501ME23	Full Semester Internship	AC			12	12	50	50	100	-
Total					12	12				

Mandatory Course (MC)

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

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

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

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

Minor Stream: Automation & Robotics

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME24	Elements of Robotics	FC	2			2	50	50	100	-
2501ME25	Programming for Robotics	IC	2		1	3	50	50	100	PPSC
2501ME26	Digital Manufacturing	IC	3			3	50	50	100	MP-I
2501ME27	Advanced Fluid Power & Control Systems	IC	2		1	3	50	50	100	FMHM
2501ME28	Robotic Mobility Systems	AC	2		1	3	50	50	100	EOR
2501ME29	Control of Robotic System	AC	2		1	3	50	50	100	RMS
2501ME30	AI for Robotics	AC	2		1	3	50	50	100	EOR
2501ME31	Robotic Operating System	AC	2		1	3	50	50	100	DAP
2501ME32	Advanced Robotic Operating System	AC	2		1	3	50	50	100	ROS
2501ME33	Field & Service Robotics	AC	2		1	3	50	50	100	PFR
2501ME34	Robotic Process Automation (Industry Partnered Certification Program)	AC	3			3	50	50	100	EOR
Total			24		8	32				

Minor Stream: Thermal Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME35	Power Plant Engineering	FC	2			2	50	50	100	-
2501ME36	Sustainable Energy Systems	FC	3			3	50	50	100	-
2501ME37	Solar Energy Systems	FC	3			3	50	50	100	-
2501ME38	Alternative Fuels for IC engines	IC	3			3	50	50	100	ICE
2501ME39	Fuel Cell Technology	IC	3			3	50	50	100	ICE
2501ME40	Refrigeration & Air Conditioning	IC	2	1		3	50	50	100	ETD
2501ME41	Hydraulic Machinery & Systems	IC	3			3	50	50	100	FMHM
2501ME42	Cryogenic Engineering	AC	3			3	50	50	100	R&AC
2501ME44	Energy Storage Systems	AC	3			3	50	50	100	BEEE
2501ME45	Gas Dynamics & Jet Propulsion	AC	2	1		3	50	50	100	HPE

2501ME46	Computational Fluid Dynamics	AC	2	1		3	50	50	100	HT, FMHM
Total			29	3		32				

Minor Stream: Automotive Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME47	Automotive Electrical & Electronics	FC	2			2	50	50	100	BEEE
2501ME48	Automotive Maintenance	IC	2		1	3	50	50	100	AE
2501EE54	Hybrid & Electric Vehicles	IC	3			3	50	50	100	BEEE
2501ME49	Electronic Engine Management System	IC	3			3	50	50	100	HEV
2501ME50	Automotive Certification & Homologation	IC	3			3	50	50	100	AE
2501ME51	Vehicle Infotronics	IC	3			3	50	50	100	AEE
2501ME52	Automotive Aerodynamics	AC	3			3	50	50	100	FMHM, AE
2501ME53	Automotive Noise Vibration & Harshness	AC	3			3	50	50	100	DOM
2501ME54	Vehicle Stability & Control	AC	3			3	50	50	100	AE
2501ME55	Special Purpose Vehicles	AC	3			3	50	50	100	AE
2501ME56	Automotive & Pedestrian Safety	AC	3			3	50	50	100	AE
Total			31		1	32				

Minor Stream: Design and Manufacturing

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME57	Plant Layout & Material Handling	FC	2			2	50	50	100	-
2501ME59	Additive Manufacturing	IC	3			3	50	50	100	MF - I
2501ME60	Composite Materials	IC	3			3	50	50	100	SSP/MP
2501ME61	Design for Manufacturing	IC	3			3	50	50	100	MSD
2501ME62	Industrial Automation	IC	3			3	50	50	100	MF - I
2501ME63	Flexible Manufacturing System	IC	3			3	50	50	100	MF - I
2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	100	-

2501ME64	Design of Transmission Systems	AC	2	1		3	50	50	100	MD
2501ME65	Advanced Mechanics of Solids	AC	2	1		3	50	50	100	MSD
2501ME66	Mechanical Vibrations	AC	2	1		3	50	50	100	DOM
2501ME67	Condition Monitoring	AC	3			3	50	50	100	DOM
Total			30	2		32				

Minor Stream: Advanced Specialization on Electric Vehicles Industry Integrated Program- L & T

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE41	Foundations of EV & Hybrid Vehicles	FC	3			3	50	50	100	-
2501ME68	Automotive Mechanics for EV	IC	2			2	50	50	100	MF - I
2501ME69	EV Mechanical Design Development & Analysis	IC	3			3	50	50	100	MSD
2501ME70	EV Product Development, Homologation & Hydrogen FCEV	IC	3			3	50	50	100	AE
2501EE42	EV Battery Technology & Powertrain Development	IC	3			3	50	50	100	BEEE
2501ME43	EV Charging Infrastructure, Vehicle Testing & Homologation	IC	3			3	50	50	100	BEEE
2501EE44	EV Power Electronics & Embedded Systems	AC	3			3	50	50	100	BEEE
2501ME71	EV Data Analytics & Cyber Security	AC	3			3	50	50	100	MD
2501ME72	EV FEA Analysis	AC	3			3	50	50	100	MSD
2501ME54	Vehicle Stability & Control	AC	3			3	50	50	100	AE
2501ME56	Automotive & Pedestrian Safety	AC	3			3	50	50	100	AE
Total			32			32				

L&T Syllabus for the industry partnered courses will be released in the department as and when required.

University Open Elective Courses (UEC)

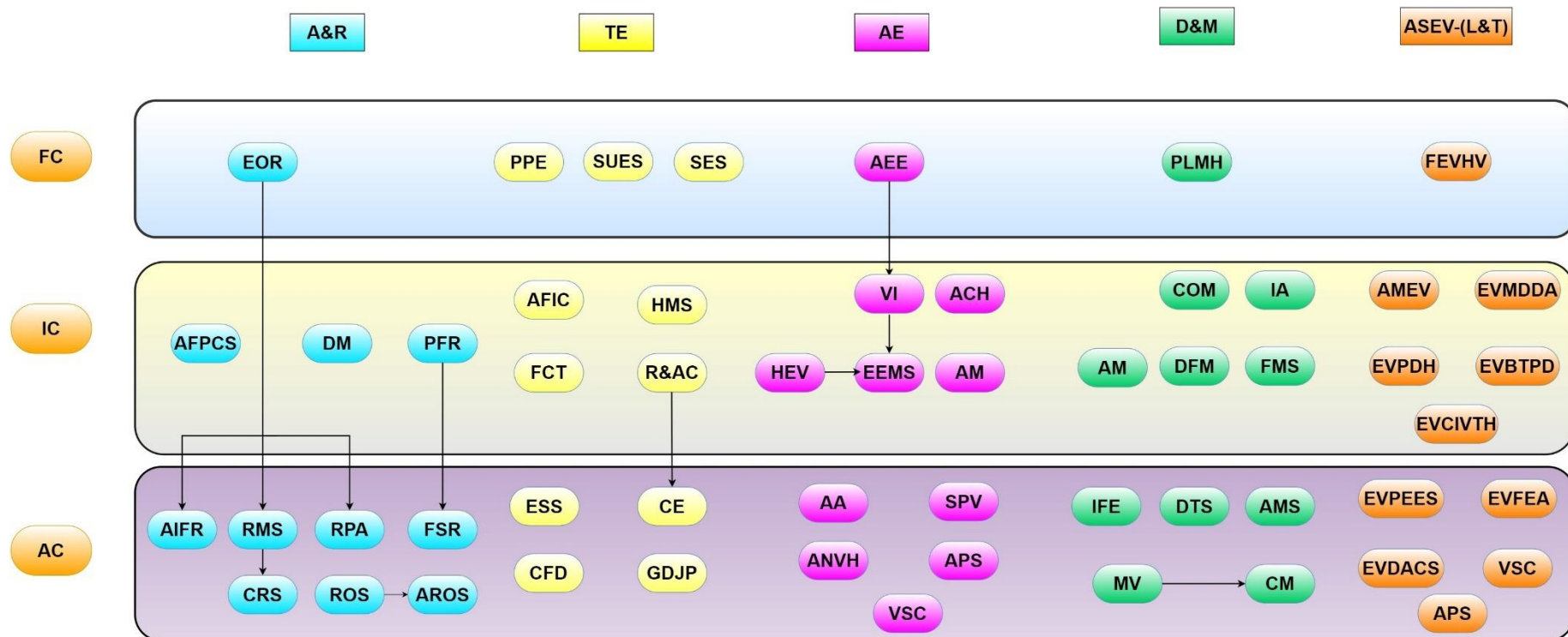
Branch	Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Offered to	Pre-requisite
CE	2501CE66	Natural Disaster Management & Mitigation		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE81	Wastewater Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE82	Integrated Solid Waste Management for a Smart City		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
CE	2501CE83	Watershed Management		3	0	0	3			EEE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE53	Electric Power Generation, Transmission & Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE, ME, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME36	Sustainable Energy Systems	FC	3			3	50	50	CE, EEE, ECE, CSE, IT, AIML, CSE(DS) PT, Min.E	
ECE	2501EC97	Biomedical Electronics	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	

ECE	2501EC98	Fundamentals of Wireless Communications	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA3	Introduction to Quantum Computing	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/2601DS02	Data Structures* / Data Structures using C++#	FC	2		2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2		2	4	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS
IT	2501CS07	Computer Networks	AC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2		1	3	50	50	CE, EEE, ECE, PT, Min.E	-
AI&ML	2501AI05	Machine Learning	AC	2		2	4	50	50	CE, ECE, PT, Min.E	DAUP
DS	2501CS34	Fundamental of Data Science	FC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	PPSC / CP&DS

Foundation Courses (FC)		Intermediate-Level Courses (IC)		Advanced Courses (AC)	
LAC	Linear Algebra & Calculus	ITAPDE	Integral Transforms & Applications of Partial Differential Equations	HT	Heat Transfer
DEVC	Differential Equations & Vector Calculus	NMST	Numerical Methods & Statistical Techniques	DOM	Dynamics of Machinery
SSP	Solid State Physics	ETD	Engineering Thermodynamics	TPP	Technical Paper publication
EC	Engineering Chemistry	ICE	Internal Combustion Engine	SI-II	Summer Internship-II
EG	Engineering Graphics	MP-I	Manufacturing Process-I	FSI	Full Semester Internship
EM	Engineering Mechanics	HPE	Heat Power Engineering	AS LAB	Analysis & Simulation Lab
EW	Engineering Workshop	FMHM	Fluid Mechanics & Hydraulic Machines	AIML Lab	AIML Lab
BEEE	Basic Electrical & Electronics Engineering	MSD	Material Science and Deformation	ES - V	Employability Skills – V
PPSC	Programming for Problem Solving Using C	MP-II	Manufacturing Process-II	SABL	Student Activity Based Learning
ECSE	Essential Cognitive Skills for Engineers	AE	Automobile Engineering	MSC - Minor Stream Courses UEC - University Open Elective Courses	
UHV	Universal Human Values	KOM	Kinematics of Machinery		
ACSE	Advanced Cognitive Skills for Engineers	MD	Machine Design		
DT	Design Thinking using AI	MECHA	Mechatronics		
IOT	Internet of Things	OR	Operations Research		
BIL	Business Intelligence Lab	EEM	Engineering Economics & Management		
ES - I	Employability Skills – I	DAP	Data Analysis using Python		
ES - II	Employability Skills – II	DML	Digital Manufacturing Lab		
ES	Environmental Science	ES - III	Employability Skills – III		
COI	Constitution of India	ES - IV	Employability Skills – IV		
RM	Research Methodology	SI-I	Summer Internship-I		
IPR	Intellectual Property Rights & Patents	CAMD	Computer Aided Machine Drawing		
BE	Biology for Engineers				

B. Tech (ME) Minor Stream

Pre-requisite Flow Chart



Minor Stream		FOUNDATION COURSE (FC)		INTERMEDIATE COURSE (IC)	ADVANCED COURSES (AC)	
Automation & Robotics (A&R)	EOR	Elements of Robotics	PFR DM AFPCS	Programming for Robotics Digital Manufacturing Advanced Fluid Power & Control Systems	RMS CRS AIFR ROS AROS FSR RPA	Robotic Mobility Systems Control of Robotic System AI for Robotics Robotic Operating System Advanced Robotic Operating System Field & Service Robotics Robotic Process Automation (Industry Partnered Certification Program)
Thermal Engineering (TE)	PPE SUES SES	Power Plant Engineering Sustainable Energy Systems Solar Energy Systems	AFIC FCT R&AC HMS	Alternative Fuels for IC engines Fuel Cell Technology Refrigeration & Air Conditioning Hydraulic Machinery & Systems	CE ESS GDJP CFD	Cryogenic Engineering Energy Storage Systems Gas Dynamics & Jet Propulsion Computational Fluid Dynamics
Automotive Engineering (AE)	AEE	Automotive Electrical & Electronics	AM HEV EEMS ACH VI	Automotive Maintenance Hybrid & Electric Vehicles Electronic Engine Management System Automotive Certification & Homologation Vehicle Infotronics	AA ANVH VSC SPV APS	Automotive Aerodynamics Automotive Noise Vibration & Harshness Vehicle Stability & Control Special Purpose Vehicles Automotive & Pedestrian Safety
Design and Manufacturing (D&M)	PLMH	Plant Layout & Material Handling	AM COM DFM IA FMS	Additive Manufacturing Composite Materials Design for Manufacturing Industrial Automation Flexible Manufacturing System	IFE DTS AMS MV CM	Industry 5.0 for Engineers Design of Transmission Systems Advanced Mechanics of Solids Mechanical Vibrations Condition Monitoring
Advanced Specialization on Electric Vehicles (Mechanical) Industry Integrated Program- L & T (ASEV L & T)	FEVHV	Foundations of EV & Hybrid Vehicles	AMEV EVMDDA EVPDH EVBTPD EVCIVTH	Automotive Mechanics for EV EV Mechanical Design Development & Analysis EV Product Development, Homologation & Hydrogen FCEV EV Battery Technology and Powertrain Development EV Charging Infrastructure, Vehicle Testing & Homologation	EVPEES EVDACS EVFEA VSC APS	EV Power Electronics & Embedded Systems EV Data Analytics & Cyber Security EV FEA Analysis Vehicle Stability & Control Automotive & Pedestrian Safety

Suggestive Semester wise Curriculum

I SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA01	Linear Algebra & Calculus	MCC	FC	2	1		3	3
2501PH01	Solid State Physics	MCC	FC	2		1	3	4
2501ME01	Engineering Graphics	MCC	FC	1		2	3	5
2501ME02	Engineering Mechanics	MCC	FC	2	1	1	4	5
2501ME03	Engineering Workshop	MCC	FC			1	1	2
2501EN01	Essential Cognitive Skills for Engineers	AEC	FC			1	1	2
2501UC08	Universal Human Values	AEC	FC	2			2	2
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	VAC	FC			2	2	4
Total				9	2	8	19	27

II SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA02	Differential Equations & Vector Calculus	MCC	FC	2	1		3	3
2501CH01	Engineering Chemistry	MCC	FC	2		1	3	4
2501EE01	Basic Electrical & Electronics Engineering	MDC	FC	2		2	4	6
2501ME04	Engineering Thermodynamics	MCC	IC	2	1		3	3
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	MDC	FC	2		2	4	6
2501MB01	Engineering Economics & Management	MCC	IC	2			2	2
2501EN02	Advanced Cognitive Skills for Engineers	AEC	FC			1	1	2
2501CS04	Internet of Things	VAC	FC			1	1	2
2501UC07	Design Thinking using AI	AEC	FC			1	1	2
2501UC11	Employability Skills – I	VAC	FC			3	0	3
2501AC01	Environmental Science	MC	FC	2			0	0
Total				14	2	11	22	33

III SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA03	Integral Transforms & Applications of Partial Differential Equations	MCC	IC	2	1		3	3
2501ME05	Fluid Mechanics & Hydraulic Machines	MCC	IC	2	1	1	4	5
2501ME06	Material Science and Deformation	MCC	IC	2		2	4	6
2501ME09	Kinematics of Machinery	MCC	IC	2	1	1	4	5
2501ME10	Internal Combustion Engine	MCC	IC	2		2	4	6
2501ME19	Digital Manufacturing lab	SEC	IC			2	2	4
2501UC13	Employability Skills – II	VAC	FC			3	0	3
2501AC02	Constitution of India	MC	FC	2			0	0
Total				12	3	11	21	32

IV SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA04	Numerical Methods & Statistical Techniques	MCC	IC	2	1		3	3
2501ME07	Manufacturing Process-I	MCC	IC	2		2	4	6
2501ME14	Computer Aided Machine Drawing	MCC	IC			3	3	6
2501ME17	Dynamics of Machinery	MCC	IC	2		2	4	5
	Minor Stream Course-1 (or) University Open Elective Course – 1	MSC/UEC	FC/IC	2			2	2
2501CS02	Data Analysis using Python	VAC	IC			2	2	4
2501UC14	Employability Skills – III	VAC	IC			3	0	3
2501AC03	Research Methodology	MC	FC	2			0	0
Total				10	1	12	18	29

V SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501ME08	Automobile Engineering	MCC	IC	3		1	4	5
2501ME11	Manufacturing Process-II	MCC	IC	2		2	4	6
2501ME12	Heat Power Engineering	MCC	IC	2	1		3	3
	Minor Stream Course-2 (or) University Open Elective Course -2	MSC/ UEC	FC/IC	3			3	3
	Minor Stream Course-3 (or) University Open Elective Course -3	MSC/ UEC	IC/AC	3			3	3
	Minor Stream Course -4 (or) University Open Elective Course -4	MSC/ UEC	IC/AC	3			3	3
2501UC15	Employability Skills – IV	VAC	IC			3	0	3
2501ME21	Summer Internship – I	SI	IC			2	2	4
2501AC04	Intellectual Property Rights & Patents	MC	FC	2			0	0
Total				18	1	8	22	30

VI SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501ME16	Heat Transfer	MCC	IC	2		2	4	5
2501ME18	Operations Research	MDC	IC	2	1		3	3
2501ME13	Machine Design	MCC	IC	2	1		3	3
	Minor Stream Course-5 (or) University Open Elective Course -5	MSC/ UEC	IC/AC	3			3	3
	Minor Stream Course -6 (or) University Open Elective Course -6	MSC/ UEC	IC/AC	3			3	3
	Minor Stream Course -7 (or) University Open Elective Course -7	MSC/ UEC	IC/AC	3			3	3
2501ME20	Analysis & Simulation Lab	SEC	AC			2	2	4
2501AC05	Indian Knowledge Systems	MC	FC	2			0	2
Total				17	2	4	21	26

VII SEMESTER

Course Code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501ME15	Mechatronics	MCC	IC	2		2	4	5
	Minor Stream-8 (or) University Elective Course -8	MSC/UEC	AC	3			3	3
	Minor Stream Course -9 (or) University Open Elective Course -9	MSC/UEC	AC	3			3	3
	Minor Stream Course -10 (or) University Open Elective Course -10	MSC/UEC	AC	3			3	3
	Minor Stream Course -11 (or) University Open Elective Course -11	MSC/UEC	AC	3			3	3
2501AI01	Artificial Intelligence & Machine Learning Lab	SEC	AC			2	2	4
2501ME22	Summer Internship – II	SI	IC			2	2	4
Total				14	0	6	20	25

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
2501ME23	Full Semester Internship	PROJ	AC			12	12	24
2501ME91	Student Activity Based Learning	AEC	AC				2	
Total						17	17	31

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 Mechanical Engineering

(Offered to other branches students):

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 and 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 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	3			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			18		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
2501EE06	Electric Power Generation and Distribution Systems	IC	3			3	50	50	100	ENA-1/BEEE
2501EE13	Electrical Measurements & Instrumentation	FC	2		2	4	50	50	100	ENA-1/BEEE
2501EE34	Alternative Energy Sources (or)	IC	3			3	50	50	100	EPGDS / BEEE/ ISM
2501EE27	Utilization of Electrical Energy									
2501EE37	Hybrid Electric Vehicles (or)	AC	3			3	50	50	100	FPE/ OCEM
2501EE35	Special Electric machines									
2501EE43	Electrical Safety (or)	AC	3			3	50	50	100	EPGDS/P SA
2501EE30	Methods & Algorithms for Intelligent Control									
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	3			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
2501EC93										
2501EC67	Introduction to Internet of Things (or)	AC	2		1	3	50	50	100	EM, WLAN's & PAN's
2501EC74	Modern Wireless Communications		3			3	50	50	100	FC
Total			16		4	20				

Minor Degree in Computer Science and Engineering

Course Code	Course Title	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS13	Operating Systems	IC	2		1	3	50	50	100	-
2501CS07	Computer Networks	IC	2		1	3	50	50	100	-
2501IT07	Agile Software Engineering	IC	2		1	3	50	50	100	PPSC
2501AI03	Data Mining	IC	2		1	3	50	50	100	-
2501CS08	Object Oriented Programming through C++	IC	2		2	4	50	50	100	PPSC
2501IT06	(or) Java Programming									
2501CS16	Introduction to MERN Stack Development	IC			2	2		100	100	JP
2501CS30	(or) Information Security Analysis & Audit	IC	2			2	50	50	100	-
2501CS18	Advanced MERN Stack Development	AC			2	2		100	100	IMSD
2501IT12	(or) 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	AC	2		1	3	50	50	100	DM
2501AI48	(or) Data Visualization Techniques									DAP
2501CS41	Social Network Analysis	AC	2		1	3	50	50	100	-
2501CS40	(or) Social Networks & Semantic Web									
Total			14		6	20				

Minor Degree in Artificial Intelligence and Machine Learning

Course Code	Course Title	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	IC	2		1	3	50	50	100	AI
2501CS34	(or) Fundamentals of Data Science		2		1					PPSC
2501AI47	Natural Language Processing and Text Analytics (or)	AC	2		1	3	50	50	100	DAP
2501AI48	Data Visualization Techniques									
2501AI16	Prompt Engineering & GenAI	AC	2		1	3	50	50	100	ML
2501CS41	(or) 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) Fundamentals of Liquefied Natural Gas	AC	2			2	50	50	100	-
2501PT05			3			3				
2501PT50	Artificial Lift Techniques (or) Enhanced Oil Recovery	AC	3			3	50	50	100	-
2501PT03			2	1		3				
2501PT12	Petroleum Refinery Engineering	AC	3			3	50	50	100	-
Total			18	2		20				

Minor Degree in Mining Engineering

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

Minor Degree in Agricultural Engineering

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

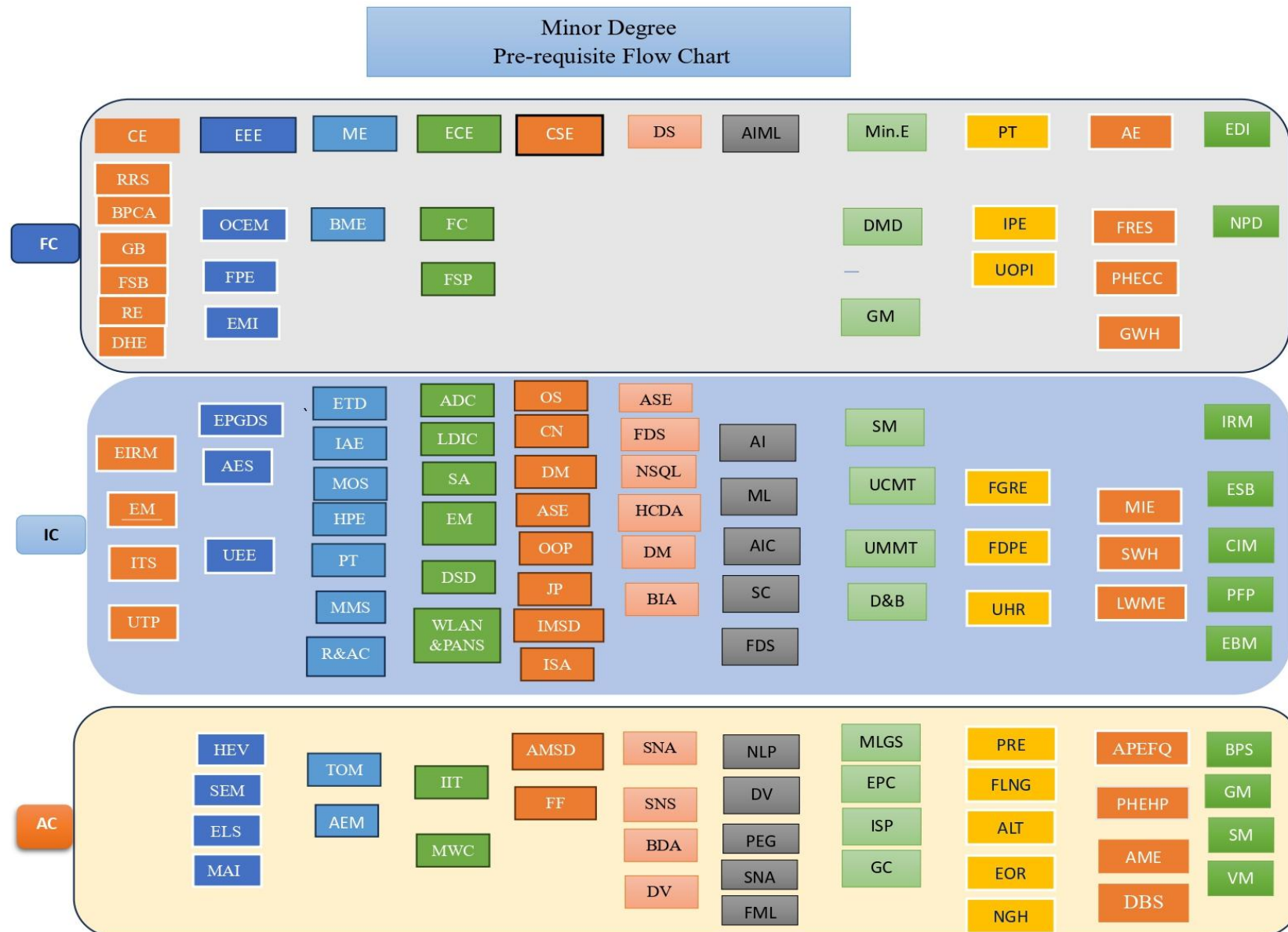
Minor Degree in Entrepreneurship Development & Incubation

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MB07	New Product Development	FC	3			3	50	50	100	-
2501MB08	Entrepreneurship & Small Business Management	IC	2			2	50	50	100	-
2501MB09	Insurance & Risk Management	IC	3			3	50	50	100	-
2501MB10	Change & Innovations Management	IC	3			3	50	50	100	-
2501MB11	Personal Financial Planning	IC	3			3	50	50	100	-
2501MB12	(or) E-Business management									
2501MB13	Business Policy & Strategic Management	AC	3			3	50	50	100	-
2501MB14	(or) Green Marketing									
2501MB15	Startup Management	AC	3			3	50	50	100	-
2501MB16	(or) Venture Management									
Total			20			20				

Minor Degree in Quantum Technologies

S.No.	Course Code	Course Name	L	T	P	C	Semester
Mandatory Courses							
1	251EC097	Survey of Quantum technologies and Application	3	0	0	3	IV
2	251EC098	Foundations of Quantum Technologies	3	0	0	3	V
3	251EC099	Basic Programming Lab (or)	1	0	2	3	V
	251EC100	Basic Laboratory Course for Quantum Technologies					
4	251EC101	Quantum Algorithms and Cryptography	12 week 3 Credit - NPTEL MOOC			3	VII/VIII

Any One course from the below							
5	251EC102	Introduction to Quantum Computation	3	0	0	3	VI
6	251EC103	Introduction to Quantum Communication	3	0	0	3	VI
7	251EC104	Introduction to Quantum Sensing	3	0	0	3	VI
8	251EC105	Introduction to Quantum Materials	3	0	0	3	VI
Any One course from the below							
9	251EC106	Engineering Foundations of Quantum Technologies	3	0	0	3	VII
10	251EC107	Solid State Physics for Quantum Technologies	3	0	0	3	VII
11	251EC108	Quantum Optics	3	0	0	3	VII
12	251EC109	Quantum Cybersecurity	3	0	0	3	VII
13	251EC110	Quantum Machine Learning	3	0	0	3	VII
Total			18	0	0	18	



Dept.	FOUNDATION COURSE		INTERMEDIATE- LEVEL COURSE		ADVANCED COURSE	
CE	RRS	Repair & Rehabilitation of Structures	EIRM	Environmental Impact & Risk Management		
	BPCA	Building Planning & Computer-Aided Drawing	EM	Environmental Microbiology		
	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 SEM	Hybrid Electric Vehicles Special Electric Machines
	EMI	Electrical Measurements & Instrumentation	UEE	Utilization of Electrical Energy		
					ELS	Electrical Safety
ME	BME	Basic Mechanical Engineering	ETD	Engineering Thermodynamics	TOM	Theory of Machines
			IAE	Introduction to Automobile Engineering	AEM	Advanced Engineering Metrology
			MOS	Mechanics of Solids		
			HPE	Heat Power Engineering		
			PT	Production Technology		
			MMS	Metallurgy & Material Science		
ECE	FC	Fundamentals of Communications	R&AC	Refrigeration & Air Conditioning		
			ADC	Analog & Digital Circuits	IIT	Introduction to Internet of things
			LDIC	Linear & Digital IC Applications		
	FSP	Fundamentals of Signal Processing	SA	Sensors & Actuators		
			EM	Embedded Microcontrollers	MWC	Modern Wireless Communications
			DSD	Digital System Design		
CSE			WLAN&PAN	Wireless LAN'S & PAN'S		
			ASE	Agile 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		
			IMSD	Introduction to MERN Stack Development		
			ISA	Information Security Analysis & Audit		
DS			DM	Data Mining		
			DM	Data Mining	SNA	Social Network Analysis
			FDS	Fundamentals of Data Science	DV	Data Visualization Techniques
			ASE	Agile Software Engineering	BDA	Big Data Analytics
			NSQL	NoSQL Databases	SNSW	Social Networks & Semantic Web
			BIA	Business Intelligence & Analytics		
			HCDA	Health Care Data Analysis		
AIML						
			ML	Machine Learning	DV	Data Visualization Techniques
			AI	Artificial Intelligence	PEG	Prompt Engineering & GenAI
			AI C	AI Chatbot	SNA	Social Network Analysis
			FDS	Fundamentals of Data Science	FML	Federated Machine Learning
			SC	Soft Computing	NLP	Natural language processing and text analytics

Min.E	DMD	Development of Mineral Deposits	SM	Surface Mining	MLGS	Mine Legislation & General Safety
	GM	Green Mining	UCMT	Underground Coal Mining Technology	EPC	Environmental Pollution & Control
			UMMT	Underground Metal Mining Technology	ISP	Industrial Safety Practices
			DB	Drilling & Blasting	GC	Ground Control
PT	IPE	Introduction to Petroleum Engineering	FGRE	Fundamentals of Geology & Reservoir Engineering	PRE	Petroleum Refinery Engineering
	UOPI	Unit operations in Petroleum Industry	FDPE	Fundamentals of Drilling & Production Engineering	FLNG	Fundamentals of Liquefied Natural Gas
					NGH	Natural Gas Hydrates
			UHR	Unconventional Hydrocarbon Resources	ALT	Artificial Lift Techniques
					EOR	Enhanced Oil Recovery
Ag.E	GWH	Ground Water Hydrology	LWME	Land & Water Management	DBS	Design of Bio-Energy Systems
	PHECC	Post-harvest Engineering of Cereal Crops	SWH	Surface Water Hydrology	PHEHP	Post-Harvest Engineering for Horticultural Produce
			MIE	Micro Irrigation Systems		
	FRES	Fundamentals of Renewable Energy Sources			AME	Agricultural Machinery & Equipment
					APEFQ	Agriculture Process Engineering & Food Quality
EDC	NPD	New Product Development	ESB	Entrepreneurship & 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 & Risk Management		

Major Core Courses (MCC)										
Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501MA01	Linear Algebra & Calculus	FC	2	1		3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501PH01	Solid State Physics	FC	2		1	3	50	50	100	-
2501CH01	Engineering Chemistry	FC	2		1	3	50	50	100	-
2501ME01	Engineering Graphics	FC	1		2	3	50	50	100	-
2501ME03	Engineering Workshop	FC			1	1	100	-	100	-
2501ME02	Engineering Mechanics	FC	2	1	1	4	50	50	100	-
2501ME04	Engineering Thermodynamics	IC	2	1		3	50	50	100	SSP/MP
2501MA03	Integral Transforms & Applications of Partial Differential Equations	IC	2	1		3	50	50	100	LAC
2501MA04	Numerical Methods & Statistical Techniques	IC	2	1		3	50	50	100	ITAPDE
2501ME05	Fluid Mechanics & Hydraulic Machines	IC	2	1	1	4	50	50	100	SSP
2501ME06	Material Science and Deformation	IC	2		2	4	50	50	100	EC
2501ME07	Manufacturing Process-I	IC	2		2	4	50	50	100	EW
2501ME08	Automobile Engineering	IC	3		1	4	50	50	100	SSP
2501ME09	Kinematics of Machinery	IC	2	1	1	4	50	50	100	EM
2501ME10	Internal Combustion Engine	IC	2		2	4	50	50	100	ETD
2501ME11	Manufacturing Process-II	IC	2		2	4	50	50	100	MP – I
2501ME12	Heat Power Engineering	IC	2	1		3	50	50	100	ETD
2501ME13	Machine Design	IC	2	1		3	50	50	100	EG
2501ME14	Computer Aided Machine Drawing (CAMD)	IC			3	3	50	50	100	MD

2501MB01	Engineering Economics & Management	IC	2			2	50	50	100	-
2501ME15	Mechatronics	IC	2		2	4	50	50	100	MP-I
2501ME16	Heat Transfer	AC	2		2	4	50	50	100	HPE
2501ME17	Dynamics of Machinery	AC	2		2	4	50	50	100	KOM
Total			44	10	26	80				

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)

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

UNIT – II

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

Practice (Using any computational tool):

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

UNIT – III

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

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

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

UNIT – IV

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

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

UNIT – V

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

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

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

Text Books:

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

Reference Books:

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

Web Links:

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

Differential Equations & Vector Calculus
(Common to CE,EEE,ME,ECE,CSE,IT,AIIML,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/>

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:

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

UNIT-II

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

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

Practice:

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

UNIT – III

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

Practice:

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

UNIT – IV

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

Practice:

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

UNIT – V

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

Practice:

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

Text Books:

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

3. Physics for Engineers, T.Vijaya Krishna, Cengage publications, ISBN: 978-93-5350-755-8.

Reference Books:

1. Engineering Physics, M.R. Srinivasan, New Age international publishers, 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>

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>

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

Additional Practice:

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

Text Books:

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

Reference Books:

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

Web Links:

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

Engineering 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 Thermodynamics

Course Code: 2501ME04

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Apply thermodynamic concepts to analysis of energy system.
- CO2:** Apply the first law of thermodynamics for closed and open systems.
- CO3:** Apply the second law of thermodynamics and principle of entropy for the engineering system.
- CO4:** Analyse the properties of pure substances.
- CO5:** Explain the working of various refrigeration system and psychrometric process

Mapping of Course Outcomes with Program Outcomes:

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

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: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility, Forms of energy, pressure, work and heat transfer, temperature and the Zeroth Law of thermodynamics.

UNIT - II

First Law of Thermodynamics: Energy analysis of closed and open system, energy analysis of steady flow devices – Nozzle, Diffusers, Turbine, Compressor, and Throttle. Limitation of first law of thermodynamics.

UNIT – III

Second Law of Thermodynamics: Heat engine and reversed heat engine, Statements of second law (Kelvin-Planck and Clausius Statement) and their equivalence, PMM-II, Carnot's

principle, Carnot cycle and its specialties, Thermodynamic Temperature Scale, Thermodynamic scale of Temperature, Entropy, Clausius Inequality, The increase in entropy principles – Energy Equation, Reversibility and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

UNIT – IV

Properties of Pure Substances: Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy transfer.

UNIT – V

Introduction to Refrigeration: Properties of the refrigerants Working of Air Refrigeration System, Vapour Compression Refrigeration System, Coefficient of performance (COP), Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & Psychrometric process - adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing.

Text Books:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill Publishers, 6th Edition, ISBN: 9789352606429.
2. Thermodynamics: An Engineering Approach, Cengel, Y.A and Boles, M.A, McGraw Hill, 5th Edition, ISBN: 0073107689.

Reference Books:

1. Treatises on Heat Engineering, V.P.Vasandhani & D.S Kumar, Metropolitan Book Depot, 4th Edition, ISBN: 9788120003507.
2. Engineering Thermodynamics, Mayhew and Rogers, Longman Green & Co Ltd., 4th Edition, ISBN: 0582045665.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/106/112106310/>
2. <https://archive.nptel.ac.in/courses/112/104/112104113/>
3. <https://ocw.mit.edu/courses/3-00-thermodynamics-of-materials-fall-2002/download/>

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

Course Code: 2501MA03

L	T	P	C
2	1	0	3

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

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

UNIT – II

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

UNIT – III

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

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

UNIT – IV

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

UNIT – V

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

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

Text Books:

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

Reference Books:

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

Web Links:

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

Numerical Methods & Statistical Techniques

(Common to CE & ME)

Course Code: 2501MA04

L	T	P	C
2	1	0	3

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Solution of Algebraic and Transcendental Equations and Interpolation:

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

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

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

UNIT – II

Numerical Differentiation, Integration and Solutions of Ordinary Differential Equations:

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

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

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

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

UNIT – III

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

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

UNIT – IV

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

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

UNIT – V

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

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

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

Text Books:

- 1 Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021 · ISBN 978-8184875607
- 2 Miller and Freund's, Probability and Statistics for Engineers, 9/e, Pearson, 2020. ISBN 978-9353945237.

Reference Books:

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

Web Links:

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

Fluid Mechanics & Hydraulic Machines

Course Code: 2501ME05

L	T	P	C
2	1	1	4

Course Outcomes:

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

- CO1:** Explain the fluid properties and calculate buoyancy forces
- CO2:** Explain different types of fluid flow.
- CO3:** Apply Bernoulli's equation in fluid flow.
- CO4:** Demonstrate boundary layer theory for fluid flow.
- CO5:** Explain the working principle of turbines and pumps.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Fluid Statics: Introduction: Fluids and continuum, Importance of fluid mechanics in various engineering fields, Properties of fluids – Mass, Density, Specific weight, Specific volume, Specific gravity, Surface tension, Viscosity, Newton's law of viscosity, Newtonian and non - Newtonian fluids, Vapor pressure and their influence on fluid motion, Methods of pressure measurement. Buoyancy and Flotation: Meta center, Stability of floating body, Submerged bodies, Calculation of metacentric height, Stability analysis and applications.

UNIT – II

Fluid Kinematics: Preliminaries of Eulerian and Lagrangian description of fluid flow, Streamline, Path line, Streak lines and Stream tubes, stream function and velocity potential function. Types of fluid, Classification of fluid flows - Steady and unsteady, Uniform and non-uniform, Laminar and turbulent, Rotational and irrotational, Principle of conservation of mass – equation of continuity for a one-dimensional flows, stream tube for unsteady three dimensional flow, Deformation of a fluid particle – linear and angular deformation and rotation.

UNIT – III

Fluid Dynamics: Principle of conservation of linear momentum, Various forces acting on a fluid element, Euler's and Bernoulli's equation for flow along a stream line, Practical applications of Bernoulli's equation, Momentum equation and its applications for pipe bend problem, Fundamental dimensions, Dimensional homogeneity, Rayleigh's method and Buckingham Pi theorem, Dimensionless numbers and its physical significance.

Practice:

1. Determine the co-efficient of discharge of a Venturi meter.
2. Determine the co-efficient of discharge of an Orifice meter.
3. Determine the velocity of flow at any point in a pipe using Pitot tube.

UNIT – IV

Closed Conduit Flow: Reynolds number, Reynolds experiment, Darcy–Weisbach equation, Minor losses in pipes, Pipes in series and pipes in parallel, Total energy line, Hydraulic gradient line. Concept of Boundary Layer Theory: Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub layer, velocity profile, calculation of drag, boundary layer separation.

Practice:

1. Determine the major losses in pipes.
2. Determine the minor losses in pipes.

UNIT – V

Introduction to Hydraulic Machine: Turbines: Classification of turbines–Impulse and reaction turbines, Working principle of Pelton wheel, Francis turbine and Kaplan turbine, Draft tube theory and its function, Pump: Types of pump, Working principle of centrifugal pump and reciprocating pump, Characteristics of pumps, Comparison between centrifugal and reciprocating pump.

Practice:

1. Determine the performance of centrifugal pump.
2. Determine the performance of reciprocating pump.
3. Determine the efficiency of pelton wheel.
4. Determine the efficiency of francis turbine
5. Determine the efficiency of kaplan turbine

Text Books:

1. Fluid Mechanics and Hydraulic Machines, R. K. Bansal, Laxmi Publications (P) Ltd., 10th Edition, ISBN 978-8131808153
2. Hydraulics and Fluid mechanics including Hydraulics machines by P. N. Modi & S. M. Seth, Rajsons publications Pvt. Ltd, Standard Book House, 22nd Edition, 2019, ISBN 9788189401269

Reference Books:

1. Fluid Mechanics and Hydraulic Machines: In SI units, R. K. Rajput, S. Chand & Company Ltd, 6th Edition, ISBN 978-9385401374
2. Fluid Mechanics and Hydraulic Machines, Mahesh Kumar, Pearson, 1st Edition, 2019, ISBN 9789353433697

Web Links:

1. <https://archive.nptel.ac.in/courses/112/105/112105182/>.
2. <https://nptel.ac.in/courses/112/105/112105183/>.
3. <https://ocw.mit.edu/courses/16-01-unified-engineering-i-ii-iii-iv-fall-2005-spring-2006/resources/learningobjectives/>.

Material Science and Deformation

Course Code: 2501ME06

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Explain the concepts of structure of metals.
- CO2:** Interpret the phases present in iron- iron carbide equilibrium diagram.
- CO3:** Describe the microstructure of steel and Cast iron.
- CO4:** Explain the concept of stress, strain and elastic constants
- CO5:** Illustrate the shear force and bending moment diagram

Mapping of Course Outcomes with Program Outcomes:

CO/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	2	2	-	-	-	-	1	1	1	-	-
CO5	2	2	-	-	-	-	1	1	1	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Material Science

Introduction to material science, crystallization of metals, grain and grain boundaries, crystal imperfection, slip and dislocation, twinning, isotropic and anisotropic properties of crystals, dislocation mechanics, hardening.

Introduction to fracture, modes of fracture. Introduction to Fatigue, mechanism of fatigue failure. Introduction to creep

UNIT – II

Phase Diagrams

Phase rule, Hume-Rothery rule, Experimental method of construction of equilibrium diagrams, Isomorphous alloy systems, Equilibrium cooling and heating of alloys. Lever rule, Study of important binary phase diagrams of Cu-Ni, Al-Cu, Iron-carbon phase diagram.

Practice:

1. To study the Microstructure of Al.
2. To study the Microstructure of Cu.

UNIT – III

Heat Treatment:

Types of steels, low, medium and high carbon steels, stainless steels, alloy steels and their applications. Annealing, normalizing, hardening, tempering, surface hardening; Cast irons, types- white, grey, malleable and nodular, Properties and applications of cast irons.

Non-Ferrous alloys

Introduction to non-ferrous metals, their types and applications.

Practice:

1. To study the Microstructure of heat treated steel.
2. To study the Microstructure of Mild steel.
3. To study the Microstructure of Cast iron.

UNIT – IV

Mechanical properties and behaviour

Mechanical properties, stress, strains and their types, stress-strain relationship of steel, Poisson's ratio, Generalized hook's law, working stress, volumetric stress, Elastic moduli and their relationship.

Practice:

1. To conduct tension test on Mild steel bar.
2. To determine the compression strength on a cube.

UNIT – V

Shear Force and Bending Moment

Definition of beam, Types of beams, Concept of shear force and bending moment. S.F and B.M diagrams for cantilever, simply supported beam subjected to point load, Uniformly Distributed Load (UDL) & Uniformly Varying Load (UVL), Point of contra flexure. Introduction to bending (Simply supported beam, Cantilever beam). Torsion Equation (solid and hollow shaft).

Practice:

1. To conduct the bending test on simply supported beam and cantilever beam.
2. To determine the modulus of rigidity of given specimen by conducting torsion test on circular shaft.

Text Books:

1. Materials Science and Metallurgy, V.D. Kodgire, Everest Publishing House, 39th Edition, ISBN 978-8176314008.
2. Strength of Materials, Sadhu Singh, Khanna Publication, 11th Edition, ISBN 978-81-7409-048-5.

Reference Books:

1. Materials Science and Engineering-An Introduction, W. D. Callister, Wiley India, 6th Edition, ISBN 978-0471135760
2. Mechanics of Solids, E.P. Popov, Pearson, 2nd Edition, ISBN 978-9332550216

Web Links:

1. <https://archive.nptel.ac.in/courses/113/106/113106101/>
2. https://onlinecourses.nptel.ac.in/noc22_mm25/preview

Manufacturing Process - I

Course Code: 2501ME07

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Elaborate the fundamental principles of casting process.
- CO2:** Classify the various joining process with applications
- CO3:** Discuss the basic concepts of metal forming techniques
- CO4:** Explain the basic concepts of forging techniques.
- CO5:** Explain the basic concepts of plastic processing techniques and powder metallurgy

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Introduction to manufacturing process, Classification and Overview of Manufacturing Processes. Introduction to Metal Casting, Casting design considerations, Sand casting process- Casting Terminology, Types of Patterns, Pattern Materials and Pattern Allowances, Classifications of Moulds, moulding materials and their properties, Core, Gating system and its Design, Riser and its design, Foundry furnaces (Cupola Furnace, Crucible Furnace, Electric Arc Furnace & Induction Furnace), Solidification of pure metals and alloys, Casting defects and remedies, Advanced casting processes (Investment Casting, Shell Mould Casting, Die Casting & Centrifugal Casting), advantages and applications.

Practice:

1. To design and manufacture a Wooden Pattern for a given Casting.
2. To prepare a Casting for the given Solid Pattern & Split Pattern using Green Sand Moulding Processes.

UNIT – II

Metal Joining: Introduction, Classification of Welding Processes, Gas Welding & Cutting , Arc Welding-Theory of heat generation, ISI classification of coated electrodes,

SMAW,GTAW,GMAW- SAW,LBW,EBW,UW, Resistance welding, Solid state welding processes, Hybrid Welding Processes, Brazing, Soldering and their applications, HAZ, characteristics of weldment, Welding Defects and Remedies.

Practice:

1. To prepare Lap Joint, V Butt, corner Joint, T Joint using Gas Welding, Arc Welding, GMAW, Resistance Spot Welding machine.
2. To prepare a Single Strap Butt Joint on the given work pieces using spot welding equipment.

UNIT – III

Sheet Metal Work: Sheet Metal Operations, Yield criteria, Plastic deformation of metals, Tools and Equipment in SMW, Deep drawing.

Forming : Hot working and Cold working, Rolling and its types, Embossing, Thread rolling, Tube Piercing, Hot spinning, Defects in metal working, Wire Drawing, Tube drawing. High Energy rate Forming (HERF) processes

Practice:

1. To perform the punching, blanking and deep drawing operation on hydraulic press.

UNIT – IV

Forging: Introduction Forging, Forging dies, Forging operations, Forging Process, Hand Forging, Power Forging, Impression Die Forging, Press Forging, Upset forging, Forging Defects and Remedies.

UNIT – V

Plastic Processing: Types of Plastics, Properties, Applications, and their processing methods, Blow molding and Injection molding.

Powder Metallurgy: Powder production methods, compaction, and sintering. Applications of powder metallurgy. Advantage and Disadvantage of Powder Metallurgy in comparison to Conventional Shaping process.

Practice:

1. To prepare a plastic bottle and its cap by using Blow Molding.
2. To prepare a plastic bottle cap, Jewellery box by using Injection Moulding

Text Books:

1. Manufacturing Engineering and Technology, Kalpakjain S, Schmid S.R., Pearson Education, Delhi, 7th Edition 2018, ISBN 978-9332587908.
2. Fundamentals of Modern Manufacturing, Groover Mikell P, John Wiley and Sons Inc, 7th Edition, 2018, ISBN 978-1119722014.

Reference Books:

1. Manufacturing Science, A. Ghosh & A.K. Mallik, East West Press Pvt. Ltd Publication, 3rd Edition, ISBN 978-8176710633.
2. Manufacturing Processes, H.S. Shan, Cambridge University Publication, 2nd Edition, ISBN 978-1316638583.

3. Process and materials of manufacture, Lindberg, PHI Publications, 4th Edition, ISBN 978-8120306639.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc25_me16/preview
2. https://onlinecourses.nptel.ac.in/noc25_me51/preview
3. <https://archive.nptel.ac.in/courses/113/106/113106098/>

Automobile Engineering

Course Code: 2501ME08

L	T	P	C
3	0	1	4

Course Outcomes:

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

- CO1:** Summarize the Vehicle Chassis Layouts of 4-wheelers
- CO2:** Identify the different constructional features and working principles of Un-Sprung components of the given vehicle
- CO3:** Identify the different constructional features and working principles Sprung components of the given vehicle.
- CO4:** Summarize the functionalities of various Electrical systems of typical Automobile
- CO5:** Explain the different Active and Passive Vehicle Safety Systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction: History of Automobile and introduction to Automobile Industry, Chassis Layouts : Components of four wheeler automobile – chassis and body - power transmission modes, Front Axle & its types and Introduction to Homologation of Vehicles.

UNIT – II

Transmission: Introduction to Clutches, Gear Box, Propeller shaft, Rear Axles and its Types, Differential and its applications.

Steering System: Steering geometry – Types of steering mechanism steering linkages of Independent and Conventional Suspension.

Practice:

1. Demonstration of Clutch working Principle and types of Clutches
2. Demonstration of Conventional and Power Steering and types of Steering systems

UNIT – III

Suspension System: Objectives of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system, Air Suspension, Rubber Suspension, Hydrolastic suspension system, Hydragas suspension system.

Braking System:

Introduction to Mechanical braking system, hydraulic braking system.

Practice:

1. Demonstration of Conventional and Independent Suspension System
2. Demonstration of Shock absorber
3. Demonstration of Mechanical Braking system
4. Demonstration of Hydraulic Braking system

UNIT – IV

Wheels and Tyres: Basic Requirements of Wheels and Tyres, Construction of Wheel Assembly, Tyre Construction, Types, Tyre Sizes and Designation, Aspect Ratio, Tyre Tread Pattern, Selection of Tyre under Different Applications.

Practice:

1. Demonstration of constructional features and its importance of different tyres
2. Demonstration of constructional features and its importance of different wheels

UNIT – V

Electrical System: Charging circuit, generator, starting system, lighting, horn, wiper, fuel gauge, oil pressure gauge, engine temperature indicator.

Safety Systems: Introduction, safety systems - seat belt, air bags, bumper, anti-lock brake system (ABS), Electronic Brake force Distribution (EBD), mirrors, Head restraints, seats with anti-submarine effects and fuel cut off switch.

Practice:

1. Demonstration of wiring harness of typical Automotive Vehicle
2. Demonstration of Active and Passive Safety systems of an Automotive vehicle

Text Books:

1. Automobile Engineering, Kirpal Singh, Vol- I, Standard Publisher, New Delhi, 2020, ISBN: 9788180142520.
2. Motor Vehicles, Newton Steeds and Garret, Butterworth, 13th Edition, ISBN : 0750637633.

Reference Books:

1. Modern Vehicle Technology, Heinz Hazler, Butterworth, London, 2nd edition, ISBN : 0750651318.
2. Automotive Chassis, Heldt P.M., Chilton Co., New York, 2012, ISBN: 1258386380.

Web Links:

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>
2. <https://www.udemy.com/course/automotive-engineering-automobile-fundamentals-and-advanced/?couponCode=LEADERSALE25A>

Kinematics of Machinery

Course Code: 2501ME09

L	T	P	C
2	1	1	4

Course Outcomes:

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

- CO1:** Apply the knowledge of mechanisms in real time applications
- CO2:** Construct the velocity and acceleration diagrams using relative velocity method and instantaneous centre method.
- CO3:** Calculate the velocity and acceleration of follower motions and construct the cam profile.
- CO4:** Calculate the velocities of different components of a compound and epicyclic gear trains.
- CO5:** Construct the turning moment diagram of engine and flywheel.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Elements of Kinematics: Classification of Mechanisms-Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain -Limit positions- Mechanical advantage- Description of common mechanisms- Inversions of 4-bar chain: Crank and Slotted Lever mechanism, Quick Return Motion mechanism, Davis and Ackermann Steering gear mechanisms, Hooke's joint.

Practice:

- Study of Four bar Chain mechanism

UNIT – II

Velocity and Acceleration Analysis: Plane motion of a rigid body: Instantaneous centre of rotation, centrode and axode - Relative motion between two bodies – Kennedy's Theorem – Graphical determination of instantaneous centre for Four bar and Single Slider Crank chain

mechanisms, Determination of Angular Velocity of points and links. Motion of a Link in Machine - Determination of Displacement, Velocity and Acceleration for a Four Bar Mechanism, Single Slider Crank chain mechanism, Double Slider Crank chain mechanism.

Practice:

1. Plot slider displacement, velocity, and acceleration against crank rotation for single slider crank mechanism/Four bar mechanism.

UNIT – IV

Power Transmission: Introduction –Modes of Power Transmission applications. Gears and Gear Trains- Classification, Terminology, Law of Gearing, Path of contact, Arc of contact. Interference, Methods of avoiding interferences. Simple gear train, Compound gear train, reverted gear train, epicyclic gear train and Differential. Table method to find velocity of components of a gear train

Practice:

1. Measurement of Gear parameters using Gear tooth vernier.

UNIT – V

Turning Moment Diagrams: Static and dynamic force analysis of planar mechanisms, Dynamic force analysis of slider crank mechanism, Inertia Torque, Angular Velocity and Acceleration of connecting rod, Crank Effort and Turning Moment Diagrams – Fluctuation of energy – Fly Wheel design.

Practice:

1. Find the moment of inertia of a flywheel.

Text Books:

1. Theory of machines, S.S.Rattan, Tata Mc Graw Hill, 5th Edition, 2019, ISBN: 9789351343479.
2. Theory of machines, Thomas Bevan, CBS Publishers, 3rd Edition, ISBN: 9788123908748.

Reference Books:

1. Theory of machines: Kinematics and Dynamics , Sadhu Singh, 3rd Edition, Pearson Publisher, 2011, ISBN: 9788131760697.
2. Theory of machines, R.K.Bansal, J.S.Brar, Laxmi Publications, 6th Edition, ISBN: 9788131808054.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/104/112104121/>

Internal Combustion Engine

Course Code: 2501ME10

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Differentiate the ideal, air standard cycles and actual thermodynamic cycles
- CO2:** Evaluate the Engine performance based on the experimental data.
- CO3:** Analyze the fueling system and combustion behavior of SI engine
- CO4:** Analyze the fueling system and combustion behaviour of CI engine
- CO5:** Explain the formation of emissions and its control strategies of both SI & CI Engines

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Actual Cycles & their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

Practice:

1. Draw & Study the Valve Timing Diagrams for Four Stroke Diesel Engine. (Cut Section Model).
2. Draw & Study the Port Timing Diagrams for Two Stroke Petrol Engine. (Cut Section Model).

UNIT – II

Engine Performance: Brake Power, Indicated Power, Frictional Power, Fuel consumption, BSFC, BSEC, different efficiencies, Mean Effective Pressure, and Methods to calculate the frictional power in diesel engines, Stoichiometric analysis of different fuels.

Practice:

1. Evaluate the Performance of 4 -Stroke Petrol & Diesel Engine
2. Evaluate the frictional Power using Wilian's Line Method and Morse test
3. Draw the Heat Balance Sheet for a Diesel Engine
4. Evaluate influence of varying the compression ratio on performance of a diesel engine

UNIT – III

Gasoline Fuel injection and Combustion Characteristics: Multi-point Injection system- Gasoline Direct Injection – Flexi fuel engines- Pre-mixed charge combustion, abnormal combustion - Detonation/ Knocking, factors influencing the abnormal combustion and its control.

Practice:

1. Demonstration of MPFI and GUI Pump of a Petrol Engine
2. Evaluate the Combustion Characteristics (P- ϕ , Heat Release Rate, Ignition delay, MassFraction burned of a Petrol Engine)

UNIT – IV

Diesel Fuel injection, Combustion Characteristics & Low Temperature Combustion modes: Fuel Atomization and Droplet size distribution, Sauter Mean Diameter calculations, Spray Penetration. Fuel Injection Pumps, Injector. Combustion Process Characterization: Dual fuel technologies - Introduction to Low Temperature Combustion - Homogeneous Charge Compression Ignition (HCCI), Fuel Stratified Charge combustion/ Reactivity Controlled Compression Ignition (RCCI) Technologies, Pre-mixed Charge Compression (PCCI).

Practice:

1. Demonstration of Fuel Spray Pattern using different Fuel Injectors
2. Evaluate the Combustion Characteristics (P- ϕ , Heat Release Rate, Ignition delay, Mass Fraction burned of a Diesel Engine
3. Evaluate the different Low Temperature Combustion Strategies (at least Two)

UNIT – V

Engine Emission Formation & Control Strategies(SI & CI): Sources of Engine emissions: Diesel NO_x-Particulate Trade off, SI Engine Emission Control Technology: CI Engine Emission Control Technology: Exhaust Gas Recirculation, Diesel Particulate Filter, Selective Catalyst Reduction and Diesel Oxidation Converter, Lean NO_x Trap (LNT).

Practice:

1. Measuring and Analysis of Petrol Engine Emissions using 4Gas/5- Gas Analyser with and without Catalytic Converter
2. Demonstration of cut- Sectional Models of Exhaust Gas Recirculation, Selective Catalyst Reduction, Diesel Particulate Filter and Diesel Oxidation Converter.
3. Measuring and Analysis of Diesel Engine Emissions using Smoke Meter with and without Exhaust Gas Recirculation, Selective Catalyst Reduction, Diesel Particulate Filter and Diesel Oxidation Converter.

Text Books:

1. Internal Combustion Engine, M.L. Mathur & R.P. Sharma, Dhanpat Rai Publications, 4th Edition, ISBN 978-9383182528
2. IC Engine Combustion & Emissions by B.P. Pundir, Narosa Publications, 4th Edition, 2020, ISBN 978-8184870879

Reference Books:

1. Internal Combustion Engines Fundamentals, John B. Heywood, , Mc Graw Hill Publications, 2nd Edition, 2018, ISBN 9781260116106
2. Engineering Fundamentals of I C Engines, Wiliard W. Pulkrabek, Prentice Hall Publications, ISBN 9780131405707

Web Links:

1. <https://nptel.ac.in/courses/112104033>
2. <https://ocw.mit.edu/courses/2-61-internal-combustion-engines-spring-2017/>
3. <https://teaching.eng.cam.ac.uk/content/engineering-tripos-part-iib-4a13-combustion-ic-engines-2018-19>

Manufacturing Process - II

Course Code: 2501ME11

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Explain the principles of metal cutting.
- CO2:** Demonstrate the conventional machining processes such as turning, milling, shaping, slotting and planning.
- CO3:** Demonstrate the principles and applications of milling, drilling and boring operations.
- CO4:** Demonstrate the principles of abrasive machining process using grinding machine.
- CO5:** Demonstrate the principles of modern machining processes such as CNC and advanced machining processes.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Theory of Metal Cutting: Introduction to machine tool, Geometry of Single Point Cutting tool, Mechanics of metal cutting, Tool angles, Chip formation, Types of chips, Cutting fluids, Tool Material Property. Tool nomenclature-ASA, ORS & NRS systems, Orthogonal and Oblique cutting, Feed, Depth of Cut, Tool Life Equation, Tool Wear, Machinability, Merchant circle diagram, Coolants.

UNIT – II

Lathe Machine: Introduction, Principle, Specifications, Accessories, Workholders, Tool holders, Thread turning, Attachments, Constructional features of speed and feed gear box. Turret and capstan lathes, Features of automatic lathes, Classification, Single spindle and multi-spindle automatic lathes, Applications

Shaping, Slotting and Planning Machine: Principles, Parts, Specifications, Operations performed, applications, Machining time calculations.

Practice:

1. Step turning, Taper turning, Thread cutting and Knurling using lathe machine.
2. Shaping of Vgroove using shaping machine.
3. Slotting of a keyway using slotting machine.
4. Eccentric Turning using lathe machine.

UNIT – III

Milling Machine: Principle, Classification, Features of Horizontal, Vertical and Universal milling machine, Up & Down Milling, Types of milling cutters & geometry, Indexing: Simple and compound, Accessories of milling machines, Gear manufacturing processes- hobbing, Applications.

Drilling Machine: Principles, Types, Operations performed, Tool holding devices, Twist drill, Drilling related operations: Reaming, Boring and Tapping.

Practice:

1. Cutting Spur gear using milling machine.
2. Drilling and Tapping operations using drilling machine.

UNIT – IV

Abrasive Machining Process: Grinding Machine: Principle, Classification, Cylindrical and surface grinding, tool and cutter grinding machine, Types of abrasives, Bonds, Specification and selection of a grinding wheel, Applications

Practice:

1. Grinding of Flat surfaces using Surface Grinding Machine.
2. Grinding of HSS Tool using Tool and Cutter grinder.
3. Finishing the component using hand grinder.

UNIT – V

Modern Machining Processes: CNC Machines: Principle, Classification, Features of CNC machines, 3-axis and 5-axis CNC machines, CNC controller, CNC programming, Applications of CNC machines.

Advanced Machining Processes: Introduction, Principle, Applications, Advantages and Disadvantages, Types, Electron Beam Machining (EBM), Electrical Discharge Machining (EDM) & Abrasive Jet Machining (AJM). Introduction to industry 4.0 & 5.0

Practice:

1. CNC programming for turned components using FANUC Controller.
2. CNC programming for milled components using FANUC Controller.
3. Automated CNC Tool path & G-Code generation using Pro-E/Master CAM.

Augmented Experiments:

1. Drilling, Boring and Internal threading on Lathe machine and Gang Milling on Milling machine
2. Gear tooth thickness measurement using gear tooth vernier calipers

Text Books:

1. Production Technology (Manufacturing Process, Technology & Automation), R.K. Jain, Khanna Publishers, 17th Edition, ISBN 9788174090997
2. Elements Of Workshop Technology Vol 2 Machine Tools, S. K. Hajra Choudhury, Indian Book Distributing Co. Calcutta, ISBN 978-8185099156

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools, Geoffrey Boothroyd, CRC Press Inc, 3rd Edition, ISBN 978-1574446593
2. Metal Cutting Principles, Milton C. Shaw, Oxford University Press, 2nd Edition, ISBN 978-0198086116

Web Links:

1. <https://archive.nptel.ac.in/courses/112/105/112105126/>
2. <https://ocw.mit.edu/courses/2-670-mechanical-engineering-tools-january-iap-2004/pages/tutorials/>

Heat Power Engineering

Course Code: 2501ME12

L	T	P	C
2	1	0	3

Course Outcomes:

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

CO1: Apply the various techniques to improve the performance of Rankine Cycle

CO2: Explain the working principle and performance of boiler and draught system

CO3: Analyse the performance of Steam nozzles

CO4: Analyse the performance of Impulse and Reaction Turbines

CO5: Analyse the performance of Steam Condensers and Gas Turbines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Steam Power Cycles: Steam Power plant - Layout, Rankine cycle - Schematic layout, Thermodynamic analysis - Simple Cycle. Methods to improve cycle performance - Regeneration & Reheating cycle.

UNIT – II

Boiler: Classification, Working principles of low-pressure (LP) & high-pressure (HP) boilers with sketches, Boiler mountings and accessories. Performance of boiler - Equivalent evaporation - Efficiency.

Draught System: Classification – Natural and Artificial draught – Induced, Forced & Balanced draught - height of chimney for given draught and discharge - condition for maximum discharge and chimney efficiency

UNIT – III

Steam Nozzles: Function of a nozzle – applications – types, Flow through nozzles and thermodynamic analysis, assumptions, Velocity coefficient and condition for maximum

discharge, Critical pressure ratio, Supersaturated flow and its effects, Degree of super saturation and Degree of undercooling, Wilson line.

UNIT – IV

Steam Turbines: Impulse turbine: Mechanical details - Velocity diagram - Effect of friction power developed, Axial thrust, Blade or diagram efficiency - condition for maximum efficiency.

Reaction Turbine: Mechanical details, principle of operation, Thermodynamic analysis of a stage, Degree of reaction velocity diagram, Parson's reaction turbine, Condition for maximum efficiency, Calculation of blade height. Compounding – Velocity, Pressure and Velocity Pressure compounding

UNIT – V

Steam Condensers: Classification - working principle, vacuum efficiency and condenser efficiency, air leakage, sources and their effects, air pump, cooling water requirement.

Gas Turbines: Simple gas turbine plant - Ideal cycle - Essential components - Actual cycle. Regeneration, Inter cooling and Reheating cycle, Merits and demerits.

Text Books:

1. Heat Engineering, V.P Vasandani and D.S Kumar, Metropolitan Book Company, 4th Edition, ISBN 978-8120003507
2. Thermodynamics and Heat Engines, R. Yadav, Central publishing house, 6th Edition, ISBN 978818544403

Reference Books:

1. Thermodynamics: An Engineering Approach, Cengel, Y. A. and Boles, M. A., Tata McGraw-Hill, 7th Edition, ISBN 978-0-07-352932-5.
2. Thermal Engineering, P.L.Ballaney, Khanna publishers, 25th Edition, ISBN 978-81-7409-031-7

Web Links:

1. <https://nptel.ac.in/courses/112/106/112106303/>
2. <https://nptel.ac.in/courses/112103262>.

Machine Design

Course Code: 2501ME13

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain the steps involved in the design process and fatigue strength.
- CO2:** Design shafts, keys and couplings as per the international standards.
- CO3:** Design the temporary, permanent joints and curved beams.
- CO4:** Select mechanical springs for various applications and design the engine components
- CO5:** Calculate the design parameters of bearing and gears.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Design: Factors influencing machine design, Selection of Materials, Direct, Bending and Torsional Stresses in Machine Elements, Factor of Safety, Design Stress, Theories of Failures.

Fatigue Strength: Fatigue Stress Concentration Factor, Size Factor, Surface Limits Factor, Variable and Cyclic Loads, S-N Curve, Gerber, Soderberg and Goodman Equations.

UNIT – II

Design of Shafts, Key & Couplings: Design of solid and hollow shafts based on strength, rigidity and critical speed, Design of Keys-Stresses in Keys, Design of Rigid and Flexible couplings.

UNIT – III

Design of Temporary and Permanent Joints: Bolted Joints, Simple and eccentrically loaded bolted joints- Welded joints – Butt, Fillet and parallel transverse fillet welds.

Design of Knuckle Joints & Curved Beam: Introduction to Knuckle Joints, Design of Knuckle Joint - Eccentric loading – curved beams – crane hook and frame only rectangular.

UNIT – IV

Design of Mechanical Springs: Stresses and Deflections of Helical Springs, Design of helical and concentric springs, Compression Springs, Helical Torsion Springs

Design of Engine Components: Introduction to IC engine components, Design of Cylinder, Design of Piston

UNIT – V

Design of Bearing: Sliding contact bearings, Design of Bearing, Selection of Bearing, Sommerfeld Number.

Design of Gear: Types of Gear, Spur Gears, Load Concentration Factor Dynamic load Factor, Surface Compressive Strength Bending Strength (Lewis equation).

Note: Design Data Book is Mandatory.

Text Books:

1. Design of Machine Elements, V.B.Bhandari, TMH Publishers, 5th Edition, 2020, ISBN: 9781259006364.
2. Machine Design, N.C.Pandya & C.S.Shaw, Charotar publishers, 21st Edition, 2022

Reference Books:

1. Shigley's Mechanical Engineering Design , McGraw-Hill Series, 11th Edition, 2020, ISBN 978-9390219636 : .
2. Machine Design , Robert L. Norton , Pearson Publishers, 5th Edition, 2018, ISBN : 9789353062508.

Web Links:

1. <https://nptel.ac.in/courses/112105125>
2. <https://www.me.iitb.ac.in/~ramesh/courses/ME423/me423.html>

Computer Aided Machine Drawing (CAMD)

Course Code: 2501ME14

L	T	P	C
0	0	3	3

Course Outcomes:

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

- CO1:** Discuss the conventional representation of materials and machine components.
- CO2:** Sketch various types of temporary fasteners.
- CO3:** Sketch various types of permanent fasteners.
- CO4:** Construct assembly drawings of Engine and Machine tool parts.
- CO5:** Construct assembly drawings Valves and other machine parts.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice

Introduction to Machine Drawing

1. Introduction, Representation of Engineering Materials., Surface finishes tolerances
2. Standard forms of screw threads, Pins, Washers.

Part Drawing of Detachable Fasteners

1. Sketch the part Drawings of Bolts, Nuts, Stud bolts, Tap bolts, Set screws and Keys.
2. Cottered joints and Knuckle joint. Shaft coupling, spigot and socket pipe joint.

Part Drawing of Permanent Fasteners and Bearings

1. Sketch the part Drawings of Journal and pivot bearings
2. Sketch the part Drawings of Collar and foot step bearings.
3. Sketch the part Drawings of Rivetted joints, Types of welds and welded joints.

Assembly of Engine and Machine tool parts

1. Construct assembly drawings of Connecting Rod and stuffing box
2. Construct assembly drawings of Cross Head and Eccentric
3. Construct assembly drawings of Tail stock and Tool Post.
4. Construct assembly drawings of Machine Vices

Additional Practice:**Assembly of Valves and other machine parts**

1. Construct assembly drawings of steam stop valve and spring-loaded safety valve
2. Construct assembly drawings of feed check valve and Air cock

Reference Books:

1. Machine Drawing, Bhatt, N.D., Charotar Publishing House, 51st Edition 2022, ISBN : 9789385039560.
2. Machine Drawing, Narayana K.L., Kannaiah. Pand Venkata Reddy K, New Age International Publishers, India, 2016, ISBN: 9788122540546.
3. Machine Drawing, Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Tata McGraw Hill Book Company, New Delhi, ISBN: 9780074603376.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/105/112105294/>
2. <https://www.coursera.org/learn/3d-cad-fundamental>

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

Course Code: 2501MB01

L	T	P	C
2	0	0	2

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

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

UNIT – V

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

Text Books:

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

Reference Books:

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

Web Links:

1. www.managementstudyguide.com
2. www.citehr.com
3. www.nptel.ac.in/courses/122106032
4. www.btechguru.com/courses--nptel--basic-course

Mechatronics

Course Code: 2501ME15

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Explain the importance of mechatronics in the engineering field
- CO2:** Identify the appropriate sensor and Transducers, for a given application
- CO3:** Identify the appropriate actuation system for a given application
- CO4:** Explain the concepts of different controllers in mechatronics.
- CO5:** Suggest a Mechatronic product design for a given application and evaluate its performance

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Basics of Mechatronics: Definition of mechatronics, Key elements of mechatronics system, measurement system, concepts in mechatronics, need for mechatronics systems, mechatronics systems design approach, classification of mechatronics systems, control systems, microprocessor-based controllers and emerging application areas of mechatronics.

UNIT – II

Sensors and transducers: Definition of sensor, Transducer- characteristics, Classification. Tactile sensor, displacement sensor, torque sensor, strain gauge sensor, force sensor. Proximity sensors: Magnetic, optical, ultrasonic, inductive, capacitive and eddy current methods. Digital Logic: Logic gates, Boolean algebra, Karnaugh maps.

Practice: 1. Measurement of speed using Magnetic speed pick-up Sensor. 2. Draw a ladder program for logic gates 3. Characteristics of Reflective Opto Transducer.

UNIT – III

Actuators: Actuation systems, pneumatic and hydraulic systems, process control valves, rotary actuators, mechanical actuation systems, and electrical actuation systems-servo motors, dc motors, ac motors, stepper motors.

Practice: 1. Draw a series and parallel cylinders hydraulic circuit using automation studio software. 2. Draw meter-in and meter-out Hydraulic circuits using automation studio software.

UNIT – IV

Controllers: Basics of micro-processors, micro-controllers and programmable logic controllers – architecture. Basic programming and input-output devices interfacing with micro-controllers (serial, parallel, A/D and D/A). Operational Amplifiers ideal amplifiers, characteristics, integrators and differentiators, filters, and analogue computers.

Practice: 1. Characteristics of Summing Amplifier

UNIT – V

Case Studies: Robotics and automation in manufacturing and process industries. Mechatronics control in automotive, prosthetics, artificial limbs, pick and place Robot, CNC Machine, Agriculture and energy systems, Automated car parking systems, Automated Washing Machine System, and Automated Traffic signal Method.

Practice: 1. Draw a ladder program for a traffic light control system. 2. Draw a Ladder program for Conveyor control system.

Cornerstone Project

The cornerstone project in Mechatronics is intended to integrate theoretical knowledge with engineering design, system integration, automation, control strategies, and intelligent system development. Unlike conventional laboratory experimentation, this cornerstone emphasizes problem identification, conceptual design, hardware–software integration, control logic development, sensor–actuator interfacing, and simulation-based analysis of mechatronic systems. Limited prototyping or experimental testing, where undertaken, is intended primarily for validation and demonstration of system functionality and performance.

The project enables students to address open-ended engineering problems involving automated and intelligent systems, thereby developing interdisciplinary knowledge, innovation, analytical thinking, programming skills, and system-level problem-solving abilities.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project shall involve system design, analytical study, CAD modeling where applicable, controller programming, sensor integration, simulation, and performance evaluation. Emphasis shall be placed on understanding the interaction between mechanical, electrical, electronic, and control subsystems under varying operating conditions and interpreting results using principles of mechatronics and automation engineering.

Project 1: Home Automation System

Project Objective

The main objective of this project is to design and develop a smart home automation system that enables users to monitor and control household appliances remotely and automatically.

Project Description

The Home Automation System is a mechatronics-based smart system that integrates sensors, actuators, and a microcontroller to control home appliances.

Scope of Analysis

It involves evaluating its performance, efficiency, reliability, and feasibility in real-world applications. It ensures that the system meets functional requirements and operates effectively under different conditions.

Project 2: Smart Parking System

Project Objective

The objective of this project is to design and develop a Smart Parking System that helps in efficient management of parking spaces using sensors and automation.

Project Description

The Smart Parking System is a mechatronics-based automated system that uses sensors, controllers, and display/communication modules to monitor and manage parking spaces.

Scope of Analysis

The scope of analysis of a smart parking system involves evaluating its functionality, efficiency, reliability, and practicality in managing parking spaces. It ensures the system operates accurately and improves overall parking management. It ensures that the smart parking system is efficient, reliable, cost-effective, and user-friendly, contributing to better parking management and reduced traffic congestion.

Project 3: Smart Obstacle Detection Robot

Project Objective

The objective of this project is to design and develop a robot that can detect obstacles and avoid them automatically using sensors and control logic.

Project Description

The Smart Obstacle Detection Robot is a mechatronics-based autonomous system that uses sensors, a controller, and motors to detect and avoid obstacles in its path.

Scope of Analysis

The scope of analysis of a Smart Obstacle Detection Robot focuses on evaluating its accuracy, performance, reliability, and efficiency in detecting and avoiding obstacles in real-time. It ensures that the robot operates effectively in different environments and conditions.

Project 4: Smart Traffic Control System

Project Objective

The objective of this project is to design and implement a smart traffic control system that automatically manages traffic signals based on vehicle density and timing control using sensors and controllers.

Project Description

The Smart Traffic Control System is a mechatronics-based automation system that uses sensors to detect vehicles and a controller (PLC/microcontroller) to adjust signal timings dynamically.

Scope of Analysis:

The scope of analysis of a smart traffic control system involves evaluating its efficiency, responsiveness, reliability, and effectiveness in managing traffic flow at intersections. It ensures that the system improves traffic conditions and operates safely under varying traffic scenario. The Smart Traffic Control System demonstrates the integration of sensors, digital logic, and control systems to solve real-world traffic problems. It improves efficiency, reduces congestion, and supports modern smart city infrastructure

Project 5: Automatic Car Washing System

Project Objective

The objective of this project is to design and develop an automatic car washing system that cleans vehicles efficiently using actuators, sensors, and control systems with minimal human intervention.

Project Description

The Automatic Car Washing System is a mechatronics-based automated setup where a car is cleaned through multiple stages such as washing, brushing, rinsing, and drying using actuators and control systems.

Scope of Analysis

The scope of analysis refers to the evaluation of a system or project in terms of its performance, efficiency, reliability, cost, and feasibility. It helps determine whether the designed system meets the required objectives and operates effectively under different conditions. It provides a comprehensive evaluation of the system, ensuring that it is efficient, reliable, safe, and cost-effective, and meets both technical and practical requirements.

Project 6: Electro-Hydraulic Automatic Lifting System

Project Objective

The objective of this project is to design and develop an electro-hydraulic lifting system capable of lifting and lowering loads automatically using hydraulic actuators controlled by electrical systems.

Project Description

The Electro-Hydraulic Lifting System is a mechatronics-based system that combines:
Hydraulic actuators (for lifting heavy loads)
Electrical control systems (for automation)

Scope of Analysis

The scope of analysis of an Electro-Hydraulic Automatic Lifting System focuses on evaluating its performance, efficiency, safety, and reliability in lifting and lowering loads using hydraulic power controlled by electrical systems. It ensures that the system operates effectively under different load and operating conditions. It provides a powerful, efficient, and safe solution for lifting heavy loads, making it highly relevant in industrial automation

Project 7: Automatic Light Intensity Control System

Project Objective

The objective of this project is to design and develop an automatic light intensity control system that adjusts lighting based on ambient conditions using sensors, op-amps, and a microcontroller.

Project Description

The Automatic Light Intensity Control System is a mechatronics-based system that automatically adjusts the brightness of lights depending on surrounding light conditions.

Scope of Analysis:

The scope of analysis of an Automatic Light Intensity Control System focuses on evaluating its performance, efficiency, reliability, and effectiveness in controlling lighting based on ambient conditions. It ensures that the system provides optimal illumination while minimizing energy consumption.

Project 8: PLC-Based Elevator Control System

Project Objective

The objective of this project is to design and implement an elevator control system using a Programmable Logic Controller (PLC) to achieve safe, efficient, and automated vertical transportation.

Project Description

The PLC-Based Elevator Control System is an industrial automation system where a PLC controls elevator movement based on user inputs (floor selection) and sensor feedback.

Scope of Analysis

The scope of analysis of a PLC-Based Elevator Control System involves evaluating its performance, safety, reliability, and efficiency in controlling elevator operations. It ensures that the system provides smooth, safe, and optimized movement between floors under various operating conditions.

Text Books:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Bolton, Pearson education, 4rd Edition, ISBN 978-8131732533
Introduction to mechatronics and measurement systems, David G. Alciatore,
2. Michael B. HI stand, McGraw-Hill Professional, 2nd Edition, ISBN 978-0071195577

Reference Books:

1. A course in Electrical and Electronic Measurement and Instrumentation, A.K.Sawhney, Dhanpat Rai & Sons, ISBN 978-8177001006
2. Mechatronics, Nitaigour Premchand Mahalik, Tata McGraw-Hill, ISBN 978-0070483743

Web Links:

1. https://online.courses.nptel.ac.in/noc24_me13/preview
2. <https://www.spiceworks.com/tech/it-careers-skills/articles/what-is-mechatronics-engineering/>

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).

Heat Transfer

Course Code: 2501ME16

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Analyze heat transfer, conduction in different geometries and transient conduction.
- CO2:** Apply dimensional analysis to convective heat transfer.
- CO3:** Apply free and forced convection principles for heat transfer in plate, cylinder and pipes.
- CO4:** Explain heat exchangers, boiling and condensation using heat transfer methods.
- CO5:** Explain radiative heat transfer & heat exchange between black & gray bodies.

Mapping of Course Outcomes with Program Outcomes:

CO/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

UNIT – I

Conductive heat transfer:

Modes and mechanism of heat transfer, Fourier rate equation – general heat conduction equation in Cartesian and cylindrical coordinates, heat transfer through homogeneous slabs, hollow cylinders, overall heat transfer coefficient, electrical analogy, a critical radius of insulation, Extended surface (fins) heat transfer – long fin, short fin with insulated tip. Transient Conduction: Lumped parameter system, Significance of Biot and Fourier numbers, Heisler Chart.

Practice:

1. Determination of thermal conductivity of a metal.
2. Determination of overall heat transfer co-efficient of a composite material.

UNIT – II

Dimensional Analysis:

Classification of convective heat transfer, Dimensional analysis for heat transfer study, Buckingham π theorem for forced and free convection, Significance of non-dimensional numbers

Free Convection:

Development of hydrodynamic and thermal boundary layer along with a vertical plate, Heat transfer through constant heat flux and isothermal plate and cylinder with empirical relations in different orientations

Practice:

1. Determination of heat transfer coefficient in natural convection.
2. Study of two-phase flow.

UNIT – III**Forced Convection**

External Flows: Concepts of the hydrodynamic and thermal boundary layer, using empirical correlations for convective heat transfer through flat plates and cylinders.

Internal Flows:

Concepts about hydrodynamic and thermal entry lengths, division of internal flow based on this, use of empirical relations for horizontal pipe flow and annulus flow.

Practice:

1. Determination of heat transfer coefficient in forced convection

UNIT – IV**Heat Exchangers:**

Classification of heat exchangers, overall heat transfer coefficient and fouling factor, LMTD and NTU methods concepts.

Boiling:

Pool boiling regimes, calculations on nucleate boiling, critical heat flux and film boiling.

Condensation:

Film-wise and dropwise condensation, Nusselt's theory of condensation on a vertical plate - film condensation on vertical and horizontal cylinders using empirical correlations.

Practice:

1. Determination of effectiveness of parallel and counter flow heat exchangers.

UNIT – V**Radiative Heat transfer:**

Emission characteristics and laws of black body radiation, Irradiation, total and monochromatic quantities, Planck law, Wien displacement law, Kirchhoff, Stefan and Boltzmann law, heat exchange between two black bodies, concepts of shape factor, Emissivity, heat exchange between grey bodies, radiation shields.

Practice:

1. Determination of emissivity of a given surface
2. Determination of Stefan- Boltzman constant.

Cornerstone Project

The cornerstone project in Heat Transfer is intended to integrate theoretical knowledge with engineering analysis, thermal system design, mathematical modeling, and simulation-based evaluation of heat transfer processes. Unlike conventional laboratory experimentation, this cornerstone

emphasizes problem identification, conceptual thermal design, analytical formulation, computational analysis, and performance evaluation of thermal systems under varying operating conditions. Limited experimental validation, where undertaken, is intended primarily for verification and demonstration of predicted thermal behaviour.

The project enables students to address open-ended engineering problems involving conduction, convection, radiation, and heat exchanger systems, thereby developing analytical, design, and problem-solving skills relevant to thermal engineering applications.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project shall involve analytical calculations, parametric studies, CAD modeling where applicable, simulation-based thermal analysis, and interpretation of results. Emphasis shall be placed on understanding heat transfer mechanisms, thermal performance, energy efficiency, and system behaviour under different operating conditions using principles of heat transfer and thermal engineering.

Project 1: Solar Water Heating System

Project Objective

The objective of this project is to design and develop a solar water heating system that utilizes solar energy for efficient heating of water using heat transfer principles.

Project Description

The Solar Water Heating System is a thermal engineering application that uses solar collectors, insulated pipes, and storage tanks to absorb and transfer solar heat energy to water through conduction, convection, and radiation.

Scope of Analysis

The scope of analysis involves evaluating:

- Heat absorption efficiency of solar collectors
- Rate of heat transfer through pipes and storage tank
- Thermal losses due to radiation and convection
- Effectiveness of insulation materials
- Overall system efficiency under varying weather conditions

The project demonstrates practical applications of conductive, convective, and radiative heat transfer concepts in renewable energy systems.

Project 2: Heat Exchanger Performance Analysis

Project Objective

The objective of this project is to design and analyse the performance of a parallel-flow and counter-flow heat exchanger.

Project Description

This project focuses on studying heat transfer between hot and cold fluids using a heat exchanger setup. The system evaluates temperature distribution, overall heat transfer coefficient, and exchanger effectiveness.

Scope of Analysis

The scope of analysis includes:

- Determination of LMTD and effectiveness
- Comparison of parallel and counter flow arrangements
- Evaluation of heat transfer coefficient
- Study of fouling effects on performance
- Thermal efficiency analysis under different flow rates

The project helps students understand industrial heat exchanger applications used in power plants, refrigeration, and process industries.

Project 3: Thermal Insulation and Critical Radius Analysis

Project Objective

The objective of this project is to study heat loss reduction using thermal insulation and analyse the critical radius of insulation for cylindrical systems.

Project Description

The project investigates conductive heat transfer through insulated pipes and cylinders using different insulating materials. It demonstrates how insulation thickness affects heat transfer rate.

Scope of Analysis

The scope of analysis focuses on:

- Comparison of insulation materials
- Measurement of thermal conductivity
- Critical radius determination
- Heat loss calculations
- Economic analysis of insulation thickness

This project provides practical understanding of energy conservation in thermal systems.

Project 4: Forced Convection Cooling System

Project Objective

The objective of this project is to design and develop a forced convection cooling system for electronic or mechanical equipment.

Project Description

The Forced Convection Cooling System uses fans or blowers to improve heat dissipation from heated surfaces such as processors, motors, or heated plates.

Scope of Analysis

The scope of analysis includes:

- Determination of convective heat transfer coefficient
- Air velocity and temperature measurements
- Comparison between natural and forced convection
- Thermal boundary layer analysis
- Cooling efficiency evaluation

The project demonstrates the importance of forced convection in thermal management systems.

Project 5: Natural Convection Heat Transfer Apparatus

Project Objective

The objective of this project is to study heat transfer through natural convection from vertical and horizontal surfaces.

Project Description

The project consists of a heated plate or cylinder exposed to atmospheric air where heat transfer occurs naturally due to buoyancy effects.

Scope of Analysis

The scope of analysis involves:

- Measurement of surface and ambient temperatures
- Calculation of Nusselt, Grashof, and Prandtl numbers
- Comparison of heat transfer in different orientations
- Observation of thermal boundary layer formation
- Evaluation of empirical correlations

This project helps students understand natural convection applications in cooling systems and building ventilation.

Project 6: Radiation Heat Transfer Chamber**Project Objective**

The objective of this project is to design a chamber to study radiative heat transfer between black and Gray surfaces.

Project Description

The Radiation Heat Transfer Chamber demonstrates thermal radiation exchange between surfaces with different emissivities using heated plates and radiation shields.

Scope of Analysis

The scope of analysis includes:

- Determination of emissivity of materials
- Verification of Stefan-Boltzmann law
- Study of radiation shields
- Heat exchange analysis between Gray bodies
- Effect of surface finish on radiation

The project demonstrates practical applications of thermal radiation in furnaces and thermal insulation systems.

Project 7: Mini Refrigeration and Condensation System**Project Objective**

The objective of this project is to study boiling and condensation heat transfer processes in a refrigeration setup.

Project Description

The project consists of a miniature refrigeration or vapor condensation system where phase change heat transfer processes are analysed.

Scope of Analysis

The scope of analysis includes:

- Observation of boiling and condensation phenomena
- Calculation of heat transfer rates
- Study of film-wise and drop-wise condensation
- Evaluation of cooling efficiency
- Analysis of refrigerant flow conditions

This project demonstrates industrial applications of phase change heat transfer in refrigeration and air-conditioning systems.

Project 8: Electronic Component Cooling Using Fins

Project Objective

The objective of this project is to design and analyse fin arrangements for improving heat dissipation from electronic components.

Project Description

The project uses extended surfaces (fins) attached to heated components to increase surface area and improve conductive and convective heat transfer.

Scope of Analysis

The scope of analysis involves:

- Comparison of fin geometries and materials
- Temperature distribution along fins
- Fin efficiency and effectiveness calculations
- Heat dissipation analysis
- Optimization of cooling performance

The project demonstrates practical applications of fins in electronic cooling and automobile radiators.

Note: The Heat Transfer Data book is to be allowed in the Examinations

Text Books:

1. Fundamentals of Engineering Heat and Mass Transfer, R. C. Sachdeva, New Age International Publications, 5th Edition, ISBN: 9789386070968.
2. Heat and Mass Transfer - Fundamentals and Applications, Yunus A. Cengel and Afshin J. Ghajar, McGraw Hill Publications, 5th Edition, 2014, ISBN :978-0073398181.

Reference Books:

1. Heat Transfer, P.K.Nag, TMH Publications, 3d Edition, 2011, ISBN: 978-0070702530.
2. Principles of Heat and Mass Transfer, Frank P. Incropera, David P. Dewitt, Theodore L, AdrienneS. Lavine, Wiley Publications, 7th Edition, 2018, ISBN: 978-8126542734.
3. Heat Transfer, J.P. Holman, McGraw Hill Education; 10th Edition, 2017, ISBN: 978-0071069670.

Web Links:

1. <https://nptel.ac.in/courses/112108149>
2. <https://nptel.ac.in/courses/112105271>

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).

Dynamics of Machinery

Course Code: 2501ME17

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Analyse stabilization of ships, aircrafts, and automobile vehicles
- CO2:** Analyse frictional losses, torque transmission capacity of clutches, brakes, and dynamometers
- CO3:** Analyse and plot the characteristics of a governor
- CO4:** Apply the analytical and graphical methods for balancing of rotating and reciprocating masses.
- CO5:** Determine the natural frequency for free and forced vibrations

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Precession

Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motorcycle, aero planes, and ships

Practice:

1. Analyse the motion of a motorized gyroscope when the couple is applied along its spin axis.

UNIT – II

Clutches & Brakes

Clutches: Working principle of clutch, classification-Friction clutches-uniform pressure, uniform wear, single disc or plate clutch, multiple disc clutch, cone clutch, centrifugal clutch.

Brakes and Dynamometers: Working principle of brake, simple block brakes, internal expanding brake, band brake of vehicle. General description and operation of dynamometers: Prony, Rope brake, Epicyclic, Bevis Gibson and belt transmission.

Practice:

1. Determine the position of sleeve against controlling force and speed of a Hartnell governor and plot the characteristic curve of radius of rotation.

UNIT – III**Governors:**

Watt, porter and proell governors, spring loaded governors– Hartnell and Hartung with auxiliary springs-Lift of the governor- Sensitiveness, isochronism and hunting.

Practice:

1. Determine the position of sleeve against controlling force and speed of a porter governor and to plot the characteristic curve of radius of rotation.

UNIT – IV

Balancing: Balancing of rotating masses single and multiple – single and different planes, use analytical and graphical methods. Primary, secondary, and higher Balancing of reciprocating masses: Graphical methods, unbalanced forces and couples locomotive balancing, hammer blow, swaying couple, variation of tractive effort.

Practice:

1. Study the static and dynamic balancing using rigid blocks.

UNIT – V**Vibrations:**

Free and forced vibration of single degree of freedom systems, effect of damping-Dunkerley's method- vibration isolation and transmissibility; resonance; critical speeds of shafts.

Practice:

1. Determine the frequency of un-damped free vibration of an equivalent spring mass system.

Cornerstone Project

The cornerstone project in Dynamics of Machinery is intended to integrate theoretical knowledge with engineering design, analytical modeling, and system-level evaluation of dynamic mechanical systems. Unlike laboratory experimentation, this cornerstone emphasizes problem definition, conceptual design, mathematical modeling, computer-aided design, and simulation-based performance analysis. Limited prototyping or measurements, where undertaken, are intended solely for validation and demonstration of predicted system behavior. The project enables students to address open-ended mechanical problems involving rotating and vibrating systems, thereby developing higher-order engineering and problem-solving skills.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project requires analytical formulation, parametric studies, CAD modeling, and simulation-based validation.

Emphasis shall be placed on understanding system behavior under varying operating conditions and interpreting results using principles of dynamics.

Project 1: Gyroscopic Effect Demonstrator

Project Objective

To design and analyze a rotating mechanical system exhibiting gyroscopic couple and precessional motion.

Project Description

The project involves conceptualizing a motor-driven rotating disc mounted on a gimbal arrangement. The system is analyzed to understand the relationship between angular momentum, applied torque, and resulting precession. Emphasis is placed on system behavior rather than experimental measurement.

Scope of Analysis

- Analytical formulation of gyroscopic couple and precession rate
- Parametric study of disc speed and applied torque
- CAD-based representation of disc–gimbal assembly
- Simulation-based validation of theoretical trends

Project 2: Centrifugal Governor System

Project Objective

To design and evaluate a centrifugal governor for mechanical speed regulation.

Project Description

This project focuses on modeling a centrifugal governor mechanism and analyzing its speed control characteristics. The governing action is studied through analytical relationships between speed, radius of rotation, and controlling force.

Scope of Analysis

- Stability and sensitivity analysis
- Speed–radius characteristic modeling
- CAD modeling of governor arms and joints
- Simulation-based evaluation of governing performance

Project 3: Single Degree of Freedom (SDOF) Vibration System

Project Objective

To model and analyze free and damped vibrations in a single degree of freedom system.

Project Description

Students develop a mathematical model of an SDOF system and study its dynamic response. The project focuses on understanding how system parameters influence vibration characteristics.

Scope of Analysis

- Derivation of governing vibration equations
- Determination of natural frequency and damping ratio
- Time-domain and frequency-domain simulation
- CAD modeling of the physical system configuration

Project 4: Disc Brake Energy Dissipation System

Project Objective

To design and analyze a disc brake system with respect to braking torque and energy dissipation.

Project Description

The project involves analytical modeling of braking action and evaluation of stopping behavior under varying conditions. The focus is on understanding how energy is dissipated during braking.

Scope of Analysis

- Braking torque and stopping time estimation
- Energy dissipation and thermal trend analysis
- CAD modeling of brake disc, caliper, and mounting
- Simulation of braking performance under load variations

Project 5: Unbalanced Rotor Dynamics System

Project Objective

To analyze vibration behavior of rotating systems with mass unbalance.

Project Description

This project studies the dynamic response of a rotor with eccentric mass distribution. The emphasis is on understanding how unbalance affects vibration amplitude and system stability.

Scope of Analysis

- Modeling of unbalanced centrifugal forces
- Simulation of vibration amplitude versus speed
- CAD modeling of rotor–shaft geometry
- Identification of resonance and critical operating ranges

Project 6: Flywheel Speed Regulation System

Project Objective

To design and analyze a flywheel system for energy storage and speed regulation.

Project Description

The project examines how flywheels reduce speed fluctuations in rotating systems. Analytical and simulation tools are used to study energy storage and release during load variations.

Scope of Analysis

- Fluctuation of energy and speed analysis
- Turning moment diagram interpretation
- CAD modeling of flywheel and shaft assembly
- Evaluation of speed regulation effectiveness

Project 7: Critical Speed Analysis of Shafts

Project Objective

To analyze shaft whirling behavior and determine critical speed.

Project Description

This project focuses on modeling flexible shafts and identifying conditions leading to resonance. Classical analytical methods are used alongside simulations to predict critical speed.

Scope of Analysis

- Analytical estimation using Rayleigh's method
- Simulation of shaft vibration response
- CAD modeling of shaft and bearing supports
- Identification of resonance and stability limits

Project 8: Clutch Slip Analysis System

Project Objective

To design and analyze a clutch system with emphasis on torque transmission and slip behavior.

Implementation Guidance:

- a. Define the Problem Clearly**
 - State one real engineering problem.
 - Explain why it matters (industry, safety, performance, efficiency).
 - Avoid vague or already-solved problems.
- b. Set Measurable Objectives**
 - Limit to 3–5 objectives.
 - Each objective must be verifiable (computed, simulated, tested).
- c. Review Existing Work**
 - Study relevant literature/standards.
 - Identify limitations or gaps.
 - Use the review to justify your approach.
- d. Develop the Engineering Model**
 - Formulate equations, logic, or design rules.
 - State all assumptions clearly.
 - Define inputs, outputs, and constraints.
- e. 5. Implement Systematically**
 - Use appropriate tools (MATLAB, CAD, simulation, experiments).
 - Keep work modular, documented, and reproducible.
 - Do not rely on one-time or trial-**and-error** results.
- f. Validate the Results**
 - Compare with theory, literature, or experiments.
 - Perform at least one sensitivity or consistency check.
 - Unvalidated results are unacceptable.
- g. Analyze and Interpret**
 - Explain trends, peaks, and anomalies.
 - Link results directly to objectives.
 - Do not just present plots or tables.
- h. Conclude and Propose Next Steps**
 - Summarize key findings.
 - State limitations honestly.
 - Suggest realistic future improvements.

Text Books:

1. Theory of machines, S.S.Rattan, Tata Mc Graw Hill, 5th Edition, 2019, ISBN: 9789353166281.
2. Theory of machines, Thomas Bevan, CBS Publishers, 3rd Edition, ISBN: 9788123908748.

Reference Books:

1. Theory of machines: Kinematics and Dynamics , Sadhu Singh, Pearson Publishers 3rd Edition, 2011, ISBN: 9788131760697.
2. Theory of machines, R.K.Bansal, J.S.Brar, Laxmi Publications, 6th Edition, 2016, ISBN : 978-8131808054.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/104/112104114/>
2. <https://archive.nptel.ac.in/noc/courses/noc21/SEM1/noc21-me08/>

Note:

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- Finally, the Source code of the cornerstone Project has to be pushed into the Students GitHub repository (if applicable).

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	-
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	FC	2	-	2	4	50	50	100	-
2501ME18	Operations Research	IC	2	1		3	50	50	100	-
Total			6	1	4	11				

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

Course Code: 2501EE01

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Analyze the concepts associated to AC and DC circuits.
- CO2:** Explain the operating principles of motors, generators and measuring instruments.
- CO3:** Analyze the different energy resources and equipment safety measures.
- CO4:** Explain the concept and the applications of semiconductor diodes.
- CO5:** Analyze the basic electronic circuits and interpret numeric information in different code formats.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

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

Practice:

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

Practice:

1. Calculation of Electrical Energy for Domestic Premises

UNIT – IV

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

Practice:

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

UNIT – V

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

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

Practice:

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

Text Books:

1. Basic Electrical and Electronics Engineering, Salivahanan S, Tata McGraw Hill Education (India) Private Limited, New Delhi, 2009, ISBN : 978-0070146129.
2. Principles of Electrical Engineering, V. K. Mehta, R. Mehta, S. Chand & Company Ltd., New Delhi, 2014, ISBN :9352837193.
3. Digital Fundamentals, Thomas Floyd, Prentice Hall, 10th Edition, 2009, ISBN: 9780138146467.

Reference Books:

1. Electronic Devices & Circuit Theory, Robert L. Boylestad and Louis Nashelsky, Pearson 11th Edition, ISBN 9789332542600.
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2009, ISBN: 8177000209.

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).

Programming for Problem Solving Using C
(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,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-Dimensional Arrays
 - a. Sum of two 2-D arrays.
<https://maya.technicalhub.io/owl-program-details/66864fa9f56afec5c0c924f6>
 - b. Multiplication of two 2-D arrays.
 - c. Transpose of a Matrix.
 - d. Trace of a Matrix.
 - e. Lower Triangular Matrix.
3. Hacker Rank
 - a. Objective: print each word of the sentence in a new line.
 - b. Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits
Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
<https://maya.technicalhub.io/owl-program-details/6698e2fbc6bd470f35b73d8>
<https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e>
 - c. find the frequency of each digit in the given string.
<https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true>
 - d. Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.
<https://maya.technicalhub.io/owl-program-details/6698ed2dcb6bd470f35b7ae7>

UNIT – IV

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

Practice: Functions in C

1. Objective: Learn simple usage of functions.
<https://www.hackerrank.com/challenges/functions-in-c/problem?isFullScreen=true>
2. Objective: Fibonacci Numbers using recursive function.
<https://www.hackerrank.com/challenges/ctci-fibonacci-numbers/problem>
3. Objective: N^{th} factorial using recursion.
4. Objective: Find the super digit of the integer.
5. Implement LCM
6. Objective: Calculate the Nth term of series.
<https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true>

UNIT – V

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

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

Practice:

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

Text Books:

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

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education. ISBN.No: 9352604172
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill. ISBN No. 0071367993
3. Let Us C Yashwanth, Kanetkar, Eighth edition, BPB Publications. ISBN No. 1934015253

4. Programming in C A-Practical Approach, Ajay Mittal. Pearson Education.ISBN No. 9788131729342
5. R G Dromey How to Solve It by Computer (Prentice-Hall International Series in Computer Science.ISBN-13 : 978-0134340012

Web Links:

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

Additional Practice:

S.No .	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICE_CPP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/

17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/
24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/
26	Easy	Missing Number	https://leetcode.com/problems/missing-number/
27	Easy	Contains Duplicate	https://leetcode.com/problems/contains-duplicate/
28	Easy	Valid Anagram	https://leetcode.com/problems/valid-anagram/
29	Easy	Valid Parentheses	https://leetcode.com/problems/valid-parentheses/
30	Easy	Fibonacci Number	https://leetcode.com/problems/fibonacci-number/
31	Easy	Climbing Stairs	https://leetcode.com/problems/climbing-stairs/
32	Easy	Binary Search	https://leetcode.com/problems/binary-search/
33	Easy	Number of 1 Bits	https://leetcode.com/problems/number-of-1-bits/
34	Easy	Hamming Weight	https://leetcode.com/problems/number-of-1-bits/description/
35	Easy	Power of Two	https://leetcode.com/problems/power-of-two/
36	Easy	Power of Three	https://leetcode.com/problems/power-of-three/
37	Easy	Same Tree	https://leetcode.com/problems/same-tree/
38	Easy	Maximum Subarray	https://leetcode.com/problems/maximum-subarray/
39	Medium	Chef and Notebooks	https://www.codechef.com/problems/CNOTE
40	Medium	Chef and Wildcard Matching	https://www.codechef.com/search?q=TWOSTR
41	Medium	Minimum Moves	https://www.codechef.com/search?q=SALARY
42	Medium	Lucky Four	https://www.codechef.com/search?q=LUCKFOUR
43	Medium	Maximum Difference	https://www.codechef.com/search?q=MAXDIFF
44	Medium	Uncle Johny	https://www.codechef.com/search?q=JOHNY

45	Medium	Chef and Strings	https://www.codechef.com/search?q=CHEFSTLT
46	Medium	Two vs Rib	https://www.codechef.com/search?q=TWOVRIB
47	Medium	Chef and Array	https://www.codechef.com/search?q=CHEFARRP
48	Medium	Add Two Numbers	https://leetcode.com/problems/add-two-numbers/
49	Medium	Longest Substring Without Repeating Characters	https://leetcode.com/problems/longest-substring-without-repeating-characters/
50	Medium	Longest Palindromic Substring	https://leetcode.com/problems/longest-palindromic-substring/
51	Medium	3Sum	https://leetcode.com/problems/3sum/
52	Medium	Container With Most Water	https://leetcode.com/problems/container-with-most-water/
53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/
58	Medium	Spiral Matrix	https://leetcode.com/problems/spiral-matrix/
59	Medium	Jump Game	https://leetcode.com/problems/jump-game/
60	Medium	Permutations	https://leetcode.com/problems/permutations/
61	Medium	Combination Sum	https://leetcode.com/problems/combination-sum/
62	Medium	Search in Rotated Sorted Array	https://leetcode.com/problems/search-in-rotated-sorted-array/
63	Medium	Group Anagrams	https://leetcode.com/problems/group-anagrams/
64	Medium	Sort Colors	https://leetcode.com/problems/sort-colors/
65	Medium	Subsets	https://leetcode.com/problems/subsets/
66	Medium	Reverse Linked List II	https://leetcode.com/problems/reverse-linked-list-ii/

67	Medium	Add Two Numbers II	https://leetcode.com/problems/add-two-numbers-ii/
68	Medium	Reorder List	https://leetcode.com/problems/reorder-list/
69	Medium	Linked List Cycle II	https://leetcode.com/problems/linked-list-cycle-ii/
70	Medium	K-th Largest Element in an Array	https://leetcode.com/problems/kth-largest-element-in-an-array/
71	Medium	Product of Array Except Self	https://leetcode.com/problems/product-of-array-except-self/
72	Medium	Word Search	https://leetcode.com/problems/word-search/
73	Medium	Unique Paths	https://leetcode.com/problems/unique-paths/
74	Medium	Minimum Path Sum	https://leetcode.com/problems/minimum-path-sum/
75	Medium	Temperature Converter - II	https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30B
76	Medium	Reverse	https://www.hackerrank.com/challenges/reverse-array-c/problem?isFullScreen=true
77	Medium	Sentence in a new line	https://www.hackerrank.com/challenges/printing-tokens-/problem?isFullScreen=true
78	Hard	Median of Two Sorted Arrays	https://leetcode.com/problems/median-of-two-sorted-arrays/
79	Hard	Regular Expression Matching	https://leetcode.com/problems/regular-expression-matching/
80	Hard	Wildcard Matching	https://leetcode.com/problems/wildcard-matching/
81	Hard	Trapping Rain Water	https://leetcode.com/problems/trapping-rain-water/
82	Hard	First Missing Positive	https://leetcode.com/problems/first-missing-positive/
83	Hard	Longest Valid Parentheses	https://leetcode.com/problems/longest-valid-parentheses/
84	Hard	Merge k Sorted Lists	https://leetcode.com/problems/merge-k-sorted-lists/
85	Hard	Reverse Nodes in k-Group	https://leetcode.com/problems/reverse-nodes-in-k-group/description/
86	Hard	Sudoku Solver	https://leetcode.com/problems/sudoku-solver/
87	Hard	N-Queens	https://leetcode.com/problems/n-queens/description/
88	Hard	Edit Distance	https://leetcode.com/problems/edit-distance/
89	Hard	Word Ladder II	https://leetcode.com/problems/word-ladder-ii/
90	Hard	Maximal Rectangle	https://leetcode.com/problems/maximal-rectangle/
91	Hard	Binary Tree Maximum Path Sum	https://leetcode.com/problems/binary-tree-maximum-path-sum/

92	Hard	Serialize and Deserialize Binary Tree	https://leetcode.com/problems/serialize-and-deserialize-binary-tree/
93	Hard	Variadic functions in C	https://www.hackerrank.com/challenges/variadic-functions-in-c/problem?isFullScreen=true
94	Hard	Small Triangles, Large Triangles	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem?isFullScreen=true
95	Hard	Permutations of Strings	https://www.hackerrank.com/challenges/permutations-of-strings/problem?isFullScreen=true

Maya Programs

S.N o.	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/669a2453c03fe56b320b215c
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:

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

- c. Objective: Nth factorial using recursion.
- d. Objective: Find the super digit of the integer.
- e. Implement LCM
- f. Objective: Calculate the Nth term of series.

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

2. Pointers

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

UNIT – V

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

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

Practice:

a. Structures

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

b. File handling concepts

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

Text Books:

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

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education. ISBN.No: 9352604172

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

Web Links:

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

Additional Practice:

S.No.	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICE_CPP2/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

Operations Research

Course Code: 2501ME18

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Formulate and solve a real-world problem using Graphical and Simplex algorithms
- CO2:** Analyse the optimal solution in Transportation and Assignment problems
- CO3:** Analyse the optimal solutions in theory of games and sequencing problem using graphical and analytical methods
- CO4:** Analyse the optimal and minimal solutions in the network models using PERT & CPM and Project crashing
- CO5:** Examine the queue characteristics and optimal solutions using Queueing and Simulation 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	3	2	-	-	-	1	1	-	-	-	2
CO2	3	2	-	-	-	1	1	-	-	-	2
CO3	3	2	-	-	-	1	1	-	-	-	2
CO4	3	2	-	-	-	1	1	-	-	2	2
CO5	3	2	-	-	-	1	1	-	-	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Linear programming: Formulation of linear programming problem, Graphical solution, Simplex method, Big-M method, Two Phase method, Duality, Post-optimality and Sensitivity analysis.

UNIT – II

Transportation Problem: Mathematical model, Methods for finding initial solution: North West Corner Method, Least Cost method, Vogel's approximation method (VAM), Test for optimality, Degeneracy, Modified Distribution(MODI) method.

Assignment problem: Hungarian method, Travelling Salesman problem

UNIT – III

Theory of Games: Two person- zero sum games, Saddle point, Value of the game, Pure and mixed strategies, Rules of dominance, Algebraic method, Graphical method.

Job Sequencing: Introduction to job sequencing - n jobs-1 machine case- Johnson's algorithm- n jobs -2 machines, 3 machines cases- 2 jobs-m machines case-Graphical Solution.

UNIT – IV

Network flow models: Min cost flow problem, Max flow problem.

Project Planning: Critical path computations in CPM/PERT- Project Crashing.

UNIT – V

Queuing theory and its applications: Introduction, components of a queuing problem, classification of queues, steady, transient and explosive states of a queue, Roles of Poisson process and exponential distribution in queuing theory, Queuing models, Kendall's Notation, Single Server and Multi Server Models with Limited population. (M/M/1: ∞ /FIFO, M/M/1: N/FIFO, M/M/C: ∞ /FIFO)

Simulation: Monte Carlo simulation; Random number generation; Discrete and continuous simulation-Applications to Inventory and Queueing models.

Text Books:

1. Operations Research: An Introduction ,H. A. Taha, , Pearson Education Limited, 11th Edition, 2019, ISBN: 978-9352865277.
2. Operations Research applications, A.Ravi Ravindra, CRC Press, 1st edition, 2019, ISBN: 9780367386467

Reference Books:

1. Introduction to Operations Research, Hillier and Lieberman, CBS Publishers and Distributors, 7th edition, 2002, ISBN: 9780072535105.
2. Operation Research: Theory and Applications, Sharma, J. K. - Macmillan Publishers, 5th edition, 2012, ISBN: 9789350593363.

Web Links:

1. <https://orc.mit.edu/academics/master%E2%80%99s-operations-research>
2. <https://or.stanford.edu/>

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C
2501EN01	Essential Cognitive Skills for Engineers	FC			1	1
2501EN02	Advanced Cognitive Skills for Engineers	FC			1	1
2501UC07	Design Thinking using AI	FC			1	1
2501UC08	Universal Human Values	FC	2			2
2501UC09	Technical Paper Publication	AC			2	2
2501ME91	Student Activity Based Learning	AC				2

ESSENTIAL COGNITIVE SKILLS FOR ENGINEERS (Common to all branches)

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</i> and <i>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: <i>Lost at sea</i> , Leaflet: <i>How to survive...an animal attack</i> , Leaflet: <i>Be wise and survive</i>
Writing	Guidelines, organizing guidelines in a leaflet
Grammar	Narrative tenses, Future time clauses and conditionals
Vocabulary	Expressions with <i>get</i> , Animals and the environment
Pronunciation	Sound and Spelling: g, Intonation in question tags
UNIT – 3	Talent A/B/C/D
Listening	Conversation: learning experiences, Radio Programme: The sports gene, Making wedding plans, Interviews about sport
Speaking	Talking about something you have put a lot of effort into, Discussing sport and ways to improve performance, planning a party, Talking about popular sports
Reading	Text about learning; <i>Learning to learn</i> , Article: <i>Born to be the best</i> ; Three articles about athletes, Article: <i>Fitness: Seattle snapshot</i>
Writing	Article describing data
Grammar	Multi-word verbs, Present perfect and present perfect continuous
Vocabulary	Ability and achievement, word connected with sport
Pronunciation	Word stress, sound and spelling consonant sounds
UNIT – 4	Life Lessons A/B/C/D
Listening	Interview: Psychology of money; Two monologues: Life-changing events, Two monologues; training for a job, Presenting photos, Three monologues; living in different places
Speaking	Talking about how your life has changes, Discuss experiences of training and rules, Describing photos: Expressing careful disagreement, Discussing living in a different country
Reading	Two texts about life-changing events that helped people become rich, Article: <i>Training for the emergency frontline</i> , Advert for being an international student ‘buddy’
Writing	Job application, Giving a positive impression
Grammar	<i>Used to</i> and <i>would</i>
Vocabulary	Cause and result, Talking about difficulty
Pronunciation	Sound and spelling: u
UNIT – 5	Chance A/B/C/D
Listening	Monologue: What are your chances?, Conversation: Talking about work, Money problems, News reports: environmental problems
Speaking	Discussing possible future events, Role Play: job interview, Explaining and responding to an idea for a café, Giving opinions on environmental problems
Reading	Quiz: <i>Are you an optimist or a pessimist?</i> ; Article: <i>Why we think we’re going to have a long and happy life</i> , Quiz: <i>The unknown continent</i> ; Article: <i>Cooking in Antarctica</i> , Essay about protecting the environment
Writing	For and against essay, Arguing for and against an idea

Grammar	Future probability, Future perfect and future continuous
Vocabulary	Adjectives describing attitude, The natural world
Pronunciation	Sound and spelling : <i>th</i> , Intonation groups

Text Book:

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

Suggested Software:

1. Cambridge Empower
2. Soft X (K-Van Solutions)

Reference Books:

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

Web links:

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

ADVANCED COGNITIVE SKILLS FOR ENGINEERS
(Common to all branches)

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 TV?</i> Email: Complaining about an important issue.

Writing	Email of complaint, Using formal language
Grammar	<i>Too/enough; so/such</i> , Causative <i>have/get</i>
Vocabulary	Describing life in cities, Film and TV; Houses
Pronunciation	Sound and spelling: o, Stress in compound nouns
UNIT – 3	Dilemmas A/B/C/D
Listening	Radio programme: person finance, Three monologues about honesty, Going to the bank, Conversation about a TV programme
Speaking	Giving opinions on financial matters, Discussing moral dilemmas, Talking about hopes and worries Discussing programmes about crime
Reading	Article: <i>Is it time to give up on cash?</i> , Newspaper article: <i>The honesty experiment</i> , Review: <i>Crime with a smile</i>
Writing	Review, Organising a review
Grammar	First and second conditionals, Third conditional; <i>should have+past participle</i>
Vocabulary	Money and finance, Crime
Pronunciation	Stressed and unstressed words; Sound and spelling: <i>l</i> , Word groups
UNIT – 4	Discoveries A/B/C/D
Listening	Conversation about inventions, Conversation about an email hoax, Finding the perfect flat, Four monologues about alternative medicine
Speaking	Talking about inventions, Describing a hoax or a scam or a case of fraud, Giving and receiving surprises
Reading	Article: <i>Too good to be true?</i> , Article: <i>The rise and fall of Barry Minkow</i> , Essay: <i>The Value of alternative medicine</i>
Writing	Opinion essay, Presenting a series of arguments
Grammar	Relative clauses, Reported speech; Reporting verbs
Vocabulary	Health, Verbs describing thought and knowledge
Pronunciation	Sound and spelling : <i>ui</i> , Linking and intrusion
UNIT – 5	Possibilities A/B/C/D
Listening	Interview about Dan Cooper, Two monologues: pursuing a dream, Celebrating good news, conversation about goals
Speaking	Telling stories about coincidences, Describing and comparing brave or amazing people, Telling an important piece of news, Talking about performing
Reading	Story: The man who disappeared; Blog: <i>The Wreck of the Titan</i> , Article: <i>Dream to help</i> , Story: Rosa's diary: <i>The ultimate goal</i>
Writing	Story, Making a story interesting
Grammar	Past modals of deduction, Wishes and regrets
Vocabulary	Adjectives with prefixes, Verbs of effort
Pronunciation	Word stress, Linking, Consonant clusters

Text Book:

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

Suggested Software:

1. Cambridge Empower
2. Soft X (K-Van Solutions)

Reference Books:

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

Web links:

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

Design Thinking using AI
(Common to CE,EEE,ME,ECE,CSE,IT,AI ML,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, John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, Cengage learning (International edition) 2nd Edition, ISBN 9788131530740
2. The Design of Business: Why Design Thinking is the Next Competitive Advantage, Roger Martin, Harvard Business Press, ISBN 9781422177808

Reference Books:

1. Engineering Design Process, Yousef Haik and Tamer M.Shahin, Cengage Learning, 2nd Edition, ISBN 9788131529041
2. Solving Problems with Design Thinking - Ten Stories of What Works, Jeanne Liedtka, Andrew King & Kevin Bennett (Columbia Business School Publishing) Hardcover, ISBN 978-0231163569

Web Links:

1. www.tutor2u.net/business/presentations/. /Product lifecycle/default.html
2. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf

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
2501ME19	Digital Manufacturing Lab	IC	-	-	2	2
2501ME20	Analysis & Simulation Lab	IC	-	-	2	2
2501AI01	Artificial Intelligence & Machine Learning Lab	AC	-	-	2	2
	TOTAL				6	6

Digital Manufacturing Lab

Course Code: 2501ME19

L	T	P	C
0	0	2	2

Course Outcomes:

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

- CO1:** Understand and Apply Basic Robotics Concepts:
- CO2:** Understand and Apply Basic Robotics Concepts:
- CO3:** Implement and Control Embedded Systems with Arduino:
- CO4:** Integrate and Operate Advanced Robotics and Communication Systems
- CO5:** Enhance Problem-Solving and Critical Thinking Skills

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice:

1. Install and explore CPRog software features and safety protocols.
2. Program an IGUS robot for pick and place tasks with a magnetic gripper.
3. Program an IGUS robot for pick and place tasks with a vacuum gripper.
4. Create a simple geometric shape using CAD software.
5. Design and assemble multiple CAD components with proper fit.
6. Develop a 3D parametric model by adjusting key parameters.
7. Slice a 3D model and print a simple part using a 3D printer.
8. Print and assemble multiple components, ensuring proper fit.
9. Print complex geometries using support structures.
10. Use Arduino and a potentiometer to control DC motor speed.
11. Use Arduino to control a servo motor's angular position.
12. Build and program an Arduino robot to avoid obstacles using ultrasonic sensors.

Additional Practice:

1. Design and program an Arduino system to monitor and display temperature data.
2. Develop and program a robot controlled via Bluetooth communication using Arduino.

Reference Books:

1. 3D Printing and Additive Manufacturing: Principles and Applications, Chee Kai Chua and Kah Fai Leong, World Scientific publishers, 2020, 5th edition, ISBN: 9813146761.
2. 3D Printing for Dummies, Richard Horne and Kalani Kirk Hausman, Wiley Publication, 2019, 2nd edition, ISBN: 978-8126569892.
3. A comprehensive approach to Digital Manufacturing, Arif Sirinterlikci, Yalcin Ertekin, Springer, 2023rd edition, 2023, ISBN: 9783031253539.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc21_mg83/preview
2. <https://www.coursera.org/learn/introduction-digital-manufacturing-fusion-360>
3. https://onlinecourses.swayam2.ac.in/ntr25_ed17/preview

Analysis & Simulation Lab

Course Code: 2501ME20

L T P C
0 0 2 2

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

- CO1:** Demonstrate the ability to create and analyze the FE models for trusses using ANSYS
- CO2:** Demonstrate the ability to evaluate and interpret FE analysis results for design and evaluation purposes.
- CO3:** Study the different meshing.
- CO4:** Solve the problem related to Finite Different Method.
- CO5:** Solve the problem for heat transfer.

Mapping of Course Outcomes with Program Outcomes:

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

Practice

1. Introduction to FEA software ANSYS Workbench.
2. Solving truss problems using ANSYS.
3. Two-dimensional truss problem using ANSYS
4. Analysis for 1-D temperature analysis.
5. Harmonic analysis of a Cantilever beam
6. Analysis of 3D Problems using ANSYS.
7. Introduction to CFD workbench (CFX/FLUENT).
8. Mesh generation technique with models.
9. Heat conduction through a slab.
10. Lumped heat capacity model.
11. Flow over a flat plate.
12. Flow through pipe

Additional Practice:

1. Project using ANSYS
2. Project using FLUENT

Reference Books:

1. Principles of CAD/CAM/CAE, Kunwoo Lee, Pearson, 1st Edition, ISBN 978-0201380361
2. Autodesk Fusion 360 Black Book, Verma G., CADACAMCAE Works, 2nd Edition, 2021, ISBN 978-1988722344

Web Links:

1. <https://kashanu.ac.ir/Files/Content/ANSYS%20Workbench.pdf>
<https://www.ansys.com/content/dam/amp/2023/december/quick-request/ansys-education-resources-23q4-part-1/basics-of-fea-tutorial-tutfeameen25.pdf>
2. <https://archive.nptel.ac.in/courses/112/105/112105254/>

Artificial Intelligence & Machine Learning Lab

Course Code: 2501AI01

L	T	P	C
0	0	2	2

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

- CO1:** Apply basic data loading, preprocessing, and visualization techniques using Python.
- CO2:** Handle missing data, normalization, and basic data transformations using Python.
- CO3:** Implement fundamental classification algorithms such as Decision Tree, Naive Bayes, k-NN, and Logistic Regression using Python.
- CO4:** Implement regression algorithms such as Simple Linear Regression and Multiple Linear Regression using Python.
- CO5:** Apply unsupervised machine learning techniques and model evaluation methods such as K-Means clustering, train-test split, and cross-validation using Python.

Mapping of Course Outcomes with Program Outcomes:

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

Practice

Write a program using PYTHON

1. To load a dataset and display its attribute details. Use any appropriate dataset.
2. To handle missing values using the Replace Missing Values filter or equivalent Python code. Use an appropriate dataset.
3. To demonstrate normalization and standardization of data. Use an appropriate dataset.
4. To visualize the dataset (plots/summary/statistics) and interpret the basic information. Use an appropriate dataset.
5. To demonstrate the working of a Decision Tree classifier, Use an appropriate dataset.
6. To demonstrate the working of the Naive Bayes classifier. Use an appropriate dataset.
7. To demonstrate the working of the k-Nearest Neighbors (IBk / KNN) classifier. Use an appropriate dataset.
8. To demonstrate the working of the Logistic Regression classifier. Use an appropriate dataset.
9. To demonstrate the working of Simple Linear Regression. Use an appropriate dataset.
10. To demonstrate the working of Multiple Linear Regression. Use an appropriate dataset.
11. To demonstrate the working of the K-Means clustering algorithm. Use an appropriate dataset.
12. To demonstrate train-test split and cross-validation for any classifier. Use an appropriate dataset.

Additional Practice:

1. To demonstrate the k-fold cross-validation for any classifier. Use an appropriate dataset.
2. To demonstrate the working of the Random Forest classifier. Use an appropriate dataset.

Reference Books:

1. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, ISBN 978-1492032649
2. Practical Machine Learning, Sunila Gollapudi, ISBN 978-1784399689

Web Links:

1. <https://archive.ics.uci.edu/ml/datasets.php>
2. <https://www.kaggle.com/>
3. <https://www.geeksforgeeks.org/machine-learning/>

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	FC			2	2	50	50	100	-
2501CS04	Internet of Things	FC			1	1	50	50	100	-
2501CS02	Data Analysis using Python	IC			2	2	50	50	100	PPSC
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				20	6				

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

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,	https://www.kaggle.com/datasets/abecklas/fifa-world-cup

		and AI insights to identify historical trends and performance patterns.	
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 Microsoft Excel, Power BI, and AI-driven insights, the dashboard enables comparative analysis of tourism performance across countries and years.	https://data.worldbank.org/indicator/ST.INT.ARVL
15	Global Internet Usage & Digital Connectivity Dashboard	Develop a Business Intelligence dashboard that analyzes internet penetration, broadband subscriptions, mobile connectivity, and digital adoption across countries. The project combines Spreadsheet Analytics in Microsoft Excel, interactive Power BI dashboards, and AI-generated insights to explore global digital transformation and connectivity trends.	https://data.worldbank.org/indicator/IT.NET.USER.ZS

Text Books

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

Reference Books

- 1 Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life, Devin Knight and Siddharth Mehta.
- 2 Learn Power BI: A Beginner's Guide to Analyzing Data and Creating Reports with Power BI, Murilo Miranda.
- 3 Co-Intelligence: Living and Working with AI, Ethan Mollick (for responsible AI use).

Web Links / e-Resources

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

Note:

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

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:

- Study of Arduino UNO and Raspberry Pi boards including architecture, pin configuration, power supply, communication interfaces and development environments.
- 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.
- Design and implement basic digital input–output operations using Arduino by controlling LED/buzzer.
- Interface an analog sensor (LDR) with Arduino and display sensor values on Serial Monitor.
- Interface a digital sensor (Ultrasonic sensor) with Arduino and display measured values on Serial Monitor.
- Develop conditional logic using Arduino to control LED or buzzer based on sensor threshold values.

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

Additional Practice (Any 2 from the following)

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

Reference Books:

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

Web Links:

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

Data Analysis 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 DataFrames.
- CO5:** Create plots using Matplotlib library for better visualization.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	1	-	2	-	-	1	1	-	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 todo list application for adding, deleting and updating tasks.

Reference Books:

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

Web Links:

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

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

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

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

Reference Books:

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

Web Links:

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

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

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Aptitude:

Problems on Ages, Partnership, Percentages, Profit and Loss

Reasoning:

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

Verbal:

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

Text Books:

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

Reference Books:

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

Web Links:

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

Employability Skills- III

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

Course Code: 2501UC14

L T P C
0 0 3 0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

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

Reference Books:

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

Web Links:

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

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

Course Code: 2501UC15

L T P C
0 0 3 0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

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

Reference Books:

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

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

Web Links:

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

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

Course Code: 2501UC16

L T P C
0 0 3 1

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

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

Reference Books:

- 1 Quantitative Aptitude – Abhijit Guha Mc Graw Hill Publications, ISBN-13 9789389957426.
- 2 How To Crack Test of Reasoning Verbal, Non-Verbal & Analytical – Jaikishan and Premkishan, Arihant Publications, New Edition 2024, ASIN : B0CRQ9BVBC.

- 3 A New Approach to Objective English – R. S. Dhillon DGP Publications, ISBN-13: 978-8186651032

Web Links:

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

Mandatory Course (MC)

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

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

Course Code: 2501AC01

L T P C
2 0 0 0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

UNIT – II

Ecosystem, Biodiversity and Its Conservation:

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

UNIT – III

Environmental Pollution and Solid Waste Management:

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

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

Solid Waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution

UNIT – IV

Social Issues and The Environment:

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

UNIT – V

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

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press, ISBN 788173718625
2. Environmental Studies, Palaniswamy – Pearson education, ISBN 978-9332528277
3. Environmental Studies, Dr.S.Azeem Unnisa, Academic Publishing Company, ISBN 978-1926895256

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, M.Anji Reddy, B.S Publication, ISBN 978-8178002347
3. Comprehensive Environmental studies, J.P.Sharma, Laxmi publications, ISBN 978-8170087380
4. Environmental sciences and engineering, J. Glynn Henry and Gary W. Heinke – Prentice Hall of India Private limited, ISBN 978-0132831772
5. A Textbook of Environmental Studies, G.R.Chatwal, Himalaya Publishing House, ISBN 978-9350255781

Web Links:

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

Constitution of India

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

Course Code: 2501AC02

L	T	P	C
2	0	0	0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

UNIT – V

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

Text Books:

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

Reference Books:

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

Web Links:

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

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

Course Code: 2501AC03

L	T	P	C
2	0	0	0

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Meaning of Research: 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 2008, ISBN 9788122515223.
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, 2011, ISBN 9788120343818.
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.
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 Singhanian, 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: Automation & Robotics

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME24	Elements of Robotics	FC	2			2	50	50	100	-
2501ME25	Programming for Robotics	IC	2		1	3	50	50	100	PPSC
2501ME26	Digital Manufacturing	IC	3			3	50	50	100	MP-I
2501ME27	Advanced Fluid Power & Control Systems	IC	2		1	3	50	50	100	FMHM
2501ME28	Robotic Mobility Systems	AC	2		1	3	50	50	100	EOR
2501ME29	Control of Robotic System	AC	2		1	3	50	50	100	RMS
2501ME30	AI for Robotics	AC	2		1	3	50	50	100	EOR
2501ME31	Robotic Operating System	AC	2		1	3	50	50	100	DAP
2501ME32	Advanced Robotic Operating System	AC	2		1	3	50	50	100	ROS
2501ME33	Field & Service Robotics	AC	2		1	3	50	50	100	PFR
2501ME34	Robotic Process Automation (Industry Partnered Certification Program)	AC	3			3	50	50	100	EOR
Total			24		8	32				

Minor Stream: Thermal Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME35	Power Plant Engineering	FC	2			2	50	50	100	-
2501ME36	Sustainable Energy Systems	FC	3			3	50	50	100	-
2501ME37	Solar Energy Systems	FC	3			3	50	50	100	-
2501ME38	Alternative Fuels for IC engines	IC	3			3	50	50	100	ICE
2501ME39	Fuel Cell Technology	IC	3			3	50	50	100	ICE
2501ME40	Refrigeration & Air Conditioning	IC	2	1		3	50	50	100	ETD
2501ME41	Hydraulic Machinery & Systems	IC	3			3	50	50	100	FMHM
2501ME42	Cryogenic Engineering	AC	3			3	50	50	100	R&AC
2501ME44	Energy Storage Systems	AC	3			3	50	50	100	BEEE
2501ME45	Gas Dynamics & Jet Propulsion	AC	2	1		3	50	50	100	HPE
2501ME46	Computational Fluid Dynamics	AC	2	1		3	50	50	100	HT, FMHM
Total			29	3		32				

Minor Stream: Automotive Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME47	Automotive Electrical & Electronics	FC	2			2	50	50	100	BEEE
2501ME48	Automotive Maintenance	IC	2		1	3	50	50	100	AE
2501EE54	Hybrid & Electric Vehicles	IC	3			3	50	50	100	BEEE
2501ME49	Electronic Engine Management System	IC	3			3	50	50	100	HEV
2501ME50	Automotive Certification & Homologation	IC	3			3	50	50	100	AE
2501ME51	Vehicle Infotronics	IC	3			3	50	50	100	AEE
2501ME52	Automotive Aerodynamics	AC	3			3	50	50	100	FMHM, AE
2501ME53	Automotive Noise Vibration & Harshness	AC	3			3	50	50	100	DOM
2501ME54	Vehicle Stability & Control	AC	3			3	50	50	100	AE
2501ME55	Special Purpose Vehicles	AC	3			3	50	50	100	AE
2501ME56	Automotive & Pedestrian Safety	AC	3			3	50	50	100	AE
Total			31		1	32				

Minor Stream: Design and Manufacturing

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME57	Plant Layout & Material Handling	FC	2			2	50	50	100	-
2501ME59	Additive Manufacturing	IC	3			3	50	50	100	MF - I
2501ME60	Composite Materials	IC	3			3	50	50	100	SSP/MP
2501ME61	Design for Manufacturing	IC	3			3	50	50	100	MSD
2501ME62	Industrial Automation	IC	3			3	50	50	100	MF - I
2501ME63	Flexible Manufacturing System	IC	3			3	50	50	100	MF - I
2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	100	-
2501ME64	Design of Transmission Systems	AC	2	1		3	50	50	100	MD
2501ME65	Advanced Mechanics of Solids	AC	2	1		3	50	50	100	MSD
2501ME66	Mechanical Vibrations	AC	2	1		3	50	50	100	DOM
2501ME67	Condition Monitoring	AC	3			3	50	50	100	DOM
Total			30	2		32				

Minor Stream Syllabus

Minor Stream: Automation Robotics

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME24	Elements of Robotics	FC	2			2	50	50	100	-
2501ME25	Programming for Robotics	IC	2		1	3	50	50	100	PPSC
2501ME26	Digital Manufacturing	IC	3			3	50	50	100	MP-I
2501ME27	Advanced Fluid Power & Control Systems	IC	2		1	3	50	50	100	FMHM
2501ME28	Robotic Mobility Systems	AC	2		1	3	50	50	100	EOR
2501ME29	Control of Robotic System	AC	2		1	3	50	50	100	RMS
2501ME30	AI for Robotics	AC	2		1	3	50	50	100	EOR
2501ME31	Robotic Operating System	AC	2		1	3	50	50	100	DAP
2501ME32	Advanced Robotic Operating System	AC	2		1	3	50	50	100	ROS
2501ME33	Field & Service Robotics	AC	2		1	3	50	50	100	PFR
2501ME34	Robotic Process Automation (Industry Partnered Certification Program)	AC	3			3	50	50	100	EOR
Total			24		8	32				

Elements of Robotics

Course Code: 2501ME24

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Describe the historical development and fundamental concepts of robotics.
- CO2:** Analyze and design robotic drive systems effectively.
- CO3:** Apply direct kinematics and inverse kinematics in the mathematical modelling of robot
- CO4:** Explain the principles and applications of sensors
- CO5:** Explain robotic systems for sensing and feedback control using microcontroller

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamentals of Robotics: Historical development of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision of Robot, Work cell control.

UNIT – II

Robot Drive systems: Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives-D.C. Servo Motors, Stepper Motors, BLDC Motors -Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive, Power transmission systems for robot.

UNIT – III

Mathematical Modeling of Robot: Direct Kinematics, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-ordinate

System, inverse kinematics of two joints, DH Parameters, Jacobian Transformation in Robotic Manipulation

UNIT – IV

Introduction to Sensors: Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Position sensors – Piezo Electric Sensor, LVDT, Touch Sensors, Force and torque sensors.

Practice:

1. Application of IR Proximity Sensor
2. Application of Ultrasonic Proximity Sensor
3. Application of Touch Sensor

UNIT – V

Role of Microcontroller in Robotics: Introduction to microcontrollers, Microcontrollers and microprocessors, Introduction to Arduino, Types of Arduino boards, Programming basics: Structure of a code

Practice :

1. Blink On-Board LED
2. Blink LED(S)
3. Change Brightness of LEDs
4. Control of Dc Motors (Direction and Speed)
5. Study and Control of Servo Motor Using Arduino
6. Study and Control of Bipolar Stepper Motor Using Arduino

Text Books:

1. Robotics: Modelling, Planning and Control, Bruno Siciliano et al., Springer London Ltd, 1st edition. 2009, ISBN : 9781846286414.
2. Introduction to Robotics: Analysis, Control, Applications, Saeed B. Niku, Wiley, 2019, 3rd edition, ISBN : 9781119527626.

Reference Books:

1. Robotics: Control, Sensing, Vision, and Intelligence, C.S.G. Lee et al., CRC Press, 2018, ISBN : 9780071004213.
2. Robotics: Theory and Industrial Applications, Larry Ross et al., Wiley-IEEE Press, 2nd edition, 2010, ISBN-13 : 9781605253213.

Web Links:

1. <https://nptel.ac.in/courses/107106090>
2. <https://www.coursera.org/specializations/introduction-robotics-webots>
3. <https://nptel.ac.in/courses/108105102>

Programming for Robotics

Course Code: 2501ME25

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain the installation procedure and programming structure of Python
- CO2:** Demonstrate the ability to create, manipulate, and apply various data structures and algorithms, including arrays and lists.
- CO3:** Utilize data structures and algorithms in engineering applications, incorporating advanced Python features such as list comprehensions and decorators.
- CO4:** Manipulate multi-dimensional arrays using numpy and perform complex numerical operations relevant to engineering tasks
- CO5:** Conduct data analysis and create visualizations using pandas and matplotlib to derive insights from 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	-	-	3	-	-	1	1	-	2
CO2	3	3	-	-	3	-	-	1	1	-	2
CO3	3	3	1	-	3	-	-	1	1	-	2
CO4	3	2	1	2	3	-	-	1	1	-	2
CO5	3	2	1	2	3	-	-	1	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Python (Basics): Overview of Python language, Basic syntax and data types, Control structures (loops, conditionals). Installation of PYTHON, Installation Of Libraries

Practice:

- Write a program that takes users input and prints the type of input and also creates loops to calculate the factorial of numbers

UNIT – II

Data Structures & Algorithms: Arrays and Lists in Python, Creating and manipulating arrays/lists, Array slicing and indexing, Array operations (concatenation, repetition), Array Manipulation Techniques, Sorting arrays, Searching arrays, Filtering and selecting array elements. Array Algorithms, Linear search and binary search algorithms, Sorting algorithms (selection sort, bubble sort, merge sort),

Practice:

- Implement and compare the performance of sorting techniques.

UNIT – III

Applications of DSA: Applications of Array Manipulation in Engineering. List Comprehensions, Multiple Function Arguments, Regular Expressions, Exception Handling, Sets, Serialization, Partial functions, Code Introspection, Closures, Decorators, Map, Filter, Reduce.

Practice:

1. Write a function that takes variable number of arguments and returns their sum ,

UNIT – IV

Array Manipulation: Multi-dimensional Arrays, Introduction to multi-dimensional arrays, manipulating multi-dimensional arrays, Applications of multi-dimensional arrays in engineering, numpy operations.

Practice:

1. Create a program to use numpy to perform matrix addition, subtraction and multiplication
2. Perform any statical operations like mean/median/standard deviation on numpy arrays

UNIT – V

Data Analysis and Visualization: Introduction to Pandas library and its importance in data analysis, installation and understanding of Series and DataFrame; Series creation and manipulation, DataFrame creation, slicing and filtering; data cleaning techniques, transformation methods, visualization using Pandas' built-in plotting functions. Visualization with Matplotlib.

Practice:

1. Install pandas and create series and data frame objects, perform data transformation like normalization , scaling.
2. Create more complex visualizations using Matplotlib: scatter plots, pie charts.

Text Books:

1. Data Structure and Algorithmic Thinking with Python, Narasimha Karumanchi, CareerMonk Publications, 1st edition, 2015, ISBN : 9788192107592.
2. Fundamentals of Python First Programs, Kenneth. A. Lambert, Cengage, 2nd edition, 2019, ISBN : 9789353502898.

Reference Books:

1. Introduction to Python Programming, Gowrishankar.S, Veena A, CRC Press, 2019, ISBN : 9780367410179.
2. Introduction to Programming Using Python, Y. Daniel Liang, Pearson, 1st edition, 2017, ISBN : 9789332551848.

Web Links:

1. <https://nptel.ac.in/courses/106106182>
2. <https://www.tutorialspoint.com/python/index.htm>

Digital Manufacturing

Course Code: 2501ME26

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the concept and historical evolution of Digital Manufacturing, including Industry 4.0 and Cyber-Physical Systems.
- CO2:** Apply various CAD modeling techniques to create three-dimensional models, including parametric and assembly modeling.
- CO3:** Assess the need and process of Reverse Engineering, and develop geometric models using appropriate hardware and software tools.
- CO4:** Utilize Computer-Aided Manufacturing (CAM) tools to model components, select machines and tools, generate tool paths, simulate processes, and perform post-processing.
- CO5:** Evaluate the processes and technologies involved in Additive Manufacturing, including material selection, process planning, and post-processing techniques.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Digital Manufacturing: Definition of digital manufacturing, Historical perspective on industrial production and outlook, Industrial Revolutions, Industry 4.0, Cyber physical system, Factory of the future, Operation Mode and Architecture of Digital Manufacturing System.

UNIT – II

CAD Modeling: Design process and role of CAD, Types and applications of design models, Three-dimensional modelling schemes, Wire frames and surface representation schemes, Solid modelling - Parametric modelling, Assembly modelling.

UNIT – III

Reverse Engineering: Need, Reverse engineering process, reverse engineering hardware and software, Geometric model development from physical objects using 3D Scanning or manual measurements.

UNIT – IV

Computer Aided Manufacturing: Component modeling, Machine and tool selection, Defining process and parameters, Tool path generation, Simulation, Post processing.

UNIT – V

Additive Manufacturing for Digital Transformation: Introduction to additive manufacturing, Additive manufacturing process chain, Material selection, Manufacturing, Post processing, Additive manufacturing technologies and processes, Vat photo polymerization, fused filament fabrication, Material jetting, Sheet lamination, Powder bed fusion, Binder jetting, Planning and slicing additive manufacturing software.

Text Books:

1. Fundamentals of Digital Manufacturing Science, Zude Zhou, Shane Xie, Dejun Chen, Springer, 2013, ISBN : 9781447127147.
2. CAD/CAM - Theory and Practice, Ibrahim Zeid and Sivasubramanian R, Tata McGraw Hill Education, 2nd edition, 2009, ISBN : 9780070151345.

Reference Books:

1. Reverse Engineering An Industrial Perspective, Vinesh Raja and Kiran J Fernandes, Springer, 1st edition, 2010, ISBN : 9781849966603.
2. Rapid Prototyping: Principles and Applications, C. K. Chua, L. F. Leong, C.S Lim, World Scientific Publications, 3rd edition, 2010, ISBN : 9789812778987.

Web Links:

1. <https://nptel.ac.in/courses/110106146>
2. <https://www.coursera.org/learn/introduction-digital-manufacturing-fusion-360>
3. https://onlinecourses.swayam2.ac.in/nt2.4_ed17/preview

Advanced Fluid Power & Control Systems

Course Code: 2501ME27

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Explain the principles and terminology of fluid power systems and hydraulic fundamentals.
- CO2:** Develop skills in PLC programming and design of PLC-based control circuits.
- CO3:** Explain the functioning of hydraulic actuators and control components
- CO4:** Design and implement pneumatic circuits and systems, integrating electrical drives for enhanced control.
- CO5** Explain the principles and applications of electrical drives and compact drives

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamentals of Fluid Power and Hydraulics: Introduction to Fluid Power: Definition and significance of fluid power systems, Advantages and applications in various industries.

Basics of Hydraulics: Pascal's Law, Explanation and applications, Principles of fluid flow: Laminar and turbulent flow, Friction loss in hydraulic systems.

Sources of Hydraulic Power: Pumping Theory: Basic principles and mechanisms. Classification of Pumps: Types (gear, vane, piston pumps) and their applications, Construction and Working of Hydraulic Pumps, Design considerations, advantages, and disadvantages, Performance characteristics and selection criteria for pumps.

Practice:

1. To demonstrate Pascal's Law and the principles of fluid flow

UNIT – II

Programmable Logic Controllers (PLCs): Introduction to PLCs: Basic structure and components, Principle of operation.

PLC Programming: Introduction to programming languages (Ladder logic, Function block diagram), Concept of ladder diagram and programming techniques, Latching in PLCs.

Logic Gates Using PLCs: Implementation of basic logic gates (AND, OR NOT) using PLCs. Complex logic circuits and their applications.

PLC-Based Electro-Pneumatic Circuits: Design and implementation of electro-pneumatic control circuits.

Practice:

1. To understand the basics of PLC programming and implement simple logic gates

UNIT – III

Hydraulic Actuators and Control Components: Hydraulic Actuators: Types and construction of hydraulic cylinders. Applications of different types of cylinders. Hydraulic cushioning mechanisms, Hydraulic motors: Types and applications.

Control Components: Direction control valves: Types, construction, and operation, Flow control valves: Types and applications, Pressure control valves: Types and mechanisms, Servo and proportional valves: Working principles and applications.

Hydraulic System Accessories: Reservoirs, pressure switches, and their roles, Introduction to Fluid Power ANSI Symbols.

Practice:

1. To study the construction and operation of hydraulic cylinders and motors.
2. To understand the operation of different types of control valves.

UNIT – IV

Pneumatic Circuits and Systems: Properties of Air: Overview of air properties and perfect gas laws.

Pneumatic Components: Compressors: Types and working principles, Filters, regulators, lubricators, and mufflers: Functions and applications, Air control valves and quick exhaust valves.

Pneumatic Actuators: Types and applications in various systems.

Design of Pneumatic Circuits: Cascade method for circuit design, Electro-pneumatic systems: Components and design principles, Ladder diagrams for pneumatic control.

Electro-Pneumatic Logic Circuits: Design and implementation, Practical problems

Practice :

1. To design and test basic pneumatic circuits.
2. To design and implement electro-pneumatic control system

UNIT – V

Electrical Drives: Working Principle of Servo Drives: Introduction to Servo drives and their applications, Harmonic drives and their advantages.

Compact Drives and Variable Frequency Drives (VFDs): Working principles and applications in industry.

Integration with Fluid Power Systems: Combining electrical drives with hydraulic and pneumatic systems for enhanced control.

Practice :

1. To implement and calibrate PID control in a hydraulic or pneumatic system

Text Books:

1. Fluid Power Engineering, M. Galal Rabie, McGraw-Hill Professional, 2009, ISBN : 9780071622562.
2. Programmable Logic Controllers, Frank D. Petruzella, McGraw-Hill Education, 4th edition, 2010, ISBN : 9780073510880.

Reference Books:

1. Introduction to Hydraulics for Industry Professionals, Medhat Khalil, Compudraulic LLC, 2016, ISBN : 9780692622360.
2. Pneumatic Systems: Principles and Maintenance, S.R. Majumdar, McGraw Hill Education, 1st edition, 2017, ISBN : 9780074602317.

Web Links:

1. <https://nptel.ac.in/courses/112106300>
2. <https://www.coursera.org/lecture/fluid-power/hydraulics-and-pneumatics-SD8dv>

Robotic Mobility Systems

Course Code: 2501ME28

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain the principles of kinematic and dynamic analysis of robot manipulators
- CO2:** Apply techniques to control both the position and orientation of the tool in three-dimensional space
- CO3:** Analyze the relationship between joint variables and the position/orientation of the tool
- CO4:** Create plans for guiding the tool along trajectories to execute specific tasks effectively
- CO5:** Evaluate methods for precisely controlling high-speed motion within the system

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Introduction, position and orientation of objects, objects coordinate frame Rotation matrix, Euler angles Roll, pitch and yaw coordinate Transformations, Joint variables and position of end effector, Dot and cross products, coordinate frames and Rotations, Homogeneous coordinates.

Practice:

1. Installation of MATLAB and implementing the basic exercise to execute the position, orientation of objects.
2. Implementation of homogeneous transformations

UNIT – II

Direct Kinematics: Link coordinates D-H Representation, The ARM equation. Direct kinematic analysis for Four axis, SCARA Robot and three, five and six axis Articulated Robots.

Practice:

1. Implementation of basic exercise in matlab to demonstrate the DH Convention
2. Implementation of basic exercise in matlab to demonstrate kinematic analysis

UNIT – III

Inverse Kinematics: The inverse kinematics problem, General properties of solutions. Tool configuration, Inverse kinematics of four axis SCARA robot and three and five axis, Articulated robot.

Practice:

1. Practice exercises solving the inverse kinematics

UNIT – IV

Workspace Analysis and Trajectory Planning: Workspace Analysis, work envelope of a Four axis SCARA robot and five axis articulated robot workspace fixtures, the pick and place operations, Joint space technique - continuous path motion, Interpolated motion, straight line motion and Cartesian space technique.

Practice:

1. Practice exercises to implement various motions associated like continuous path motion, interpolated motion, straight line motion, etc.

UNIT – V

Manipulator Dynamics: Introduction, Lagrange's equation kinetic and potential energy. Link inertia Tensor, link Jacobian Manipulator inertia tensor. Gravity and Generalized forces, Lagrange-Euler Dynamic model, Dynamic model of a Two-axis planar robot, Newton Euler formulation, Lagrange - Euler formulation, Example problems.

Practice:

1. Basic exercise to implement Lagrange's equation to explore the effects of forces and dynamic modelling of newton Euler and Lagrange formulations.

Text Books:

1. Robotics Engineering an Integrated Approach, Richard D. Klafter, A. Thomas, Chri Elewski, Michael Negin, PHI Learning, ISBN: 981-250-625-5
2. Engineering foundation of Robotics, Francis N. Nagy Andras Siegler, Prentice Hall Inc ISBN: 978-0132788052

Reference Books:

1. Industrial Robotics, Bernard Hodges, Jaico Publishing house, ISBN: 978-0434907823
2. Foundations of Robotics Analysis and Control, Tsuneo Yohikwa, MIT Press, ISBN: 9780262514583
3. Introduction to Robotics Mechanics and Control, John J. Craig, Pearson, ISBN: 978-0201543612

Web Links:

1. <https://www.ros.org/>
2. <https://www.classcentral.com/course/robotics-delft-university-of-technology-hello-rea-11555>
3. <https://www.classcentral.com/course/udemy-ros-essentials-68029>

Control of Robotic System

Course Code: 2501ME29

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Explain MATLAB fundamentals for practical application.
- CO2:** Comprehend transfer functions and signal flow graphs for linear system analysis.
- CO3:** Explain time and frequency responses, along with state-space models and their connection to frequency domains.
- CO4:** Comprehend dynamic system modeling techniques.
- CO5:** Explain stability concepts for system analysis.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

MATLAB: MATLAB for Control system Basics, Language Fundamentals, Mathematical Operations, Graphics and Programming

Practice:

1. Installation of MatLab and getting familiarized with the basic environment.
2. Creating variables by exploring built-in functions.

UNIT – II

Basics of Control, Control Systems: Types of Controllers, Introduction to closed loop control, Differential Equations, Transfer functions, Block diagrams, Signal Flow Graph.

Practice:

1. Perform exercises related different types of controllers
 - a. Closed loop control
 - b. Differential equations
 - c. Transfer functions
 - d. Block diagrams

UNIT – III

Time Response and Frequency Response: Time Response, Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lead design, Frequency response, Bode Plots, polar plots, Nyquist Plots.

Practice:

1. Implementing the time response analysis , root locus design and understanding of frequency response using bode plots, polar plots, etc.

UNIT – IV

Linear Control System:

Concept of states, state space model, different form, controllability, observability; pole placement by state feedback, observer design, P, PI & PID Controller, control law partitioning, modelling and control of a single joint.

Practice:

1. Implementing exercises related to controllability, observability and design basic controllers for linear systems

UNIT – V

Non-Linear Control System:

Common physical non-linear system, phase plane method, system analysis using phase plane methods, stability of non-linear system, Lyapunov's stability criterion, the control problems in manipulators.

Practice:

1. Explore the stability analysis using Lyapunov's stability criterion

Text Books:

1. Control Systems, M. Gopal, McGraw-Hill, 4th edition, 2012, ISBN : 9780071333269.
2. Modern Control Engineering, K. Ogata, Prentice Hall India, 5th edition, 2015, ISBN : 9789332550162.
3. Robot Modeling and Control, M. Spong, M. Vidyasagar, S. Hutchinson, Wiley & Sons, 1st edition, 2005, ISBN : 9780471649908.

Reference Books:

1. Introduction to Robotics: Mechanics and Control, J. J. Craig, Addison-Wesley, 3rd edition, 2004, ISBN : 9780201543612.
2. Introduction to Robotics, S. K. Saha, TATA McGraw Hills Education, 2008, ISBN : 9780070140011.
3. Linear Systems: Optimal and Robust Control, Alok Sinha, Taylor & Francis, 1st edition, 2007, ISBN : 9780849392177.

Web Links:

1. <https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted>
2. <https://nptel.ac.in/courses/103106118>
3. <https://nptel.ac.in/courses/107106081>

AI for Robotics

Course Code: 2501ME30

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Describe the role of AI in robotic systems and set up a basic Python-based robotics simulation environment.
- CO2:** Apply probability-based state estimation techniques for robot localization
- CO3:** Apply pre-trained deep learning models for robot vision and object detection.
- CO4:** Apply classical path planning algorithms for robot navigation
- CO5:** Apply basic reinforcement learning to train a simulated robot for simple control tasks.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to AI in Robotics & Python Toolbox: What makes a robot intelligent — sense-think-act cycle, real-world examples (warehouse robots, self-driving vehicles, robotic arms). Levels of autonomy — teleoperation, semi-autonomous, fully autonomous. Sensors used in robotics — camera, ultrasonic, IR, LiDAR, IMU (working principle and data they produce, no deep mathematics). Why simulation matters — cost, safety, rapid prototyping. Python refresher — variables, loops, functions, NumPy arrays, basic Matplotlib plotting. Introduction to PyBullet — installing, loading a robot model, reading sensor values.

Practice:

1. Load a simulated mobile robot in PyBullet, write a Python script to move it forward and stop when an obstacle is within a threshold distance.

UNIT – II

Robot Localization: The localization problem — everyday analogy (blindfolded person in a room). Probability recap — conditional probability, Bayes' theorem with simple numerical examples. 1D Histogram Filter — belief representation on a discrete grid, sense and move update steps. Sensor noise and odometry drift — why robots get lost. Brief conceptual overview of Kalman Filter and SLAM (no implementation, intuition and video demo only).

Practice:

1. Implement a 1D histogram filter in Python — a robot on a 5-colour grid guesses its position from noisy sensor readings over multiple steps.

UNIT – III

Robot Vision: How cameras produce images — pixels, RGB channels, grayscale. Basic image operations using OpenCV — read, display, resize, edge detection (Canny). What is a CNN — intuitive explanation (filters sliding over an image, no backpropagation math). Pre-trained models — what “pre-trained” means, why we don’t train from scratch. Object detection using YOLOv8 — loading the model, running inference, interpreting bounding boxes and confidence scores.

Practice:

1. Run a pre-trained YOLOv8 model on sample images using the Ultralytics library; display detected objects with bounding boxes and class labels.

UNIT – IV

Robot Navigation: The navigation problem — find a collision-free path on a grid map. Grid world representation — free cells, obstacles, start, goal. Breadth-First Search (BFS) — step-by-step walkthrough, guarantees shortest path. A* Algorithm — heuristic concept (Manhattan distance), why it is faster than BFS, worked example. Obstacle avoidance intuition — potential fields (goal attracts, obstacle repels).

Practice:

1. Implement the A* algorithm on a 2D grid in Python; visualize the explored cells and final path using Matplotlib.

UNIT – V

Basics of Reinforcement Learning: What is Reinforcement Learning — agent, environment, state, action, reward. Real-world RL in robotics — video demonstrations of robotic arm grasping and quadruped walking. Exploration vs. exploitation — restaurant analogy. Q-Learning — Q-table, simplified Bellman update rule, training on a small grid world. Brief conceptual introduction to Deep RL and sim-to-real transfer (no implementation). Ethical and safety considerations in autonomous systems.

Practice:

1. Train a Q-learning agent on the Gymnasium Frozen Lake environment; observe the Q-table evolving and the agent learning an optimal path over episodes.

Text Books:

1. Hands-On Machine Learning with Scikit-Learn, A. Géron, Keras, and TensorFlow, O’Reilly, 3rd Edition, 2022, ISBN: 9781098125974.

Reference Books:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, ISBN : 9780262035613.
2. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publishing, 3rd Edition, 2019, ISBN : 9781789955750.
3. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, the MIT Press, , ISBN : 9780262018029.

Web Links:

1. <https://www.udacity.com/course/artificial-intelligence-for-robotics--cs373>
2. <https://www.coursera.org/learn/introduction-to-aipervised2014a.pdf> (umass.edu)
3. <https://nptel.ac.in/courses/106105077>

Robotic Operating System

Course Code: 2501ME31

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Utilize Ubuntu and Linux operating systems for applications
- CO2:** Use C++ for programming for Robot Operating System
- CO3:** Use Python for programming for Robot Operating System
- CO4:** Install and explain architectural aspects of ROS
- CO5:** Create ROS workspace and package for Robot programming

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

UBUNTU Linux for Robotics: GNU/Linux - Installing Ubuntu - Installing VirtualBox - Playing with Ubuntu – Useful Ubuntu Applications – Shell Commands.

Practice:

1. Installing of required Tools and packages like Ubuntu, Virtualbox and some shell commands.

UNIT – II

C++ for Robotics Programming: Getting Started with C++ C/C++ in Ubuntu Linux - Learning OOP Concepts – Building a C++ Project.

Practice:

1. Writing programs to implement the basics of C++ programming to run in Ubuntu

UNIT – III

Python for Robotics Programming: Python - Timeline: The Python Language — Python in Ubuntu Linux - Introduction to Python Interpreter – Installing Python on Ubuntu — Verifying Python Installation - Writing First Code — Understanding Python Basics.

Practice:

1. Setting up Python on Ubuntu platform executing some basic programs that covers the core fundamentals of python

UNIT – IV

KICK-Starting Robot Programming Using ROS: Robot Programming - The ROS Equation - Robot Programming Before and After ROS Installing ROS - Robots and Sensors Supporting ROS - Popular ROS Computing Platforms - ROS Architecture and Concepts.

Practice:

1. Installing ROS on ubuntu
2. Exploring ROS to understand the various architectural functions like nodes, topics, messages, services etc of robots and sensors compatibility

UNIT – V

Programming with ROS: Programming Using ROS - Creating a ROS Workspace and Package - Using ROS Client Libraries – Programming Embedded Boards.

Practice:

1. Creating workspace and working with different packages using ROS

Text Books:

1. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, Lentin Joseph, Apress, 1st edition, 2018, ISBN : 9781484234044.

Reference Books:

1. Learning ROS for Robotics Programming, Aaron Martinez, Enrique Fernández, Packt Publishing Ltd, 2013, ISBN : 9781782161448.
2. Robot Operating System (ROS): The Complete Reference, Volume 3, Anis Koubaa, Springer, 1st edition, 2019, ISBN : 9783319915890.
3. Programming Robots With ROS: A Practical Introduction To The Robot Operating System, Morgan Quigley, Shroff Publishers & Distributors Pvt Ltd, 1st edition, 2015, ISBN-9781449323899.

Web Links:

1. <https://www.ros.org/>
2. <https://www.classcentral.com/course/robotics-delft-university-of-technology-hello-rea-11555>
3. <https://www.classcentral.com/course/udemy-ros-essentials-68029>

Advanced Robotic Operating System

Course Code: 2501ME32

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Apply advanced ROS setup and administration techniques
- CO2:** Create and optimize complex ROS nodes for real-time data processing.
- CO3:** Integrate ROS nodes with various robotics hardware
- CO4:** Utilize intermediate ROS functionalities
- CO5:** Implement advanced ROS 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	1	1	1	-	2	-	-	1	1	-	1
CO2	2	2	2	-	2	-	-	1	1	-	2
CO3	2	2	2	-	2	-	-	1	1	-	2
CO4	2	2	2	-	2	-	-	1	1	-	2
CO5	2	2	2	-	2	-	-	1	1	-	2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Advanced ROS Setup and Administration: Set up multiple ROS environments, Optimize ROS installation for different hardware platforms, Network Configuration for ROS: Configure ROS for networked robots, Set up ROS Master URI and multi master setups, ROS Security and Permissions Management: Implement security measures in ROS, Manage permissions and access control.

Practice:

1. Setting up and configuring a ROS environment with multiple masters and implementing basic security measures.

UNIT – II

Advanced ROS Programming in C++: Writing Advanced ROS Nodes in C++, Develop complex nodes with advanced functionality, Optimize nodes for performance, Implementing ROS Services and Actions in C++, Create and manage ROS services and actions Implement synchronous and asynchronous communication, Real-time Data Processing in ROS with C++, Handle real-time data streams, Optimize data processing for latency and throughput ROS Nodelets for Efficient Communication, Integration with Robotics Hardware in C++, Interface with sensors and actuators, Develop hardware drivers in C++ .

Practice:

1. Developing and optimizing a complex ROS node in C++ for real-time data processing.

UNIT – III

Advanced ROS Programming in Python: Writing Advanced ROS Nodes in Python: Develop complex nodes with advanced functionality, Optimize nodes for performance, Implementing ROS Services and Actions in Python: Create and manage ROS services and actions, Implement synchronous and asynchronous communication, Real-time Data Processing in ROS with Python: Handle real-time data streams, Optimize data processing for latency and throughput, Using Python for ROS-based Data Analysis and Visualization: Analyze and visualize ROS data, Use Python libraries for data processing (e.g., NumPy, Matplotlib), Integration with Robotics Hardware in Python: Interface with sensors and actuators, Develop hardware drivers in Python

Practice:

1. Creating and optimizing a complex ROS node in Python for data analysis and visualization.

UNIT – IV

Intermediate ROS Functionalities: Using ROS Parameters and Parameter Server: Configure ROS parameters, Use the parameter server for dynamic configuration, Dynamic Reconfiguration of ROS Nodes: Implement dynamic reconfiguration, Use the dynamic reconfigure package, Implementing ROS Actions: Set up and use ROS actions, Handle action goals, feedback, and results, ROS Bag for Data Recording and Playback: Record and playback ROS topics, Analyze recorded data, Visualize robot states and sensor data ,Use plugins for advanced visualization.

Practice:

1. Implementing dynamic reconfiguration and using ROS bags for recording and analyzing robot sensor data.

UNIT – V

Advanced ROS Applications: ROS Navigation Stack: Implement autonomous navigation, Configure and use SLAM (Simultaneous Localization and Mapping), ROS for Manipulation: Plan and execute robotic arm movements, Use motion planning algorithms, Use cloud-based services for advanced robotics applications.

Real-time Robot Control with ROS: Develop real-time control applications

Practice:

1. Implementing an autonomous navigation system using the ROS navigation stack and SLAM.

Text Books:

1. Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easy, Lentin Joseph, Apress, 1ST edition, 2018, ISB : 9781484234044.
2. Learning ROS for Robotics Programming, Aaron Martinez, Enrique Fernández, Packt Publishing Ltd, 2013, ISBN : 9781782161448.

Reference Books:

1. Robot Operating System (ROS): The Complete Reference, Volume 3, Anis Koubaa, Springer, 1st edition, 2019, ISBN : 9783319915890.
2. Programming Robots With ROS: A Practical Introduction To The Robot Operating System, Morgan Quigley, Shroff Publishers & Distributors Pvt Ltd, 1st edition, 2015, ISBN : 9781449323899.

Web Links:

1. <https://www.ros.org/>
2. <https://www.classcentral.com/course/robotics-delft-university-of-technology-hello-rea-11555>
3. <https://www.classcentral.com/course/udemy-ros-essentials-68029>

Field & Service Robotics

Course Code: 2501ME33

L T P C
2 0 1 3

Course Outcomes:

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

- CO1:** Evaluate the historical development and assess the importance of service robotics.
- CO2:** Identifying and resolve localization challenges using appropriate techniques.
- CO3:** Acquire the necessary skills to employ path planning methodologies proficiently
- CO4:** Develop competency in utilizing various navigation techniques effectively.
- CO5:** Implement the efficacy of obstacle avoidance techniques in service robotics.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: History of service robotics – Present status and future trends – Need for service robots - applications- examples and Specifications of service and field Robots. Non-Conventional Industrial robots.

Practice:

1. Demonstrate the Specifications and working of Service and Field Robots

UNIT – II

Localization: Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization- Monte-Carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

Practice:

1. Design and implement a system where a robot navigates using landmarks (e.g., QR codes, visual markers) placed in its environment.

UNIT – III

Planning and Navigation: Introduction-Path planning overview- Road map path planning- Cell decomposition path planning- Potential field path planning-Obstacle avoidance - Case studies: tiered robot architectures.

Practice:

1. Implement a simple grid-based map representation for a robot's environment and develop algorithms for updating and querying the map.

UNIT – IV

Navigation Techniques and Algorithms: Sensor-based navigation, Dead reckoning, Beacon-based navigation, Landmark-based navigation

Practice:

1. Develop a navigation system that utilizes sensor data (e.g., LiDAR, cameras) for localization and obstacle avoidance.

UNIT – V

Obstacle Avoidance Techniques: Potential field method, Virtual force field method, Artificial potential fields method

Optimal Path Planning Techniques and Trajectory Planning: Dijkstra's algorithm, M algorithm, Probabilistic Road map method.

Practice:

1. Implement Dijkstra's algorithm to solve a maze.
2. Implement A* to solve a maze.

Text Books:

1. Introduction to Autonomous Mobile Robots, Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, Bradford Company Scituate, MIT Press, 2nd edition, 2011, ISBN : 9780262015356.
2. The Future of Humanoid Robots: Research and Applications, Riadh Ziaer, Intech Publications, 2014, ISBN : 9789533079516.

Reference Books:

1. Robotics Engineering – An Integrated Approach, Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, ISBN : 9788120308428.
2. Field and Service Robotics, Alonzo Kelly, Karl Iagnemma, Andrew Howard, Springer, 1st edition, 2016, ISBN : 9783662519165.

Web Links:

1. https://docs.ros.org/en/melodic/api/robot_localization/html/index.html
2. <https://wiki.ros.org/navigation/Tutorials/Writing%20A%20Global%20Path%20Planner%20As%20Plugin%20in%20ROS>
3. https://wiki.ros.org/teb_local_planner/Tutorials/Obstacle%20Avoidance%20and%20Robot%20Footprint%20Model

Minor Stream: Thermal Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME35	Power Plant Engineering	FC	2			2	50	50	100	-
2501ME36	Sustainable Energy Systems	FC	3			3	50	50	100	-
2501ME37	Solar Energy Systems	FC	3			3	50	50	100	-
2501ME38	Alternative Fuels for IC engines	IC	3			3	50	50	100	ICE
2501ME39	Fuel Cell Technology	IC	3			3	50	50	100	ICE
2501ME40	Refrigeration & Air Conditioning	IC	2	1		3	50	50	100	ETD
2501ME41	Hydraulic Machinery & Systems	IC	3			3	50	50	100	FMHM
2501ME42	Cryogenic Engineering	AC	3			3	50	50	100	R&AC
2501ME44	Energy Storage Systems	AC	3			3	50	50	100	BEEE
2501ME45	Gas Dynamics & Jet Propulsion	AC	2	1		3	50	50	100	HPE
2501ME46	Computational Fluid Dynamics	AC	2	1		3	50	50	100	HT, FM&HM
Total			29	3		32				

Power Plant Engineering

Course Code: 2501ME35

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Explain the sources of energy, various components and layouts of steam power plant.
- CO2:** Explain the layout, construction and working of the diesel and gas power plants.
- CO3:** Describe the working of hydroelectric power plant and hydraulic turbines
- CO4:** Explain the working of nuclear power plants.
- CO5:** Describe the load curves and method to reduce the pollutants

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Power Plants : Classification power plants - Current scenario of national and global power generation, Carbon capture and storage.

Steam Power Plant: Site selection, Components and Layouts - Coal handling and preparation - Combustion equipment and firing methods - Mechanical stokers - Pulverized coal firing systems - Cyclone furnace – Fuel & Ash handling systems- Dust collection – Draft Systems – Cooling Towers.

UNIT – II

Diesel Power Plant: Components & layout – working, Different systems – Fuel system, lubrication system, Air intake system, Exhaust system, cooling system. Starting system.

Gas Power Plant: Components and Layout, Open and closed cycles - Intercooling - Reheating and Regenerating – hydrogen fuelled GTs, Hydrogen-fired GTs .

UNIT – III

Hydroelectric Power Plant: Site selection, Components and Layout, Estimation of power potential, Classification of Hydro - electric power plants- Selection of turbines- Governing of turbines.

UNIT – IV

Nuclear Power Plant: Site selection, Principles of nuclear energy - Energy from nuclear reactions - Components and Layout, Thermal reactors: Boiling water reactor - Pressurized water reactors and heavy water reactors - Boiling Water Reactor - Gas cooled reactor - High temperature gas cooled reactor - Fast breeder reactor - biological effects of nuclear radiation, - Nuclear waste disposal.

UNIT – V

Load Curve & Pollution Control: Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants. O₂ and CO₂ measurements.

Text Books:

1. Power Plant Technology, El-Wakil M.M, Tata McGraw-Hill Publishing, 1st Edition, 2017, ISBN : 9780070702548.
2. Power Plant Engineering, P. K. Nag, Tata McGraw-Hill Publishing Company Ltd, 4th Edition, 2017, ISBN : 9789339204044.

Reference Books:

1. Power Plant Engineering, Hegde R.K, , Pearson India Education services (P) Ltd., 1st edition, 2015, ISBN : 9789332534100.
2. Power Plant Engineering, G.R.Nagpal, Khanna Publishers, 16th Edition, ISBN : 9788174093097.

Web Links:

1. <https://nptel.ac.in/courses/108105058/8>
2. <https://ocw.mit.edu/courses/22-312-engineering-of-nuclear-reactors-fall-2015/download/>
3. <https://archive.nptel.ac.in/courses/112/107/112107291/>

Sustainable Energy Systems

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	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction 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, 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, ISBN : 9780415584388.
2. Non-Conventional Energy Resources, B H Khan, TMH Publishers, 3rd Edition, ISBN : 9789352601882.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2. <https://www.energy.gov/eere/renewable-energy>

Solar Energy Systems

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.
- 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	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Solar Radiation and its measurement: Solar angles, Sun path diagrams, Radiation, extraterrestrial 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, 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>

Alternative Fuels for IC Engines

Course Code: 2501ME38

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain about conventional and alternative fuels for IC engines and BS emission standards.
- CO2:** Explain the characteristics of alcohols in SI & CI engines.
- CO3:** Determine properties of biodiesels and their significance in IC engines.
- CO4:** Illustrate the storage and safe handling techniques of Hydrogen.
- CO5:** Analyze the various gaseous alternative fuels for IC engine 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	-	-	2	-	-	-	-	2
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	-	1
CO2	-	1
CO3	-	1
CO4	-	1
CO5	-	1

UNIT – I

Introduction to Alternative Fuels: Sources of Status of petroleum reserves. Review of fuel properties, constituents of exhaust gas emissions from ICs - its impact on environmental and human health. Emission norms as per Bharat Standards up to BS – VI.

Alternative fuels: Classification, importance in solving energy crisis and environmental issues.

UNIT – II

Alcohols as Fuels: Sources of ethanol and Methanol and their methods of production. Properties of ethanol and methanol as engine fuels. Permissible blending limits and their effects on engine design, combustion, performance and emissions.

UNIT – III

Biodiesels: Feed stocks, biodiesel production from Transesterification process, Properties of biodiesel. Effect of biodiesel and biodiesel blends on overall performance of an engine.

Recycled Fuels: Pyrolysis of plastic, tyre and waste cooking oils. Properties of pyrolytic – oils and its effects on engine attributes.

UNIT – IV

Hydrogen: Sources and methods of hydrogen production. Properties, advantages and limitations of hydrogen. Challenges associated with hydrogen used as a fuel for IC engine, its storage and transportation. Performance, emission and combustion characteristics of hydrogen as a fuel.

UNIT – V

Biogas: Introduction to Biogas system, production methods and properties, factors affecting biogas formation. Usage of Biogas in IC engines.

CPG & LPG: Properties of LPG & CNG used as engine fuels, fuel metering systems, storage and transportation, combustion characteristics, effect on performance, emission, cost and safety.

Text Books:

1. Alternate Fuels, S. S. Thipse, Jaico Publications, 1st Edition, ISBN : 9788184950786.
2. Alternative Fuels and Advanced Vehicle Technologies kavathi venkateswarlu PHI publications, 2021, ISBN : 9788194685166.

Reference Books:

1. Richard L. Bechtold, Alternative Fuels Guidebook, Society of Automotive Engineers (SAE), ISBN : 9780768000528.
2. Internal Combustion Engine Fundamentals Heywood, J.B., McGraw-Hill, 1st Edition, ISBN : 9781259002076.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/103/112103262/>
2. <https://archive.nptel.ac.in/courses/103/105/103105110/>

Fuel Cell Technology

Course Code: 2501ME39

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Apply the basic principles of fuel cell operation, including electrochemical reactions and cell thermodynamics.
- CO2:** Analyse the fuel cell electro chemistry and membranes used for fuel cells
- CO3:** Identify and describe the key components of a fuel cell system, such as the anode, cathode, electrolyte and bipolar plates.
- CO4:** Apply the chemical and physical principles of fuel processing.
- CO5:** Discuss the integration of fuel cells into various applications

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

Mapping of Course Outcomes with Program specific Outcomes:

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

UNIT-I

Overview of Fuel Cells: Description of fuel cell, brief history, classification, working principle,

Fuel cell basic chemistry and thermodynamics of fuel cell and performance.

Fuel Cell Thermodynamics: Free energy change of a chemical reaction, heat of reaction, reversible and net output voltage, theoretical fuel cell efficiency, effect of pressure.

UNIT-II

Fuel Cell Electrochemistry: Electrode kinetics, Butler-Volmer equation, voltage losses, cell potential-polarization curve, fuel cell efficiency.

Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments.

UNIT-III

Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others, hydrogen generation and storage; limitations, recent advances.

Fuel Cell Components: Materials, properties, processes, membrane, electrodes, bipolar plates, stack design, hydrogen and oxygen supply systems, PEM fuel cell.

UNIT-IV

Fuel processing: Direct and in-direct internal reforming, Production of hydrogen, Reformation of hydrocarbons by steam, CO₂ and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal, Using renewable fuels for SOFCs.

UNIT-V

Fuel Cell Applications: Automobiles, stationary power, fuel cells and hydrogen economy, medium and high temperature fuel cells.

Text Books:

1. Fuel Cell Fundamentals, Ryan O'Hayre, Suk-Won Cha Whitney Colella, John Wiley & Sons Inc, 3rd edition, ISBN : 9781119113805.
2. Fuel cells – Principles and Applications, M. Aulice Scibioh and B. Viswanathan, CRC Press, 1st edition, ISBN : 9781420060287.

Reference Books:

1. Fuel cells for Automotive Applications, RH Thing, Professional Engineering Publishing, 1st edition, ISBN : 9781860584237.
2. Fuel Cells – From Fundamentals to Applications, Srinivasan, Springer -Verlang New York Inc, ISBN : 9780387251165.

Web Links:

1. <https://www.coursera.org/specializations/battery-technologies>.
2. <https://nptel.ac.in/courses/103102015>.
3. <https://elearn.nptel.ac.in/shop/iit-workshops/completed/battery-cell-technology-materials-and-industrial-applications/?v=c86ee0d9d7ed>.

Refrigeration & Air Conditioning

Course Code: 2501ME40

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain the principle and applications of air refrigeration system.
- CO2:** Describe vapour compression refrigeration system.
- CO3:** Explain different types of vapour absorption refrigeration system.
- CO4:** Describe air-conditioning processes using the principles of Psychrometry.
- CO5:** Calculate loads in air-conditioning system and explain different heat pump circuits.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Refrigeration: Necessity, application, Unit and C.O.P of refrigeration, Reversed Carnot cycle, Bell Coleman cycle with its numerical problem, Air Refrigeration System (ARS), Open & Dense air system, Refrigeration system used in air crafts and its problem. Classification of Refrigerants & its Properties, Nomenclature, Ozone layer Depletion, Global Warming.

UNIT – II

Vapour Compression Refrigeration System (VCRS): Simple Vapour Compression Refrigeration Cycle, Comparison between ARS & VCRS, Representation of cycle on T-S and P-H charts, Effect of sub cooling & super heating, Actual cycle influence of various parameters on system performance, Brief description about Actual VCRS.

UNIT – III

Vapour Absorption Refrigeration System (VARs): Working principal of VARs, Comparison between VCRS & VARs, Description & working of principle of Ammonia-Water VARs, Lithium-Bromide water VARs, Principle & operation of three Fluid

Absorption System. Salient features, working principle and basic components of Steam Jet Refrigeration System, Principle & operation of thermoelectric refrigeration system - Vortex tube.

UNIT – IV

Introduction to Air Conditioning: Psychometric properties & processes, Ventilation, Infiltration, Comfort conditions, Factors Affecting Human Comfort, Factors Affecting Optimum Effective Temperature, Requirements of human comfort and concept of effective temperature, comfort chart. Air Conditioning Systems: Working principle of comfort, industrial, winter, summer, year-round, Unitary and central air conditioning system.

UNIT – V

Air-conditioning load calculations: Load concepts of Room Sensible Heat Factor, Grand Sensible Heat Factor and Effective Room Sensible Heat Factor. Classification of equipment used in an air conditioning system, Humidifier, filters, grills, registers, fans, and blowers. Air Handling Units, Heat pump – heat sources, Different types of heat pump circuits.

Text Books:

1. Refrigeration and Air-conditioning, Arora C.P., Tata Mc Graw –Hill, 4th edition, 2021, ISBN : 9789390385843.
2. Refrigeration and Air Conditioning, Khurmi R. S., S Chand, Revised edition, 2019, ISBN : 9788121927819.

Reference Books:

1. Refrigeration and Air Conditioning, Manohar Prasad, New Age International, Pvt Ltd, 3rd edition 2021, ISBN-13 : 978-8122536945
2. A Course in Refrigeration and Air conditioning, S. C. Arora & S. Domkundwar, Dhanpatrai, ISBN - 9788120339156.

Web Links:

1. <https://nptel.ac.in/courses/112105128>.
2. <https://www.udemy.com/course/water-cooler-dispenser-working-and-circuit-diagram/?couponCode=NVDPRODIN35>
3. <https://bharatskills.gov.in/Home/StudyMaterial?var=06nHBys5P85EmOqtjA1wsA==&Default=YES>

Hydraulic Machinery & Systems

Course Code: 2501ME41

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Determine the forces exerted by a jet of fluid on stationary and moving vanes.
- CO2:** Differentiate types of turbines and further analyze their working principles.
- CO3:** Determine the performance of hydraulic turbines.
- CO4:** Distinguish different types of pumps and further analyze their performance.
- CO5:** Explain the working principles of various hydraulic systems, hydraulic control 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	3	2	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-
CO4	2	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

Impact of jet and jet propulsion: Impact of jet on a stationary vertical plate, stationary inclined plate, stationary curved plate, hinged plate, moving vertical and inclined, moving curved plate, series of moving flat and curved vanes, Jet propulsion.

UNIT – II

Hydraulic Turbines: General layout of hydro power plant, heads and efficiencies of turbines, classification of turbines, Impulse turbine: Pelton turbine-components, work and efficiencies, Reaction turbine: Francis turbine-construction features, work and efficiencies, draft tube theory, Axial flow turbine – Kaplan turbine, working principles and efficiencies.

UNIT – III

Performance of turbines: Unit quantities and their significance, specific speed of turbines, performance characteristic curves-constant head, constant speed and constant efficiency

curves, model testing of turbines, cavitation in turbines, selection of turbines, governing of turbines.

UNIT – IV

Pumps: Classification of pumps-positive displacement and non-positive displacement, Reciprocating Pumps: Description and working, types, work done by pumps, coefficient of discharge, slip, negative slip, Indicator diagram, acceleration head and its effects in suction and delivery pipes, effect of friction, air vessels-description, working, functions and effect of air vessels on discharge, pressure head, work, indicator diagram, maximum speed and work saved against friction, Centrifugal Pumps: Components and working principle, priming of centrifugal pumps, work done by impeller, head, losses and efficiencies, minimum starting speed, specific speed, multistage pumps, performance of pumps-characteristic curves, NPSH, cavitation.

UNIT – V

Hydraulic systems: Hydraulic accumulator-single and differential types, hydraulic intensifier, hydraulic press, hydraulic crane, hydraulic ram, hydraulic jack, hydraulic coupling and torque converter. Hydraulic control systems: components and symbols, types of control systems-closed loop and open loop, control methods, applications of control systems in turbines and machine tools.

Text Books:

1. Hydraulics and Fluid Mechanics Including Hydraulics Machines, P. N. Modi & S. M. Seth, Standard Book House, 23rd Edition, 2022, ISBN : 9788189401269.
2. Fluid Mechanics and Hydraulic machinery, R. K. Bansal, Laxmi publications, 10th edition, 2019, ISBN : 9788131808153.

Reference Books:

1. Hydraulic machines, T. R. Banga & S. C. Sharma, Khanna publishers, 2019, ISBN : 9789387394704.
2. A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines, R. S. Khurmi, S. Chand & Company Pvt. Ltd, 19th Edition, 2019, ISBN : 9788121901628.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/103/112103259/>.
2. https://ocw.mit.edu/courses/2-000-how-and-why-machines-work-spring-2002/resources/lecture8_hydraulicsii/
3. <https://archive.nptel.ac.in/courses/112/105/112105182/>

Cryogenic Engineering

Course Code: 2501ME42

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 cryogenic systems.
- CO2:** Demonstrate the air and helium liquefaction processes.
- CO3:** Explain about rectification and cryogenic storage.
- CO4:** Explain Cryogenic Refrigeration System.
- CO5:** Demonstrate vacuum technology in cryogenics.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Historical background, Insight on Cryogenics, Definition and Engineering applications of Cryogenics, Properties of solids for cryogenic systems, Properties of Cryogenic fluids, Material properties at Cryogenic Temperatures, Mechanical properties, Thermal properties, Electrical and Magnetic Properties, Present area involving cryogenics.

UNIT – II

Gas-Liquefaction System: Carnot liquefaction cycle, F.O.M, and Yield of liquefaction Cycles, Joule-Thomson effect, Adiabatic expansion, Simple Linde-Hampson system, Precooled Linde- Hampson system, Linde dual-pressure system, Cascade system, Claude system, Kapitza system, Collins helium liquefaction system, Ortho-Para hydrogen conversion, Critical components in liquefaction systems.

UNIT – III

Separation of cryogenic gases and cryogenic Storage system: Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification, Rectification Column Analysis - McCabe Thiele Method, Adsorption Systems for purification.

Cryogenic Storage and transfer Systems: Cryogenic fluid storage vessels, insulations, cryogenic transfer systems.

UNIT – IV

Cryogenic Refrigeration System: Philips refrigerator, Importance of regenerator effectiveness for Philips refrigerator, Gifford-McMohan refrigerator, J. T. Cryocoolers, Stirling Cycle Refrigerators, Pulse Tube Refrigerators, Regenerators used in Cryogenic Refrigerators, Magnetic Refrigerators.

UNIT – V

Vacuum Technology: Introduction and importance of vacuum technology in cryogenics, Flow regimes in vacuum systems, Conductance in vacuum systems, Operation of vacuum pumps, Calculation of pump-down time for a vacuum systems, Components of a vacuum systems, Mechanical vacuum pumps, Diffusion pumps, Ion pumps, Cryopumping. Vacuum gauges and valves.

Text Books:

1. Fundamentals of Cryogenic Engineering, Mamata Mukhopadhyay, PHI Learning, ISBN: 9788120330573
2. Cryogenic Engineering, Thomas Flynn, CRC Press, 2nd edition, 2020, ISBN : 9780367578169.

Reference Books:

1. Cryogenic Technology and Applications, A. R. Jha, Butterworth-Heinemann, 1st edition, ISBN : 9780750678872.
2. Cryogenic Mixed Refrigerant Processes, Gadhiraaju Venkatarathnam, Springer-Verlag New York Inc, 2008, ISBN : 9780387785134.
3. Cryogenic Engineering: Fifty Years of Progress, Timmerhaus et. al., Springer, 2007, ISBN : 9781493999774.

Web Links:

1. <https://nptel.ac.in/courses/112101004>.
2. <https://www.slac.stanford.edu/econf/C0605091/present/CERN.PDF>.

Energy Storage Systems

Course Code: 2501ME44

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Describe the different energy storage methods
- CO2:** Explain about mechanical energy storage system
- CO3:** Explain about thermal energy storage methods.
- CO4:** Explain different types of electrochemical energy storage devices.
- CO5:** Explain the design of battery for transportation.

Mapping of Course Outcomes with Program Outcomes:

CO/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	1	-	-	-	-	-	-	-	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-
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: Introduction of energy storage technology, Scope, needs and opportunities in energy storage, Electricity storage services and benefits, Methods and tools for valuation of storage, Maturity of different energy storage systems and cost effects, Energy storage in the power and transportation sectors, Current electric vehicle market, Importance of energy storage systems in electric vehicles, Future prospect of storage, global energy and the required CO₂ reduction.

UNIT – II

Mechanical Energy Storage Systems: Flywheel energy storage (FES), Pumped hydropower storage (PHS), Compressed-air energy storage (CAES). Comparison and application state-of-arts including principle, function and deployments, Technical characteristics - in terms of power rating, discharge time, storage duration, energy efficiency, energy density, cycle life and life time, capital cost.

UNIT – III

Thermal energy storage (TES) methods: Sensible TES: Working principle and classification, Properties of solid sensible storage materials, short-term/long-term storage,

cool/low/medium/high-temperature storage, Sensible thermal storage technologies - storage methods in space-heating system, solar-cooling system, solar power plant with sensible TES, Passive and active systems, Importance of thermal stratification, Strategies to enhance the thermal stratification.

Latent TES: Cold TES, Seasonal TES, Selection of phase change materials (PCM), PCMs classifications, Specific PCM applications, Mechanisms to improve PCM applications, Nanoparticle-encapsulated PCMs, Cascades of PCM systems. Design and operation of TES - Performance characteristics, testing, safety, standards and system sizing.

UNIT – IV

Electrochemical energy storage: Battery: Working principle, Types, Flow battery, Battery aging, Battery-based hybrid storage system, Fuel cell: operational principle, types, hybrid fuel cell-battery systems.

Supercapacitors: Working principle, types, cycling and performance characteristics, difference between battery and supercapacitors, Introduction to Hybrid electrochemical supercapacitors, Comparison and application state-of-arts including principle, function and deployments, Technical characteristics of various electrochemical energy storage systems, Concept of chemical storage of solar energy, application of chemical energy storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems

UNIT – V

Battery Design for Transportation: Mechanical design and packaging of battery packs for electric vehicles, Advanced battery-assisted quick charger for electric vehicles, Charging optimization methods for lithium-ion batteries, Thermal run-away for battery systems, Thermal management of battery systems, State of charge and state of health estimation over the battery lifespan, Recycling of batteries from electric vehicles.

Text Books:

1. Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), Frank S. Barnes, Jonah G. Levine, CRC press, 1st Edition. ISBN-13, 978-1138071964
2. Energy storage: A new approach, Ralph Zito, Wiley, 2nd Edition, 2019, ISBN-13: 9781119083597.

Reference Books:

1. Thermal Energy Storage Using Phase Change Material, Fleischer Amy S, Springer International Publishing AG, ISBN: 9783319209210.
2. Lithium-Ion Battery Design for Transportation, Alvaro Masias, Springer, 2018.

Web Links:

1. <https://archive.nptel.ac.in/courses/113/105/113105102/>.
2. <https://nptel.ac.in/courses/112107283>.
3. https://ocw.mit.edu/courses/10-626-electrochemical-energy-systems-spring-2014/resources/mi1.0_626s14_s11lec03/

Gas Dynamics & Jet Propulsion

Course Code: 2501ME45

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Explain the principles of isentropic flow through variable ducts
- CO2:** Explain the principles of Rayleigh flow and fanno flow in constant area ducts
- CO3:** Explain the fundamental principles and governing equation of normal and oblique shock waves
- CO4:** Analyse the performance of various type of jet propulsion
- CO5:** Explain the working principle of rocket engine and performance

Mapping of Course Outcomes with Program Outcomes:

CO/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	1	-	-	-	2	-	-	-	-	-
CO5	3	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: Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers, Differences between Incompressible and Compressible flows.

UNIT – II

Flow through Ducts: Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) –variation of flow properties

UNIT – III

Normal and Oblique Shock Wave: Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT – IV

Jet Propulsion: Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT – V

Rocket Science: Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

Text Books:

1. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, S M Yahya New Age International Private Limited, 7th Edition, 2023, ISBN : 9789395161718.
2. Modern Compressible flow, Anderson, J.D, Third Edition, McGraw Hill, 3rd edition, ISBN : 9780072525430.

Reference Books:

1. Fundamentals of Gas Dynamics, Robert D. Zucker, Oscar Biblarz, John Wiley & Sons Inc, 3rd Edition, 2019, ISBN : 9781119481706.
2. Fundamentals of Compressible Fluid Dynamics, Balachandran, P., Prentice-Hall of India, ISBN : 9788120328570.

Web Links:

1. <https://archive.nptel.ac.in/courses/101/108/101108086/>
2. <https://nptel.ac.in/courses/webcourses>
3. <https://www.classcentral.com/course/swayam-fundamentals-of-gas-dynamics-5293>

Computational Fluid Dynamics

Course Code: 2501ME46

L	T	P	C
2	1	0	3

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

- CO1:** Explain the concepts of PDEs, their application to CFD problems and fundamentals of discretization.
- CO2:** Solve the problems related to energy equation.
- CO3:** Explain the concept of Finite Difference Method
- CO4:** Solve the problem related to Finite Different Method.
- CO5:** Explain and solve the problems using Finite Volume Method.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	2	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-
CO4	2	2	3	-	-	-	-	-	-	-	-
CO5	2	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 CFD: Role of CFD and its applications, future of CFD. Introduction to heat transfer, Compressible flows, Incompressible flows.

Governing equations (GE's) of Fluid dynamics: Modelling of flow, control volume concept, Continuity equation, momentum equation, energy equation and its conservation form.

UNIT - II:

The energy equation: Navier-Stokes equations for viscous flow, Euler equations for inviscid flow, Physical boundary conditions.

Mathematical behaviour of partial differential equations: Classification of quasi-linear partial differential equations, General behaviour of Hyperbolic, Parabolic and Elliptic equations.

UNIT – III

Finite Difference Method: Basic aspects of Discretization Finite Difference, formulae for first order and second order terms, Solution of physical problems with Elliptic, type of

Governing Equations for different boundary conditions Numerical treatment of 1D and 2D problems in heat conduction.

UNIT – IV

Application of Finite Difference Method: Solution of physical problems with parabolic type of Governing Equations, Initial Condition, Explicit, implicit and semi-implicit methods, Solution of simple physical problems in 1D and 2D.

UNIT – V

Finite Volume Method: Diffusion Problems, 1D steady state diffusion, 2D steady state diffusion, Convection-Diffusion Problems, 1D steady state convection-diffusion, Central differencing scheme, Conservativeness, Boundedness, Transportiveness.

Text Books:

1. Introduction to Computational Fluid Dynamics, an: The Finite Volume Method, H. Versteeg, W. Malalasekera, Pearson Education Limited, 2nd Edition, ISBN : 9780131274983.
2. Introduction to Computational Fluid Dynamics Development, Application and Analysis, Atul Sharma, Wiley Publication, 1st edition, ISBN : 9781119002994.

Reference Books:

1. Numerical Heat Transfer and Fluid Flow, Suhas V Patankar, McGraw-Hill Publication, 2017, ISBN : 9781138564695.
2. Computational Fluid Dynamics, John D. Anderson, McGraw-Hill Book Company, 2017, ISBN : 9781259025969.

Web Links:

1. <https://nptel.ac.in/courses/112105045>
2. <https://archive.nptel.ac.in/courses/112/105/112105254/>

Minor Stream: Automotive Engineering

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME47	Automotive Electrical & Electronics	FC	2			2	50	50	100	BEEE
2501ME48	Automotive Maintenance	IC	2		1	3	50	50	100	AE
2501EE54	Hybrid & Electric Vehicles	IC	3			3	50	50	100	BEEE
2501ME49	Electronic Engine Management System	IC	3			3	50	50	100	HEV
2501ME50	Automotive Certification & Homologation	IC	3			3	50	50	100	AE
2501ME51	Vehicle Infotronics	IC	3			3	50	50	100	AEE
2501ME52	Automotive Aerodynamics	AC	3			3	50	50	100	FM, AE
2501ME53	Automotive Noise Vibration & Harshness	AC	3			3	50	50	100	DOM
2501ME54	Vehicle Stability & Control	AC	3			3	50	50	100	AE
2501ME55	Special Purpose Vehicles	AC	3			3	50	50	100	AE
2501ME56	Automotive & Pedestrian Safety	AC	3			3	50	50	100	AE
Total			31		1	32				

Automotive Electrical & Electronics

Course Code: 2501ME47

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Explain the Construction and working of different Batteries and Automotive Electrical accessories
- CO2:** Explain about the Starting system
- CO3:** Describe about the Charging system
- CO4:** Explain about the fundamentals of Automotive Electronics
- CO5:** Describe about the Sensors & Actuators

Mapping of Course Outcomes with Program Outcomes:

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

Batteries and Accessories: Principle and Construction of Lead Acid Battery, Characteristics of battery, rating capacity and Efficiency of Batteries, Maintenance and Charging.

Lighting System: Insulated and Earth Return System, Details of Head Light and Side Light, LED Lighting System, Head Light Dazzling and Preventive Methods – Horn, Wiper System and Trafficator.

UNIT – II

Starting System: Behavior of Starter during Starting, Series Motor and its Characteristics, Principle and Construction of Starter Motor, Working of Different Starter Drive Units, Care and Maintenances of Starter Motor, Starter Switches.

UNIT – III

Charging System: Generation of Direct Current, Shunt Generator Characteristics, Armature Reaction, Third Brush Regulation, Cutout. Voltage and Current Regulators, Compensated Voltage Regulator, Alternators Principle and Constructional Aspects and Bridge Rectifiers, New Developments.

UNIT – IV

Fundamentals of Automotive Electronics: Current Trends in Automotive Electronic Engine Management System, Electro Magnetic Interference Suppression, Electromagnetic Compatibility, Electronic Dashboard Instruments, Onboard Diagnostic System, Security and Warning System.

UNIT – V

Sensors & Actuators: Types of Sensors: Sensor for Speed, Throttle Position, Exhaust Oxygen Level, knock, Manifold Pressure, Crankshaft Position, Coolant Temperature, Exhaust Temperature, Impact sensor, Air Mass Flow for Engine Micromechanical yaw-rate sensors, Accelerator-pedal sensors, Position sensors for transmission control Steering-angle sensors, Axle sensors, Application. Solenoids, Stepper Motors, Relay.

Text Books:

1. Automotive Electrical Equipment, Young A.P. & Griffiths.L, ELBS & NewPress, ISBN-10. 0592006352
2. Understanding Automotive Electronics, William B.Riddens, Butter worth Heinemann Woburn, 5th edition, ISBN-13. 978-0750670081.

Reference Books:

1. Modern Electrical Equipment of Automobiles, Judge A.W , Chapman & Hall, London, 1st edition, 2012, ISBN: 9789401168830.
2. Automotive Electrical Equipment, Kohli .P.L, Tata McGraw-Hill Co., Ltd., New Delhi, 1st edition, 2017, ISBN 9780074602164: .

Web Links:

1. <https://www.udemy.com/course/basics-of-automotive-electronics/?couponCode=LEADERSALE25A>
2. <https://www.rv-skills.com/electric-vehicle-embedded-systems-courses-jobs.php>

Automotive Maintenance

Course Code: 2501ME48

L	T	P	C
2	0	1	3

Course Outcomes:

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

- CO1:** Explain the procedure involved in Inspection Schedule And Maintenance of Records
- CO2:** Plan the Engine maintenance activities
- CO3:** Plan the Chassis maintenance activities
- CO4:** Plan the Electrical system maintenance activities
- CO5:** Plan the Electronic system maintenance activities

Mapping of Course Outcomes with Program Outcomes:

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

Inspection Schedule and Maintenance of Records: Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: general safety, tool safety.

Practice:

- Demonstration of Standard Preventive Maintenance Sheet
- Demonstration of Inspection sheet of a typical Automotive vehicle at Service centre

UNIT – II

Engine Maintenance: Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components, servicing and maintenance of fuel system, engine tune-up, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, anticorrosion and anti-freeze additives

Practice:

- Dismantling and assembling of typical automotive engine
- Servicing & maintenance of MPFI of SI engine and Fuel Injection system (Fuel Injection pump and Injector) of a CI engine.

UNIT – III

Chassis Maintenance: Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system. Service and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, wheel alignment, and vehicle body maintenance.

Practice:

1. Servicing & maintenance of Drivetrain components (any two)
2. Demonstration and practice of Wheel alignment for a typical automotive vehicle
3. Demonstration and practice of Wheel Balancer

UNIT – IV

Electrical System Maintenance: Servicing and maintenance of battery, starter motor, alternator and generator, ignition system lighting system, electric horn, and wiper motor.

Practice:

1. Servicing & maintenance of Electric motors used in Automotive vehicle (any two)
2. Servicing & maintenance of Electric equipment of a typical Automotive vehicle (any two)

UNIT – V

Electronic System Maintenance: On Board Diagnostics of different types and procedures adopted in testing the vehicles. Fault diagnostics of different sensors and actuators, Maintenance of ECU and its possible errors and its detection with possible preventive and breakdown maintenance. Maintenance of Dashboard instruments.

Practice:

1. Demonstration of testing of Engine functioning using Onboard Diagnostics
2. Servicing & maintenance of dashboard electronics (any two)

Text Books:

1. An Introductory Guide to Motor Vehicle Maintenance: Light Vehicles, Knott and Phil Knott, EMS publishing, 2010, ISBN : 9781903348256.
2. Vehicle Maintenance and Garage Practice, Jigar A Doshi, PHI Pub, 1st edition, ISBN-13: 978-8120349827.

Reference Books:

1. An Introduction to Modern Vehicle Design, JullianHappian-Smith, SAE, ISBN:9780750650441.
2. Automotive service: Inspection, maintenance and repair, Tim Giles, 3rd edition, , ISBN: 9781418037581.

Web Links:

1. <https://www.udemy.com/course/automotive-ownership-maintenance/?couponCode=LEADERSALE25A>
2. <https://www.classcentral.com/course/udemy-automotive-101-46082>

Hybrid & Electric Vehicles

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 and Electric Vehicles
- CO4:** Illustrate the Charging Infrastructure
- CO5:** Evaluate Energy Management Strategies used in hybrid and electric vehicle

Mapping of Course Outcomes with Program Outcomes:

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

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 Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies-Challenges and 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-various hybrid drive-train topologies.

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 and Electric Vehicles -Battery based - Fuel Cell based - Super Capacitor based - Flywheel based 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 and 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 and control - Role of advanced metering infrastructure (AMI)/Smart Meters in EV Management.

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).

Web Links:

1. <https://nptel.ac.in/courses/108102121>
2. <https://nptel.ac.in/courses/108103009>
3. <https://www.nrel.gov/research/transportation-hybrid-electric.html>

Electronic Engine Management System

Course Code: 2501ME49

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Make use of different Sensors and Actuators for Computerized Electronic Fuel Injection
- CO2:** Analyse the Speed Density/Mass Air Flow Fuel Management Strategies
- CO3:** Analyse the Engine Diagnostic Procedures
- CO4:** Analyse the SI Engine Management system
- CO5:** Analyse the CI Engine Management system

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Computerized Electronic Fuel Injection: Engine Input Sensors Coolant & Intake Temperature, Crankshaft Position, Camshaft Position, Manifold Absolute Pressure, Throttle Position, Oxygen, Air/Fuel Ratio, Knock Speed & Distance, Battery & Switches Output Devices -Relays, Injector Sequencing & Management, Ignition Operation, Idle Air Control, EGR, EVAP, Waste gate Solenoids, Torque Converter & Speed Control, Malfunction Indicator Light.

UNIT – II

Speed Density/Mass Air Flow Fuel Management Strategies: Key ON Mode, Crank Mode, Open & Closed Loop, Wide-Open Throttle, Adaptive Memory Cells, Cruise & Deceleration, Wide-Open Throttle, Key OFF Mode Fuel Injection Systems -Electronic Fuel Systems, Computer Self-Diagnostic Circuits, Electronic Throttle Actuator Control Systems, Fuel Control, Fuel Supply System Control, Injection System Inspection and Maintenance.

UNIT – III

Engine Diagnostic Procedures: On Board Diagnostics, Monitored & Non Monitored Circuits, Diagnostic Trouble Codes, engine cooling and warm up control, idle speed control,

acceleration and full load enrichment, deceleration fuel cut off. future automotive electronic systems, Electronic dash board instruments – Onboard diagnosis system.

UNIT – IV

SI Engine Management System: Feedback throttle body injection, multi-point fuel injection and direct injection systems, Layout and working of SI engine management systems Group and sequential injection techniques. Advantages of electronic ignition systems. Contactless electronic ignition system, Electronic spark timing control. Three-way catalytic converter, conversion efficiency versus lambda.

UNIT – V

CI Engine Management System: Fuel injection system, parameters affecting combustion, noise and emissions in CI engines. Pilot, main, advanced, post injection and retarded post injection. Electronically controlled Unit Injection system. Layout of the common rail fuel injection system. Working of components like fuel injector, fuel pump, rail pressure limiter, flow limiter, EGR valve control in electronically controlled systems.

Text Books:

1. Diesel Engine Management, Robert Bosch, SAE Publications, 3rd Edition, ISBN : 9780470026892.
2. Gasoline Engine Management, Bosch, SAE Publications, 2nd Edition, ISBN : 9781860584343.

Reference Books:

1. Automotive Fuel and Emissions Control Systems Upper Saddle River Halderman, J. & Linder, JNJ, Pearson Education, 3rd Edition, ISBN : 9780132542920.
2. Diagnosis & Troubleshooting of Automotive Electrical, Electronic, & Computer Systems, Halderman, J. D Upper Saddle River, NJ: Pearson Education, 6th Edition, ISBN 9780132551557: .
3. Automotive Computers & Digital Instrumentation, Robert N. Brandy, Prentice Hall, ISBN : 9780137443277.

Web Links:

1. <https://www.autotrainingcentre.com/automotive-online-training/engine-management-simulation/>
2. <https://www.delphiautoparts.com/en-gb/workshop-solutions/delphi-academy/training-academy-courses/vehicle-electronics-engine-management>

Automotive Certification & Homologation

Course Code: 2501ME50

L T P C
3 0 0 3

Course Outcomes:

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

CO1: Classify the vehicle and identify the regulations governing for each vehicle type

CO2: Analyse the Vehicle Performance Testing

CO3: Analyse the Road and Track Testing

CO4: Analyse the different Active and Passive Safety Testing

CO5: Analyse the different Automotive Components testing

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	1	3	3	1	-	1	-	-	-	-	1
CO2	3	3	3	3	-	3	-	-	-	-	1
CO3	3	3	3	3	-	3	-	-	-	-	1
CO4	3	3	3	3	-	3	-	-	-	-	1
CO5	3	3	3	3	-	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: Specification & Classification of Vehicles, Regulations overview(ECE, FMVSS, AIS, CMVR, ADR), Type approval and Conformity of Production, Engine and Vehicle specifications, Two Wheeler certification.

UNIT – II

Vehicle Performance Testing: Methods for evaluating vehicle performance- energy consumption (well to wheel) in conventional automobiles, performance, emission and fuel economy, Operation at full load and part load conditions, effect of vehicle condition, tyre and road condition and traffic condition and driving habits on fuel economy, Gradeability test, Turning circle diameter test, Steering Impact test, Steering effort test.

UNIT – III

Road and Track Testing: Initial inspection, PDI, engine running in and durability, intensive driving, maximum speed and acceleration, brake testing on the road, hill climbing, handling and ride characteristics, safety, mechanism of corrosion, three chamber corrosion testing, wind tunnel testing, road testing, test tracks, coast down test, Portable exhaust measurement system.

UNIT – IV

Active and Passive Safety Testing: Wheel rim testing for cornering and radial fatigue, Fire resistance test, bumper test, crash test, side impact test, rollover test, safety belt test, Airbag test, Safety belt anchorages, Seat anchorages & head restraints, Occupant protection Impact test, Side door intrusion test.

UNIT – V

Components Testin: Size and Ply rating of tyres, Safety Glasses, Wind screen wiping system, Hydraulic brake hose, Hydraulic brake fluid, Rear view mirror specification (Exterior), Rear view mirror specification (Interior), Wheel rims, Wheel nut, Wheel discs & hub caps, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints, door locks & door retention. Overview and study of testing standards like; AIS testing standards, Euro Standards, SAE standards. ISO26262 standards for functional safety of electrical and/or electronic systems in automobiles.

Note: Compulsory visit of either ARAI/CIRT/iCAT/IDIADA testing agencies to the students

Text Books:

1. Vehicle Accident Analysis and Reconstruction Methods, Raymond M. Brach and R. Matthew Brach, SAE International, 3rd edition, 2022, ISBN : 9781468604191.
2. Automotive Industry Standards, AIS.

Reference Books:

1. Automotive Safety Handbook, Ulrich Seiffert and Lothar Wech, SAE International, 2nd edition, ISBN : 9780768017984.
2. ISO Standards, ICS: 43.020, 43.040, 43.100

Web Links:

1. <https://www.araiindia.com/services/certification-and-standardisation/automotive-certification-%7C-automotive-homologation-%7C-arai>
2. <https://www.ul.com/services/automotive-homologation-training>

Vehicle Infotronics

Course Code: 2501ME51

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the holistic view of Vehicle Infotronics
- CO2:** Identify the different Electronics systems of a typical Automobile
- CO3:** Explain about the Telematics
- CO4:** Analyze the different Intelligent vehicle control systems
- CO5:** Explain about the Adaptive Control system of a vehicle

Mapping of Course Outcomes with Program Outcomes:

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

Overview of Infotronics: Concept of Infotronics, Web-enabled Vs Web Based systems, Applications of Infotronics, Vehicle buses and protocols – LIN, CAN, MOST & Flexray, AUTO SAR

UNIT – II

Electronic based Systems in vehicle: Smart control of Vehicle[ESP] dynamics, drive Electronic Throttle control by wire, active suspensions/mounting system, Automated Guided Vehicles(AGV), Multi-disciplinary optimization in Vehicles (MDO) and advanced propulsion systems(APS), Radio Communication Technologies For Vehicle Information Systems, IEEE 802.11 and DSRC.

UNIT – III

Telematic: Global positioning systems, geographical information systems, navigation systems, automotive vision system, road recognition, driver assistance systems.

UNIT – IV

Intelligent vehicle Control: Active and Semi active suspensions/Mounts for NVH, Optimization and stability of Hydraulic Engine mounts and Bushing in Vehicle, Rollover control and Active stability control, combined control of ride comfort in passenger cars,

Active Roll over control in hydraulically actuated articulated vehicles, intelligent drive by wire vehicles, Design and realization of steer and brake by wire.

UNIT – V

Adaptive Control System: Conventional control schemes, system model for adaptive control, Design of self-tuning controllers, ACC overview, system based on ACC, Stop and Go, Anti- collision system, Impact of ACC on traffic and drivers, Adaptive noise control, automatic and adaptive control of highway traffic and moving vehicles. Power steering and power window: Requirements, Introduction, characteristics.

Text Books:

1. Intelligent Vehicle Technology, L Vlacic, M PARENT, F HARA, Butterworth-Heinemann publication, ISBN : 9780750650939.
2. Navigation and Intelligent transportation systems, Ronald K. Jurgen, SAE, ISBN 9780768002645: .

Reference Books:

1. Robert Bosch, Automotive Hand Book, SAE, 11th edition, 2022, ISBN: 9781119911906.
2. Understanding Automotive Electronics, Willam B. Ribbens, SAE, 8th edition, ISBN : 9780128104347.

Web Links:

1. <https://www.udemy.com/course/automotive-communication-busses-can-lin-and-flexray/?couponCode=LEADERSALE25A>
2. <https://academy.nit-institute.com/course/vehicle-networks-and-infrastructure/>

Automotive Aerodynamics

Course Code: 2501ME52

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 Automotive Aerodynamics on vehicle Performance
- CO2:** Analyze the Aerodynamic forces on Passenger Vehicles
- CO3:** Analyze the Aerodynamic forces on high performance Vehicles
- CO4:** Analyze the Aerodynamic forces on Commercial Vehicles
- CO5:** Examine the Automotive vehicle with respect to Stability, Safety and Comfort

Mapping of Course Outcomes with Program Outcomes:

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

Fundamentals of Aerodynamics: Scope – Development trends – Flow phenomena related to vehicles – External and Internal flow problems – body shapes, Performance of cars and light vans – Resistance to vehicle motion – Drag – Types of Aerodynamic forces – Aerodynamic development of cars – Optimization of car bodies for low drag

UNIT – II

Aerodynamic Drag of Passenger Vehicles: Passenger car as a bluff body, Flow field around passenger car, Analysis of Aerodynamic Drag on Fore body, Wind Shield A-Pillar, roof, vehicle rear end, side of the vehicle, underside, wheels and wheel wells, rear spoiler, attachments, and Trailer & Luggage racks

UNIT – III

Aerodynamic forces on high performance vehicles: Introduction, influence of aerodynamic forces on high performance vehicles handling driving, Yawed airflow, draughting, low drag alternative designs, sonic speed vehicles, Trends in future high -performance vehicle development.

UNIT – IV

Aerodynamic forces on Commercial vehicles: Tractive resistance & fuel consumption, Aerodynamic drag coefficients of different commercial vehicles, Drag as a function of yaw

angle, wind influence, cab shape, drag reducing devices for trucks, Future trends in tractor trailer designs.

UNIT – V

Stability, Safety and Comfort: The origin of forces and moments – effects – vehicle dynamics under side wind – Force and Moment coefficients – Safety limit – dirt accumulation on vehicle – wind noise – Air flow around individual components – High performance vehicles – Very long drag cars – Design alternatives – High efficiency radiator arrangement.

Text Books:

1. Theory and Applications of Aerodynamics for Ground Vehicles, Yomi Obidi, SAE Publications, ISBN : 9780768021110.
2. Aerodynamics of Road Vehicles, W.H. Hucho, SAE Publications, 4th edition, ISBN : 9780768000290.

Reference Books:

1. The Aerodynamics of Heavy Vehicles, R.McCallen, Browand, Ross, Springer, ISBN : 9783642535864.
2. Flow Visualization: Techniques and Examples, Smits, Lim, Imperial College, 2nd Edition, ISBN : 9781848167919.

Web Links:

1. <https://www.edx.org/learn/engineering/massachusetts-institute-of-technology-introduction-to-aerodynamics>
2. https://onlinecourses.nptel.ac.in/noc22_ae09/preview

Automotive Noise Vibration & Harshness

Course Code: 2501ME53

L T P C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the Fundamentals of Acoustics and Noise, Vibration
- CO2:** Analyse the Effects of Noise, Blast, Vibration, and Shock
- CO3:** Identify sources of noise and vibration in automotive applications
- CO4:** Identify the Vehicle Interior Noise and Vibration Sources and Control
- CO5:** Explain the Noise And Vibration Transducers, Signal Processing, And Measuring Techniques

Mapping of Course Outcomes with Program Outcomes:

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

Fundamentals of Acoustics and Noise, Vibration: Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT – II

Effects of Noise, Blast, Vibration, and Shock: General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT – III

Vehicle Noise and Vibration—Sources, Prediction, and Control: Introduction to Vehicle Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—

Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT – IV

Vehicle Interior Noise, Vibration Prediction Control: Introduction to Vehicle Interior Noise and Vibration Sources, Automobile, Bus, and Truck and Off-Road Vehicle.

UNIT – V

Noise and Vibration Transducers, Signal Processing, and Measuring Techniques: Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, System for Data Acquisition, Noise and Vibration Measurements and Data Analysis.

Text Books:

1. Vibration Monitoring, Testing, and Instrumentation, Clarence W. de Silva , CRC Press, 1st edition, 2007, ISBN9781420053197: .
2. Engineering Noise Control: Theory and Practice, David A.Bies and Colin H.Hansen, Spon Press, London, 4th edition, 2009, ISBN : 9780415487078.

Reference Books:

1. Shock and Vibration Handbook, Allan G. Piersol, Thomas L. Paez Harris, McGraw-Hill, New Delhi, 6th edition, ISBN : 9780071508193.
2. Understanding Active Noise Cancellation, Colin H Hansen, Spon Press, London, 1st edition, ISBN : 9780415231916.
3. Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles, Matthew Harrison, Elsevier Butterworth-Heinemann, Burlington, ISBN : 9780750661294.

Web Links:

1. <https://www.ansys.com/en-in/blog/what-is-automotive-nvh#:~:text=What%20is%20NVH%3F,is%20coming%20from%20and%20why.>
2. <https://www.sciencedirect.com/topics/engineering/noise-vibration-and-harshness>

Vehicle Stability & Control

Course Code: 2501ME54

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Develop the Mathematical Model for a given Automotive system or Sub- system
- CO2:** Analyze the Static and Dynamic Loads of a given Vehicle
- CO3:** Analyze the Vehicle stability for various types of Loads
- CO4:** Analyze the Road Excitations of the given Vehicle
- CO5:** Analyze the Steady state cornering for the stability of the vehicle

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Hypothetical vehicle control loop, Fundamental Approach, Vehicle coordinates, motion variables. Forces – Dynamic axle loads, Static loads on level ground, hitch forces and Mathematical modeling of Automotive vehicles and their sub systems.

UNIT – II

Acceleration & Braking Performance: Power limited acceleration, Fundamental Expressions, Constant retardation, Wind Resistance, Power, Braking forces, Brakes: disc and drum, front, rear and four wheel braking, Road friction rolling resistance.

UNIT – III

Stability of Vehicle: Aerodynamic, Mechanics of pressure distribution – Aerodynamic forces: lift & drag, Spoilers, Lift force, side force and roll, pitch and yaw moments, Crosswind sensitivity. Rolling Resistance, Factors affecting pressure, velocity, slip, temperature– Total road loads – Fuel Economy Effects.

UNIT – IV

Ride Excitation sources: Road roughness, wheel assembly, driveline excitation, engine transmission. Vehicle response properties: Suspension isolation, suspension stiffness &

damping Wheel Hop Resonance. Road-tyre friction – dynamic response of tires – Rigid body bounce, pitch motion. Perception of ride and other vibration forms.

UNIT – V

Steady – State Cornering: Introduction, Low and high speed turning – Tire cornering forces, governing expressions, understeer, over steer and neutral conditions. Characteristic speed, critical speed, yaw velocity gain, sideslip angle, static margin. Suspension effects on cornering: roll moment distribution – effect of tractive forces on cornering.

Text Books:

1. Fundamentals of Vehicle dynamics, Thomas Gillespie, Society of Automotive engineers Inc, ISBN : 9781560911999.
2. Theory of Ground Vehicles, Wong H, McGraw Hill, 2nd edition, ISBN : 9780471525960.

Reference Books:

1. Tire and Vehicle Dynamics, Hans B Pacejka, Elsevier Ltd, 3rd Edition, ISBN : 9780080970165.
2. Vehicle Dynamics, Amitosh D, Galgotia Book Ltd, ISBN : 9788175156357.

Web Links:

1. <https://nptel.ac.in/courses/107106080>
2. <https://www.sae.org/learn/content/99020/>

Special Purpose Vehicles

Course Code: 2501ME55

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Classify the different Earth Moving Equipment
- CO2:** Articulate the different Constructional Equipment
- CO3:** Classify the different Farm Equipment
- CO4:** Classify the different Industrial Vehicles
- CO5:** Distinguish the different Military and Combat Vehicles

Mapping of Course Outcomes with Program Outcomes:

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

Earth Moving Equipment: Construction layout, capacity and applications of dumpers, articulated haulers, front-end loaders, backhoe loaders, bulldozers, scrapers, motor graders, skid steer loaders, excavator, hydraulic shovels, bucket conveyors, surface miners – high wall Miners. Selection criteria of prime mover for dumpers.

UNIT – II

Constructional Equipment: Construction layout, capacity and applications of cranes – types, Articulated Trucks, concrete ready mixer, trenchers, Scrapers, Asphalt Pavers, road reclaimers, Compactors – types, draglines, drillers, borewell machine.

UNIT – III

Farm Equipment: Classification of tractors – Main components of tractor. Working attachment of tractors – Auxiliary equipment - Top lifting harvesters. General description, working, specification and functions paddy harvesting machines, Sugarcane harvesting, feller bunchers, forest machines.

UNIT – IV

Industrial Vehicles: Constructional features, capacity and working of fork lifts, Utility vehicles, towing vehicles, man-lift chassis, scissor lift trucks, material handlers, Street sweepers.

UNIT – V

Military And Combat Vehicles: Special features and constructional details of Main Battle tank, gun carriers, transport vehicles, Armoured vehicle-launched bridge, amphibious bridging vehicle, communication vehicles.

Text Books:

1. Road making Machinery, Abrosimov. K. Bran berg.A. and Katayer.K, MIR Publishers, Moscow, ISBN 9780750665940
2. Tractor and Automobiles, Rodichev and G.Rodicheva, MIR Publishers, ISBN : 9785030008554.

Reference Books:

1. Theory of Ground vehicles, Wong.J.T, John Wiley & Sons, New York, 4th edition, ISBN : 9780470170380.
2. Tanks and Transport vehicles, Bart H Vanderveen, , Frederic Warne and Co ltd., London, ISBN-13: 9780723218081.

Web Links:

1. <https://nexus.talentsprint.com/automated-electric-vehicles-certification-program>
2. <https://fnttibudni.gov.in/index.php/en/>

Automotive & Pedestrian Safety

Course Code: 2501ME56

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 Safety legislations towards safety of typical Automotive Vehicle
- CO2:** Discuss the various Biomechanics and Simulations aspects against the vehicle accidents
- CO3:** Evaluate the various vehicle body parts against the Crash worthiness
- CO4:** Explain the different dynamic vehicle simulation tests
- CO5:** Evaluate the Pedestrian safety against vehicle hit the pedestrian

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Introduction to Safety Legislations, Overview of road accidents, Accident avoidance measure like - Human Factors, Comfort and Ergonomics, Acceleration and Braking conditions.

UNIT – II

Biomechanics & Occupant Simulation: Injury tolerance limits, External and internal injuries, Spinal and Chest injuries, Directions of FMVSS 208, EEC directives for frontal and lateral impacts, Body part test devices- Head impact, Torso impact and 3D dummies, Frontal/Rear collision, Rollover and lateral impact

UNIT – III

Vehicle Body considerations: Low Speed Impact, Quasi- Static test requirement - Seat & Seat Belt anchorage points tests as per FMVSS 210, roof strength as per FMVSS 216, Vehicle side structure as per FMVSS 214 procedures.

UNIT – IV

Dynamic Vehicle Simulation Tests:

Frontal Collisions - Pole Test, Car-to-Car Crash, Lateral collisions, Rear end collisions and Rollover.

UNIT – V

Pedestrian Safety:

Pedestrian hit by front of car, European NCAP Test, Pedestrian Protection test procedure according to 2003/102/EC and 70/156/EC (both Phase I & II)

Text Books:

1. Automotive Vehicle Safety, George A. Peters, Taylor and Francis, London and New York, 1st edition, 2019, ISBN : 9780367395872.
2. Recent development in Automotive Safety Technology, SAE International Publication. Editor: Daniel J Helt, ISBN : 9780768015034.

Reference Books:

1. Automotive Safety Handbook, Ulrich Seiffert and Lothar Wech, SAE International, 2nd edition, ISBN : 9780768017984.
2. The Intelligent Safety of Automobile (Key Technologies on New Energy Vehicles), Jianqiang Wang, Bingbing Nie, Hong Wang, Springer, 2023, 1st edition, ISBN : 978-9819963980.

Web Links:

1. <https://skill-lync.com/mechanical-engineering-courses/automotive-safety-standards>
2. <https://www.nhtsa.gov/vehicle-safety>

Minor Stream: Design and Manufacturing

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501ME57	Plant Layout & Material Handling	FC	2			2	50	50	100	-
2501ME59	Additive Manufacturing	IC	3			3	50	50	100	MF - I
2501ME60	Composite Materials	IC	3			3	50	50	100	SSP/M P
2501ME61	Design for Manufacturing	IC	3			3	50	50	100	MSD
2501ME62	Industrial Automation	IC	3			3	50	50	100	MF - I
2501ME63	Flexible Manufacturing System	IC	3			3	50	50	100	MF - I
2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	100	-
2501ME64	Design of Transmission Systems	AC	2	1		3	50	50	100	MD
2501ME65	Advanced Mechanics of Solids	AC	2	1		3	50	50	100	MSD
2501ME66	Mechanical Vibrations	AC	2	1		3	50	50	100	DOM
2501ME67	Condition Monitoring	AC	3			3	50	50	100	DOM
Total			30	2		32				

Plant Layout & Material Handling

Course Code: 2501ME57

L	T	P	C
2	0	0	2

Course Outcomes:

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

- CO1:** Identify the suitable plant layout design.
- CO2:** Explain the concept of facility location.
- CO3:** Identify the principles of good ventilation systems.
- CO4:** Implement the concepts of group technology and line balancing in material handling system.
- CO5:** Explain the usage and principles of material handling equipment.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Plant Layout: Introduction of production system, scope, objectives, importance, and types of plant layout, characteristics of a good plant layout, factoring affecting plant layout, procedure of developing a plant layout, installation and evaluation of plant layout, optimum plant layout.

UNIT – II

Plant Location and Site Selection: Introduction to plant location, influence of location on plant layout, plant location selection factors, models for the plant location selection: median model, gravity model, rural, urban, and suburban location of plants, optimum plant location, location theories.

UNIT – III

Working Conditions: Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application, purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various works, standards- housekeeping, principles of 5S.

UNIT – IV

Group Technology & Line Balancing: Definition, objectives, planning, part families and machine cell formation, evaluation of machine cells, types of GT layout, benefits of GT, implementation of GT.

Line Balancing: Definition, heuristic, and analytical methods of balancing the assembly and production line, single and mixed model line balancing, alternatives to line balancing.

UNIT – V

Materials Handling: Definition, scope, objectives, principles, importance, and factors in materials handling problem, analysis of materials handling, types and selection of materials handling equipment, aids, and techniques in material handling equipment selection, time analysis, planning of material flow, advantages of planned material flow, flow planning principles, flow patterns, analysis of material flow.

Text Books:

1. Material Handling Principles and Practice, T. H. Allegri, CBS Publishers & Distributors, 1st Edition, 2019, ISBN: 9788123908403.
2. Automation, Production Systems, and Computer-Integrated Manufacturing, M. P. Groover, Pearson, 4th Edition, 2019, ISBN : 9789332572592.

Reference Books:

1. Introduction to Material Handling, S. Roy, New Age International (P) Ltd, 2nd Edition, ISBN : 9788122540072.
2. Computer Aided Production Management, P.B. Mahapatra, Prentice Hall of India, Prentice-Hall of India Pvt. Ltd, 1st Edition, ISBN : 978-8120317420.

Web Links:

1. <https://hmhub.in/equipment-material-management/relationship-operational-layoutmaterial-handling-equipments/>
2. <https://mbahub.in/?s=facilities+layout+and+material+handling>

Additive Manufacturing

Course Code: 2501ME59

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Summarize the basics of Additive manufacturing technologies
- CO2:** Explain the methodology to manufacture the products using material and binder jetting
- CO3:** Apply the methodology to manufacture the products using material extrusion and sheet lamination
- CO4:** Illustrate powder bed fusion and directed energy deposition Additive manufacturing technologies.
- CO5:** Explain the applications of Additive manufacturing process 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	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	2	1	-	-	-	-	-
CO3	3	2	-	-	2	1	-	-	-	-	-
CO4	3	2	-	-	2	1	-	-	-	-	-
CO5	3	2	2	-	2	1	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Basic principle, need, advantages, Challenges in Additive manufacturing (AM), AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing, Classification of additive manufacturing processes-Baseline approach, Raw material-based approach and ASTM classification, Materials used in additive manufacturing

UNIT – II

VAT Photo Polymerization of AM process: VAT Photo Polymerization, Material Jetting and Binder Jetting AM technologies: Stereo lithography Apparatus (SLA), Digital Light Projection (DLP), Solid Ground Curing (SGC), Nano Particle Jetting (NPJ), Binder Jetting and Multi Jet Fusion (MJF) processes - Working Principle, Materials, Applications, Advantages and Disadvantages

UNIT – III

Material Extrusion and Sheet Lamination AM technologies: Fused Deposition Modelling (FDM), Contour Crafting (CC), Laminated Object Manufacturing (LOM), – Working principle, Materials, Applications, Advantages and Disadvantages

UNIT – IV

Powder Bed Fusion and Direct Energy Deposition: Selective Laser Sintering (SLS), Direct Metal Laser Sintering (DMLS), Electron Beam Melting (EBM), Laser Engineered Net Shaping (LENS), Wire Arc Additive Manufacturing (WAAM) - Working principle, Materials, Applications, Advantages and Disadvantages

UNIT – V

Additive Manufacturing - Applications: Applications in prototyping, concept models, visualization aids, replacement parts, tooling, jigs & fixtures, moulds, casting, and end-use parts, Industrial Applications in aerospace, automobile, medical, jewellery, sports, electronics, food, construction and architectural, Case studies.

Text Books:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Ian Gibson, David W. Rosen, Brent Stucker, Springer, 2nd Edition, ISBN: 9781493921
2. 3D Printing and Additive Manufacturing: Principles and Applications, Chua C.K., and Leong K.F., World Scientific publications, 4th Edition, ISBN : 978-9814571418.

Reference Books:

1. Additive Manufacturing, Amit Bandyopadhyay, Sushmita Bose, CRC Press, 1st Edition, ISBN : 9781482223590.
2. Rapid Prototyping & Manufacturing, Paul F. Jacobs, ASME Press, 1st Edition, ISBN : 9780070325336.
3. Additive Manufacturing Technologies and Applications, P.B.Bagali, V.V.Kamesh, P.S.Ranjit, S.Hangargi, Scientific International Publishing House, 1st Edition, 2022
4. KG Jaya Christiyani, DVSSSV Prasad, KR Senthil Kumar , “Applications of 3D Printing Technology”, Scientific International Publishing House, ISBN: 9789356254794, 2022.
5. Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants and Custom Jewellery, John O. Milewski, Springer, 1st Edition, ISBN : 9783319863481.

Reference Books:

1. <https://www.3dprintingindustry.com>
2. <https://www.reprap.org>
3. <https://www.all3dp.com>

Composite Materials

Course Code: 2501ME60

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Classify the composites with types of fibers and matrices, and applications of composites
- CO2:** Evaluate mechanical properties of composite materials using macro and micro mechanics
- CO3:** Develop suitable Metal Matrix Composites
- CO4:** Explain Polymer Matrix Composites with applications
- CO5:** Discuss various Ceramic Matrix Composites for high temperature applications

Mapping of Course Outcomes with Program Outcomes:

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

Introduction to composites: Fundamentals of composites - need for composites – enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Types of Reinforcement and Matrix, Carbon and Glass. Reinforcements – particles – fibres. Effect of reinforcement - volume fraction – rule of mixtures

UNIT – II

Evaluation of Mechanical Properties: Micromechanical analysis of lamina – Volume and mass fraction, density and void content – Evaluation of Elastic moduli, Ultimate strength of unidirectional lamina. Macromechanical analysis of laminates – Laminate code, Stress strain relations – Inplane and Flexural moduli.

UNIT – III

Metal Matrix Composites (MMC): Characteristics of MMC, various types of metal matrix composites alloy vs. MMC, advantages of MMC, limitations of MMC, Processing of MMC – powder metallurgy process- diffusion bonding – stir casting – squeeze casting, In-situ reactions-Interface-measurement of interface properties applications of MMC in aerospace, automotive industries

UNIT – IV

Polymer Matrix Composites: Polymer resins – thermosetting resins, thermoplastic resins – reinforcement fibres – rovings – woven fabrics – non woven random mats – various types of fibres. Processing of thermoset matrix composites, thermoplastic matrix composites, structure and properties, structural defects, mechanical properties and applications

UNIT – V

Ceramic Matrix Composites (CMC): Engineering ceramic materials – properties – advantages – limitations – monolithic ceramics - need for CMC – ceramic matrix - various types of ceramic matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres, whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing), applications of CMC in aerospace, automotive industries- Carbon /carbon composites

Text Books:

1. Composite Material Science and Engineering, Krishan K , Chawla, Springer, 2nd Edition, ISBN : 9788132233442.
2. Composite Materials: Engineering and Science , Mathews F. L. and Rawlings R. D, Chapman and Hall, London, England, 1st Edition, ISBN : 9781855734739.

Reference Books:

1. Composite Materials Science and Applications, Deborah D.L. Chung, Springer London Ltd, 2nd Edition, ISBN9781848828308: .
2. Composite Materials Design and Applications, Daniel Gay, Suong V. Hoa & Stephen W. Tsai, CRC Press, 1st Edition, ISBN : 9781587160844.

Web Links:

1. <https://nptel.ac.in/courses/112104229>
2. <https://www.coursera.org/learn/ceramics-and-composites>.

Design for Manufacturing

Course Code: 2501ME61

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Outline the appropriate design for economical production and select the materials.
- CO2:** Select between various casting and metal joining processes
- CO3:** Apply a systematic understanding of knowledge in the field of metal casting and forging.
- CO4:** Fabricate basic parts and assemblies using powered and non –powered machine shop equipment in conjunction with mechanical documentation.
- CO5:** Integrate the knowledge of compliance analysis and interference analysis for assembly and environment.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Design philosophy – steps in design process – general design rules for manufacturability – basic principles of designing for economical production – creativity in design, application of linear & non-linear optimization techniques. Material selection interrelationship with process selection – process selection charts.

UNIT – II

Metal casting and Metal joining: Appraisal of various casting processes, selection of casting process, - general design considerations for casting – casting tolerances – use of solidification.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines – pre and post treatment of welds – effects of thermal stresses in weld joints – design of brazed joints. Simulation in casting design – product design rules for sand casting.

UNIT – III

Extrusion and sheet metal work: Design guidelines for extruded sections - design principles for punching, blanking, bending, and deep drawing – Keeler Goodman forming line diagram – component design for blanking.

Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – IV

Machining process: Overview of various machining processes – general design rules for machining - dimensional tolerance and surface roughness – design for machining – ease – redesigning of components for machining ease with suitable examples, general design recommendations for machined parts.

UNIT – V

Assembly: Compliance analysis and interference analysis for the design of assembly – design and development of features for automatic assembly – liaison diagrams.

Environment: Introduction to environment; motivations for environment principles of environment- eco-efficiency, product life cycle perspective, environment tools and processes, environment design guidelines.

Text Books:

1. Product Design and Manufacturing, A K Chitale and R C Gupta, PHI, New Delhi, 5th edition, ISBN : 9788120342828.
2. George E Deiter, “Engineering Design”, McGraw Hill International, 5th edition, ISBN9780073398143: .

Reference Books:

1. Product design for Manufacture and Assembly, Boothroyd G, First Edition, Marcel Dekker Inc, New York, ISBN : 9780825791766.
2. Materials and Design - the art and science of material selection in product design, M F Ashby and K Johnson, Butterworth-Heinemann, 3rd edition, ISBN: 9780080982052.

Web Links:

1. NPTEL :: Mechanical Engineering - Design For Manufacturing
2. Manufacturing process selection and Design for manufacturing | Udemy

Industrial Automation

Course Code: 2501ME62

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Comprehend the need for industrial process automation.
- CO2:** Differentiate various types of automation systems and components of automation.
- CO3:** Develop automation system for manufacturing and process industries
- CO4:** Perform supervisory control and data acquisition
- CO5:** Develop skills on wireless sensor networks and the industrial networking

Mapping of Course Outcomes with Program Outcomes:

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

Basic Concepts: Introduction of Mechanization and Automation, Classification and Strategies of Automation, Reasons for and Arguments against Automation. Mechanical, Electrical, Hydraulic, and Pneumatic Devices and Controls.

UNIT – II

High Volume Manufacturing: Automated Flow Lines, Types of Automatic Transfer Mechanisms, Design and Fabrication Considerations, Analysis of Automated Flow Lines.

UNIT – III

Assembly Automation: Assembly Systems and their Types, Manual Assembly Lines and Line Balancing, Automated Assembly Lines and their Types, Automatic Assembly Transfer Systems, Automatic Feeding and Orienting Devices- Vibratory and Mechanical Feeders - types, Orientation of Parts, Performance and Economics of Assembly Systems, Feasibility Study for Assembly Automation.

UNIT – IV

Supervisory Digital Control (SCADA): Computer Process interface for Data Acquisition and control – Computer control loops. – Supervisory Digital Control (SCADA) - introduction and brief history of SCADA – SCADA Hardware and software – Landlines for SCADA – use of modems in SCADA – SCADA with LAN

UNIT – V

Intelligent Systems: Fuzzy inference technique, Artificial neural network technique, Pneumatic and electro pneumatic system, Hydraulic and electrohydraulic system - Micro controllers and processors, PLC Programming and flow control.

Text Books:

1. Programmable Logic Controllers: Principles and Applications, John W. Webb, Ronald A. Reis, Pearson, 4th edition, ISBN : 9780136794080.
2. Distributed Computer Control for Industrial Automation, Poppovik Bhatkar, Dekkar Publications, 1st edition, ISBN : 9780825781187.

Reference Books:

1. Automation, Production Systems, and Computer-Integrated Manufacturing, 4e by Mikell P. Groover, ISBN-13-978-9332572592.
2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation and Control, Kevin James, Elsevier, 1st edition, 2011, ISBN: 9789380931517.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_me50/preview
2. https://onlinecourses.nptel.ac.in/noc22_me50/preview

Flexible Manufacturing System

Course Code: 2501ME63

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Comprehend the need for a Flexible Manufacturing System
- CO2:** Differentiate several types of Machining center
- CO3:** Implement the concepts of Manufacturing systems
- CO4:** Explain the basic concepts of Industry 4.0
- CO5:** Identify Material Handling System in FMS

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

FMS Introduction and Description: Limitations with conventional manufacturing, Flexible Manufacturing System (FMS) Need -Definition, Basic Component, Significance -General layout and configuration- Principles, Objectives, Benefits and limitations, Area of Application in Industries, Hardware, Software, CIM Technology Hierarchy of CIM, FMS Justification.

UNIT – II

Turning and Machining Centres: Introduction, Types, Construction and Operation Performed on Turning Center, Automated Features and Capabilities, Advantages and Disadvantages of Vertical and Horizontal Machining Centres, Pallet and Part Loading and Programming Options in Machining Centres, Importance of Cleaning and Deburring in Automated Manufacturing. Concepts of Mechanization, Automation and Integration.

UNIT – III

Manufacturing systems: Single Station Manufacturing Cells, Manual Assembly Lines, Concepts of scheduling and line balancing, Group Technology & Cellular Manufacturing, Automated Assembly Systems
Manufacturing philosophy: Just in time (JIT) manufacturing, Kanban system, Agile Manufacturing, Lean manufacturing, Reconfigurable Manufacturing Systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems

UNIT – IV

Industry 4.0: Introduction - Industry 4.0 – Smart manufacturing: Smart design, smart machining, smart monitoring, smart control, smart scheduling - Internet of Things - Industrial Internet of Things - Framework: Connectivity devices and services - Intelligent networks of manufacturing - Cyber physical systems -Machine to Machine communication- case studies, Introduction to Industry 5.0 Automated assembly and Automated operation planning for layered manufacturing processes.

UNIT – V

Automated Material Movement and Storage System: Introduction, Types of AGV -working principle, Advantages, Limitation and AGV Guide path Tool Management, Tool Strategies, Tool Preset, Identification and Data Transfer, Tool Monitoring and Fault Detection, Basic components and benefits of Automated Storage and Retrieval Systems, Conveyors and Pallet, Queuing Carrousel and Automatic Work Changers, Coolant and Chip Disposal and Recovery system. FMS Installation and Implementation

Text Books:

1. Flexible Manufacturing Cells and System, William W. Luggen, Prentice Hall of Inc New Jersey, ISBN : 9780133217384.
2. Flexible manufacturing, David J. Parrish Butterworth-Heinemann Ltd., ISBN : 9780750610117.

Reference Books:

1. Automation, Production Systems and Computer Integrated Manufacturing, M. P. Groover, Prentice Hall, 4th edition, ISBN : 9789332572592.
2. Flexible Manufacturing System, H. K. Shivanand, M. M. Benal, V. Koti, New Age Publication, 1st edition, ISBN : 9789386070227.

Web Links:

1. <https://nptel.ac.in/courses/110106044>
2. www.ignou.ac.in/upload/UNIT6-55.pdf

Industry 5.0 for Engineers

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 Editi & Francis, ISBN: 978-1-032-04127-8, 2022.
2. Alessandro Massaro, “Electronics in Advanced Research Industries: Industry 4.0 to 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 Technology: Prototyping to Direct Digital Manufacturing”, Springer, 2010.
3. Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, “The CNC Handbook: Manufacturing and Automation from CNC to Industry 4.0”, Industrial Press Inc., 10831136367, Nov 2021.
4. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, “Healthcare Generation Processes with the Latest Technologies”, Palgrave Pivot, 2019, ISBN9781138113-3.

Web Links:

1. <http://www.mqtt.org/>
2. <https://opcfoundation.org/about/opc-technologies/opc-ua/>
3. <https://www.etherncat.org/default.htm>

Design of Transmission Systems

Course Code: 2501ME64

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Utilize principles for designing belt transmissions, chain drives, and wire ropes, including material selection and load capacity considerations.
- CO2:** Apply lubrication principles to design friction bearings, analyzing stability and heat balance.
- CO3:** Develop designs for spur and helical gears considering speed ratios, fatigue strength, and tooth stresses, and analyze forces in helical and bevel gear drives.
- CO4:** Explain and apply principles for designing multispeed gearboxes, including kinematic layout and speed diagrams.
- CO5:** Examine and design various types of clutches and brakes, considering factors like uniform pressure, wear, and thermal effects.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Design of Flexible Mechanical Drives: Introduction to flexible drives – Design of belt transmissions. Geometry. Construction details and assembly. Types of failure– Ratio of Tensions – Belt materials – Design procedure– Design of chain drives and sprockets – Load carrying capacity – Design of wire ropes – construction and designation – Selection procedure.

UNIT – II

Design of Bearings: Conditions of proper lubrication, Mechanism of dry friction, Petroff's law, Assumptions involved in Petroff's law, Hydrodynamic lubrication, Practical examples, hydrodynamic conditions in a bearing, McKeey's equation, Thick and thin film lubrications, Stability of lubrication, Bearing modulus, Heat balance in a journal bearing. Rolling contact bearings- rated load, dynamic capacity calculation. Bearing selection.

UNIT – III

Design of Gears: Gear materials - Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength, and wear considerations.

Force analysis –Tooth stresses - Dynamic effects - Helical gears – Module - normal and transverse, Equivalent number of teeth – forces. – Stresses on bevel gear tooth – Design of bevel gear drive using manufacturer’s catalogue – Equivalent number of teeth – Force analysis on bevel gear – Design based on beam strength and wear

UNIT – IV

Design of Multispeed Gearbox: Introduction to multispeed gearbox – Components of speed reduction Unit – Principles for optimum gearbox design – Progression ratio – Construction of kinematic layout and speed diagram – Centre distance calculation – Selection of number of teeth. Design of multi-speed gearbox for machine tool applications, Variable speed gearbox, Fluid Couplings, and Torque Converters for automotive applications

UNIT – V

Design of Clutches and Brakes: Design of disc or plate clutches – Cone clutch – Centrifugal clutch – Design of Block brakes with short and long shoe – Internal expanding shoe brakes – Band brakes – Disc brakes.

Text Books:

1. Design of machine elements, V.B.Bhandari, McGrawHill Publications, 5th Edition, 2020, ISBN : 9789390177479.
2. Mechanical Engineering Design, J Shigley, McGrawHill Publications, 10th Edition, ISBN : 9780073398204.

Reference Books:

1. Design Data, P.S.G. College of Technology, Coimbatore, 2020, ISBN : 9788192735504.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/106/112106137/>
2. <https://archive.nptel.ac.in/courses/112/105/112105125/>

Advanced Mechanics of Solids

Course Code: 2501ME65

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Analyze the biaxial stresses using graphical and analytical methods
- CO2:** Find the bending and shear stresses in beams of various cross sections
- CO3:** Find the deflection of beams by Double integration method , Macaulay's method and Conjugate beam method
- CO4:** Find the stresses and deformations in shafts and springs using torsion formulae
- CO5:** Analyze the cylinders and columns using deformation and buckling formulae

Mapping of Course Outcomes with Program Outcomes:

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

Bi-axial Stresses: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses and strain, Strain rosette – Principal stresses and strains – Analytical and graphical solutions. Theories of failure.

UNIT – II

Stresses in beams: Introduction to theory of bending – Assumptions – Bending equation - Neutral axis – Determination of bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections – Design of simple beam sections, Bending stress in unsymmetrical sections, **Shear Stresses:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T sections

UNIT – III

Deflection of beams: Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.

UNIT – IV

Torsion: Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Parallel and series shafts – shafts fixed at the both ends, Comparison of solid and hollow shafts for strength and weight, stresses in springs

UNIT – V

Thin and Thick Cylinders, Columns: Thin cylinders and shells – deformation of thin cylinders and shells; Thick Cylinders, Shrink fits, Compounding. Theory of columns – Long column and short column - Euler's formula – Rankine's formula

Text Books:

1. Strength of Materials ,Rattan S. S., McGraw Hill Education, 3rd edition, ISBN : 9789385965517.
2. Mechanics of Materials ,James M. Gere, Barry J. Goodno, , Cengage Learning India Pvt. Ltd , 9th Edition, 2019, ISBN : 9789355737847.

Reference Books:

1. Mechanics of Materials, Russell C. Hibbeler, Pearson Education, 9th Edition; 2018, ISBN : 9789332584037.
2. Mechanics of Materials, Ferdinand P. Beer, E. Russell Johnston, John T. DeWolf, David F. Mazurek, Sanjeev Sangh, McGraw Hill Education, 8th Edition, 2020, ISBN-13: 978-1260571387.

Web Links:

1. <https://ocw.mit.edu/courses/1-050-solid-mechanics-fall-2004/>
2. https://onlinecourses.nptel.ac.in/noc22_ce46/preview

Mechanical Vibrations

Course Code: 2501ME66

L	T	P	C
2	1	0	3

Course Outcomes:

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

- CO1:** Analyze the free vibrations of single degree of freedom systems.
- CO2:** Derive the equations of motion for vibrating systems subjected to harmonic excitation and general forcing conditions.
- CO3:** Analyze the vibrations of two degree of freedom systems and principles of vibration measuring instruments.
- CO4:** Formulate the equations of motion for free and forced vibrations of multi degree of freedom systems.
- CO5:** Formulate the equations of motion for free and forced vibrations of continuous systems.

Mapping of course outcomes with Program Outcomes:

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

Mapping of course outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamentals of Vibration: Classification of vibration-Vibration analysis procedure-Spring elements - Mass or Inertia elements- Damping Elements - Harmonic Analysis.

Free Vibration of Single-Degree of freedom Systems: Equation of motion for undamped and damped translational and torsional systems - Viscous damping - Coulomb damping -Hysteretic damping –Response and stability of systems.

UNIT – II

Harmonically Excited Vibration: Equation of motion and response of an undamped damped systems under harmonic force - Quality Factor and Bandwidth - Response of a damped system under rotating unbalance- Self-Excitation and Stability Analysis.

Vibration Under General Forcing Conditions: Response under a general periodic force –First order and Second order systems-Response under a nonperiodic force - Convolution Integral - Response Spectrum - Laplace Transform- Numerical methods.

UNIT – III

Two Degree of freedom Systems: Equations of motion for free and forced vibration of damped and undamped systems - Coordinate Coupling and Principal Coordinates -Self-Excitation and Stability Analysis -Solutions Using Laplace Transform.

Vibration Measurement and Applications: Transducers-Vibration Pickups-Frequency measuring instruments-Vibration Exciters- Dynamic testing of machines and structures -Experimental modal analysis-Machine condition monitoring and diagnosis.

UNIT – IV

Multi degree of freedom Systems: Equations of motion for free and forced vibration of damped and undamped systems- Influence Coefficients - Potential and Kinetic Energy Expressions in Matrix Form - Generalized Coordinates and Generalized Forces - Eigenvalue Problems.

UNIT – V

Continuous Systems: Transverse Vibration of a String or Cable -Longitudinal Vibration of a Bar-Torsional Vibration of a Shaft -Lateral Vibration of Beams-Principle of orthogonality-Classical and energy methods by Rayleigh, Ritz and Galerkin-Torsional vibrations of shafts-Critical speeds with and without damping-Secondary critical speed.

Text Books:

1. Mechanical Vibrations, G.K.Grover, Nemchand publishers, 8th Edition, ISBN : 9788185250565.
2. Mechanical Vibrations, Singiresu S Rao, Pearson education, 5th Edition, ISBN : 9780132128193.

Reference Books:

1. Theory of Vibration, W.T., Thompson, CBS Publishers, 5th Edition, ISBN : 9788131704820.
2. Vibration: Fundamentals and Practice, Clarence W. de Silva , CRC Press LLC,2nd Edition, ISBN : 9780849318085.
3. Elements of Vibration analysis, L. Meirovich, Tata Mc-Grawhill, 2nd Edition, ISBN : 9780070413429.

Web Links:

1. <https://archive.nptel.ac.in/courses/112/103/112103111/>
2. <https://archive.nptel.ac.in/courses/112/107/112107212/>

Condition Monitoring

Course Code: 2501ME67

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 and importance of condition monitoring and preventive maintenance.
- CO2:** Identify various sensors and signal conditioning techniques for condition monitoring.
- CO3:** Plan data acquisition and signal processing methods for effective condition monitoring.
- CO4:** Utilize machine learning techniques for advanced condition monitoring and predictive maintenance.
- CO5:** Examine real-world applications and case studies of condition monitoring across various industries.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Overview of condition monitoring and the need for reliable operation of equipment in a system, causes of failure, preventive maintenance concepts Structural Health Monitoring (SHM) – Advantages & Challenges. Machinery Fault Diagnosis - Principles, Fault Diagnostics and Prognostics.

UNIT – II

Sensors and Signal Conditioning Techniques: Vibration Monitoring Accelerometers, Types. Temperature Monitoring – Thermocouple, RTD (Resistance Temperature Detector), Infrared Thermography. Fiber Optic Sensors, NDT (Non-Destructive Testing) – Eddy Current Testing.

UNIT – III

Smart Sensing for Condition Monitoring: Data Acquisition Systems, Application of various signal processing methods – Time domain analysis, Frequency domain analysis, non-stationary signal analysis.

UNIT – IV

Machine Learning (ML) for Condition Monitoring: Introduction, Review of Linear Algebra, Logistic Regression, Regularization, Neural Networks – Representation and Learning, Machine Learning System Design, Support Vector Machines, Unsupervised Learning, Dimensionality Reduction, Anomaly Detection. Application to Condition Monitoring.

UNIT – V

Applications & Case Studies: Future of Condition-based Monitoring – SHM & Rotating Machinery, Railway – Noise and Vibration Monitoring, Ball indentation testing, Crack Detection in Composites (Aerospace structures), Condition Monitoring in – Agriculture, Biomedical, Food Processing & Packaging, Pipelines and Piping.

Text Books:

1. Vibration-Based Condition Monitoring –Industrial,Aerospace and Automotive applications, Robert Bond Randall , John Wiley & Sons Ltd, 1st edition, ISBN : 9780470747858.
2. Structural Health Monitoring: Current Status and Perspectives, Stanford University Fu-Kuo Chang, ISBN : 9781566766050.

Reference Books:

1. Machine Learning Yearning ,S.Sridhar, M Vijayalakshmi, ISBN 13-978-0190127275
2. Machinery Condition Monitoring Principles and Practices, Amiya Ranjan Mohanty, Taylor and Francis, CRC Press, 1st edition, ISBN : 9781138748255.

Web Links:

1. https://onlinecourses.swayam2.ac.in/nou21_me10/preview
2. <https://info.deeplearning.ai/machine-learning-yearning-book#MYL-form>

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/dwww/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. Aarne Vesilind, Cengage Learning, 2nd Edition (SI Edition). (ISBN: 13-978-8131520420).
2. Integrated Solid Waste management, George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Tata McGraw Hill. (ISBN: 13-978-0070632370).

Reference Books:

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India.
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website
3. Construction and Demolition Waste Management Rules, 2016, MoEF&CC
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.

Web Links:

1. <https://nptel.ac.in/courses/105/105/105105160/>
2. <http://swachhbharatmission.gov.in/sbmcms/index.html>
3. <http://swachhbharaturban.gov.in/>

Watershed Management

(EEE,ME,ECE,CSE,IT,AI ML,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,AIIML,CSE(DS), PT, Min.E.)

L	T	P	C
3	0	0	3

Course Code:2501EE36

Course Outcomes:

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

- CO1** Analyze the characteristics of electrical energy storage technologies.
- CO2** Analyze the needs for electrical energy storage.
- CO3** Analyze the needs for electrical energy storage.
- CO4** Underst& the various types of electrical energy storage systems.
- CO5** Identify various real time applications of energy storage systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Electrical Energy Storage (EES) Technologies: Characteristics of electricity, Electricity & the roles of EES, High generation cost during peak-dem& periods, Need for continuous & flexible supply, Long distance between generation & consumption, Congestion in power grids, Transmission by cable.

UNIT – II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT – III

Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H₂),Synthetic natural gas (SNG).

UNIT – IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, 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 Books:

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

	L	T	P	C
Course Code:2501EE54	3	0	0	3

Course Outcomes:

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

- CO1:** Describe the History of Hybrid Electric vehicles
- CO2:** Classify the various electric drivetrain topologies
- CO3:** Articulate the Energy Storage Requirements in Hybrid & Electric Vehicles
- CO4:** Illustrate the Charging Infrastructure
- CO5:** Evaluate Energy Management Strategies used in hybrid & electric vehicle

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction to Hybrid Electric Vehicles: History of hybrid & electric vehicles, social & environmental importance of hybrid & electric vehicles, impact of modern drive-trains on energy supplies-Challenges & Key Technologies of EVs – Challenges for EV Industry in India

UNIT – II

Electric Drive-trains:

Basic concept of electric traction - introduction to various electric drivetrain topologies - Power flow control in electric drive-train topologies - fuel efficiency analysis

Electric Propulsion unit:

Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, configuration and control of Induction Motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency

UNIT – III

Energy Storage:

Introduction to Energy Storage Requirements in Hybrid & Electric Vehicles -Battery based energy storage & its analysis - Fuel Cell based energy storage & its analysis - Super Capacitor based energy storage- Flywheel based energy storage & its analysis.

UNIT – IV

Sizing the drive system:

Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT – V

Energy Management Strategies

Introduction to Energy Management Strategies used in hybrid & electric vehicle, Classification of different Energy Management strategies - Comparison of different Energy Management Strategies - Implementation issues of energy strategies - Effect of charging infrastructure on grid protection & control.

Text Books:

1. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley-Blackwell (ISBN: 9781119942733).
2. Energy Management Strategies for Electric & Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer (ISBN: 9781493955237).

Reference Books:

1. Electric Vehicle Battery Systems, Sandeep Dhameja, Elsevier (ISBN: 9780750699167).
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press (ISBN: 9781138072855).
3. Hybrid electric Vehicles Principles & applications with practical perspectives, Chris Mi, M. Abul Masrur, D. Wenzhong Gao, A Dearborn, John Wiley & Sons Ltd (ISBN: 9781118970560).

Solar Energy Systems
(CE,EEE,ECE,CSE,IT,AI ML,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, Pyr heliometer, Sunshine recorder. Estimation of average solar radiation and estimation on horizontal and tilted surfaces

UNIT – II

Solar Collectors for Industrial process heat: Flat plate collector, Materials for flat plate collector and their properties, classification, evacuated tubular collectors, concentrator collectors, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus, Heliostats.

UNIT – III

Solar Thermal Technologies: Working principle, types, design, and operation, Solar heating and cooling systems, Thermal Energy storage systems, Solar Desalination, Solar cooker, Solar Pond, Solar drying, Solar chimney, Solar water disinfection (SODIS), Solar furnaces.

UNIT – IV

Solar Cells: Semiconductor materials, Doping, PN junction and characteristics, Photovoltaic effect, Photovoltaic material, Parameters of solar cells, Effects of cell temperature on cell efficiency, Types of solar cells, Solar modules and arrays, Solar cell power plant, Silicon, thin film and polymer processing, Silicon wafer based solar cells, Hybrid organic- inorganic solar cells.

UNIT – V

Solar Passive Architecture: Thermal comfort, bioclimatic classification. Passive heating concepts: direct heat gain, indirect heat gain, isolated gain and sunspaces

Passive cooling concepts: evaporative cooling, Radiative cooling, shading - paints and cavity walls for cooling, roof radiation traps, thermal comfort.

Text Books:

1. Solar Energy-Principles of Thermal Collection and Storage, S P Sukhatme & J K Nayak, McGraw Hill Education, 3rd Edition, 2009, ISBN : 9780070142961.
2. Principles of Solar Engineering, D.Yogi Goswami, Frank Kreith and Jan F. Kreider Taylor and Francis, 2nd Edition, 2000, ISBN : 9781560327141.

Reference Books:

1. Solar Energy- Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa publishing house. 1st Edition, 2002, ISBN : 9780849325093.
2. Solar Energy and Non-conventional Energy Sources, Domkundwar, Dhanpat Rai & Co, (P) Ltd., 2nd Edition, ASIN : B0BQWR83GF

Web Links:

1. <https://archive.nptel.ac.in/courses/115/103/115103123/>
2. <https://www.nrel.gov/research/re-solar.html>

Industry 5.0 for Engineers

(CE,EEE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code: 2501ME58

L	T	P	C
3	0	0	3

Course Outcomes:

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

- CO1:** Explain the basic concept of Industry 5.0.
- CO2:** Explain the concepts of Industrial IOT, IOS and Predictive Analytics
- CO3:** Explain the cyber physical systems and AI technologies
- CO4:** Analyse the applications of Industry 5.0 in various sectors
- CO5:** Analyse case studies on automation and healthcare services

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Industry 5.0: Introduction of Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes.

UNIT – II

Importance of Internet of Things (IOTs): Introduction to Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Services, Fundamental of Predictive Analytics, Smart Logistics, Smart Devices and Products.

UNIT – III

Technology Evolution: Basics of cyber Physical Systems, Process Automations and Collaborative robots, Fundamental to artificial Intelligence, Mobile Computing, Cyber Security, Ethical technology, Responsive and distributed supply chain system, Human-centric and Value-oriented approaches.

UNIT – IV

Technology Implementation and Case Studies: 3D printing, Solar energy sector, Healthcare sector, Maintain records related to education, finance, clean bioenergy generation and Intelligent NextG Wireless Networks.

UNIT – V

Case studies on CNC/NC automation - Benefits, challenges, and industry applications. In-house, Healthcare services-Examples of innovations improving patient care and operational efficiency.

Text Books:

1. Uthayan Elangovan, Industry 5.0, “The Future of the Industrial Economy”, First Edition, Taylor & Francis, ISBN: 978-1-032-04127-8, 2022.
2. Alessandro Massaro, “Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances”, Wiley-IEEE Press, 2021, ISBN: 2021028944.

Reference Books:

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 2016.
2. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
3. Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, “The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0”, Industrial Press Inc., U.S. ISBN 0831136367, Nov 2021.
4. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, “Healthcare 4.0 Next Generation Processes with the Latest Technologies”, Palgrave Pivot, 2019, ISBN 978-981-13-8113-3.

Web Links:

1. <http://www.mqtt.org/>
2. <https://opcfoundation.org/about/opc-technologies/opc-ua/>
3. <https://www.ethercat.org/default.htm>

Organizational Behaviour
(CE,EEE,ECE,CSE,IT,AI ML,CSE(DS), PT, Min.E.)

Course Code: 2501ME73

L P T C
3 0 0 3

Course Outcomes:

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

- CO1:** Explain the roles, approaches of organizational behaviour models.
- CO2:** Summarize the behaviour of individuals and groups in organizations in terms of organizational behaviour.
- CO3:** Illustrate various stress and emotional organizational behaviour concepts, models and theories to real life management situations.
- CO4:** Analyze the functions of organizational communication and culture for effective communication and managing cultural diversity
- CO5:** Organize different groups and teams in the organization for better results.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Organizational Behaviour: Concept of Organizational Behaviour (OB)- Importance of Organizational Behaviour- Key Elements of Organizational Behaviour, Role of Managers in OB- Interpersonal Roles-Informational Roles- Decisional Roles, Approaches to Organizational Behaviour

UNIT – II

Interpersonal Behaviour: Nature and meaning of Interpersonal Behaviour, Concept of Self, Transaction Analysis (TA), Benefits and uses of Transactional Analysis, Johari Window Model

Personality: Definition and Meaning of Personality - Importance of Personality, Determinants of Personality, Theories of Personality, Personality Traits Influencing OB.

UNIT – III

Emotions: Nature and Meaning of Emotions - Characteristics of Emotions, Theories of Emotions, Emotions in the Context of OB. Organizational Stress: Definition and Meaning, Sources of Stress, Types of Stress, Impact of Stress on Organizations, Stress Management Techniques.

UNIT – IV

Organizational Communication: Meaning and Importance of Communication, Functions, process, types, Interpersonal Communication, Organizational Communication, Tips for Effective Communication.

Organization Culture: Meaning and Nature of Organization Culture – Origin of Organization Culture, Functions of Organization Culture, Types of Culture, Creating and Maintaining Organization Culture, Managing Cultural Diversity

UNIT – V

Groups and Teams: Meaning and Importance of Groups, Reasons for Group Formation, Types of Groups, Stages of Group Development, Meaning and Importance of Teams, Types of Teams, Creating an Effective Team.

Text Books:

1. Organizational Behaviour, K. Ashwathappa, Himalaya Publishing House, ISBN-13. 978-8184889390.
2. Management and Organizational Behaviour - (Text and Cases), Dr.P.Subba Rao and Prof. N.Sambasiva Rao, Himalaya Publishing House, Mumbai, ISBN: 978-93-5025-951-2.

Reference Books:

1. Understanding Organisational Behaviour, Udai Pareek, Oxford Higher Education, 2nd Edition, ISBN-13: 978-0195690866
2. Mc Shane & Von Glinov, Organisational Behaviour, Tata McGraw Hill, 4th Edition, ISBN-13, 978-1259927676.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg51/preview
2. <https://www.udemy.com/course/organisational-behaviour/>

Sustainable Energy Systems

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

Course Code: 2501ME36

L	T	P	C
3	0	0	3

Course Outcomes:

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

CO1: Demonstrate the various components of solar thermal energy systems.

CO2: Describe the working of Wind turbines.

CO3: Explain the principle and working of Biomass and Geothermal Energy systems

CO4: Explain the Ocean, Tidal, Wave and hydro energy conversion systems.

CO5: Illustrate working of hybrid energy systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Renewable energy sources: Energy demand and availability, energy crisis, renewable and non-renewable energy resources, environmental impact of conventional energy usage.

Solar Energy: Overview of the fundamental physics of solar radiation. Solar energy collectors.

Solar energy storage: Stratified storage, well mixed storage, comparison, Hot water system, solar ponds, non-convective solar pond, extraction of thermal energy and application of solar ponds.

Solar PV systems and its applications. Solar cell, module, and array.

UNIT – II

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for windfarms. Horizontal and vertical axis wind mills, Wind farms- offshore, Onshore, various methods of control, and Environmental issues – Applications.

UNIT – III

Biomass: Bio-resources, Conversion process, Biomass gasifier - Types of biomass gasifiers, Biodiesel production – Ethanol production -Applications.

Geothermal Energy: Origin and types of geothermal energy and utilisation, Power generation from Geothermal energy, Environmental impact.

UNIT – IV

Ocean, Wave & Tidal Energy: Introduction - Resource Assessment - Power generation through OTEC systems. Wave and Tidal energy- Working principle, Availability, and energy conversion systems.

Mini & Micro Hydropower: Introduction, Power from water, System components of Mini and Micro Hydropower, Micro Hydropower plant in India, Potential Hydropower plant projects identified in India.

UNIT – V

Hybrid Energy Systems: Systems for processes and power applications – solar – wind – Biomass hybrid technologies

Fuel cell: Working principle- types - construction and applications. Solar – Fuel cell hybrid systems.

Text Books:

1. Renewable Energy: Power for a Sustainable Future, Boyle, G, Oxford University Press, 3rd Edition,2012, ISBN : 9780199681273.
2. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, 6th edition, ISBN : 9788174090737.

Reference Books:

1. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir, Taylor & Francis, 3rd edition, 2015, ISBN : 9780415584388.
2. Non-Conventional Energy Resources, B H Khan, TMH Publishers, 3rd Edition, 2017, ISBN : 9789352601882.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2. <https://www.energy.gov/eere/renewable-energy>

Biomedical Electronics

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

Course Code: 2501EC97

L	T	P	C
3	0	0	3

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

CO1: Understand the basic medical instrumentation system and bioelectric potentials.

CO2: Illustrate different types of electrodes to acquire bio-signals.

CO3: Demonstrate clinical laboratory measurements and assistive devices.

CO4: Discuss the latest developments in medical imaging systems.

CO5: Outline patient care and safety while using biomedical equipment.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Components of Medical Instrumentation Systems

Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. Sources of Bioelectric Potentials, Resting and Action Potentials.

UNIT – II

Bio-Potential Electrodes and Physiological Transducers:

Electrode potential and its equivalent circuit, Types of Electrodes: Surface Electrodes, Needle Electrodes, Micro Electrodes. Biochemical Transducers.

Bio-Signal Acquisition:

Electrical Conduction system of the heart, Electrocardiogram, ECG leads, Einthoven triangle, Plethysmography, EEG 10-20 lead system and EMG. basics of biomedical signal acquisition, common signal artifacts and simple noise reduction techniques.

UNIT – III

Clinical laboratory Measurements:

Blood cell Counter, Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter, automated blood pressure measurements.

Physiological Assist Devices & Therapeutic Equipment:

Pacemakers - External & internal, Defibrillators- External & internal, Hemodialysis machine.

UNIT – IV

Monitory and Imaging Equipment:

Spirometry, Ventilators, Arrhythmia Monitor, Foetal Monitor and Incubator. X-ray machine, Computed Tomography (CT), Magnetic Resonance Imaging System, Ultrasound Imaging system.

UNIT – V

Patient Care and Safety:

The elements of Intensive Care Monitor, Diagnosis, Calibration and reparability of Patient Monitoring equipment, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, and Isolated Power Distribution System.

Text Books:

1. Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, *Biomedical Instrumentation and Measurements*. 2nd Edition, PHI, 2004.
2. Dr. M. Arumugam, *Biomedical Instrumentation*. 2nd Edition, Anuradha publications, 2002.

Reference Books:

1. R.S. Khandpur, *Hand-book of Biomedical Instrumentation*. 2nd Edition, TMH, 2003.
2. John G. Webster, *Medical Instrumentation, Application and Design*. John Wiley, 3rd Edition, 2009.
3. Onkar N. Pandey, Rakesh Kumar, *Bio-Medical Electronics and Instrumentation*. 3rd Edition, Katson Books, 2002.

Web Links:

- 1 https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_bt49.
- 2 https://www.youtube.com/watch?v=Qq3t01LytkU&list=PLnsf_0i_t0FC4EdRdhLwjQgp5cYytJ5Oe.

Fundamentals of Wireless Communications
(CE,EEE,ME,CSE,IT,DS,AIIML,PT,Min.E, Ag.E)

L T P C
3 0 0 3

Course Code:2501EC98

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

Course Code: 2501EC99

L	T	P	C
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)

Course Code: 2501ECA0

L	T	P	C
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)

	L	T	P	C
Course Code: 2501ECA1	3	0	0	3

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

- CO1:** Outline the fundamental concepts related to MOS and Bi-CMOS Circuits fabrication.
- CO2:** Analyze the electrical properties of MOS and Bi-CMOS Circuits.
- CO3:** Make use of design rules for developing stick and layout diagrams.
- CO4:** Interpret the issues related to subsystem design.
- CO5:** Interpret FPGA and ASIC design approaches for semi-custom design.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, Bi-CMOS Technology, Comparison between CMOS and Bipolar technologies.

UNIT – II

Basic Electrical Properties of MOS and Bi-CMOS Circuits: I_{ds} versus V_{ds} Relationships, Threshold Voltage, MOS transistor Trans-conductance, Output Conductance and Figure of Merit, The Pass transistor, NMOS Inverter, Alternative forms of the pull-up, The CMOS Inverter, Bi- CMOS Inverter, Transistor switches, Schematics of Inverter, NAND, NOR gates using NMOS, PMOS, and CMOS technologies.

UNIT – III

MOS Circuit Design Processes: MOS Layers, Design Rules, General observations of design rules, 2 μ m Double Metal, Double Poly, CMOS rules, 1.2 μ m Double Metal, Double Poly CMOS rules, Stick Diagrams, Layout Diagrams of NAND and NOR gates and CMOS inverter.

UNIT – IV

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances.

UNIT – V

IC Design: PLAs, PLDs, FPGA, ASIC, Selection of an Appropriate Integrated Circuit.

FPGA Design Process: Architectures of Popular FPGAs, Choosing an FPGA, FPGA Design Process, FPGA Families of Different Vendors, FPGA Design Examples.

Text Books:

1. Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell, Sholeh Eshraghian, Prentice-Hall of India Private Limited, ISBN: 978-8120327726
2. VLSI Design, Black Book by Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc, ISBN: 978-9350048047

Reference Books:

1. CMOS Digital Integrated Circuits Analysis & Design, Sung-Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw-Hill, 3rd Edition, ISBN: 978-0072460537
2. Modern VLSI Design-Wolf Wayne, Pearson Edition, 3rd Edition, ISBN: 978-0130619709
3. VLSI Design, K. LalKishore, V.S.V.Prabhakar, I.K. International Publishing House Private Limited, 1st Edition, ISBN: 978-9380026671

Web Links:

1. NPTEL – VLSI Physical Design- <https://nptel.ac.in/courses/106105161>
2. NPTEL – Advanced VLSI Design <https://nptel.ac.in/courses/117/101/117101004>.

System on Chip Design

(CE,EEE,ME,CSE,IT,DS,AI ML,PT,Min.E, Ag.E)

Course Code: 2501ECA2

L	T	P	C
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.)

Course Code: 2501CS03

L	T	P	C
2	0	2	4

Course Outcomes:

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

- CO1:** Utilize structure, union to handle heterogeneous data.
- CO2:** Illustrate Time and Space complexities for different 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:

- Write a C program to find the total, average of n students using structures
- Copy one structure variable to another structure of the same type.
- 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:

- 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>

5. Program to illustrate the use of Constructors and Destructors.
6. C++ Class Templates
<https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true>

UNIT – II

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

Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.

Linked Lists: Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

Practice:

1. Single Linked List: Perform different operations in single linked list.
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source
4. Reversing a Linked List

UNIT – III

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

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

Practice:

1. Stack and its operations using arrays and Linked List
<https://www.hackerrank.com/challenges/balanced-brackets/problem>
https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
<https://leetcode.com/problems/evaluate-reverse-polish-notation/description/>
3. Queue and its operations using arrays and Linked List
<https://leetcode.com/problems/implement-queue-using-stacks/description/>
https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
<https://leetcode.com/problems/design-circular-queue/description/>

UNIT – IV

Trees: Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.

Binary Search Trees – Definition, Operations: Searching, Insertion, Deletion.

Practice:

1. Implement Binary search tree (BST).
<https://leetcode.com/problems/insert-into-a-binary-search-tree/description/>
<https://leetcode.com/problems/delete-node-in-a-bst/description/>
2. Implement Binary search Tree (BST) Traversals.
<https://www.hackerrank.com/challenges/tree-inorder-traversal/problem>
<https://www.hackerrank.com/challenges/tree-preorder-traversal/problem>
<https://www.hackerrank.com/challenges/tree-postorder-traversal/problem>

UNIT – V

Graphs: Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjacency list, Graph Traversals (BFS & DFS), Bi-Connected Components.

Practice:

1. Graph Traversal using Breadth First Search (BFS)
<https://www.hackerrank.com/challenges/bfsshortreach/problem>
2. Graph Traversal using Depth First Search (DFS)
<https://leetcode.com/problems/number-of-islands/description/>

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
2. Fundamentals of Data Structures in C++,Ellis Horowitz, Sartaj Sahni, DineshMehta, ISBN: 81-7515-278-8
3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition,ISBN · 9780133522884.
2. Object oriented programming in C++, JoyceeFarrell,Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek,Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

Web Links:

1. <http://nptel.ac.in/courses/106105151/>
2. <https://nptel.ac.in/courses/106102064>
3. <https://archive.nptel.ac.in/courses/106/105/106105225/>
4. <https://www.udemy.com/topic/data-structures/>
5. <https://www.coursera.org/specializations/data-structures-algorithms>
6. <https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html>

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
2	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
3	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
4	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
5	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
6	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
7	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
8	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
9	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
10	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
11	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
12	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Code chef	Hacker rank	Leet code	Geek for Geeks
Unit-1	3	0	2	1	0
Unit-2	0	1	3	2	0
Unit-3	0	0	1	5	0
Unit-4	0	0	3	2	0
Unit-5	0	0	1	1	0
Additional Practice	0	0	3	8	1
Total	3	1	13	19	1

Operating Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

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

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

Practice:

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

UNIT – II

Process Concept: Process scheduling, Operations on processes, Inter-process communication.

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

Multithreaded Programming: Multithreading models, Thread libraries, Threading issues

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

Practice:

1. Simulate the following CPU scheduling algorithms:FCFS and SJF
2. Simulate the following CPU scheduling algorithms: Priority and Round Robin

UNIT – III

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

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

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

Practice:

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

UNIT – IV

Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.

Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.

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

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

Practice:

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

UNIT – V

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

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

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

Practice:

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

Text Books:

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

Reference Books:

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

- 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:

- 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 polices, Approaches to Congestion Control, Traffic Aware Routing, Admission Control, **Traffic Throttling:** Load Shedding

Traffic Control Algorithm: Leaky bucket & Token bucket.

Practice:

1. Programs to implements routing protocols like shortest path.

UNIT – V

IP Protocols: IP Addressing, IP & ICMP.

Transmission Control Protocol: UDP & TCP.

Application Layer: World Wide Web, HTTP, Electronic mail, Architecture, web based mail, email security, TELENET, local versus remote Logging, Domain Name System: Name Space, DNS, SNMP.

Practice:

1. NS2 Simulator i. NS2 Simulator-Introduction ii. Simulate to Find the Number of Packets Dropped iii. Simulate to Find the Number of Packets Dropped by TCP/UDP

Capstone Project:

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

Text Books:

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

Reference Books:

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

Web Links:

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

Artificial Intelligence

(CE, EEE, ECE, PT, Min.E.)

Course Code: 2501AI02

L	T	P	C
2	0	1	3

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

- CO1:** Illustrate the foundations, history, and applications of Artificial Intelligence using modern tools
- CO2:** Develop AI-based problem-solving models using Python
- CO3:** Implement search and optimization algorithms using Python libraries
- CO4:** Apply knowledge representation techniques using Python frameworks
- CO5:** Design simple intelligent systems and expert systems using Python

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit - I

Introduction to AI & Python Foundations

What is AI? Foundations and History of AI, AI Applications in real-world systems, Intelligent Agents and Environment, Rationality and Types of Agents, Fundamentals of Python for AI applications.

Practice (Python-based):

1. Implement simple AI agent (e.g., vacuum cleaner agent simulation)
2. Rule-Based AI Agent (Weather Decision Agent)

Unit – II

Problem Solving & Search Algorithms

Problem formulation and state space representation, Control strategies, Search strategies, Uninformed Search: BFS, DFS, Uniform Cost Search, Informed Search: Greedy, A* Algorithm, Heuristics and evaluation functions.

Practice (Python):

1. Implement DFS algorithm for Water Jug Problem
2. Solve Tic-Tac-Toe using BFS search strategy.
3. Implement A* Algorithm for pathfinding (e.g., grid navigation)

Unit – III**Optimization & Game Playing**

Problem graphs, Matching, Indexing, Local Search Algorithms: Hill Climbing, Simulated Annealing, Optimization Problems, Searching with Nondeterministic Actions, Constraint Satisfaction Problems (CSP), Game Playing: Minimax Algorithm, Alpha-Beta Pruning

Practice (Python):

1. Solve 8-Puzzle using Hill Climbing
2. Implement Travelling Salesman Problem (TSP) using heuristic approach

Unit – IV**Knowledge Representation**

Knowledge Representation Techniques, Propositional Logic & Predicate Logic, Inference & Resolution, Semantic Networks and Frames, Representation of knowledge through Planning generation Systems-K Strips Strategic explanations Why, why not and how explanations.

Practice (Python):

1. a) Implement Predicate Logic using Python (SymPy / logic module)
b) Develop a Semantic Network (e.g., Animals or Transport)
2. Create a Frame-based system (Restaurant domain)

Unit – V**Expert Systems & Modern AI Applications**

Expert Systems Architecture, Knowledge Acquisition & Representation, Meta knowledge, Rule-based Systems, Ethics in AI, Typical expert systems – EMYCIN, DART, XOON, Expert systems shells.

Practice (Python):

1. Build a Travel Recommendation Expert System
2. Develop a Student Career Guidance System

Text Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig (need to add details)
2. Artificial Intelligence: Foundations of Computational Agents – Poole & Mackworth

Reference Books

1. Artificial Intelligence with Python – Prateek Joshi
2. Hands-On Machine Learning with Scikit-Learn & TensorFlow – Aurélien Géron
3. Python AI Projects for Beginners – Prateek Joshi

Web Resources

1. <https://docs.python.org>
2. <https://nptel.ac.in/courses/106105077>
3. <https://nptel.ac.in/courses/106106126>

Machine Learning
(CE, ECE, PT, Min.E.)

Course Code: 2501AI05

L	T	P	C
2	0	2	4

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2			2	2		1	1		
CO2	2	2	3		2	2		1	1		
CO3	3	2	3		2			1	1		2
CO4	3	2	3		2			1	1		
CO5	2	2	2		2			1	1		2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

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

Practice :

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

UNIT – II

Supervised Learning(Regression/Classification):Basic Methods:

Concept Learning: General-to-Specific Hypotheses Ordering, Find-S and Candidate Elimination Algorithm, Version Space, and Inductive Bias.

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

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

Practice :

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

UNIT – III

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

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

Practice :

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

UNIT – IV

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

Unsupervised Learning:

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

Practice :

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

UNIT – V

Ensemble Learning :

Bagging and Boosting, Adaboost and Random Forest ,

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

Practice :

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

Additional Practice:

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

Corner Stone Project:

PROJECT 1: Intelligent Loan Risk Assessment System (End-to-End ML Pipeline)

Project Implementation, Documentation and Viva Voce

• Implementation mainly focuses on

- Collecting and integrating multiple datasets (loan + financial history)
- Advanced preprocessing (missing values, outliers, feature engineering)
- Implementing multiple models (Logistic Regression, Random Forest, XGBoost)
- Handling imbalanced data (SMOTE / resampling techniques)
- Model evaluation using ROC-AUC, F1-score, cross-validation
- Building a simple UI (Streamlit/Web app) for predictions
- Model comparison and optimization

• Documentation must contain

- Objective & real-world problem definition
- Dataset merging and preprocessing pipeline
- Feature engineering techniques
- Model comparison and evaluation metrics
- System architecture diagram
- Screenshots (UI + outputs)
- Enhancements (hyperparameter tuning, deployment)

PROJECT 2: Smart Disease Prediction System with Model Ensemble

• Implementation mainly focuses on

- Using medical datasets (heart disease/diabetes/multi-disease)
- Data preprocessing and feature selection
- Applying multiple classifiers (SVM, kNN, Random Forest, Gradient Boosting)
- Ensemble learning (Voting / Stacking models)
- Model evaluation using confusion matrix, ROC curves
- Explainability (feature importance / SHAP basics)
- Web-based prediction interface

• Documentation must contain

- Objective
- Dataset and preprocessing steps
- Model architecture and ensemble approach
- Evaluation metrics and comparison
- Screenshots (prediction system)
- Enhancements (multi-disease prediction)

PROJECT 3: Real-Time Sentiment Analysis System with Web Scraping

• Implementation mainly focuses on

- Scraping live data (Twitter/news using APIs or scraping tools)
- Text preprocessing (stopwords, stemming, vectorization – TF-IDF)
- Training models (Naïve Bayes, Logistic Regression, LSTM optional)
- Real-time sentiment prediction
- Visualization dashboard (charts for sentiment trends)
- Handling large-scale streaming data

• Documentation must contain

- Objective
- Data collection methodology (APIs/web scraping)
- NLP preprocessing pipeline
- Model building and evaluation
- Dashboard explanation
- Screenshots
- Enhancements (real-time alerts, topic modeling)

PROJECT 4: Heart Disease Prediction using SVM

• Implementation mainly focuses on

- Loading patient dataset
- Applying Support Vector Machine (SVM)
- Data preprocessing and feature scaling
- Classification of patients (disease/no disease)
- Model evaluation using confusion matrix

• Documentation must contain

- Objective
- Dataset description

- SVM working principle
- Evaluation metrics
- Output results
- Screenshots
- Enhancements (kernel comparison)

PROJECT 5: Customer Segmentation using Clustering

• Implementation mainly focuses on

- Loading customer dataset
- Applying K-Means clustering
- Identifying groups based on features
- Visualizing clusters using plots
- Comparing clustering results

• Documentation must contain

- Objective
- Dataset details
- Clustering technique explanation
- Cluster visualization
- Results interpretation
- Screenshots
- Enhancements (DBSCAN comparison)

PROJECT 6: Fake News Detection System using Machine Learning

• Implementation mainly focuses on

- Dataset collection (news datasets / scraping)
- Text preprocessing (tokenization, TF-IDF, n-grams)
- Applying classification models (Logistic Regression, SVM, Random Forest)
- Model evaluation using precision, recall, F1-score
- Comparing multiple models
- Building a simple interface for prediction

• Documentation must contain

- Objective
- Dataset description
- NLP pipeline
- Model comparison
- Evaluation metrics
- Screenshots
- Enhancements (deep learning models)

PROJECT 7: Sentiment Analysis using Ensemble Learning

• Implementation mainly focuses on

- Collecting dataset (Twitter/Kaggle)
- Text preprocessing
- Applying Bagging and Boosting techniques
- Training ensemble models (Random Forest / AdaBoost)
- Predicting sentiment (positive/negative)

- **Documentation must contain**

- Objective
- Dataset source
- Preprocessing steps
- Ensemble methods explanation
- Performance comparison
- Screenshots
- Enhancements (real-time data analysis)

PROJECT 8: Model Evaluation and Comparison System

- **Implementation mainly focuses on**

- Implementing multiple models (kNN, SVM, Regression)
- Performing cross-validation
- Calculating accuracy, precision, recall, F1-score
- Comparing model performance
- Visualizing results using graphs

- **Documentation must contain**

- Objective
- Models used
- Evaluation metrics explanation
- Comparison results
- Graphs and charts
- Screenshots
- Enhancements (hyperparameter tuning)

Text Books:

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

Reference Books:

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

Web Links:

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

Note:

- Students must submit the Certificate of Completion offered by any Industry.
- The capstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The SEE – Lab shall be evaluated for 50 marks based on project implementation, oral presentation, 10-minute video presentation, and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.

Fundamentals of Data Science

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

Course Code: 2501CS34

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/>