B. TECH. PROGRAM CURRICULUM - 2025

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

Version 2.0

ELECTRICAL & ELECTRONICS ENGINEERING

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

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

ADITYA UNIVERSITY

Aditya Nagar, ADB Road, Surampalem - 533 437

ADITYA UNIVERSITY

Department of EEE

Vision

To become a global leader in Electrical Engineering with innovation for sustainable development.

Mission

M1: **I**mpart quality education and entrepreneur skills through cutting-edge technologies.

M2: Encourage innovation, interdisciplinary collaboration, and industry engagement.

M3: Promote ethics, social responsibility, and environmental awareness.

Graduates of the B.Tech. (Electrical and Electronics Engineering) will

PEO 1: Excel as professionals with leadership in industry, academia, and research.

PEO 2: Adapt emerging technologies to design complex systems with innovation.

PEO 3: Pursue lifelong learning with integrity, professionalism, and sustainability.

At the end of the program the students will be able to:

PSO 1: Apply power electronics for efficient energy conversion and automation.

PSO 2: Design and manage reliable, sustainable power systems.

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 Electrical and Electronics Engineering

B. Tech (EEE) Program Curriculum – 2025

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

UG Program Offered

- B.Tech in (Electrical and Electronics Engineering)

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

- Minor Stream in Intelligent and Integrated Power Systems
- Minor Stream in Power Electronics and Energy Systems
- Minor Stream in Advanced Specialization on Electric Vehicles (Industry Integrated Program- L & T)
- Minor Stream in Design of Electrical System for Smart Buildings (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	33
3	Multidisciplinary Courses (MDC)	09	10
4	Ability Enhancement Courses (AEC)	08	09
5	Skill Enhancement Courses (SEC)	09	08
6	Value Added Courses (VAC)	06-08	04
7	Summer Internships (SI)	02 - 04	04
8	Full Semester Internship (PROJ)	12	12
9	Mandatory Courses (MC)		-
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	-
2501CH02	Applied 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	-
2501PH02	Modern Physics	FC	2		1	3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501EE02	Electromagnetic Theory	FC	2	1		3	50	50	100	-
2501EE03	Electrical Network Analysis-I	FC	2		2	4	50	50	100	-
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	DEVC
2501EE04	DC Machines &Transformers	IC	2		2	4	50	50	100	ENA-I
2501EE05	Electrical Network Analysis-II	IC	2		2	4	50	50	100	ENA-I
2501MA06	Complex Variables & Statistical Methods	IC	2	1		3	50	50	100	LAC
2501EE06	Electric Power Generation & Distribution Systems	IC	3			3	50	50	100	ENA-I/BEEE
2501EE07	Induction & Synchronous Machines	IC	2	1	1	4	50	50	100	EMT
2501EE08	Analog Electronic Circuits	IC	2	1	1	4	50	50	100	-
2501EC01	Digital Electronics & Logic Design	IC	2		2	4	50	50	100	-
2501EE09	Microprocessor & Interfacing	IC	2		2	4	50	50	100	DELD
2501EE10	Power Electronics	IC	2		2	4	50	50	100	-
2501EE11	Control Engineering	IC	2		2	4	50	50	100	-
2501EE12	Electric Power Transmission Systems	IC	2	1		3	50	50	100	EPGDS
2501EE58	Artificial Intelligence and Machine learning for Electrical Systems	IC	2	0	2	4	50	50	100	-

2501EE14	Power System Analysis	AC	2	1	1	4	50	50	100	EPTS
2501EE39	Energy converters	AC	2	1		3	50	50	100	PE
2501EE16	Power System Operation & Control	AC	2		2	4	50	50	100	PSA
	Total		**46**	**10**	**26**	**82**				

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	**FC**	2		2	4	50	50	100	-
2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	IC	2		2	4	50	50	100	PPSC
2501MB01	Engineering Economics & Management	IC	2			2	50	50	100	-
	Total		**06**		**04**	**10**				

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EN01	Essential Cognitive skills for Engineers	FC			1	1	100	-	100	-
2501EN02 2501UC01 2501UC02 2501UC05 2501UC04 2501UC06 2501UC03	Advanced Cognitive Skills for Engineers **(or)** Proficiency in Sanskrit / Hindi / Foreign language (Japanese/German/Spanis h/ French)	FC			1	1	100	-	100	-
2501UC07	Design Thinking using AI	FC			1	1	100	-	100	
2501UC08	Universal Human Values	FC	2			2	50	50	100	
2501UC09	Technical Paper Publication	AC			2	2	100	-	100	-
2501EE57	Student Activity Based Learning	AC				2	100	-	100	-
	Total		**02**		**05**	**09**				

Skill Enhancement Courses (SEC)

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	-
2501CS05	Machine Learning with Python	IC			2	2	50	50	100	-
2501EE18	Intelligent Algorithms for Power Systems	AC	2		1	3	50	50	100	-
	Total				**05**	**07**				

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS04	Internet of Things	FC			1	1	100	-	100	-
2501UC11	Employability skills -1	FC			3	0	100	-	100	-
2501UC13	Employability skills -2	FC			3	0	100	-	100	ES-1
2501CS02	Data Analysis Using Python	IC			2	2	50	50	100	PPSC
2501UC14	Employability skills -3	IC			3	0	100	-	100	ES-2
2501UC15	Employability skills -4	IC			3	0	100	-	100	ES-3
2501UC16	Employability skills -5	AC			3	1	100	-	100	ES-4
2501AC06	Advanced Data Structures & Algorithms	IC	2		1		100	-	100	DS
	Total		**2**		**19**	**04**				

Summer Internships (SI)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE19	Summer Internship-I	IC			2	2	100	-	100	-
2501EE20	Summer Internship-II	AC			2	2	100	-	100	-
	Total				**04**	**04**				

Full Semester Internship (PROJ)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE21	Full Semester Internship	AC			12	12	50	50	100	-
	Total				**12**	**12**				

Mandatory Courses (MC)

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

Minor Stream Courses: Intelligent and Integrated Power Systems

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE22	Electrical Machine Design	FC	3			3	50	50	100	-
2501EE27	Utilization of Electrical Energy	FC	3			3	50	50	100	DCMT
2501EE24	Electrical Distribution System	IC	2	1		3	50	50	100	EPGDS
2501EE26	HVDC Transmission	IC	3			3	50	50	100	PE
2501EE30	Methods & Algorithms for Intelligent Control	IC	2	1		3	50	50	100	-
2501EE23	High Voltage Engineering	IC	3			3	50	50	100	EPTS
2501EE28	Restructured Power Systems	AC	3			3	50	50	100	EPTS
2501EE31	Advance Control Systems	AC	2	1		3	50	50	100	CE
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
2501EE25	Flexible Alternating Current Transmission Systems	AC	3			3	50	50	100	PE
2501EE29	Soft Computing Techniques in Power Systems	AC	2		1	3	50	50	100	PSA
	Total		**28**	**3**	**1**	**32**				

Minor Stream Courses: Power Electronics and Energy Systems

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE13	Electrical Measurements & Instrumentation	IC	2		1	3	50	50	100	-
2501EE34	Alternative Energy Sources	FC	3			3	50	50	100	-
2501EE27	Utilization of Electrical Energy	FC	3			3	50	50	100	DCMT
2501EE35	Special Electrical Machines	IC	2	1		3	50	50	100	ISM
2501EE36	Electric Energy Storage Systems	IC	3			3	50	50	100	AES
2501EE38	Digital Control Systems	AC	2	1		3	50	50	100	CE
2501EE15	Switch Gear & Protection	AC	3			3	50	50	100	EPTS
2501EE33	Energy Audit, Conservation & Management	AC	2	1		3	50	50	100	EPGDS
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
2501EE40	Power Quality	AC	3			3	50	50	100	EPGDS
2501EE37	Hybrid Electric Vehicles	AC	3			3	50	50	100	PE
	Total		**28**	**3**	**1**	**32**				

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

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE43	Electrical safety	FC	3			3	50	50	100	-
2501EE47	Finance for Professionals	FC	3			3	50	50	100	
2501EE41	Foundations of EV & Hybrid Vehicles	FC	3			3	50	50	100	PE
2501EE35	Special Electrical Machines	IC	2	1		3	50	50	100	ISM
2501EE44	EV Power Electronics & Embedded Systems	IC	3			3	50	50	100	EVBT
2501EE42	EV Battery Technology & Power train Development	IC	3			3	50	50	100	PE
2501EE45	EV Design & Analysis	IC	3			3	50	50	100	
2501EE33	Energy Audit, Conservation & Management	AC	2	1		3	50	50	100	EPGDS
2501ME43	EV Charging Infrastructure, Vehicle Testing & Homologation	AC	3			3	50	50	100	-
2501EE46	EV PCB Design & Data Analytics	AC	3			3	50	50	100	
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
	Total		**30**	**2**		**32**				

Minor Stream Courses: Design of Electrical System for Smart Buildings (Industry Integrated Program- L & T)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE43	Electrical safety	FC	3			3	50	50	100	-
2501EE47	Finance for Professionals	FC	3			3	50	50	100	
2501EC65	Applied Industrial IoT	FC	3			3	50	50	100	IOT
2501EE48	Electrical Power Distribution & Automation	IC	3			3	50	50	100	EPGDS
2501EE35	Special Electrical Machines	IC	2	1		3	50	50	100	ISM
2501EE49	Integrated Approach to Building Services	IC	3			3	50	50	100	-
2501EE33	Energy Audit, Conservation & Management	AC	2	1		3	50	50	100	EPGDS
2501EE50	Building Information Modelling	AC	3			3	50	50	100	-
2501EE51	Advanced Electrical System Design for Builders	AC	3			3	50	50	100	
2501EE52	Extra Low Voltage System Design for Buildings	AC	3			3	50	50	100	
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
	Total		**30**	**2**		**32**				

#Syllabus for the industry partner courses will be released in the department as and when required.

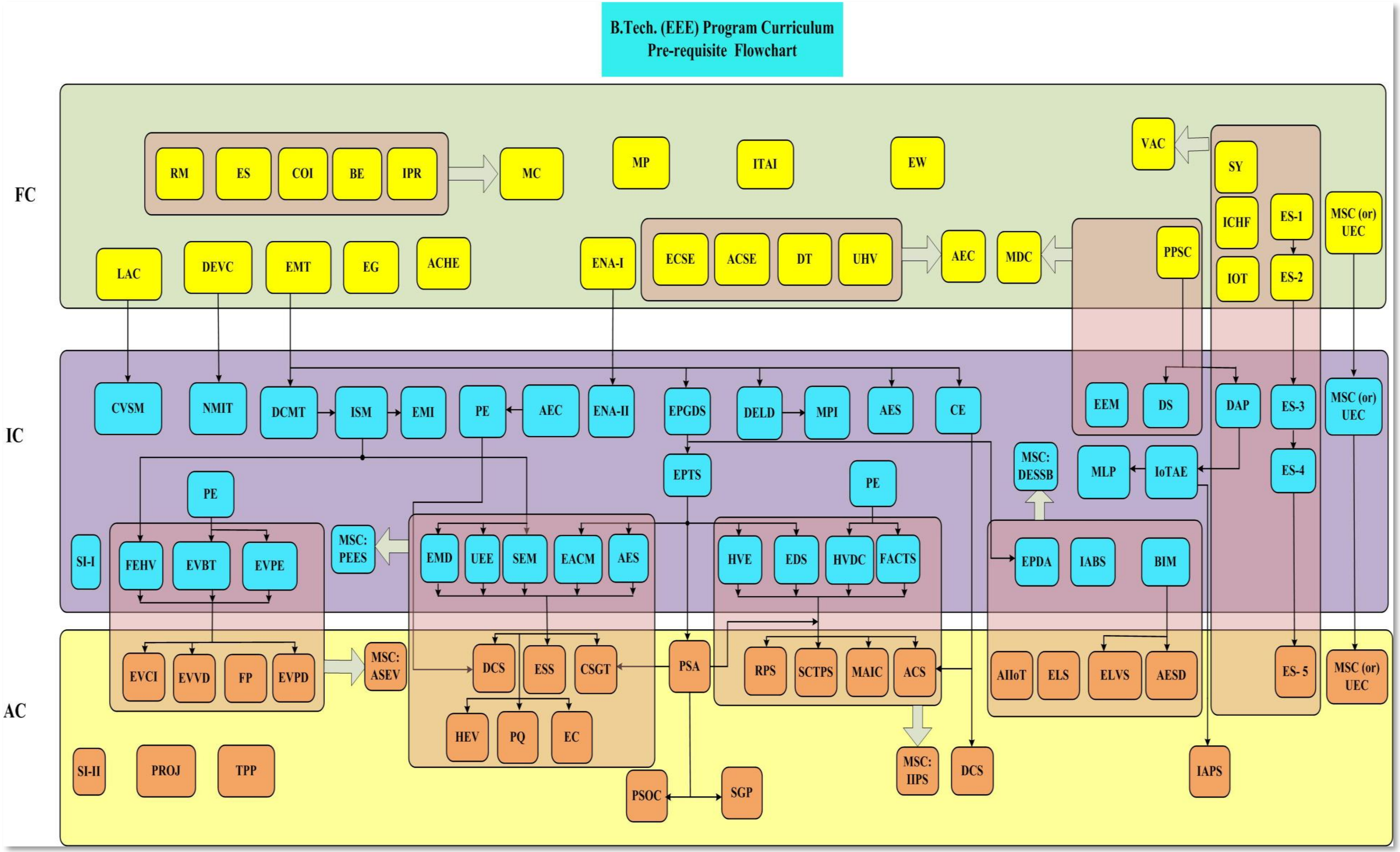
UNIVERSITY OPEN ELECTIVE COURSES

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, TransmissionC Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE,ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE,ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	

ME	2501ME36	Sustainable Energy Systems	FC	3				3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ECE	2501EC97	Biomedical Electronics	FC	3				3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC98	Fundamentals of Wireless Communications	FC	3				3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3				3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3				3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3				3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3				3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA3	Introduction to Quantum Computing	FC	3				3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	FC	2			2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2			1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2			2	4	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	PPSC / CP&DS
IT	2501CS07	Computer Networks	AC	2			1	3	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2			1	3	50	50	CE, EEE, ECE, PT, Min.E	-

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

Note: *Courses are applicable only to students admitted in the year 2025.
#Courses are applicable to the students admitted from the year 2026 onwards.
All the other courses are applicable to students admitted from the year 2025 onwards.


B.Tech. (EEE) Program Curriculum
Pre-requisite Flowchart
FC
RM
ES
COI
BE
IPR
MC
MP
ITAI
EW
VAC
SY
ICHF
IOT
ES-1
ES-2
MSC (or) UEC
LAC
DEVC
EMT
EG
ACHE
ENA-I
ECSE
ACSE
DT
UHV
AEC
MDC
PPSC
IC
CVSM
NMIT
DCMT
ISM
EMI
PE
AEC
ENA-II
EPGDS
DELD
MPI
AES
CE
EEM
DS
DAP
ES-3
MSC (or) UEC
EPTS
PE
MSC: DESSB
MLP
IoTAE
ES-4
PE
SI-I
FEHV
EVBT
EVPE
MSC: PEES
EMD
UEE
SEM
EACM
AES
HVE
EDS
HVDC
FACTS
EPDA
IABS
BIM
AC
EVCI
EVVD
FP
EVPD
MSC: ASEV
DCS
ESS
CSGT
PSA
RPS
SCTPS
MAIC
ACS
AIIoT
ELS
ELVS
AESD
ES- 5
MSC (or) UEC
HEV
PQ
EC
SI-II
PROJ
TPP
PSOC
SGP
MSC: IIPS
DCS
IAPS

FC: Foundation Courses

LAC	Linear Algebra & Calculus	ACHE	Applied Chemistry	EMT	Electromagnetic Theory
MP	Modern Physics	DEVC	Differential Equations & Vector Calculus	EW	Engineering Workshop
ENA-I	Electrical Network Analysis-I	EG	Engineering Graphics		

SEC: Skill Enhancement Courses

BIL	Business Intelligence Lab	MLP	Machine Learning with Python	IoTAE	IoT Applications of Electrical Engineering
IAPS	Intelligent Algorithms for Power Systems				

AEC: Ability Enhancement Courses

ECSE	Essential Cognitive Skills for Engineers	ACSE	Advanced Cognitive skills for Engineers	DT	Design Thinking using AI
				UHV	Universal Human Values

VAC: Value Added Courses

ICHF	Indian Cultural Heritage & Fine Arts	SY	Sports &Yoga	IOT	Internet of Things
		DAP	Data Analysis Using Python	ES-1	Employability Skills - 1
ES-2	Employability Skills - 2	ES-3	Employability Skills - 3	ES-4	Employability Skills - 4
ES-5	Employability Skills - 5				

MC: Mandatory Courses

ES	Environmental Science	COI	Constitution of India	IPR	Intellectual Property Rights & Patents
RM	Research Methodology	BE	Biology for Engineers		

MDC: Multidisciplinary Courses

PPSC	Programming for Problem Solving Using C	DS	Data Structures	EEM	Engineering Economics & Management

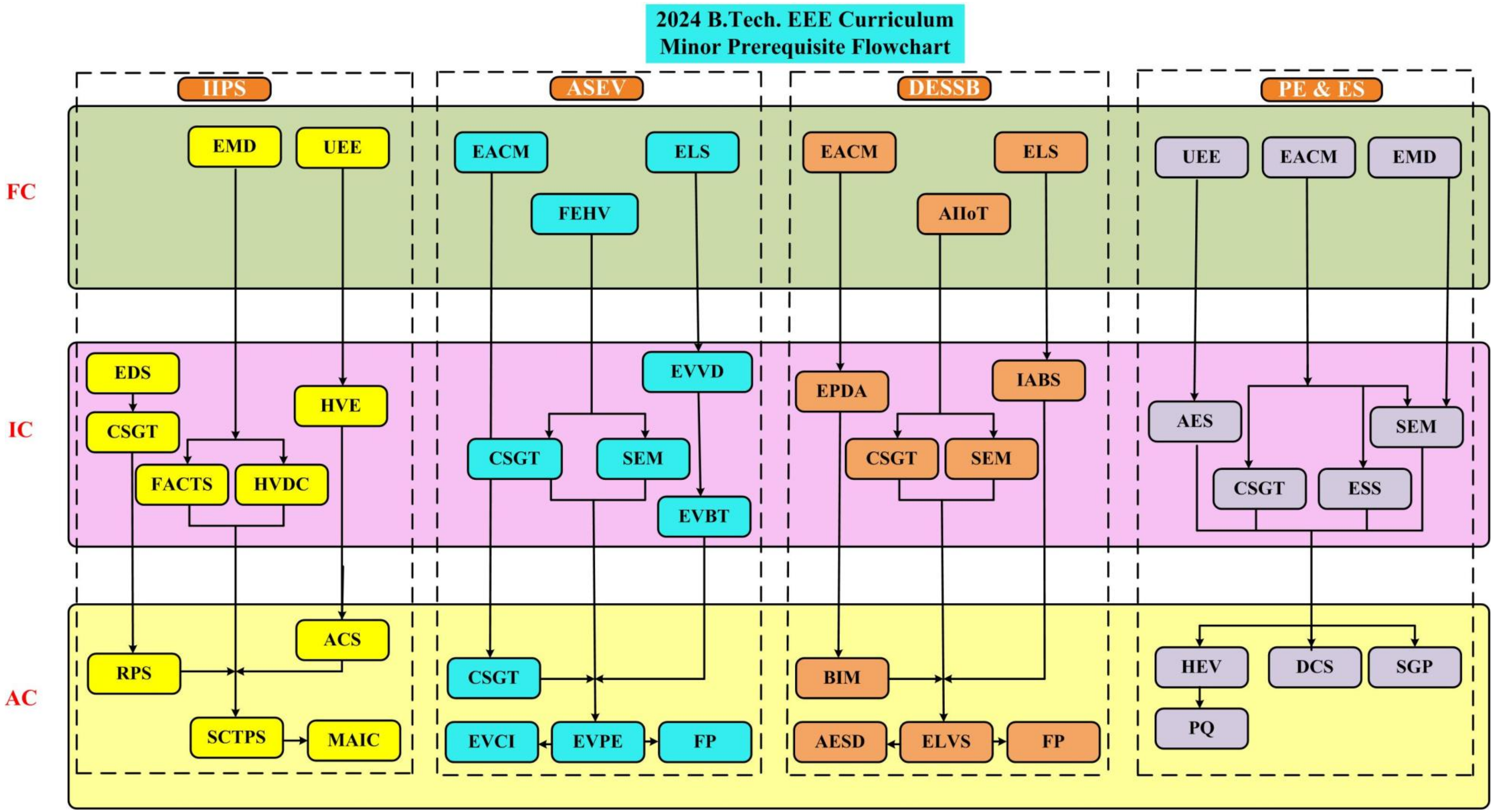
IC: Intermediate-level courses

ISM	Induction Synchronous Machines	CVSM	Complex Variables & Statistical Methods	NMIT	Numerical Methods & Integral Transforms
DCMT	DC Machines & Transformers	PE	Power Electronics	AEC	Analog Electronic Circuits
ENA-II	Electrical Network Analysis-II	CE	Control Engineering	SI-I	Summer Internship-I

EMI	:	Electrical Measurements &Instrumentation	EPGDS	:	Electric Power Generation &Distribution Systems	EPTS	:	Electric Power Transmission Systems
DELD	:	Digital Electronics & Logic Design	MPI	:	Microprocessor & Interfacing			

AC: Advanced Courses

PSA	:	Power System Analysis	EC	:	Energy Converters	TPP	:	Technical Paper Publication
PSOC	:	Power System Operation & Control	SI-II	:	Summer Internship-II	PROJ	:	Full Semester Internship
SABL	:	Student Activity Based Learning						


2024 B.Tech. EEE Curriculum
Minor Prerequisite Flowchart
IIPS
ASEV
DESSB
PE & ES
FC
IC
AC
EMD
UEE
EACM
ELS
FEHV
EACM
ELS
AIIoT
UEE
EACM
EMD
EDS
CSGT
HVE
FACTS
HVDC
EVVD
CSGT
SEM
EVBT
EPDA
IABS
CSGT
SEM
AES
SEM
CSGT
ESS
ACS
RPS
SCTPS
MAIC
CSGT
EVCI
EVPE
FP
BIM
AESD
ELVS
FP
HEV
DCS
SGP
PQ

MSC: Minor Stream Courses

IIPS: Intelligent and Integrated Power Systems

HVE:	High Voltage Engineering	EDS	Electrical Distribution System	HVDC	HVDC Transmission
FACTS	Flexible Alternating Current Transmission Systems	SCTPS	Soft Computing Techniques in Power Systems	MAIC	Methods & Algorithms for Intelligent Control
RPS	Restructured Power Systems	EMD	Electrical Machine Design	ACS	Advance Control Systems

PEES: Power Electronics and Energy Systems

EACM	Energy Audit, Conservation & Management	CSGT	Concept of Smart Grid Technology	UEE	Utilization of Electrical Energy
				AES	Alternative Energy Sources
SEM	Special Electrical Machines	ESS	Electric Energy Storage Systems	HEV	Hybrid Electric Vehicles
DCS	Digital Control Systems	PQ	Power Quality	SGP	Switch Gear & Protection

ASEV: Advanced Specialization on Electric Vehicles

FEHV	Foundations of EV & Hybrid Vehicles	EVBT	EV Battery Technology & Powertrain Development	ELS	Electrical Safety
EVPD	EV PCB Design & Data Analytics	EVPE	EV Power Electronics & Embedded Systems	EVCI	EV Charging Infrastructure, Vehicle Testing & Homologation
EVVD	EV Design & Analysis	FP	Finance for Professionals		

DESSB: Design of Electrical System for Smart Buildings

EPDA	Electrical Power Distribution & Automation	IABS	Integrated Approach to Building Services	BIM	Building Information Modelling
				AIIoT	Applied Industrial IoT
ELVS	Extra Low Voltage System Design for Buildings	AESD	Advanced Electrical System Design for Builders		

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
2501PH02	Modern Physics	MCC	FC	2		1	3	4
2501ME01	Engineering Graphics	MCC	FC	1		2	3	5
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	MDC	FC	2		2	4	6
2501UC08	Universal Human Values	AEC	FC	2			2	2
2501EN01	Essential Cognitive Skills for Engineer	AEC	FC			1	1	2
2501IT01/ 2601AI01	Business Intelligence Lab* / Business Intelligence & AI Tools Lab#	SEC	FC			2	2	4
2501ME03	Engineering Workshop	MCC	FC			1	1	2
	Total			**09**	**01**	**09**	**19**	**26**

II SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501EE03	Electrical Network Analysis-I	MCC	FC	2		2	4	6
2501MA02	Differential Equations & Vector Calculus	MCC	FC	2	1		3	3
2501CH02	Applied Chemistry	MCC	FC	2		1	3	4
2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	MDC	IC	2		2	4	6
2501MB01	Engineering Economics & Management	MDC	IC	2			2	2
2501EC01	Digital Electronics & Logic Design	MCC	IC	2		2	4	6
2501UC07	Design Thinking using AI	AEC	FC			1	1	2
2501EN02	Advanced Cognitive Skills for Engineers	AEC	FC			1	1	2
2501UC11	Employability skills -1	VAC	FC			3	0	3
2501AC01	Environmental Science	MC	FC	2			0	2
	Total			**14**	**01**	**12**	**22**	**36**

III SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA05	Numerical Methods & Integral Transforms	MCC	IC	2	1		3	3
2501EE04	DC Machines & Transformers	MCC	IC	2		2	4	6
2501EE02	Electromagnetic Theory	MCC	FC	2	1		3	3
2501EE05	Electrical Network Analysis-II	MCC	IC	2		2	4	6
2501EE08	Analog Electronic Circuits	MCC	IC	2	1	1	4	5
2501CS04	Internet of Things	VAC	FC			1	1	2
2501UC13	Employability skills -2	VAC	FC			3	0	3
2501AC06	Advanced Data Structures & Algorithms	VAC	IC	2		1		4
2501AC02	Constitution of India	MC	FC	2			0	2
	Total			**14**	**03**	**10**	**19**	**37**

IV SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501MA06	Complex Variables & Statistical Methods	MCC	IC	2	1		3	3
2501EE06	Electric Power Generation & Distribution Systems	MCC	IC	3			3	3
2501EE07	Induction & Synchronous Machines	MCC	IC	2	1	1	4	6
2501EE10	Power Electronics	MCC	IC	2		2	4	5
	Minor Stream Course –1/ University Elective Course – 1	MSC/UEC	FC/IC	3			3	3
	Minor Stream Course –2/University Elective Course – 2	MSC/ UEC	IC/AC	3			3	3
2501CS02	Data Analysis Using Python	VAC	IC			2	2	4
2501UC14	Employability skills -3	VAC	IC			3	0	3
2501AC03	Research Methodology	MC	FC	2			0	2
	Total			**17**	**02**	**8**	**22**	**34**

V SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501EE11	Control Engineering	MCC	IC	2		2	4	6
2501EE58	Artificial Intelligence and Machine learning for Electrical Systems	MCC	IC	2		2	4	6
	Minor Stream Course – 3/ University Elective Course –3	MSC/ UEC	IC	2	1		3	3
	Minor Stream Course – 4 /University Elective Course –4	MSC/ UEC	IC	3			3	3
	Minor Stream Course – 5/University Elective Course –5	MSC/ UEC	FC/IC	3			3	3
2501UC15	Employability skills -4	VAC	IC			3	0	3
2501EE19	Summer Internship-I	SI	IC			2	2	4
2501AC04	Intellectual Property Rights & Patents	MC	FC	2			0	2
	Total			**14**	**1**	**9**	**19**	**30**

VI SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501EE09	Microprocessor & Interfacing	MCC	IC	2		2	4	6
2501EE12	Electric Power Transmission Systems	MCC	IC	2	1		3	3
2501EE14	Power System Analysis	MCC	AC	2	1	1	4	5
2501CS05	Machine Learning with Python	SEC	IC			2	2	4
2501AC05	Indian Knowledge Systems	MC	FC	2			0	2
	Minor Stream Course – 6/ University Elective Course – 6	MSC/ UEC	IC/AC	3			3	3
	Minor Stream Course – 7/ University Elective Course – 7	MSC/ UEC	IC/AC	3			3	3
	Minor Stream Course – 8/ University Elective Course –8	MSC/ UEC	IC/AC	3			3	3
	Total			**17**	**02**	**5**	**22**	**29**

VII SEMESTER

Course code	Course Title	Course		Credits				Total Hours
		Category	Level	L	T	P	Total	
2501EE39	Energy converters	MCC	AC	2	1		3	3
2501EE16	Power System Operation & Control	MCC	AC	2		2	4	6
	Minor Stream Course – 9/ University Elective Course –9	MSC/ UEC	AC	2			2	2
	Minor Stream Course – 10/ University Elective Course - 10	MSC/ UEC	AC	3			3	3
	Minor Stream Course – 11/ University Elective Course –11	MSC/ UEC	AC	3			3	3
2501EE18	Intelligent Algorithms for Power Systems	SEC	AC	2		1	3	4
2501EE20	Summer Internship-II	SI	AC			2	2	4
	Total			**14**	**01**	**5**	**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 -5	VAC	AC			3	1	3
2501EE21	Full Semester Internship/Project	PROJ	AC			12	12	24
2501EE57	Student Activity-Based Learning		AC				2	4
	Total					**17**	**17**	**35**

Total Credit: 160.

Note: *Courses are applicable only to students admitted in the year 2025.
#Courses are applicable to the students admitted from the year 2026 onwards.
All the other courses are applicable to students admitted from the year 2025 onwards.

Minor Degree in Electrical and Electronics Engineering (offered to other branches students)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE55	Operation &Control of Electric Machines	FC	3			3	50	50	100	BEEE
2501EE56	Fundamentals of Power Electronics	FC	2			2	50	50	100	BEEE
2501EE13	Electrical Measurements & Instrumentation	IC	2		1	3	50	50	100	ENA-1/BEEE
2501EE53	Electric Power Generation, Transmission & Distribution Systems	IC	3			3	50	50	100	ENA-1/BEEE
2501EE34 2501EE27	Alternative Energy Sources (or) Utilization of Electrical Energy	IC	3			3	50	50	100	EPGDS / BEEE/ ISM
2501EE37 2501EE35	Hybrid Electric Vehicles (or) Special Electric machines	AC	3			3	50	50	100	FPE/ OCEM
2501EE43 2501EE30	Electrical Safety (or) Methods & Algorithms for Intelligent Control	AC	3			3	50	50	100	EPGDS/PSA
	Total		19		1	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**	

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	-
2501CH02	Applied 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	-
2501PH02	Modern Physics	FC	2		1	3	50	50	100	-
2501MA02	Differential Equations & Vector Calculus	FC	2	1		3	50	50	100	-
2501EE02	Electromagnetic Theory	FC	2	1		3	50	50	100	-
2501EE03	Electrical Network Analysis-I	FC	2		2	4	50	50	100	-
2501MA05	Numerical Methods & Integral Transforms	IC	2	1		3	50	50	100	DEVC
2501EE04	DC Machines &Transformers	IC	2		2	4	50	50	100	ENA-I
2501EE05	Electrical Network Analysis-II	IC	2		2	4	50	50	100	ENA-I
2501MA06	Complex Variables & Statistical Methods	IC	2	1		3	50	50	100	LAC
2501EE06	Electric Power Generation & Distribution Systems	IC	3			3	50	50	100	ENA-I/BEEE
2501EE07	Induction & Synchronous Machines	IC	2	1	1	4	50	50	100	EMT
2501EE08	Analog Electronic Circuits	IC	2	1	1	4	50	50	100	-
2501EC01	Digital Electronics & Logic Design	IC	2		2	4	50	50	100	-
2501EE09	Microprocessor & Interfacing	IC	2		2	4	50	50	100	DELD
2501EE10	Power Electronics	IC	2		2	4	50	50	100	-
2501EE11	Control Engineering	IC	2		2	4	50	50	100	-
2501EE12	Electric Power Transmission Systems	IC	2	1		3	50	50	100	EPGDS
2501EE58	Artificial Intelligence and Machine learning for Electrical Systems	IC	2	0	2	4	50	50	100	-

2501EE14	Power System Analysis	AC	2	1	1	4	50	50	100	EPTS
2501EE39	Energy converters	AC	2	1		3	50	50	100	PE
2501EE16	Power System Operation & Control	AC	2		2	4	50	50	100	PSA
	Total		**46**	**10**	**26**	**82**				

Linear Algebra and Calculus

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

	L	T	P	C
Course Code: 2501MA01	**2**	**1**	**0**	**3**

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

Practice(Using any computational tool)

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

UNIT – II

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

Practice(Using any computational tool):

Computing eigen values and eigen vectors, matrix diagonalization.

UNIT – III

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

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

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

UNIT – IV

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

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

UNIT – V

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

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

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

Text Books:

1	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN978-8184875607
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

Applied Chemistry

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

	L	T	P	C
CourseCode:2501CH02	**2**	**0**	**1**	**3**

Course Outcomes:

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

CO1: Explain the fundamentals of polymers and explore engineering applications.

CO2: Interpret the principles and applications of Electrochemical cells.
CO3: Summarize the fundamentals of Computational Chemistry and its applications.
CO4: Illustrate the fundamentals of nano and smart materials and their applications.
CO5: Apply the knowledge of water treatment and E-waste management.

Mapping of Course Outcomes with Program Outcomes

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

Unit 1: Polymer Chemistry

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, with specific examples and methods of polymerization (Suspension polymerization and Emulsion Polymerization) Difference between thermoplastics and thermosetting plastics; Engineering application of plastics - PTFE and Bakelite
Polymer composites – Composites as structural material; Synthesis and applications of Kevlar and Carbon fibers.
Conducting polymers - Polyacetylene- Mechanism of conduction – applications (polymers in sensors, self-cleaning windows)
Biodegradable polymers - Introduction, Polyglycolic acid - synthesis, degradation and uses.

Practice:
Preparation of a polymer (Bakelite)
Determination of molecular weight of polymer using Ostwald's viscometer

Unit 2: Electrochemistry and Applications

Electro chemical cell, Nernst equation, cell potential calculations and numerical problems, Primary cells – Zinc-air battery, Secondary cells –Ni-Cd and, Lead-Acid battery, lithium-ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, Methanol-Oxygen fuel cell– working of the cells. Polymer Electrolyte Membrane Fuel cells (PEMFC)

Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with example (Glucose Electrochemical sensor)

Practice

1. Conduct metric titration of strong acid vs strong base
2. Potentiometric titration of red-ox
3. P^H-metric titration of Acid-Base
4. Determination of Glucose by Electrochemical sensor

Unit 3: Computational Chemistry

Computational Quantum Chemistry and its applications, Prediction of Molecular Properties using Computational Chemistry, Molecular Modeling and Structure - molecular modeling today: overview of problems, tools, and solution analysis. Techniques for Conformational Sampling-Monte Carlo, global optimization, etc.

Practice

1. Molecular docking to predict the interaction energy between molecules

Unit 4: Nano and Smart Materials

Introduction to nano materials and general applications, basic chemical methods of preparation (top down and bottom up approach) - Sol-gel method. Applications of Carbon nano tubes and Fullerenes, Graphene (water treatment and drug delivery)

Characterization of nanomaterials by SEM and TEM (only Principle).
Smart materials and their engineering applications
Shape memory materials- Poly L-Lactic acid,
Thermo response materials – Poly acryl amides, Poly vinyl Amides

Practice

1. Preparation of nano particles by green synthesis
2. Characterization of nanoparticles (SEM & TEM)

Unit V Water Treatment & E-Waste Management

Water treatment: Introduction, hardness of water, types, determination of hardness by EDTA method, disadvantages of hard water, removal of hardness by Zeolite and ion exchange method, Desalination of water – reverse osmosis and Electrodialysis.

E-Waste: Introduction, sources of e-waste, Composition, Characteristics, and Need of e-waste management. Toxic materials used in manufacturing electronic and electrical products; Recycling: Recycling of Li-Ion batteries. Extraction of copper from E-waste.

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

Textbooks:

1. Prasanta Rath, S.Aruna Kumari "Engineering Chemistry", CENGAGE Learning (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. Uppal M.M, Jain and Jain. Engineering Chemistry, Khanna Publishers, 35th Edition, 2013.(ISBN 978-817-409-2625)
2. Dr. S.S. Dara, Dr. S.S. Umare, A Textbook of Engineering Chemistry, S.Chand Publication,2022 .(978-935—283-6068)
3. Andrew R.Leach Molecular Modelling Principles and applications. (201) IIed. PrenticeHall. (978-935-501-2585).

Web Links:

1. https://archive.nptel.ac.in/courses/104/106/104106096/
2. https://archive.nptel.ac.in/courses/104/105/104105124/
3. https://archive.nptel.ac.in/courses/104/106/104106137/
4. https://nptel.ac.in/courses/11810203

Engineering Graphics

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

Course Code: 2501ME01	**L**	**T**	**P**	**C**
	1	**0**	**2**	**3**

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Practice:

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

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

3. **Introduction to Orthographic Projection**
   a) Principles of Projection
   b) Orthographic Projection – Four Quadrants.
   c) First angle & Third angle Projection with examples, reference plane, importance of reference lines or Plane.
   d) Projections of a point situated in any one of the four quadrants.

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

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

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

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

8. **Projection of solids**
    a) Axis Perpendicular to H.P and Axis Perpendicular to V.P
    Ex: Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone
    b) Axis Parallel to H.P and V.P
    Pentagonal and Hexagonal Prisms, Pyramids, Cylinder and Cone

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

10. **Development of Surfaces**
    a) Development of Prisms and Cylinder simple cases

11. **Development of Surfaces**
    a) Development of Pyramids and Cone simple cases

12. **Conversion of Isometric views to Orthographic views**
    a) Practice figure - 1
    b) Practice figure - 2

Additional Practice:

1. **Conversion of Isometric views to Orthographic views**
    a) Practice figure - 3
    b) Practice figure - 4
2. **Conversion of Orthographic views to Isometric views**
    a) Practice figure - 1
    b) Practice figure - 2

Text Books:

1. Engineering Drawing, N. D. Bhatt, Charotar Publishing House, 54^{th} edition, 2024, ISBN : 9789385039706.
2. Engineering Drawing and Graphics , Venugopal, New Age Publications, 2^{nd} edition, 2019, ISBN: 97881225015452.

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, 1^{st}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/97808108391/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

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, 5^{th} edition, ISBN 9780415503020.
2. Engineering Practices Lab Manual, T. Jeyapoovan & M. Saravanapandian, Vikas Publishing House Pvt. Limited, 4^{th} 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/

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

Course Code:2501PH02

L	T	P	C
2	0	1	3

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

CO1 Apply the principles of interference and diffraction to design and enhance the resolving power of grating
CO2 Familiarize the concepts of LASER's and Optical fibres with applications.
CO3 Explain the fundamental concepts of Quantum behavior of matter
CO4 Differentiate various electron theories to understand the properties of solids.
CO5 Explain the basic concepts of Semiconductors and identify the type of semiconductors using Hall effect.

Mapping of Course Outcomes with Program Outcomes:

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

Unit–I Wave Optics
Interference: Introduction - Principle of Superposition - Interference of light- Conditions for sustained Interference- Interference in thin films (reflected geometry) – Colours in thin films – Newton's Rings (reflected geometry) – Determination of wavelength and refractive index – Applications.
Diffraction: Introduction – Fresnel and Fraunhofer Diffraction - Diffraction due to Single slit (quantitative), Double slit (qualitative) - N–Slits Intensity distribution curves (qualitative) – Grating spectrum–Rayleigh's criterion - Resolving powers of grating (qualitative) - Applications.

Practice:
1. Determination of Radius of curvature of a pl1ano-convex lens using Newton's Rings.

2. Measurement of Width or thickness of a thin wire by forming interference fringes.
3. Determination of Wavelength of light source using Diffraction grating by normal incidence method.
4. Resolving power of grating.
5. Determination of wavelength of light by using prism.

Unit–II Lasers & Optical Fibers

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

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

Practice:

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

Unit–III Quantum Mechanics

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

Unit–IV Free electron Theory

Free Electron Theory: Introduction–Classical free electron theory (merits and demerits only)

-Quantum Free electron theory – Electrical conductivity- Fermi energy state–Fermi Dirac distribution function - Temperature dependence – Density of states.

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

Practice:

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

Unit–V Semiconductor Physics

Semiconductors Introduction – Intrinsic semiconductors – density of charge carriers (Qualitative only) – Electrical conductivity –Fermi level - extrinsic semiconductors - P-type & N-type semiconductors-Density of charge carriers (Qualitative only) - Dependence of Fermi energy on carrier concentration and temperature–Hall effect-Hall coefficient - Applications of

Hall effect–Drift and Diffusion currents - Einstein's equation

Semiconductor Devices Working of PN junction diode – Forward and reverse bias

Zener diode -Metal-Oxide-Semiconductor (MOS) structure- Capacitance-voltage characteristics- MOSFET structure - I–V characteristics.

Practice:

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

Text books:

1. "Engineering Physics" by M N Avadhanulu & T.V.S. Arun Murthy, S Chand &Company Ltd, 1st edition 2024. ISBN: 978-93-5870-932-3
2. "Engineering Physics" by Satyendra Sharma and Jyotshna Sharma, Pearson publications.ISBN: 978-81-3151-178-7

Reference Books:

1. "Concepts of Modern Physics" Authur Beiser, Shobhit Mahajan and S Rai Choudhary, McGraw Hill (2017). ISBN: 9789351341857
2. "Engineering Physics" by M.R. Srinivasan, New Age international publishers (209). ISBN: 978-1848290501
3. "Optics" by Ajoy Ghatak, 6th Edition McGraw Hill Education, 2017. ISBN: 978-939113590

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

Differential Equations & Vector Calculus

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

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Ordinary Differential Equations of First Order and First Degree:

Solution of first order linear differential equations, exact differential equations and equations reducible to exact differential equations, Orthogonal Trajectories, Modelling of RL- circuit.
Practice(Using any computational tool): Solving the first order initial value problems using **odesolver** and plot the solution curves.

UNIT – II

Linear Differential Equations of Higher Order:

Solution of linear differential equations with constant coefficients, method of variation of parameters, solution of simultaneous linear differential equations.
Equations reducible to Linear differential equations with constant coefficients: Cauchy's homogeneous Linear Equations, Legendre's Linear Equations. Study of oscillations arising in LCR circuit (free oscillations and forced oscillations).
Practice(Using any computational tool): Solving the second order initial value problems using **odesolver** and plot the solution curves

UNIT – III

Partial Differential Equations:

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

UNIT – IV
Vector Differentiation:
Gradient of a scalar field, finding angle between two surfaces, directional derivative. Divergence and solenoidal fields. Curl and irrotational fields, Finding Scalar Potential.
Practice(Using any computational tool): Plotting of surfaces, 3D-plots, plotting vector fields

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

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

Text Books:

1	Advanced Engineering Mathematics, E. Kreyszig, John Willey & Sons,10th Ed., 2018.ISBN978-0470458365
2	Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44’th Edition (2021).ISBN 978-9383214204

Reference Books:

1	Advanced Engineering Mathematics, Dennis G. Zill, Jones & Bartlett Learning, 2018, 6th Edition.ISBN978-1284105902.
2	Higher Engineering Mathematics, B.V. Ramana, McGraw-Hill Education, 11’th Ed., 2017.ISBN 978-9339216016.

Web Links:

1	https://www.classcentral.com/course/differential-equations-engineers-13258
2	https://archive.nptel.ac.in/courses/111/106/111106100/
3	https://www.khanacademy.org/math/differential-equations
4	https://archive.nptel.ac.in/courses/111/101/11111153/
5	https://archive.nptel.ac.in/courses/111/105/111105122/

Electromagnetic Theory

	L	T	P	C
Course Code:2501EE02	**2**	**1**	**0**	**3**

Course Outcomes:

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

CO1	Apply the laws of Electrostatics to calculate electric field intensity.
CO2	Analyze the behaviour of conductors, dielectrics & capacitors.
CO3	Apply the laws of Magneto-statics to calculate field intensity.
CO4	Explain the Self & Mutual inductances & energy stored in the magnetic field using laws of magneto-statics.
CO5	Analyze the concepts of Faraday's laws, displacement current & poynting vector.

Mapping of Course Outcomes with Program Outcomes:

CO/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	2	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-
CO5	2	3	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
Review of Coordinate systems & vector calculus
Electrostatics : Coulomb's Law, Electric field intensity – Field due to the continuous line, surface, & volume charges - Electric flux density – Gauss Law , Maxwell's first law i.e., div(D)=ρv, Potential & potential gradient, Electric Dipole, Laplace and Poisson's equations

UNIT – II
Electrostatic boundary conditions : Current and Current Density, Dipole moment, Behavior of conductors in an electric field – Conductors & Insulators. Polarization - Boundary conditions between conductor to dielectric & dielectric to dielectrics,
Capacitance of parallel plate & coaxial cable -Energy stored & energy density in a static electric field.

UNIT – III

Magnetostatics : Biot-Savart"s law ,Magnetic field intensity. Magnetic scalar & vector potentials, Maxwell's second Equation i.e., div(B)=0, Ampere's circuital law, Maxwell's third equation i.e., Curl (H)=J.

Magnetostatic Force : Force on a moving charge (Lorentz force), Force on a straight and a long current carrying conductor in a magnetic field – Force between two straight long and parallel current carrying conductors.

UNIT – IV

Inductance & mutual inductance: Determination of self-inductance of a solenoid and Toroid, mutual inductance between a straight long wire and a square loop wire in the same plane – energy stored and density in a magnetic field.

UNIT – V

Time-varying Electromagnetic field : Faraday's law, Lenz's law, Maxwell's fourth equation i.e., Curl (E)=-∂B/∂t, Statically and Dynamically induced EMFs, Maxwell's equations in point & integral forms.

Displacement current – Poynting Theorem and Poynting vector.

Text Books:

1. Engineering Electromagnetics,William Hayt & John Buck, 9th edition, Tata McGraw Hill, New Delhi, India, 2020 (ISBN: 978073380667).
2. Elements of Electromagnetics, Mathew O Sadiku, 7th edition, Oxford University Press, New York, USA, 2018(ISBN: 9780190698614).

Reference Books:

1. Field and Wave Electromagnetics,D K Cheng, 2nd edition revised, Pearson Education, Noida, India (ISBN: 9789332535022).
2. Introduction to Electrodynamics, David. J. Griffiths, 4th edition, Pearson Education, Noida, India (ISBN: 978109397759).

Web Links:

1. https://nptel.ac.in/courses/108106073/
2. https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring/

Electrical Network Analysis-I

	L	T	P	C
Course Code:2501EE03	**2**	**0**	**2**	**4**

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

CO1 Make use of network elements, types of sources, source transformation, mesh & nodal analysis for Electrical Circuits.
CO2 Analyze the behavior of RLC networks.
CO3 Apply the principles of network theorems to solve the electrical circuits.
CO4 Determine the resonant frequency & Q factor of an AC Circuit.
CO5 Identify magnetic circuits with various dot conventions.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Electrical Circuits : Basic Electrical circuit elements and their V-I relations, Ohm’s Law and its limitations, Types of Sources, kirchhoff’s laws, network reduction techniques - source transformation technique, nodal analysis, mesh analysis.

PRACTICE:

1. Verification of ohm’s law, KCL and KVL using simulation.

UNIT – II

AC Fundamentals: Concepts of AC circuits – RMS value, average value, form factor and peak factor, steady state analysis of RLC circuits, phasor diagrams – real & reactive power, power factor.

Graph Theory: Graph of a network, Incidence matrix, Cutset and Tieset matrices, Dual networks.

PRACTICE:

1. Measurement of Power and Power Factor of RLC Circuit.

UNIT – III

Network Theorems (With AC & DC Excitations): Superposition Theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegen's Theorem, Substitution Theorem. (Including dependent sources).

Practice:

1. Verification of Superposition theorem.
2. Verification of Thevenins & Norton theorem .
3. Verification of Maximum Power transfer theorem.
4. Verification of Reciprocity theorem.
5. Verification of Compensation theorem.

UNIT – IV

Resonance: Resonant circuits - series, parallel, series-parallel circuits – effect of variation of Q on resonance. Relations between circuit parameters- Q, resonant frequency & bandwidth, locus diagrams.

Practice:

1. Determination of resonance frequency, Bandwidth, and quality factror of Series & parallel RLC circuit.
2. Draw Locus diagrams of RL and RC series circuit.

UNIT – V

Magnetic Circuit : Basic definition of Magneto Motive Force, flux and reluctance. Analogy between electrical & magnetic circuits. Faraday's laws of electromagnetic induction, concept of self and mutual inductance. Dot convention, coefficient of coupling, composite magnetic circuit-Analysis of series and parallel magnetic circuits.

Practice:

1. Determination of choke coil parameters.
2. Determination of self, mutual inductance, and coefficient of coupling.

Capstone Project:

Design a series or parallel RLC resonant circuit that can be tuned to a specific frequency range. This could be for an AM/FM radio receiver's tuning stage, a band-pass/band-stop filter, or a sensor application where resonance is used to detect changes (e.g., metal detection, simple proximity sensor).

Text Books:

1	Circuit Theory (Analysis & Synthesis) by A. Chakrabarthi, Dhanpat Rai & Co (ISBN: 978817700009).
2	Electrical circuit analysis by A.Sudhakar & Shyammohan S Palli, Mc Graw Hill (ISBN: 9789339219604).

Reference Books:

1	Fundamentals of Electrical Circuits by Charles K.Alex&er & Mathew N.O.Sadiku, Mc Graw Hill Education (India) (ISBN: 978078028229).
2	Electric Circuits–(Schaum's outlines) by Mahmood Nahvi & Joseph Edminister, Adapted by K.UmaRao, 5th Edition – Mc Graw Hill (ISBN-13: 97812611968).

Web Links:

1	http://www.nptelvideos.in/2012/11/circuit-theory.html
2	https://www.youtube.com/user/nptelhrd/videos
3	https://en.wikipedia.org/wiki/Network_analysis_(electrical_circuits)

Numerical Methods and Integral Transforms
(Common to EEE, Min. E & PT)

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Solution of Algebraic and Transcendental Equations and Interpolation:
Solution of Algebraic and Transcendental Equations: Errors in Numerical Computation, Bisection method, Method of false position, Secant method and Newton - Raphson method.
Interpolation: Unequal Intervals- Lagrange's interpolation, Newton's divided difference formulae, Equal Intervals-Newton's Forward and Backward difference formlae, Central difference, Relation between operators.
Practice(Using any computational tool): Find solution of equations and Newton's forward interpolation.

UNIT – II
Numerical Differentiation, Integration and Solutions of Ordinary Differential Equations:
Numerical Differentiation: Numerical differentiation using Newton's Forward, Backward and Newton's divided difference formula.
Numerical Integration: Simpson's 1/3rd and 3/8th rule.
Numerical solution of ordinary differential equations: Taylor's series method, Euler's methodand Runge-Kutta method (second and fourth order).

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

UNIT – III

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

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

UNIT – IV

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

UNIT – V

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

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

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

Text Books:

1	Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 5th Edition (9th reprint), 2021· ISBN978-8184875607
2	Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44'th Edition (2021).ISBN 978-9383214204

Reference Books:

1	Advanced Engineering Mathematics with MATLAB, Dean G. Duffy, CRC Press.ISBN978-1498739641
2	Higher Engineering Mathematics, H. K. Dass, Er. R. Verma, S-Chand publishers, 3rd edition 2023.ISBN 9788121938907

Web Links:

1	https://swayam.gov.in/nd1_noc19_ma21/preview
2	https://onlinecourses.nptel.ac.in/noc20_ge20/preview
3	https://onlinecourses.nptel.ac.in/noc23_ma43/preview
4	https://onlinecourses.nptel.ac.in/noc22_ma62/preview

DC Machines & Transformers

	L	T	P	C
Course Code:2501EE04	**2**	**0**	**2**	**4**

Course Outcomes:

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

CO1 Explain the concepts of electromechanical energy conversion and operation of the DC machines.
CO2 Analyze starting methods and speed control of DC machines.
CO3 Analyze the performance of DC machines by conducting various tests on DC machines.
CO4 Analyze the performance of single-phase transformers.
CO5 Explain the connections of three phase transformers, Scott connection and tap changers.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Electromechanical Energy Conversion & Introduction to DC machines: Principles of Energy conversion, singly excited and multi excited systems, torque production in rotating machines and general analysis of electromechanical system.
DC Generator: Construction, principle of operation, EMF equation, Types, Armature reaction, Characteristics, Applications.

PRACTICE:

1. Draw open circuit characteristic curves of a given DC shunt generator & to find critical speed & critical field resistance.
2. Draw the internal & external characteristic curves of the given DC Shunt generator by conducting load test.

UNIT – II

DC Motors: Principle of operation, Types, Back EMF, Torque equation, Characteristics, Losses, Efficiency, Commutation, Applications, 3 point starter, 4 point starter, Speed control methods.

PRACTICE:

1. Speed control of a DC shunt motor by field control and armature control method.

UNIT – III

Testing of DC Machines & Single-phase Transformers: Testing of DC machines: Brake test, Swinburne’s test, Hopkinson’s test, retardation test, field test, separation of losses.
Single-phase Transformers: Types, constructional details, principle of operation, EMF equation, equivalent circuit, operation on no-load and on load, phasor diagrams of transformers.

Practice:

1. Draw the performance curves of the DC shunt motor by conducting brake test.
2. Determine the efficiencies of two identical shunt machines by conducting regenerative test (Hopkinson’s test).
3. Predetemine the efficiency of DC shunt machine.
4. Separation of the losses in DC shunt motor.

UNIT – IV
Performance & Testing of Transformers: Performance of Transformers: Regulation, losses and efficiency, effect of variation of frequency and supply voltage on losses, Allday efficiency.
Tests on single phase transformers – open circuit and short ciruit tests.

Practice:

1. Perform OC & SC tests on a single phase transformer and evaluate efficiency, Regulation. Draw the equivalent circuit.
2. Conduct sumpner’s test on a two identical single phase transformers and obtain copper losses, core losses and efficiency.

UNIT – V

Three Phase Transformers: Polyphase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ & open Δ, Parallel operation of 3 phase transformers, third harmonics in phase voltages – three winding transformers–off load & on load tap changers, Scott connection, Switching in transients, inrush current.

Additional Practice:

1. Draw the internal & external characteristic curves of the given DC cumulative and differential compound generators by conducting load test.
2. Load test on single phase transformer.
3. Draw the internal & external characteristic curves of the given DC Series Generator by conducting load test.
4. Scott connection on two 1- Ø transformers.

Cornerstone Project:

The cornerstone project in DC Machines & Transformers is intended to integrate theoretical knowledge with engineering design, analytical modelling, and system-level evaluation of electromechanical energy-conversion systems. Unlike laboratory experimentation, this capstone emphasizes problem definition, machine design parameter selection, performance prediction, computer-aided analysis, and simulation-based validation. Limited prototyping or measurements, where undertaken, are intended solely for validation and demonstration of predicted machine characteristics. The project enables students to address open-ended electrical machine problems involving DC generators/motors and transformer performance optimization, thereby developing higher-order electrical machine design and problem-solving skills.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project requires analytical formulation, parameter studies, equivalent circuit development, performance characteristic prediction, and simulation-based validation. Emphasis shall be placed on understanding machine behaviour under varying operating conditions and interpreting results using principles of electromechanical energy conversion and machine testing.

Project 1: Design and Performance Analysis of Small-Scale DC Shunt Generator for Renewable Energy Application

Objective: Design a small-scale DC shunt generator for standalone renewable energy application with specified voltage regulation and efficiency requirements.

Description: Complete design of a DC shunt generator including armature design, field winding calculation, performance prediction under varying load conditions, and efficiency optimization. Validate design through characteristic curves and test predictions.

Scope of Analysis:

- Electromechanical energy conversion principles
- DC generator EMF equation and construction
- Open circuit and load characteristics prediction
- Armature reaction and commutation analysis
- Efficiency calculation and loss separation
- MATLAB/Simulink model validation

Project 2: DC Motor Speed Control System Design for Industrial Application
Objective: Design complete DC motor drive system with speed control for precise industrial application meeting specified torque-speed requirements.
Description: Select appropriate DC motor type, design starting circuit (3-point/4-point starter), develop speed control strategies (armature/field control), and predict performance characteristics including efficiency map.
Scope of Analysis:

- DC motor torque equation and back EMF
- Speed control methods analysis
- Starting methods and current limiting
- Brake test performance prediction
- Efficiency and loss analysis
- Dynamic performance simulation

Project 3: Transformer Design Optimization for Distribution Application
Objective: Design single-phase distribution transformer meeting specified efficiency, regulation, and loss requirements under varying load conditions.
Description: Complete transformer design including core selection, winding design, equivalent circuit parameter estimation, performance prediction through OC/SC tests, and efficiency optimization.
Scope of Analysis:

- Transformer equivalent circuit development
- No-load and short-circuit test predictions
- Regulation and efficiency calculations
- Core and copper loss separation
- Sumpner's test performance prediction
- Effect of frequency/voltage variation analysis

Project 4: Three-Phase Transformer Bank Design with Scott Connection
Objective: Design three-phase transformer bank using Scott connection for two-phase load application with parallel operation capability.
Description: Design Y/Δ and Scott connected transformer banks, analyze phase voltages/currents, predict performance during parallel operation, and evaluate tap changer requirements for voltage regulation.
Scope of Analysis:

- Three-phase transformer connections
- Scott connection analysis and phasor diagrams
- Parallel operation conditions
- Tap changer design and off-load/on-load analysis
- Third harmonic suppression techniques
- Inrush current prediction during switching

Project 5: Performance Comparison and Optimization of DC Machine Tests
Objective: Comparative analysis of different DC machine testing methods for efficiency determination and loss separation.
Description: Develop mathematical models for brake test, Swinburne's test, Hopkinson's test, and retardation test. Compare accuracy, practical limitations, and optimization strategies for industrial applications.
Scope of Analysis:

- DC machine testing methodologies
- Brake test, Swinburne's test, Hopkinson's test analysis
- Loss separation and efficiency prediction
- Test accuracy and error analysis
- Predetermined efficiency curves
- MATLAB implementation of test predictions

Note:

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

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

Text Books:

1. Electrical Machinery by P.S. Bhimbra, R.C. Khanna & Vineet Khanna, 1st edition, 2021 (ISBN: 9788174091734).

2. DC Machines & Transformers by Dr. K.N. Srinivas, Khanna Publishers, 1st edition, 2022 (ISBN: 9789392549199).

Reference Books:

1. Electrical Machines by D. P. Kothari, I. J. Nagarth, McGraw Hill Publications, 5th edition (ISBN: 978070699670).

2. Electrical Machines by R. K. Rajput, Lakshmi publications, 5th edition (ISBN: 9788131807460).

Web Links:

1. http://nptel.ac.in/courses/108106071

2. https://lecturenotes.in/subject/41/electrical-machine-1

Electrical Network Analysis-II

	L	T	P	C
Course Code:2501EE05	**2**	**0**	**2**	**4**

Course Outcomes:

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

CO1	Analyze the three phase circuits with Star and Delta connected balanced and unbalanced loads
CO2	Analyze the transient behaviour of electrical networks for DC excitation.
CO3	Analyze the transient behaviour of electrical networks for AC excitation.
CO4	Determine the parameters of given two port networks
CO5	Develop electrical networks into different forms.

Mapping of Course Outcomes with Program Outcomes:

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

Three Phase circuits: Phase sequence – star and delta connection-relation between line, phase voltages and currents - analysis of balanced three phase circuits - measurement of active and reactive power. Analysis of three phase unbalanced circuits: Star-Delta transformation technique, Millman's Theorem, Two wattmeter method of 3 phase power measurement.

Practice:

1. Measurement of Reactive Power using one wattmeter method.
2. Measurement of Active Power for Star and Delta connected balanced loads.
3. Measurement of Active Power for Star and Delta connected unbalanced loads.

UNIT – II

Transient Analysis in DC circuits: Transient response of RL , RC and RLC circuits for DC excitation, Solutions using Differential equations and Laplace Transforms.

Practice:

1. Simulation of Transient Response of Series RLC Circuits with Step voltage input for under damp, critically damp and over damp cases.
2. Simulation of Transient Response of series RL and RC circuits with step voltage.

UNIT – III

Transient Analysis in AC circuits : Transient response of R – L , R – C & R – L – C circuits for AC excitation, Solutions using Differential equations & Laplace Transforms.

Practice:

1. Simulation of Transient response of Series RLC Circuit with Sinusoidal Input

UNIT – IV

Two Port Networks : Two Port network parameters - Z, Y, ABCD & Hybrid parameters & their relations, Cascaded networks. Poles & zeros of network functions.

Practice:

1. Calculation of Z parameters of a given two port network.
2. Calculation of Y parameters of a given two port network.
3. Calculation of ABCD of a given two port network.
4. Calculation of h-parameters of a given two port network.

UNIT – V

Network Synthesis : Positive real functions, Hurwitz polynomials, Realization of passive RL, RC & LC Networks using Foster & Cauer forms.

Additional Practice:

2. Simulation of Transient Response of series RL & RC circuits with Sinusoidal Input.
3. Verification of the Milliman's theorem.
4. Simulation of Transient Response of Series RLC Circuits Using Pulse Input

Capstone Project: Smart Home Energy Management System with Unbalanced Load Balancing

Design a conceptual system for a "smart home" that includes various single-phase and three-phase loads, potentially leading to an unbalanced load on the mains. The project would involve real-time monitoring (simulated) of load conditions and suggesting or dynamically adjusting phases/loads to maintain balance and optimize power consumption.

Text Books:

1 Fundamentals of Electric Circuits by Charles K.Alex&er, Matthew N.O.Sadiku, McGraw-Hill Publications (ISBN: 978078028229).
2 Engineering Circuit Analysis by Hayt, W.H, Kemmerly J.E. & Durbin, Mc Graw Hill Publications (ISBN: 978073529578).

Reference Books:

1 Electric Circuits Schaum's Outline Series, Joseph. A.Edminister, McGraw Hill Publications (ISBN: 978071393072).
2 Network Analysis & Synthesis, Ravish R Singh, McGraw-Hill publications (ISBN: 9789353166724).

Web Links:

1 https://en.wikipedia.org/wiki/Network_analysis_(electrical_circuits)
2 https://nptel.ac.in/courses/108/105/108105159/
3 https://nptel.ac.in/courses/108/104/108104139/

Complex Variables& Statistical Methods
(Common to EEE, PT, Min.E)

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

Course Outcomes:

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

CO1: Examine the continuity and analyticity of functions of complex variables and Evaluate different types of complex integrals
CO2: Expand a function of complex variable as Taylor and Laurent series and evaluate residues.
CO3: Apply various Probability distributions for both discrete and continuous random variables.
CO4: Compute mean and variance of sample means with replacement and without replacement and estimating maximum errors
CO5: Apply various tests to test the hypothesis concerning mean, Proportion, variance.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Functions of a complex variable and Complex integration:
Introduction – Continuity – Differentiability – Analyticity –Cauchy-Riemann equations in Cartesian and polar coordinates – Harmonic and conjugate harmonic functions – Milne – Thompson method.
Complex integration: Line integral –Cauchy's integral theorem–Cauchy's integral formula (without proofs)

UNIT – II

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

UNIT – III

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

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

UNIT – IV

SamplingTheory:
Introduction –Population and Samples–Sampling distribution of Means and Variance – Central limit theorem (without proof) –Point and Interval estimations –Maximum error of estimate.
Practice(Using any computational tool): Plotting of confidence intervals

UNIT – V

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

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

Text Books:

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

Reference Books:

1	Complex Variables and Applications, J.W.Brown and R.V.Churchill, 9th edition , Mc-Graw Hill, 2021 .ISBN 978935460364.
2	Fundamentals of Mathematical Statistics, S.C. Gupta and V.K.Kapoor, 12th edition, Sultan Chand & Sons Publications, 2020.ISBN 978-9351611738

Web Links:

1	https://archive.nptel.ac.in/courses/111/103/111103070/
2	https://onlinecourses.nptel.ac.in/noc20_ma50/preview
3	https://onlinecourses.nptel.ac.in/noc21_ma74/preview
4	http://mathworld.wolfram.com/topics/ProbabilityandStatistics.html
5	https://www.khanacademy.org/math/statistics-probability

Electric Power Generation & Distribution Systems

Course Code:2501EE06	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	Distinguish between AC/ DC distribution systems & also estimate voltage drops of distribution systems.
CO3	Classify the different components of air & gas insulated substations.
CO4	Analyze single core & multi core cables with different insulating materials.
CO5	Analyze the different economic factors of power generation & tariffs.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Power Stations: Principle of power generation, site selection, Components and layout of Thermal, Nuclear, Hydro power plant.

UNIT – II

Distribution Systems: Classification, radial distribution, ring main distribution, Design features, Voltage drop calculations: Radial DC distributor fed at one end & at both ends (equal / unequal voltages), Ring main distributor, stepped distributor & AC distribution, comparison of DC & AC distribution.

UNIT – III

Air & Gas Insulated Substations: Indoor & Outdoor substations, Substations layouts of 66/11 kV, Types of Bus bar arrangements in the Sub-Stations. Types, installation, maintenance, construction, advantages of GIS, Comparison of Air & Gas insulated substations.

UNIT – IV

Underground Cables: Types of Cables, Construction, Types of insulating materials, Calculation of insulation resistance, stress in insulation & power factor of cable. Capacitance of single & 3- Core belted Cables, Grading of Cables-Capacitance grading.

UNIT – V

Economic Aspects of Power Generation & Tariff Methods:
Types of load, Load curve, load duration & integrated load duration curves, Important terms & factors in Load Curve. Costs of Generation & their division into Fixed, Semi-fixed & Running Costs, Characteristics & 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.htm

3 https://www.slideshare.net/9anku/electrical-distribution-system

Induction & Synchronous Machines

	L	T	P	C
Course Code:2501EE07	**2**	**1**	**1**	**4**

Course Outcomes:

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

CO1	Analyze the performance of induction motors & induction generator.
CO2	Apply the methods of starting & speed control of Three phase Induction Motors
CO3	Analyze the performance of synchronous generator.
CO4	Analyze the Parallel operation of synchronous generators.
CO5	Explain hunting phenomenon, implement methods of starting & correction of power factor with synchronous motor.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Three Phase Induction Motors: Construction and types, concept of rotating magnetic field, principle of operation, rotor emf and rotor frequency, rotor current and pf at stand still and running conditions, rotor power input, rotor copper lossess, mechanical power developed and their interrelationship, equivalent circuit, phasor diagram. Torque equation – expressions for maximum torque and starting torque, torque slip characteristic, double cage and deep bar rotors, crawling & cogging.

UNIT – II

Starting & Testing of Induction Motors: Speed control of induction motor with V/f method, no load and blocked rotor tests, circle diagram for predetermination of performance, methods of starting, starting current and torque calculations, induction generator operation (Qualitative treatment only).
Single phase induction motors: Concept of starting, Double revolving field theory, Types, equivalent circuit, Shaded pole motors, AC Series motor.

Practice:

1. Performance characteristics of a three- phase Induction Motor by conducting Brake test.
2. Determination of equivalent circuit parameters, efficiency & regulation of a three phase Induction motor by conducting No–load & Blocked rotor tests.
3. Speed control of three phase induction motor by V/f method.
4. Determination of equivalent circuit parameters of single phase induction motor.
5. Determination of efficiency of a single-phase Induction Motor by conducting Brake test.

UNIT – III

Synchronous generator: Operation, Construction,Types of Armature windings, Distribution, Pitch and winding factors, E.M.F equation, armature reaction, Voltage regulation by synchronous impedance method, MMF method and Potier triangle method, Two reaction theory, Slip test.

Practice:

1. Determination of Regulation of a three–phase alternator by using synchronous impedance method.
2. Determination of Regulation of a three–phase alternator by using M.M.F. method.
3. Determination of Regulation of a three–phase alternator by using Potier triangle method.
4. Determination of efficiency of three-phase alternator by loading with three phase induction motor

UNIT – IV

Parallel Operation of Synchronous Generators: Parallel operation with infinite bus & other alternators, Power flow equations, Synchronizing power, Load sharing, Control of real and reactive power.

UNIT – V

Synchronous Motor: Principle of operation, Starting torque, Variation of current and power factor with excitation, Synchronous condenser, mechanical power developed, Hunting and its suppression, Methods of starting, applications.

Practice:

1. Determination of V and Inverted V curves of a three phase synchronous motor.

Additional Practice:

1. Synchronize the Alternator to infinite bus by using dark lamp method
2. Determine the Efficiency of 3 phase alternator by loading with 3 phase resistive load
3. Determination of X_d & X_q of a salient pole synchronous machine

Capstone Project:

Simulate the Model two (or more) synchronous generators operating in parallel to supply a common load, possibly connected to an infinite bus or operating as an isolated microgrid. Focus on the control strategies for sharing real and reactive power among the generators. Investigate the effects of excitation and prime mover control on load sharing and system stability.

Text Books:

1 Electrical Machinery by P.S. Bhimbra, R.C. Khanna & Vineet Khanna, 1st edition, 2021 (ISBN: 9788174091734).

2 Electrical Machines by R. K. Rajput, Lakshmi publications, 5th edition (ISBN: 9788131807460).

Reference Books:

1 Electrical Machines by D. P. Kothari, I. J. Nagarth, McGraw Hill Publications, 5th edition (ISBN: 978070699670).

2 Electrical Machinery by Abijith Chakrabarthi & Sudhipta Debnath, McGraw Hill, 1st edition (ISBN: 978125906456).

Web Links:

1 https//nptel.ac.in/courses/108/105/108105131

2 https://www.electrical4u.com/parallel-operation-of-alternator

3 https://www.electrical4u.com/speed-control-of-three-phase-induction-motor/.

Analog Electronic Circuits

	L	T	P	C
Course Code:2501EE08	**2**	**1**	**1**	**4**

Course Outcomes:

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

CO1	Interpret the characteristics of semiconductor diodes & transistor.
CO2	Explain the characterestics of uncotrolled rectifiers.
CO3	Analyze biasing and small signal low frequency equivalent models of BJT and FET .
CO4	Illustrate the Feedback Amplifiers ,Oscillators and multivibrator.
CO5	Analyze operational amplifier circuits for various linear and non-linear applications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Semiconductor devices and characteristics: Review of P-N junction operation, Open circuited PN junction, energy band structure of open circuited PN junction, drift and diffusion currents, law of junction, Breakdown mechanisms, V-I Characteristics, temperature dependence of V-I characteristics, Diffusion and Transition capacitances, Characteristics of Zener diode, regulated power supplies.

Practice:

1. Determination of VI Characteristics of a Diode.

2. Determination of V-I characteristics of Zener diode and Zener Diode-Voltage Regulator

UNIT – II

Uncontrolled Rectifiers: Types of rectifiers & their operation, input & output waveforms, parameters of rectifiers. Single phase half wave, full wave & bridge rectifiers with filters (L, C & π), comparison of various filter circuits in terms of ripple factor. clippers, clampers.

Practice:

1. Calculate the Ripple factor and percentage Regulation of Half-wave Rectifier
2. Calculate the Ripple factor and percentage Regulation of Full-wave bridge

UNIT – III

Transistors and FET: Construction and operation of BJT (3 configurations), FET & MOSFET, Hybrid-π model of transistor, Analysis of CE, CC & CB. Comparison of transistor amplifiers. Transistor biasing & thermal stabilization (self-bias).

Practice:

1. Determine h-parameters of CE Configuration from Input & Output Characteristics.
2. Determine h-parameters of CB Configuration from Input & Output Characteristics.
3. Studies on BJT CE Amplifier

UNIT – IV

Feedback Amplifiers & Oscillators: Classification, feedback concept, transfer gain & general characteristics of negative feedback amplifiers, effect of feedback on input & output resistances. Condition for oscillation, RC-phase shift oscillator.

Practice:

1. Determine the RC Frequency Response of Low pass filter and high pass filter

UNIT – V

Op-Amps: Block Diagram of an Op-Amp IC 741, AC & DC characteristics, Measurement of Op-Amp parameters.
Linear Applications of Op-Amps: Adder, subtractor, integrator, differentiator, & Logarithmic functions.
Non-Linear Applications of Op-Amps: Comparators, Multivibrators, Triangular &Square wave generators, Log & Antilog Amplifiers, Precision rectifiers.

Practice:

1. Study of basic properties of operational amplifier: inverting and non-inverting amplifiers
2. Design an Integrator & Differentiator Circuits using Op-Amp 741.

Additional Practice:

1. Study of voltage comparator.
2. Design astable multivibrator using 555 timer IC.
3. Analyse Function generator using operational amplifier (sine, triangular and square wave).
4. study log and antilog amplifier.

Capstone Project:

Design a circuit that automatically controls lighting based on ambient light intensity. This system would use an LDR as a sensor, a transistor (BJT) or an Op-Amp as a comparator to detect light levels, and a relay driver (using a BJT) to switch an LED or small lamp. The design should include a hysteresis mechanism to prevent rapid on/off switching near the threshold.

Text Books:

1 Electronic Devices & Circuits, R.L. Boylestad & Louis Nashelsky, Pearson Education, 11 th Edition, (ISBN: 9780133757422).

2 Electronic Devices & Circuits, Jacob Millman & Christos Halkias black edition , Tata McGraw Hill, 2018 (ISBN: 9789339219543).

Reference Books:

1 Electronic Devices & Circuits, David A. Bell, Oxford University Press, 5th Edition, (ISBN: 9780195693409).

2 Design with Operational Amplifiers analog Integrated Circuits, Sergio Franco, 4E, McGraw-Hill series (ISBN: 978070217997).

Web Links:

1 https://drmcet.digimat.in/nptel/courses/video/11711106/L23.html

2 https://drmcet.digimat.in/nptel/courses/video/108102095/L01.html

Digital Electronics & Logic Design

(Common to EEE & ECE)

	L	T	P	C
Course Code:2501EC01	**2**	**0**	**2**	**4**

Course Outcomes:

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

CO1: Interpret number representation in different code formats and the functionality of Logic Gates.
CO2: Perform logic minimization using suitable techniques.
CO3: Design various combinational logic circuits for required specifications.
CO4: Design different sequential logic circuits.
CO5: Implement logic functions using PLDs.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Number Systems: Representation of numbers of different radix, conversion from one radix to another radix, r-1's compliment and r's compliment of signed numbers, problem solving. Binary Codes: 4bit codes, 2421, 8421. Error detection & correction codes, (parity checking, even parity, odd parity), Review of logic gates.

Practice:

1. Functional verification of logic gates.
2. Develop basic logic gates using universal gates.

UNIT – II

Boolean Algebra & Minimization Techniques: Boolean theorems, principle of complementation & duality, De-Morgan theorems, minimization of logic functions using

Boolean theorems, minimization of switching functions using K-Map up to 5 variables, tabular minimization.

Practice:

1. Verification of De-Morgan's laws.
2. Design a logic circuit for a given Boolean expression.

UNIT – III

Combinational logic circuits: Review of adders, half subtractor, full subtractor, ripple carry adder, carry look-a-head adder circuit, 4-bit binary adder/subtractor circuit, BCD adder, Decoders, encoders, multiplexers, de-multiplexers, comparators and code converters, realization of Boolean functions using decoders & multiplexers.

Practice:

1. Design Full adder circuit and verify its truth table.
2. Design a combinational logic circuit for 8 to 1 MUX.
3. Verification of functional table of 3-to-8-line Decoder/De-multiplexer.
4. Design BCD to Seven Segment Display Decoder.

UNIT – IV

Sequential Circuits: Latches and flip flops, truth tables and excitation tables, flipflop with reset and clear, Conversion of flip-flops. Design of registers - shift register, bi-directional shift register, universal shift register, Design of ripple counters, design of synchronous counters, Johnson counter, ring counter.

Practice:

1. Verify the truth tables of Basic Flip-flops.
2. Design an 8-bit right shift register using D Flip-flop and verify the truth table.

UNIT – V

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

Additional Practice:

1. Design an Experimental model to demonstrate the operation of74154 De-Multiplexer. using LEDs for outputs
2. Design BCD Adder Circuit and Test the Same using Relevant IC.
3. Verify the operation of 4-bit Universal Shift Register for different Modes of operation.

Capstone project:

1. Binary Calculator (4-bit)
   Description:
   Design a simple calculator that can perform **binary addition, subtraction, AND, OR** using switches and LEDs. (Optional Extension: Use a 7-segment display to show results)

Text Books:

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

Reference Books:

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

Web Links:

1. http://nptel.ac.in/courses/117/106/117106086/
2. www.nptelvideos.in/2012/12/digital-circuits-and-systems.html
3. https://www.smartzworld.com/notes/switching-theory-and-logic-design-stld/

Microprocessor & Interfacing

	L	T	P	C
Course Code:2501EE09	2	0	2	4

Course Outcomes:

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

CO1 Interpret the generalized concepts of 8085 microprocessors.
CO2 Demonstrate programming proficiency using the various addressing modes & instructions of 8086 & distinguish the minimum & maximum mode of operations of 8086 .
CO3 Interpret the basic concepts of interfacing memory & peripheral devices to a microprocessor.
CO4 Develop the internal architecture of microprocessors systems, including counters, timers, ports, & memory.
CO5 Distinguish the circuits for various interfacing using microcontrollers.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction & evolution of Microprocessors : 8-Bit Microprocessor, 8085 architecture & memory interfacing (RAM & ROM), interfacing I/O devices, Instruction set, addressing modes, assembly language programming, interrupts, timing diagram.

Practice:

1. Write program using 8085 & verify for: a.addition of two 8-bit numbers, b.addition of two 16-bit number(with carry).

2. Write program using 8085 & verify for: a.subtraction of two 8-bit number(display of borrow) b. subtraction of two 16-bit numbers(display of borrow).
3. Write an 8085 assembly language program to add two decimal 8-bit numbers using DAA instruction. Store the result in Decimal number system.

UNIT – II

Microprocessor 8086 Architecture & Mode of Operations: Architecture, Memory Organization,Register Organization, Instruction sets, Addressing modes, Assembler directives, General bus operation of 8086, Minimum & Maximum mode operations, Control signal interfacing, Read & write cycle timing diagrams.

Practice:

1. 8 bit & 16 Bit Arithmetic operations using Assembly Language Programming
2. Multi byte addition & subtraction using Assembly Language Programming.
3. Code conversion – Binary to BCD using Assembly Language Programming
4. Sorting an array using Assembly Language Programming

UNIT – III

Peripherals & interfacing : 8255 PPI: Architecture, Modes of operation, Interfacing I/O devices to 8086, Interfacing A to D converters, Interfacing D to A converters, Stepper motor interfacing, Static memory interfacing with 8086.

Practice:

1. Parallel Communication between Two Microprocessors using 8255
2. Interface DAC to 8086 using Intel 8255.
3. Interface stepper motor to 8086.

UNIT – IV

Microprocessors I/O interfacing: Architecture & interfacing of 82501 USART, Architecture & interfacing of 8254 Timer/counter, Architecture & interfacing of DMA controller (8257), Architecture of Keyboard/display controller (8279), Modes of operation

UNIT – V

8051 Microcontroller & interfacing: Overview of 8051 Microcontroller, Architecture, Memory Organization, Register set, I/O ports & Interrupts, Timers & Counters, Serial Communication, LCD interfacing, Keyboard interfacing, ADC, DAC & sensor interfacing.

Practice:

1. Interfacing LCD to 8051.
2. Write an ALP to verify timer/counter operation in 8051.
3. Interface ADC 8051 to 8086
4. Write an ALP for Arithmetic, logical & bit manipulation operations in 8051

Cornerstone Project

The cornerstone project in Microprocessor & Interfacing is intended to integrate theoretical knowledge with embedded system design, hardware-software integration, and real-time system evaluation. Unlike simple programming exercises, this capstone emphasizes system architecture design, peripheral interfacing, firmware development, timing analysis, and performance optimization. Limited hardware prototyping, when undertaken, is intended solely for validation and demonstration of the designed system functionality. The project enables students to address open-ended embedded systems problems involving processor selection, memory mapping, I/O interfacing, and interrupt-driven operation, thereby developing higher-order embedded systems engineering and problem-solving skills.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project requires a complete system design, including schematic development, assembly/C programming, peripheral configuration, timing analysis, and functional verification. Emphasis shall be placed on understanding system behaviour under real-time constraints, interrupt handling efficiency, and interface reliability using principles of microprocessor architecture and interfacing techniques.

Project 1: 8086-Based Data Acquisition System with 8255 & ADC

Objective: Design and implement a complete data acquisition system using an 8086 microprocessor with 8255 PPI and ADC interfacing.

Description: Develop a system to acquire analog signals from multiple sensors, convert to digital, process through 8086, and display results on LCD/7-segment. Include parallel communication between the master 8086 and the slave processor.

Scope of Analysis:

- 8086 architecture, memory organization, assembly programming
- 8255 PPI modes and interfacing
- ADC interfacing and data conversion
- Parallel communication protocols
- Assembly programs for data processing and display
- System timing and interrupt handling

Project 2: Stepper Motor Control System with 8254 Timer & 8086

Objective: Design a precision stepper motor control system using 8086 with 8254 programmable timer for speed/position control.

Description: Implement a unipolar/bipolar stepper motor controller with variable speed, direction control, acceleration profiles, and position feedback. Use 8254 for precise timing of step pulses.

Scope of Analysis:

- 8086 instruction set and addressing modes
- 8254 timer/counter architecture and modes
- Stepper motor interfacing circuits

- Assembly programming for motor control algorithms
- Timer interrupt programming for precise pulse generation
- Speed control using PWM techniques

Project 3: 8051-Based Industrial Process Controller with LCD & Keyboard
Objective: Develop a complete industrial process controller using an 8051 microcontroller with LCD and keyboard interface.
Description: Create a multi-function controller for temperature/process monitoring with setpoint entry via keyboard, LCD of parameters, timer-based control, and data logging capability.
Scope of Analysis:

- 8051 architecture, timers, interrupts
- LCD interfacing and character display routines
- Keyboard matrix scanning and debouncing
- Timer/counter applications for process timing
- Serial communication for data logging
- Real-time control algorithms in embedded C/assembly

Project 4: DMA-Based High-Speed Data Transfer System with 8257
Objective: Implement a high-speed data transfer system between memory and peripherals using the 8257 DMA controller interfaced to the 8086.
Description: Design system for high-speed data acquisition/storage using DMA transfer between ADC, memory, and UART. Compare programmed I/O vs DMA performance.
Scope of Analysis:

- 8086 minimum/maximum mode operations
- 8257 DMA controller architecture and programming
- Memory interfacing and static RAM organization
- High-speed peripheral interfacing
- Performance analysis of different transfer modes
- Interrupt-driven DMA operation

Project 5: USART Communication System with 8251 & Keyboard/Display Controller
Objective: Design a bidirectional serial communication system using 8251 USART with 8279 keyboard/display controller.
Description: Develop a system for serial data exchange between two 8086 processors with keyboard entry and hexadecimal/ASCII display using an 8279 controller. Include error detection and protocol implementation.
Scope of Analysis:

- 8251 USART architecture and modes
- 8279 keyboard/display controller interfacing
- Serial communication protocols and handshaking
- 8086 assembly programming for serial I/O
- Keyboard scanning and display multiplexing

- Error detection (parity/checksum) implementation

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

Text Books:

1 Advanced Microprocessor & Peripherals,3rd Edition, By K M. Bhurchandi, A. K. Ray, Tata McGraw Hill Education Private Limited (ISBN: 9781259029776).
2 Microprocessor Architecture, Programming, & Applications with the 8085 By Ramesh S. Gaonkar, Prentice Hall (ISBN: 9780130195708).

Reference Books:

1 Microprocessors & Interfacing - Sie, 3rd Edn, by Douglas V Hall SSSP Rao Douglas V Hall, Mc Graw Hill Education (ISBN: 9780070601673).
2 Microcontrollers – Theory & Applications, Ajay V. Deshmukh, Tata McGraw–Hill Education (ISBN: 9780070585959).

Web Links:

1 https://archive.nptel.ac.in/courses/108/103/108103157/
2 https://archive.nptel.ac.in/courses/108/105/108105102/
3 https://nptel.ac.in/courses/108103157

Power Electronics

	L	T	P	C
Course Code:2501EE10	**2**		**2**	**4**

Course Outcomes:

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

CO1 Explain the different types of power semiconductor devices & their Characteristics.
CO2 Evaluate the performance of rectifiers.
CO3 Illustrate the operation of AC voltage controllers & cyclo-converters.
CO4 Design DC-DC converter with given characteristics.
CO5 Explain the operation of Inverters & application of PWM techniques.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Introduction to Power Electronics devices:
Concept of power electronics, applications, types of power converters, operation & characteristics of Power IGBT, SCR, TRIAC, static & dynamic characteristics of SCR, protection of SCR, turn on methods of SCR & commutation of SCR, Thyristor Firing Circuits.

Practice:
1. Study of Characteristics of Thyristor, MOSFET & IGBT.
2. Design & development of a firing circuit for Thyristor.
3. Design & development of gate drive circuits for IGBT.

UNIT – II

Phase Controlled Converters: Principles of single-phase fully-controlled converter with R, RL, & RLE load, effect of freewheeling diode, Principles of single-phase half-controlled converter with RL & RLE load, Principles of three-phase fully controlled converter operation with RLE load, Effect of source inductance.

Practice:

1. Single -Phase half-controlled converter with R & RL load.
2. Single -Phase fully controlled bridge converter with R & RL loads.
3. Three- Phase fully controlled converter with RL–load.

UNIT – III

AC-AC converters: AC Voltage Controllers: Introduction, principle of operation with R, R-L loads & its applications.

Cycloconverters: Principle of operation of single-phase to single-phase, three-phase to single phase, three-phase to three-phase configurations.

Practice:

1. Single -Phase AC Voltage Regulator with R & RL Loads.

UNIT – IV

DC-DC Converters: Chopper classification, study of Buck, Boost & Buck-Boost regulators, Basic operation of forward & fly back converters.

Practice:

1. Design & verification of voltages gain of Boost converter in Continuous Conduction Mode (CCM).
2. Design & verification of voltages ripple in buck converter in CCM operation.

UNIT – V

Inverters: Principle of operation of single phase bridge inverters with R, RL & RLC loads, Voltage control of single-phase inverters: single pulse width modulation, multiple pulse width modulation, sinusoidal pulse width modulation, 3-phase bridge inverters: 180- & 120-degrees mode of operation.

Practice:

1. Single -phase PWM inverter with sine triangle PWM technique.

Additional Practice:

1. Simulation of Buck, Boost & Buck-Boost converter.
2. Simulation of SPWM controlled Three-phase voltage source inverter.
3. Simulation of 3 phases half & full wave converter with R, RL, RLE & RE loads. plot the waveforms for Voltage across & current through the switch.

Cornerstone Project Section for Power Electronics

Cornerstone Project

The cornerstone project in Power Electronics is intended to integrate theoretical knowledge with converter design, power semiconductor selection, control strategy development, and system-level performance evaluation. Unlike laboratory experimentation, this capstone emphasizes problem definition, topology selection, device characterization, modulation strategy design, simulation-based validation, and efficiency analysis. Limited hardware prototyping, when undertaken, is intended solely for validation and demonstration of predicted converter performance. The project enables students to address open-ended power conversion problems involving rectifiers, choppers, AC controllers, and inverters, thereby developing higher-order power electronics design and problem-solving skills.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project requires power circuit analysis, device selection, gate drive design, control algorithm development, MATLAB/Simulink or PSIM simulation, harmonic analysis, and performance optimization. Emphasis shall be placed on understanding converter operation under varying load conditions, efficiency maximization, and power quality improvement using principles of power semiconductor devices and converter topologies.

Project 1: Design of Three-Phase Fully-Controlled Rectifier for DC Motor Drive

Objective: Design a three-phase fully-controlled rectifier system for variable speed DC motor drive application with specified output voltage regulation and power factor requirements.

Description: Complete design of three-phase bridge rectifier with RLE load (DC motor), including thyristor firing angle control, source inductance effect analysis, freewheeling diode implementation, and power factor improvement strategy.

Scope of Analysis:

- SCR characteristics and firing circuits
- Three-phase fully-controlled converter operation
- Effect of source inductance and overlap angle
- Harmonic analysis and input current distortion
- Output voltage regulation and ripple analysis
- MATLAB/Simulink simulation with motor load

Project 2: Single-Phase AC Voltage Controller for Induction Heating Application

Objective: Design phase-controlled AC voltage regulator for precise power control in induction heating application.

Description: Develop single-phase AC voltage controller using TRIACs for R-L load with symmetrical firing, including zero-crossing detection, firing angle optimization, and power factor compensation analysis.

Scope of Analysis:

- AC voltage controller principles with R-L loads
- TRIAC characteristics and triggering methods
- Symmetrical and asymmetrical firing strategies
- Power factor and harmonic analysis
- Load power vs firing angle characteristics
- Simulation of heating coil application

Project 3: DC-DC Buck-Boost Converter Design for Battery Charging System

Objective: Design high-efficiency buck-boost converter for renewable energy battery charging application with wide input voltage range.

Description: Complete design of buck-boost converter including MOSFET/IGBT selection, inductor/capacitor sizing, continuous/discontinuous conduction mode analysis, and closed-loop voltage regulation.

Scope of Analysis:

- Buck-boost converter operation and voltage gain
- Power semiconductor device selection
- Inductor current ripple and capacitor voltage ripple analysis
- CCM/DCM boundary determination
- Closed-loop control design
- Efficiency optimization and loss calculation

Project 4: Three-Phase PWM Inverter for Variable Frequency Drive

Objective: Design three-phase voltage source inverter with SPWM for induction motor variable speed drive application.

Description: Develop 120°/180° conduction mode three-phase inverter with sinusoidal PWM modulation, including DC link design, harmonic elimination techniques, and overmodulation analysis.

Scope of Analysis:

- Three-phase bridge inverter operation
- SPWM, multiple PWM, and sinusoidal modulation techniques

- Harmonic analysis and THD minimization
- DC link capacitor sizing and voltage ripple
- Modulation index effects on output voltage
- MATLAB/Simulink simulation with R-L load

Project 5: Single-Phase Grid-Tied Solar Inverter System Design

Objective: Design complete single-phase grid-tied inverter for solar PV application with maximum power point tracking integration.

Description: Design high-frequency isolated inverter (forward/flyback topology) with MPPT algorithm, grid synchronization, anti-islanding protection, and power quality compliance analysis.

Scope of Analysis:

- Isolated DC-DC converter topologies
- Single-phase bridge inverter with PWM control
- Maximum power point tracking algorithms
- Grid synchronization and phase-locked loop
- Anti-islanding detection techniques
- Harmonic standards compliance (IEEE 519)
- Complete system simulation in MATLAB/Simulink.

Note:

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

Text Books:

1 Power Electronics – by P. S. Bhimbra, Khanna Publishers.

2 Power Electronics: Circuits, Devices & Applications – by M.H Rashid, Prentice Hall of India, 3rd edition.

Reference Books:

1 Power Electronics: Essentials & Applications by L. Umanand, Wiley, Pvt. Limited, India.

2 Power Electronics, M. D. Singh & K. B. Kanchandhani, Tata

McGraw – Hill Publishing Company, 2nd Edition.

Web Links:

1. https://nptel.ac.in/courses/108/101/10811038/
2. https://nptel.ac.in/courses/108/102/108102145/
3. https://nptel.ac.in/courses/108/102/108102145/

Control Engineering

	L	T	P	C
Course Code:2501EE11	2	0	2	4

Course Outcomes:

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

CO1 Determine the overall transfer function using block diagram algebra & signal flow graphs & Mechanical systems
CO2 Determine time response specifications of second order systems & analyze the effect of PID controllers & Apply the Routh's stability criterion & the root locus method for stability of LTI systems
CO3 Analyze the stability of LTI systems using frequency response methods.
CO4 Design & compensation of LTI systems using Bode diagrams
CO5 Analyze the state space representations of LTI systems.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Mathematical Modelling of Control Systems : Introduction of open loop & closed loop control systems, Transfer function -Feedback characteristics, differential equations translational & rotational mechanical systems, transfer function of DC servo motor & AC servo motor, block diagram algebra, signal flow graph, reduction using Mason's gain formula.

Practice:

1. Study the characteristics of Synchros - Transmitter & receiver.
2. Draw the speed - torque characteristics of AC servo motor.
3. Draw the speed - torque characteristics of DC servo motor.

4. Study the effect of feedback on DC servo motor.
5. Determine the transfer function of DC motor.
6. Draw the load Characteristics of magnetic amplifiers.

UNIT – II

Time Response & S-Domain Analysis: Time Response Analysis

Standard test signals, time response of first & second order systems, time domain specifications, steady state errors & error constants, effect of PID controllers on systems.

Stability in S-domain:

The concept of stability, Routh's stability criterion, root locus concept, construction of root loci.

Practice:

1. Study the effect of P, PD, PI, PID Controller on a second order systems.
2. Study temperature controller using PID.

UNIT – III

Frequency Response Analysis : Introduction to frequency domain specifications, Bode diagrams, transfer function from the Bode diagram, Polar plots, Nyquist stability criterion, stability analysis.

UNIT – IV

Classical Control Design Techniques: Lag, lead, lag-lead compensators, physical realisation, design of compensators using Bode plots.

Practice:

1. Draw the magnitude & phase plots of lag & lead compensators.
2. Study & verify the truth table of logic gates using PLC.

UNIT – V

State Space Analysis of Linear Time Invariant (LTI) Systems: Concepts of state, state variables & state model, state space representation of transfer function, solving the time invariant state equation, State Transition Matrix & its properties, concepts of controllability & observability.

Additional Practice

1. Simulate Bode plot for the transfer functions of systems up to 3rd order using MATLAB.
2. Simulate Nyquist plots for the transfer functions of systems up to 3rd order using MATLAB.
3. Simulate Root locus for the transfer functions of systems up to 3rd order using MATLAB.
4. Simulate Controllability test using MATLAB.
5. Determine time response of Second order system.

Cornerstone Project

The cornerstone project in Control Systems is intended to integrate theoretical knowledge with engineering design, analytical modelling, and system-level evaluation of dynamic control systems. Unlike laboratory experimentation, this capstone emphasizes problem definition, system identification, controller design, simulation-based validation, and performance analysis. Limited hardware implementation, when undertaken, is intended solely for validation and demonstration of predicted closed-loop behaviour. The project enables students to address open-ended control problems involving modelling, stability analysis, frequency response, and controller optimization, thereby developing higher-order systems engineering and problem-solving skills.

Scope of Cornerstone Projects

Students shall select one of the following cornerstone project topics. Each project requires mathematical formulation, controller synthesis, MATLAB/Simulink simulation, stability analysis, and performance evaluation. Emphasis shall be placed on understanding system response under varying operating conditions, disturbance rejection, and robustness analysis using principles of classical and modern control theory.

Project 1: PID Controller Design for DC Servo Motor Position Control
Objective: Design, simulate, and validate a PID controller for precise position control of a DC servo motor system.
Description: Develop a complete position control system for a DC servo motor using PID control. Include system identification, controller tuning using the Ziegler-Nichols method, performance analysis for step and ramp inputs, and disturbance rejection capability.
Scope of Analysis:

- Mathematical modelling of DC servo motor
- Time domain analysis and PID tuning
- Root locus analysis for controller gains
- Frequency domain verification using Bode plots
- Performance comparison with P, PI, PD controllers
- Implementation and validation using MATLAB/Simulink

Project 2: Lead-Lag Compensator Design for Speed Control System
Objective: Design and analyze a lead-lag compensator to improve steady-state and transient performance of a speed control system.
Description: Select an underdamped speed control system and design lead-lag compensation to meet specified phase margin, gain margin, and steady-state error requirements. Validate through time and frequency domain analysis.
Scope of Analysis:

- System modeling and transfer function development
- Root locus analysis of uncompensated system

- Lead compensator design for phase margin improvement
- Lag compensator design for steady-state error reduction
- Bode plot analysis and stability margins
- Complete time response simulation

Project 3: State-Space Analysis and Controller Design for Inverted Pendulum
Objective: Develop state-space model and design state feedback controller for inverted pendulum stabilization.
Description: Model the inverted pendulum using state-space representation. Analyze controllability and observability. Design pole-placement controller and simulate closed-loop response.
Scope of Analysis:
- State-space formulation from physical parameters
- Controllability and observability analysis
- State feedback controller design using pole placement
- Comparison with classical control approaches
- Simulation of state trajectories and control effort
- Stability analysis using eigenvalues

Project 4: Frequency Domain Analysis and Robust Controller Design
Objective: Perform comprehensive frequency domain analysis and design robust controller for a third-order system.
Description: Select a third-order system and perform complete frequency domain characterization. Design controller to achieve specified bandwidth, phase margin, and robustness margins.
Scope of Analysis:
- Complete Bode, Nyquist, and Nichols plot analysis
- Gain and phase margin determination
- Robust controller design using loop shaping
- Sensitivity function analysis
- Time domain validation of frequency specifications
- MATLAB-based frequency response simulation

Project 5: Multi-Loop Cascade Control for Temperature Process
Objective: Design cascade control system for temperature control process with disturbance rejection.
Description: Develop inner-outer loop cascade control for a temperature control system with flow disturbance. Analyze loop interaction and optimize controller settings.
Scope of Analysis:
- Transfer function modeling of process and actuators
- Cascade control structure analysis
- PID tuning for inner and outer loops
- Interaction analysis using relative gain array
- Disturbance rejection performance evaluation

- Routh-Hurwitz stability verification

Note:

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

Text Books:

1	Modern Control Engineering by Kotsuhiko Ogata, Prentice Hall of india (ISBN: 9788120340107).
2	Automatic control systems by Benjamin C.Kuo, Prentice Hall of India, 2nd Edition (ISBN-13: 9781259643835).

Reference Books:

1	Control Systems Engineering by I.J.Nagarath & M.Gopal, Newage International Publications, 5th Edition (ISBN: 9788195175581).
2	Control Systems Engineering by Norman S. Nise, Wiley Publications, 7th edition (ISBN: 9781119590132).

Web Links:

1	Control Systems principles & design by M.Gopal, Tata Mc Graw Hill education Pvt Ltd., 4thEdition
2	http://engineering.electrical-equipment.org/panel-building/time-domain-analysis-of-controlsystems.htm

Electric Power Transmission Systems

	L	T	P	C
Course Code:2501EE12	**2**	**1**	**0**	**3**

Course Outcomes:

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

CO1 Determine parameters of transmission lines for different circuit configurations.
CO2 Analyze the performance of short, medium & long transmission lines.
CO3 Analyze the effect of travelling waves on transmission lines
CO4 Identify various factors related to sag & corona.
CO5 Demonstrate the different types of Insulators & transmission line 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	1	3	2	-	-	-	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-
CO3	2	3	3	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-
CO5	2	3	3	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT –

Calculation of inductance & capacitance: Concept of GMR & GMD, single phase and three phase lines with symmetrical & unsymmetrical spacing, with & without transposition, bundled conductors, & effect of earth on capacitance.

UNIT – II

Performance of Lines: Classification of Transmission Lines, model representations, End condenser method, Nominal-T, Nominal-Pie, Rigorous solution and A, B, C, D Constants, regulation and efficiency, Surge Impedance & SIL of Long Lines, Wave Length and Velocity of Propagation of Waves .

UNIT – III

Transients of lines: Types of System Transients Travelling wave or Propagation of Surges, Attenuation, Distortion, Reflection and Refraction Coefficients Termination of lines with different types of conditions, Open Circuited Line, Short Circuited Line, T Junction, Lumped Reactive Junctions.

UNIT – IV

Corona & 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 – V

Insulators & Transmission line effects: Types of Insulators, String efficiency and Methods for improvement, Voltage distribution, Calculation of string efficiency, Capacitance grading and Static Shielding, Skin and Proximity effects, Description and effect on Resistance of Solid Conductors, Ferranti effect, Charging Current.

Text Books:

1 Electrical power systems – by C. L. Wadhwa, New Age International (P) Limited, Publishers. Eighth edition 2022 (ISBN: 9789393159175).
2 Modern Power System Analysis by I. J. Nagarath & D. P. Kothari, Tata McGraw Hill, 5th Edition.2022 (ISBN-13: 978125903172).

Reference Books:

1 A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar A. Chakrabarthy, Dhanpat Rai & Co Pvt. Ltd (ISBN:978817700207).
2 Power system Analysis–by John J Grainger William D Stevenson, TMC Companies (ISBN: 978070612945).

Web Links:

1 https://www.electrical4u.com/performance-of-transmission-line/
2 https://gradeup.co/models-&-performance-of-transmission-lines-&-cables-iebfce936-c584-11e5 baa5-76adddde8c47

Artificial Intelligence and Machine learning for Electrical Systems

Course Code: 2501EE58	L	T	P	C
	2	0	2	4

Course Outcomes:

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

CO1	Relate basic concepts of artificial intelligence and machine learning to electrical engineering applications.
CO2	Explain the working principles of supervised, unsupervised, and reinforcement learning techniques.
CO3	Apply regression models to forecast electrical load demand and renewable energy generation.
CO4	Analyze power system faults and power quality events using classification algorithms.
CO5	Analyze the performance of artificial neural networks in electric drives and smart grid management.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I: Introduction to AI in Electrical Engineering

Overview of Artificial Intelligence and Machine Learning; History and Evolution; Types of Learning: Supervised, Unsupervised, and Reinforcement Learning.

Electrical Data Characteristics: Time-series data from smart meters, PMU data, and SCADA logs, Data Pres-processing: Handling missing values in power system datasets, normalization, and feature scaling using Python/MATLAB.

Practice:

1. Import smart meter/PMU time-series datasets into Python/MATLAB; detect and handle missing data using mean/linear interpolation methods.
2. Apply Min-Max scaling and Standard Normalization to high-voltage SCADA logs and evaluate the impact on dataset distributions.
3. Perform exploratory data analysis (EDA) and feature correlation matrix visualization on transformer operational health datasets.
4. Implement data framing and sliding-window feature scaling techniques on raw smart meter load profiles

UNIT – II: Regression and Load Forecasting

Linear and Polynomial Regression: Predicting transformer temperature and solar irradiance. **Multiple Linear Regression:** Forecasting short-term and long-term electrical loads based on weather and historical consumption. Evaluation Metrics: Mean Absolute Error (MAE), Root Mean Square Error (RMSE) in the context of utility billing accuracy.

Practice:

1. Build a Simple Linear and Polynomial Regression model to predict transformer winding temperature based on load current and ambient temperature.
2. Develop a Multiple Linear Regression model for short-term daily load forecasting using historical weather and hourly power demand data.
3. Predict hourly solar PV output power using irradiance and solar panel temperature data.
4. Evaluate regression model accuracy across different power scheduling scenarios using MAE, RMSE, and R^2 score metrics.

UNIT – III: Classification for Fault Diagnosis

Logistic Regression and k-Nearest Neighbors (k-NN): Binary classification of "Normal vs. Faulty" operations.

Support Vector Machines (SVM): Multi-class classification for identifying types of transmission line faults (L-G, L-L, L-L-G).

Decision Trees: Rule-based diagnosis of insulation health in high-voltage equipment.

Practice:

1. Implement k-NN and Logistic Regression models to classify normal vs. abnormal operating conditions in a 3-phase induction motor.
2. Train a Multi-Class Support Vector Machine (SVM) to identify transmission line fault types (L-G, L-L, L-L-G, L-L-L) using 3-phase current/voltage signals.
3. Build a Decision Tree model to diagnose the insulation health status of oil-filled power transformers based on Dissolved Gas Analysis (DGA) data.

4. Plot Confusion Matrices and ROC-AUC curves to compare the diagnostic accuracy of k-NN, SVM, and Decision Tree classifiers on power quality events.

UNIT – IV: Unsupervised Learning and Grid Clustering

K-Means Clustering: Consumer profiling based on daily load curves and Demand Response (DR) group identification. **Principal Component Analysis (PCA):** Dimensional reduction of large-scale power system stability data. **Anomaly Detection:** Identifying non-technical losses (electricity theft) and meter malfunctions in distribution systems.

Practice:

1. Apply K-Means clustering to segment distribution grid smart meter users into distinct daily load-profile groups for Demand Response programs.
2. Determine the optimal number of consumer clusters using the Elbow Method and Silhouette Score on power consumption datasets.
3. Perform Principal Component Analysis (PCA) to reduce high-dimensional PMU wide-area monitoring data for real-time dynamic stability assessment.
4. Implement an Anomaly Detection model (e.g., Isolation Forest) to identify electricity theft and suspicious billing irregularities in distribution smart meters.

UNIT – V: Neural Networks for Electrical Control

Artificial Neural Networks (ANN): Multi-layer Perceptron (MLP) architecture.

Back propagation: Training models for Maximum Power Point Tracking (MPPT) in PV systems.

Introduction to Deep Learning: Basics of CNNs for thermal image analysis of substations and RNNs for frequency stability prediction.

Practice:

1. Design and train a Multilayer Perceptron (MLP) network to predict the Maximum Power Point (MPP) voltage and current for a Solar PV system under varying irradiance.
2. Develop an ANN model to predict frequency transients in a power grid following a generator tripping event.
3. Construct a 2D Convolutional Neural Network (CNN) to classify hotspot thermal images of electrical substation equipment (connectors, insulators, transformers).
4. Build a basic Recurrent Neural Network (RNN/LSTM) to model time-series power output from a grid-connected wind farm.

Text Books:

1. *Artificial Intelligence: A Modern Approach*, Stuart Russell and Peter Norvig, Pearson, 4th Edition.
2. *Application of AI in Electrical Engineering*, Kanakasabapathy P., Alpha Science International.
3. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*, Aurélien Géron, O'Reilly Media.

Reference Books:

1. *Machine Learning for Power Systems Analysis*, Stephan Robert, Springer Nature.
2. *Soft Computing Techniques in Power Systems*, S.N. Sivanandam and S.N. Deepa.
3. *Smart Grid: Technology and Applications*, Janaka B. Ekanayake, Wiley.

Web Links:

1. https://www.youtube.com/watch?v=TuLkEtE5CHI
2. https://www.youtube.com/watch?v=JWTue4joooA
3. Coursera: Machine Learning Specialization
4. MATLAB for Machine Learning

Power System Anlaysis

Course Code:2501EE14	L	T	P	C
	2	1	1	4

Course Outcomes:

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

CO1	Explain the impedance diagram for a power system network and per unit quantities.
CO2	Apply the different load flow methods to solve the power system problems.
CO3	Explain the Formation of Z-bus.
CO4	Evaluate the fault currents for all types faults to provide data for the design of Protective devices.
CO5	Analyze the steady state, transient and dynamic stability concepts of a power system.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Per Unit Representation : Modeling of power system components, single line diagram, Impedance and Reactance diagrams, Per unit quantities, Bus impedance and Admittance matrix.

Practice:

1. Determination of Y bus using direct inspection method.

UNIT – II

Power Flow Studies: Necessity of power flow studies, Gauss-Seidel, Newton-Raphson and Fast decoupled methods.

Practice:

1. Load flow solution of a power system network using Gauss-Seidel method.
2. Load flow solution of a power system network using Newton Raphson method.

UNIT – III

Z-Bus Algorithm: Formation of Z-bus: Algorithm for the Modification of Z-bus Matrix (without mutual impedance).

Practice:

1. Calibration of Tong Tester.
2. Formation of Z-bus by building algorithm.

UNIT – IV

Fault analysis: Symmetrical fault analysis, Symmetrical components of unbalanced three phase systems, Sequence impedances and Sequence networks, Unsymmetrical Fault analysis.

Practice:

1. Estimation of Sequence impedances of 3phaseTransformer.
2. Estimation of sequence impedances of 3-phase Alternator by Fault Analysis.
3. Estimation of sequence impedances of 3-phase Alternator by Direct method.
4. Estimation of ABCD parameters on transmission line model.

UNIT – V

Power System Stability Analysis: Concepts of Steady state and transient stability, Swing equation, Equal area criterion, Introduction to Multi-Machine stability analysis.

Practice:

1. Power Angle Characteristics of 3-phase Alternator with infinite bus bars.

Additional practice:

1. Transient Stability analysis of single machine connected to an infinite bus (SMIB) using equal area criterion.
2. Estimation of fault currents for LG fault.
3. Estimation of fault currents for LL fault.
4. Develop a program for the solution of swing equation.

Capstone Project:

Develop a small program (e.g., in Python or MATLAB script) that takes power system component parameters (voltage, MVA, impedance in Ohms/percentage) and base values as input, then converts them to per unit values. Extend it to automatically calculate and display the per unit impedance diagram for a very simple power system (e.g., a generator, transformer, and load).

Text Books:

1 Electrical Power Systems - by C.L. Wadhwa: New Age International Pub. Co (ISBN: 9789393159175).
2 Modern Power system Analysis – by I. J. Nagrath & D. P. Kothari: Tata McGraw–Hill Publishing Company, 5th edition-2022 (ISBN: 978935460968)

Reference Books:

1 Elements of Power system Analysis -by W.D. Stevenson: McGraw Hill International Student (ISBN: 978070612822).
2 Power System Analysis -by Hadi Saadat: Tata Mc Graw Hill Pub.Co (ISBN: 9780984543861).

Web Links:

1 https://onlinecourses.nptel.ac.in/noc18_ee16/
2 http://nptel.ac.in/courses/108105067/3
3 https://nptel.ac.in/courses/108104051/

Switch Gear & Protection

	L	T	P	C
Course Code: 2501EE15	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1 Apply the Knowledge of arc interruption for application to high voltage circuit breakers of oil, Vacuum & SF6 gas type.
CO2 Explain the working principle & operation of different types of electromagnetic protective relays.
CO3 Analyze the various protective schemes for power generators & transformers.
CO4 Apply various types of protective schemes used for feeders & bus bar protection.
CO5 Explain over voltage protection schemes & methods of neutral grounding.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	2	1	-	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Circuit Breakers: Elementary principles of arc interruption– Restriking Voltage & Recovery voltages– Restriking phenomenon - RRRV– Average & Max. RRRV– Current chopping & Resistance switching – Concept of oil circuit breakers – Vacuum & SF6 circuit breakers– Concept of Auto reclosing – Applications.

UNIT – II

Electromagnetic Protection: Balanced beam type attracted armature relay - induction disc & induction cup relays–Torque equation - Relays classification: –Instantaneous– DMT & IDMT types– Applications of relays: Over current & under voltage relays– Directional relays– Differential relays & percentage differential relays–Universal torque equation– Distance relays: Impedance– Reactance– Mho & offset mho relays.

UNIT – III

Generator Protection: Protection of generators against stator faults– Rotor faults & abnormal conditions– restricted earth fault & inter turn fault protection.
Transformer Protection:
Percentage differential protection– Design of CT's ratio– Buchholz relay protection.

UNIT – IV

Feeder & Bus bar Protection: Over current Protection schemes – PSM – TMS – Carrier current & three zone distance relay using impedance relays - Protection of bus bars by using Differential protection.

UNIT – V

Protection against over voltage & grounding: Generation of over voltages in power systems– Protection against lightning over voltages – Valve type & zinc oxide lighting arresters.
Grounded & ungrounded neutral systems – Effects of ungrounded neutral on system performance – Methods of neutral grounding: Solid–resistance–Reactance–Arcing grounds & grounding Practices

Text Books:

1 Power System Protection & Switchgear by Badri Ram & D.N. Viswakarma - Tata McGraw Hill Publications – 3rd edition - 2023.
2 Power system protection- Static Relays with microprocessor applications by T. S. Madhava Rao - Tata McGraw Hill - 2nd edition.

Reference Books:

1 Fundamentals of Power System Protection by Y. G. Paithankar & S. R. Bhide – PHI.
2 Art & Science of Protective Relaying – by C R Mason - Wiley Eastern Ltd

Web Links:

1 https://nptel.ac.in/downloads/10811039/
2 http://electrical-engineering-portal.com/

Energy Converters

	L	T	P	C
Course Code: 2501EE39	**2**	**1**	**0**	**3**

Course Outcomes:

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

CO1: Classify the different types of converters.
CO2: Explain the resonant converters.
CO3: Illustrate the steady state analysis of power factor corrected converter.
CO4: Identify the various modulation techniques for single phase inverter.
CO5: Explain the operation of various Multilevel Inverters and it's comparison.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Switching Voltage Regulators:
Isolated converters dc-dc converters: Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuk converter, SEPIC Converter, Comparison of isolated and non-isolated converters, Design criteria for SMPS, Multi-output switch mode regulator.

UNIT – II
Resonant Converters: Classification, Load resonant converters, Resonant switch converters, Zero voltage switching dc-dc converters, Zero current switching dc-dc converters, Clamped voltage topologies.

UNIT – III

Voltage control of PWM Inverters: Single-phase inverters - Sinusoidal PWM, Modified PWM, Phase displacement Control, Trapezoidal, Staircase, Stepped, Harmonic injection and delta modulation.

Three-Phase Inverters: Sinusoidal PWM, Third Harmonic PWM, Space Vector Modulation, Comparison of PWM Techniques.

UNIT – IV

Power Factor Correction Converters: Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, and steady state- analysis, three phase boost PFC converter.

UNIT – V

Multilevel Inverters: Types of Multilevel Inverters, Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying Capacitors Inverter- Cascaded Multilevel Inverter- Principle of Operation- Features of Cascaded Inverter Switching Device Currents- Features of Multilevel Inverters Comparisons of Multilevel Converters.

Text Books:

1 Power Electronics: Converters, Applications, and Design- Ned Mohan, Tore M. Undeland (ISBN: 9780471226932).

2 Power Electronics-Md.H.Rashid –Pearson Education Third Edition (ISBN: 9788120345317).

Reference Books:

1 Control in power electronics by Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition Published by Academic Press (ISBN: 9780124027725).

2 High Power Converters and AC Drives, Bin Wu, John Willey & sons, Inc (ISBN: 9781119156031).

Web links:

1 **https://onlinecourses.nptel.ac.in/noc24_ee88/preview.**

2 **https://archive.nptel.ac.in/courses/108/102/108102157/.**

Power System Operation & Control

	L	T	P	C
Course Code:2501EE16	**2**	**0**	**2**	**4**

Course Outcomes:

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

CO1 Compute optimal load scheduling of Generators.
CO2 Formulate hydrothermal scheduling & unit commitment problem
CO3 Analyze effect of Load Frequency Control for single area systems
CO4 Analyze effect of Load Frequency Control for two area systems
CO5 Describe the effect of reactive power control for transmission lines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Economic Operation of Power Systems : Optimal operation of Generators in Thermal power stations - – Heat rate curve – Cost Curve – Incremental fuel & Production costs – Input–output characteristics – Optimum generation allocation with line losses neglected – Optimum generation allocation including the effect of transmission line losses – Loss Coefficients – General transmission line loss formula.

Practice:

1. Economic load dispatch with losses.
2. Economic load dispatch without losses.

UNIT – II

Hydrothermal Scheduling-Mathematical Formulation – Solution Technique. Unit Commitment-Need for unit commitment – Constraints in unit commitment – Cost function formulation – Solution methods – Dynamic programming.

Practice:

1. Unit commitment problem by using dynamic programming approach.

UNIT – III

Load Frequency Control-I: Modelling of steam turbine – Generator – Mathematical modelling of speed governing system – Transfer function. Definitions of Control area, Single area control system – Block diagram representation of an isolated power system – Steady state analysis -Dynamic response. Proportional plus Integral control of single area & its block diagram representation – Steady state response.

Practice:

1. Load frequency control of a Single area Power System without PI controller.
2. Load frequency control of a Single area Power System with PI controller.

UNIT – IV

Load Frequency Control-II: Block diagram development of Load Frequency Control of two area system – Load Frequency Control & Economic dispatch control.

Practice:

1. Load frequency control of a two area Power System without PI controller.
2. Load frequency control of a two area Power System with PI controller.

UNIT – V

Compensation in Power Systems: Overview of Reactive Power control – Reactive Power compensation in transmission systems. Introduction of FACTS devices – Need of FACTS controllers – Types of FACTS devices.

Practice:

1. Performance of long transmission line without compensation.
2. Performance of long transmission line without compensation.
3. Design of Thyristor controlled Series Reactor.

Cornerstone Project of Power System Operation & Control

Power System Operation & Control is a critical area in electrical engineering that deals with the real-time management, monitoring, and control of electrical power systems. It ensures that electricity is generated, transmitted, and distributed reliably, efficiently, and safely. Modern power systems are becoming increasingly complex due to the integration of renewable energy sources, smart grids, and advanced automation technologies. This capstone focuses on understanding and applying operational strategies and control mechanisms to maintain system stability and optimize performance under varying load conditions.

Scope of Cornerstone Project

The scope of a capstone project in Power System Operation and Control can be broad or specialized depending on your interests, available software/hardware, and academic level. A strong project usually combines power generation, transmission, distribution, monitoring, automation, optimization, or stability analysis with practical implementation or simulation.

Project 1: Optimal Economic Load Dispatch with and without Transmission Losses

Description

This project focuses on determining the most economical way to allocate power generation among thermal units while meeting load demand. It considers both ideal conditions (no losses) and practical conditions (with transmission losses) using cost functions and incremental cost analysis.

Objectives

- To understand heat rate curves and cost characteristics of generators
- To derive and use incremental fuel cost equations
- To perform economic load dispatch (ELD)
- To analyze the effect of transmission losses using loss coefficients (B-coefficients)

Scope & Analysis

- Model generator input-output and cost curves
- Solve ELD:
  - Without losses (equal incremental cost principle)
  - With losses using penalty factor
- Apply loss formula (B-matrix method)
- Compare:
  - Total cost
  - Power allocation
  - System efficiency
- Validate using MATLAB/ETAP

Practical Link

- Economic load dispatch with losses
- Economic load dispatch without losses

Project 2: Optimal Hydro-Thermal Scheduling and Unit Commitment using Dynamic Programming

Description

This project deals with optimal scheduling of hydro and thermal plants to minimize cost while considering water availability and operational constraints. It also includes **unit commitment decisions** using dynamic programming.

Objectives

- To formulate hydrothermal scheduling problem mathematically
- To understand unit commitment constraints
- To minimize fuel cost and water usage
- To implement dynamic programming for optimal scheduling

Scope & Analysis

- Model:
    - Thermal cost function (UNIT-2)
    - Hydro discharge constraints
- Solve scheduling:
    - With inflow
    - Without losses
- Implement **unit commitment using dynamic programming**
- Analyse:
    - Start-up and shutdown costs
    - Load demand variation
    - Optimal combination of units
- Compare cost efficiency across different schedules

Practical Link

- Unit commitment using dynamic programming

Project 3: Analysis and Control of Single Area Load Frequency Control System

Description

This project focuses on maintaining system frequency in a single-area power system under load disturbances using control strategies like **PI controllers**.

Objectives

- To model turbine, generator, and governor systems
- To derive transfer functions
- To analyse steady-state and dynamic response
- To design PI controller for frequency stabilization

Scope & Analysis

- Develop block diagram of single-area LFC (UNIT-3)
- Analyse:
    - Without controller
    - With PI controller
- Measure:
    - Frequency deviation
    - Settling time
    - Steady-state error
- Compare system performance improvement
- Use MATLAB/Simulink simulation

Practical Link

- LFC without PI controller
- LFC with PI controller

Project 4: Multi-Area Load Frequency Control and Economic Dispatch Coordination

Description
This project extends LFC to interconnected systems where multiple areas share power via tie-lines and coordinate both frequency control and economic dispatch.
Objectives
- To model two-area interconnected system
- To analyse tie-line power flow
- To implement PI controllers in multi-area systems
- To coordinate LFC with economic dispatch

Scope & Analysis
- Develop block diagram of two-area system (UNIT-IV)
- Analyse:
    - Frequency deviation in both areas
    - Tie-line power oscillations
- Compare:
    - With and without PI controller
- Study interaction between:
    - Frequency control
    - Economic load dispatch
- Evaluate system stability and performance

Practical Link
- Two-area LFC without PI controller
- Two-area LFC with PI controller

Project 5: Reactive Power Compensation and FACTS-Based Transmission Enhancement

Description
This project focuses on improving voltage stability and transmission efficiency using reactive power compensation techniques and FACTS devices like TCSC, SVC, and STATCOM.
Objectives
- To understand reactive power control concepts
- To analyse long transmission line performance
- To design thyristor-based compensators
- To study FACTS devices and their applications

Scope & Analysis
- Analyse transmission line: (Unit V)
    - Without compensation
    - With compensation
- Design:
    - Thyristor Controlled Series Reactor (TCSR)
    - Thyristor Switched Capacitor (TSC)
    - TCSC
- Evaluate:
    - Voltage profile improvement
    - Power transfer capability
    - Loss reduction
- Study different FACTS devices and compare performance

Additional practice:

1. Design a Thyristor Switched Capacitor.
2. Design a Thyristor Controlled Series Compensator.
3. Optimum generation for a hydro-thermal scheduling with inflow & without losses

Note:

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

Text Books:

1. Power Generation - Operation & Control by Allen J Wood - Bruce F WollenBerg 3rd Edition - Wiley Publication (ISBN: 9780471586999).
2. Modern Power System Analysis – by I.J.Nagrath & D.P.Kothari Tata McGraw Hill Publishing Company Ltd – 5th edition-2022 (ISBN: 9789354600968).

Reference Books:

1. Power System Analysis & Stability by S.S.Vadhera - Khanna Publications - 7th edition – 2024 (ISBN: 9788174090591).
2. Power System stability & control - Prabha Kundur - TMH – 2nd edition -2022 (ISBN: 9780070635159).

Web Links:

1. https://nptel.ac.in/courses/108104052/
2. https://nptel.ac.in/downloads/108101040/
3. https://nptel.ac.in/courses/108101040/

Multidisciplinary Courses (MDC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501CS01 / 2601DS01	Programming for Problem Solving Using C* / Problem Solving Through C Programming#	**FC**	2		2	4	50	50	100	-
2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	IC	2		2	4	50	50	100	PPSC
2501MB01	Engineering Economics & Management	IC	2			2	50	50	100	-
	Total		**06**		**04**	**10**				

Programming for Problem Solving using C

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

(Syllabus for the batch admitted in the year 2025)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Introduction to Programming and Problem Solving

Introduction to Programming Languages, Basics of a Computer Program- Algorithms, Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms, flowcharts (Using Dia Tool), pseudo code.
Structure of C Program, Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, operators, keywords, identifiers, Type Conversion, and Casting.

Practice 1:

1. Explore different platforms
   a. Basic linux environment and its editors like Vi, Vim & Emacs etc.
   b. Exposure to turbo C, gcc.
   c. Explore to hacker rank or any other Online coding platform and compiler environment.
   d. "Hello world" in C.
      https://www.codechef.com/learn/course/c/CDEVINTRO/problems/CDEV004B
   e. Objective: Learn about the syntax of reading from stdin and writing to stdout.
      https://www.hackerrank.com/challenges/hello-world-c/problem?isFullScreen=true

f. Write a simple program to read int, float, char and string using scanf() and display using printf() in all the above given platforms.

2. Basics and Operators
   a. Sum and Difference of 2 numbers.
   Objective: Learn int and float data types.
   https://www.hackerrank.com/challenges/sum-numbers-c/problem?isFullScreen=true
   https://maya.technicalhub.io/owl-program-details/668b9ec2e069313510b0235a
   b. Playing with Characters.
   Objective: Learn how to take a character, a string and a sentence as input in C.
   https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true

   c. Bitwise Operators
   Objective: Learn how to work with bits (0,1) and bitwise operators.
   https://www.hackerrank.com/challenges/bitwise-operators-in-c/problem?isFullScreen=true

   d. Conversion of Fahrenheit to Celsius and vice versa.
   https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30
   https://maya.technicalhub.io/owl-program-details/66a0c0dda7d31805366af641

   e. Distance travelled by an object.
   https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a

   f. Calculate Simple interest and compound interest.
   https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab

3. Operators and Expressions, Variables and Type conversions.
   a. Evaluate the following expressions
   i. a/b*c-b+a*d/3
   ii. j = (i++) + (++i)
   b. Square root of a given number.
   c. Find the area of circle, square, rectangle and triangle.
   https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c
   https://maya.technicalhub.io/owl-program-details/6688cf91e467bfe336f8352f
   https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com

   https://maya.technicalhub.io/owl-program-details/6688ea3ce467bfe336f8ab9d
   d. Find the maximum of three numbers using conditional operator.
   https://maya.technicalhub.io/owl-program-details/668690d230bfbd35127c9bf5

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

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

Practice:

1. Conditional Statements
    1. Objective: Understand if and else Conditional statements in C. https://www.hackerrank.com/challenges/conditional-statements-in-c/problem?isFullScreen=true
    2. Roots of a Quadratic Equation.
    3. Generate electricity bill. https://maya.technicalhub.io/owl-program-details/66868f6730bfbd35127c9ba7
    4. Simulate a calculator using switch case.
    5. Find the given year is a leap year or not.
2. Loops
    a. Objective: Learn the usage of the for loop in C. https://www.hackerrank.com/challenges/for-loop-in-c/problem?isFullScreen=true
    b. Sum of the digits of a 5-digit number. Objective: Learn the usage of while loop and usage of operators - % and /. https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true https://maya.technicalhub.io/owl-program-details/66864717f56afec5c0c917e1
    c. Given number is a prime or not. (Also Prime numbers between a given range.) https://maya.technicalhub.io/owl-program-details/6687b69ddfe02cea4b5404a3
    d. Armstrong Number or not.
    e. Palindrome or not. https://maya.technicalhub.io/owl-program-details/6687af17dfe02cea4b5376ae
    f. Objective: Print a pattern of numbers using Loops. https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true
    g. Construct a Pyramid pattern. https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20

UNIT – III

Arrays: Arrays indexing, Accessing programs with array of integers, two dimensional arrays, Introduction to Strings, string handling functions.
Sorting Techniques: bubble sort, selection sort.
Searching Techniques: linear, Binary search.

Practice:

1. 1-Dimensional Arrays
    a. Objective: Print the sum and free the memory where the array is stored. https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true
    b. Objective: Working with indices in array.
    c. Search an element in array (Linear Search). https://maya.technicalhub.io/owl-program-details/6687c40ffd042085d9ec15d6
    d. Find min and max elements in array. https://maya.technicalhub.io/owl-program-details/66879493dfe02cea4b529041
    e. Insert an element into array.
    f. Eliminate duplicate elements from array. https://maya.technicalhub.io/owl-program-details/66e920a1aca93b27f3364b57

    g. Sorting of elements in an array using Bubble sort.
2. 2-Demensional Arrays
    a. Sum of two 2-D arrays.
    https://maya.technicalhub.io/owl-program-details/66864fa9f56afec5c0c924f6
    b. Multiplication of two 2-D arrays.
    c. Transpose of a Matrix.
    d. Trace of a Matrix.
    e. Lower Triangular Matrix.
3. Hacker Rank
    a. Objective: print each word of the sentence in a new line.
    b. Count number of alphabets (lowercase, uppercase, consonants, vowels) and digits Lowercase to Uppercase, Uppercase to Lowercase, Toggle case, Sentential case
    https://maya.technicalhub.io/owl-program-details/6698e2fbcb6bd470f35b73d8
    https://maya.technicalhub.io/owl-program-details/6698ef03cb6bd470f35b7c3e
    c. find the frequency of each digit in the given string.
    https://www.hackerrank.com/challenges/frequency-of-digits-1/problem?isFullScreen=true
    d. Find string length, concatenate 2 strings, reverse a string using built-in and without built-in string functions.
    https://maya.technicalhub.io/owl-program-details/6698ed2dcb6bd470f35b7ae7

UNIT – IV

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

Practice: Functions in C

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

UNIT – V

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

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

Practice:

1. Pointers
    a. Objective: learn to implement the basic functionalities of pointers in C.
    https://www.hackerrank.com/challenges/pointer-in-c/problem?isFullScreen=true
    b. Objective: Learn using Pointers with Arrays and Functions.
    https://www.hackerrank.com/challenges/students-marks-sum/problem?isFullScreen=true

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

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

Text Books:

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

Reference Books:

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

Web Links:

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

Additional Practice:

S.No.	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/
17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/
24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/

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

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

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

Maya Programs

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

6	Profit Percentage	https://maya.technicalhub.io/owl-program-details/66865237f56afec5c0c92694
7	Area and Perimeter of Square	https://maya.technicalhub.io/owl-program-details/6686546930bfbd35127c869c
8	Volume of Sphere	https://maya.technicalhub.io/owl-program-details/6686565530bfbd35127c8818
9	Required Points	https://maya.technicalhub.io/owl-program-details/66865b1130bfbd35127c8a04
10	Instant Noodles	https://maya.technicalhub.io/owl-program-details/66865ddb30bfbd35127c8c0a
11	Find Second Number	https://maya.technicalhub.io/owl-program-details/668660a530bfbd35127c8cde
12	Kmph to Mps	https://maya.technicalhub.io/owl-program-details/668663ce30bfbd35127c8dfb
13	Inches to Centimeters	https://maya.technicalhub.io/owl-program-details/6686665e30bfbd35127c8f3a
14	Capacity	https://maya.technicalhub.io/owl-program-details/668678aa30bfbd35127c95b9
15	Average of Two Numbers	https://maya.technicalhub.io/owl-program-details/6687b002dfe02cea4b5389d6
16	Compound Interest	https://maya.technicalhub.io/owl-program-details/6687b498dfe02cea4b53e0ab
17	Average Weight	https://maya.technicalhub.io/owl-program-details/6687b93edfe02cea4b54367a
18	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1
19	Distance Between Two Points	https://maya.technicalhub.io/owl-program-details/6687c4e9fd042085d9ec254a
20	Days into Years, Weeks	https://maya.technicalhub.io/owl-program-details/6687cad1fd042085d9ec95a8
21	Convert Seconds to Hours, Minutes and Seconds	https://maya.technicalhub.io/owl-program-details/6688c926e467bfe336f8007b
22	Hours and Minutes	https://maya.technicalhub.io/owl-program-details/6688e4f0e467bfe336f89673
23	Romeo and Juliet	https://maya.technicalhub.io/owl-program-details/6688e068e467bfe336f87a8b
24	Gross Salary of an Employee	https://maya.technicalhub.io/owl-program-details/6688dd95e467bfe336f87682
25	Surface Area and Volume of a Cube	https://maya.technicalhub.io/owl-program-details/6688d909e467bfe336f872ca
26	Area of Trapezium	https://maya.technicalhub.io/owl-program-details/6688d637e467bfe336f86c5e
27	Swap Two Numbers	https://maya.technicalhub.io/owl-program-details/6688d2d0e467bfe336f84f55
28	Last Two Digits of a Given Year	https://maya.technicalhub.io/owl-program-details/6688ccfae467bfe336f81f90
29	Arithmetic Operations	https://maya.technicalhub.io/owl-program-details/6687bda0dfe02cea4b5488a1
30	Uppercase Letters in a String	https://maya.technicalhub.io/owl-program-details/669a2453c03fc56b320b215c
31	Factors Finding	https://maya.technicalhub.io/owl-program-details/66866c4a30bfbd35127c90b4

32	String Copy	https://maya.technicalhub.io/owl-program-details/669a03ded62716a9c6d4fa9a
33	Recursive Digit Sum	https://www.hackerrank.com/challenges/recursive-digit-sum/problem

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

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

	L	T	P	C
Course Code: 2601DS01	2	0	2	4

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Introduction to Programming and Problem Solving

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

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

Practice 1:

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

2. Basics and Operators
    a. Sum and Difference of 2 numbers.
       Objective: Learn int and float data types.
       https://www.hackerrank.com/challenges/sum-numbers-c/problem?isFullScreen=true
    b. Playing with Characters.
       Objective: Learn how to take a character, a string and a sentence as input in C.
       https://www.hackerrank.com/challenges/playing-with-characters/problem?isFullScreen=true
    c. Bitwise Operators
       Objective: Learn how to work with bits (0,1) and bitwise operators.
       https://www.hackerrank.com/challenges/bitwise-operators-in-c/problem?isFullScreen=true

    d. Conversion of Fahrenheit to Celsius and vice versa.
       https://www.codechef.com/practice/course/c/LPCAS03/problems/LCAS30

    e. Distance travelled by an object.
    f. Calculate Simple interest and compound interest.
3. Operators and Expressions, Variables and Type conversions.
a. Evaluate the following expressions
   i. a/b*c-b+a*d/3
   ii. j = (i++) + (++i)
   b. Square root of a given number.
   c. Find the area of circle, square, rectangle and triangle.
      https://www.hackerrank.com/challenges/rectangle-area/problem?utm_source=chatgpt.com

   d. Find the maximum of three numbers using conditional operator.
   e. Take marks of 5 subjects in integers, find the total in integer and average in float.

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

Practice:
1. Conditional Statements
    1. Objective: Understand if and else Conditional statements in C.
       https://www.hackerrank.com/challenges/conditional-statements-in-c/problem?isFullScreen=true
    2. Roots of a Quadratic Equation.
    3. Generate electricity bill.
    4. Simulate a calculator using switch case.
    5. Find the given year is a leap year or not.

2. Loops
    a. Objective: Learn the usage of the for loop in C. https://www.hackerrank.com/challenges/for-loop-in-c/problem?isFullScreen=true
    b. Sum of the digits of a 5-digit number.
       Objective: Learn the usage of while loop and usage of operators - % and /.
       https://www.hackerrank.com/challenges/sum-of-digits-of-a-five-digit-number/problem?isFullScreen=true
    c. Given number is a prime or not. (Also Prime numbers between a given range.)
    d. Armstrong Number or not.
    e. Palindrome or not.

f. Objective: Print a pattern of numbers using Loops.
https://www.hackerrank.com/challenges/printing-pattern-2/problem?isFullScreen=true
g. Construct a Pyramid pattern.
https://www.codechef.com/practice/course/c/LPCAS02/problems/LCAS20

UNIT – III

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

1. 1-Dimensional Arrays
   a. Objective: Print the sum and free the memory where the array is stored.
   https://www.hackerrank.com/challenges/1d-arrays-in-c/problem?isFullScreen=true
   b. Objective: Working with indices in array.
   Search an element in array .
   c. Find min and max elements in array.
   d. Insert an element into array.
   e. Eliminate duplicate elements from array.
   f. Sorting of elements in an array
2. 2-Demensional Arrays
   a. Sum of two 2-D arrays.
   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: N^{th} factorial using recursion.
d. Objective: Find the super digit of the integer.
e. Implement LCM
f. Objective: Calculate the Nth term of series.
https://www.hackerrank.com/challenges/recursion-in-c/problem?isFullScreen=true

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:

1. **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.
2. **File handling concepts**

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

Text Books:

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

Reference Books:

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

Web Links:

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

Additional Practice:

S.No.	Difficulty	Problem Name	Link
1	Easy	Add Two Numbers	https://www.codechef.com/practice/course/cpp/PCPP05/problems/FLOW001
2	Easy	Enormous Input Test	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/INTEST
3	Easy	ATM	https://www.codechef.com/practice/course/1-star-difficulty-problems/DIFF1200/problems/ATM2
4	Easy	Number Mirror	https://www.codechef.com/practice/course/python/PPY01/problems/START01
5	Easy	Sum of Digits	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW006
6	Easy	Remainder	https://www.codechef.com/practice/course/basic-math/BASICMATH/problems/FLOW002
7	Easy	First and Last Digit	https://www.codechef.com/practice/course/basic-programming-concepts/DIFF500/problems/FLOW004
8	Easy	Reverse The Number	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/FLOW007
9	Easy	Life, the Universe, and Everything	https://staging.codechef.com/practice/course/cpp/PRACTICECPP2/problems/TEST
10	Easy	Chef and Operators	https://www.codechef.com/practice/course/logical-problems/DIFF800/problems/CHOPRT
11	Easy	Difference and Sum	https://www.codechef.com/problems/DIFFSUM
12	Easy	Second Largest	https://www.codechef.com/practice/course/arrays/ARRAYS/problems/LARGESECOND
13	Easy	Two Sum	https://leetcode.com/problems/two-sum/
14	Easy	Reverse Integer	https://leetcode.com/problems/reverse-integer/
15	Easy	Palindrome Number	https://leetcode.com/problems/palindrome-number/
16	Easy	Roman to Integer	https://leetcode.com/problems/roman-to-integer/
17	Easy	Remove Duplicates from Sorted Array	https://leetcode.com/problems/remove-duplicates-from-sorted-array/
18	Easy	Remove Element	https://leetcode.com/problems/remove-element/
19	Easy	Find the Index of the First Occurrence in a String	https://leetcode.com/problems/find-the-index-of-the-first-occurrence-in-a-string/
20	Easy	Length of Last Word	https://leetcode.com/problems/length-of-last-word/
21	Easy	Plus One	https://leetcode.com/problems/plus-one/
22	Easy	Merge Sorted Array	https://leetcode.com/problems/merge-sorted-array/
23	Easy	Majority Element	https://leetcode.com/problems/majority-element/
24	Easy	Single Number	https://leetcode.com/problems/single-number/
25	Easy	Move Zeroes	https://leetcode.com/problems/move-zeroes/
26	Easy	Missing Number	https://leetcode.com/problems/missing-number/
27	Easy	Contains Duplicate	https://leetcode.com/problems/contains-duplicate/
28	Easy	Valid Anagram	https://leetcode.com/problems/valid-anagram/

29	Easy	Valid Parentheses	https://leetcode.com/problems/valid-parentheses/
30	Easy	Fibonacci Number	https://leetcode.com/problems/fibonacci-number/
31	Easy	Climbing Stairs	https://leetcode.com/problems/climbing-stairs/
32	Easy	Binary Search	https://leetcode.com/problems/binary-search/
33	Easy	Number of 1 Bits	https://leetcode.com/problems/number-of-1-bits/
34	Easy	Hamming Weight	https://leetcode.com/problems/number-of-1-bits/description/
35	Easy	Power of Two	https://leetcode.com/problems/power-of-two/
36	Easy	Power of Three	https://leetcode.com/problems/power-of-three/
37	Easy	Same Tree	https://leetcode.com/problems/same-tree/
38	Easy	Maximum Subarray	https://leetcode.com/problems/maximum-subarray/
39	Medium	Chef and Notebooks	https://www.codechef.com/problems/CNOTE
40	Medium	Chef and Wildcard Matching	https://www.codechef.com/search?q=TWOSTR
41	Medium	Minimum Moves	https://www.codechef.com/search?q=SALARY
42	Medium	Lucky Four	https://www.codechef.com/search?q=LUCKFOUR
43	Medium	Maximum Difference	https://www.codechef.com/search?q=MAXDIFF
44	Medium	Uncle Johny	https://www.codechef.com/search?q=JOHNY
45	Medium	Chef and Strings	https://www.codechef.com/search?q=CHEFSTLT
46	Medium	Two vs Rib	https://www.codechef.com/search?q=TWOVRIB
47	Medium	Chef and Array	https://www.codechef.com/search?q=CHEFARRP
48	Medium	Add Two Numbers	https://leetcode.com/problems/add-two-numbers/
49	Medium	Longest Substring Without Repeating Characters	https://leetcode.com/problems/longest-substring-without-repeating-characters/
50	Medium	Longest Palindromic Substring	https://leetcode.com/problems/longest-palindromic-substring/
51	Medium	3Sum	https://leetcode.com/problems/3sum/
52	Medium	Container With Most Water	https://leetcode.com/problems/container-with-most-water/
53	Medium	Integer to Roman	https://leetcode.com/problems/integer-to-roman/
54	Medium	String to Integer (atoi)	https://leetcode.com/problems/string-to-integer-atoi/
55	Medium	Divide Two Integers	https://leetcode.com/problems/divide-two-integers/
56	Medium	Rotate Image	https://leetcode.com/problems/rotate-image/
57	Medium	Set Matrix Zeroes	https://leetcode.com/problems/set-matrix-zeroes/

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

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

	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**

Data Structures
(Common to EEE, ECE, CSE, IT, AIML & CSE(DS))
(Syllabus for the batch admitted in the year 2025)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

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

Practice:

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

UNIT – II

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures.
Sorting Techniques: Quick sort, Merge sort, Radix sort

Practice:

1. Implement Merge sort using arrays.
   https://www.hackerrank.com/contests/hw1/challenges/merge-sort
2. Implement Quick sort using arrays
   https://www.hackerrank.com/challenges/quicksort1/problem
3. Implement Radix Sort using arrays
   https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm_source

UNIT – III

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

Practice:

1. Single Linked List: Perform different operations in single linked list.
   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
   https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
   https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source

UNIT – IV

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

Practice:

1. Stack and its operations using arrays and Linked List
   https://www.hackerrank.com/challenges/balanced-brackets/problem
   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
   https://leetcode.com/problems/evaluate-reverse-polish-notation/description/
3. Queue and its operations using arrays and Linked List
   https://leetcode.com/problems/implement-queue-using-stacks/description/
   https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
   https://leetcode.com/problems/design-circular-queue/description/

UNIT – V

Non-linear Data Structures:

Trees: Difinition of tree, Tree Terminology, types of trees, Binary tree traversals, Binary Search Tree – Insertion, Deletion.
Graphs: Definition and Terminology – Representation of Graphs-Adjacency Matrix and Linked list, Graph Traversals (BFT & DFT)

Practice:

1. Implement Binary search tree (BST).
   https://leetcode.com/problems/insert-into-a-binary-search-tree/description/
   https://leetcode.com/problems/delete-node-in-a-bst/description/
2. Implement Binary search Tree (BST) Traversals.
   https://www.hackerrank.com/challenges/tree-inorder-traversal/problem
   https://www.hackerrank.com/challenges/tree-preorder-traversal/problem
   https://www.hackerrank.com/challenges/tree-postorder-traversal/problem
3. Graph Traversal using Breadth First Search (BFS)
   https://www.hackerrank.com/challenges/bfsshortreach/problem
4. Graph Traversal using Depth First Search (DFS)
   https://leetcode.com/problems/number-of-islands/description/

Text Books:

1. Data Structures using C, Rema Theraja, Oxford University Press, 3rd Edition. ISBN: 978-9354979453
2. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, ISBN: 978-0716782506
3. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407
4. Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition. ISBN: 978-0198099307

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://archive.nptel.ac.in/courses/106/105/106105225/
3. https://www.udemy.com/topic/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms
5. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Structs and enums	https://www.hackerrank.com/challenges/too-high-boxes/problem
2	Easy	Structs and enums	https://www.codechef.com/problems/HS08TEST?tab=statement
3	Medium	Structs and enums	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem
4	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
5	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
6	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
7	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
8	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
9	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
10	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
11	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
12	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
13	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
14	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
15	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Aditya's Internal coding Platform(Maya)	Code chef	Hacker rank	Leet code	Geek for Geeks
Unit-1	3	0	0	0	0	0
Unit-2	0	0	0	3	0	0
Unit-3	0	0	1	0	2	0
Unit-4	0	0	0	1	5	0
Unit-5	0	0	0	4	3	0
Additional Practice	0	0	1	5	8	1
Total	**3**	**0**	**2**	**13**	**18**	**1**

Data Structures using C++

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

(Revised Syllabus for batches admitted from 2026 Onwards)

	L	T	P	C
Course Code: 2601DS02	**2**	**0**	**2**	**4**

Course Outcomes:

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

CO1: Apply C++ features for problem solving.
CO2: Apply various sorting techniques to solve computing problems.
CO3: Make use of linear data structures to solve real time problems.
CO4: Develop applications using Tree data structures.
CO5: Solve problems using Graph algorithms.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

An Overview of C++: Structure of C++ program, Input and output in C++, Class, Objects,Members Functions, Access Specifiers, Introduction to Constructors and Destructor. **Overview of Standard Template Library:** Introduction, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

Practice:

1. Find the roots of a quadratic equation.
2. Find factorial of a given number using recursion
3. Palindrome Number
   https://leetcode.com/problems/palindrome-number/description/
4. Class and Objects
   https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true

5. Program to illustrate the use of Constructors and Destructors.
6. C++ Class Templates
   https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true

UNIT – II

Data Structures: Introduction to Data Structures, Types of Data Structures.
Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.
Linked Lists: Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

Practice:

1. Single Linked List: Perform different operations in single linked list.
   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
   https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
   https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source
4. Reversing a Linked List

UNIT – III

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

Practice:

1. Stack and its operations using arrays and Linked List
   https://www.hackerrank.com/challenges/balanced-brackets/problem

   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
   https://leetcode.com/problems/evaluate-reverse-polish-notation/description/
3. Queue and its operations using arrays and Linked List
   https://leetcode.com/problems/implement-queue-using-stacks/description/

   https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
   https://leetcode.com/problems/design-circular-queue/description/

UNIT – IV

Trees: Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.
Binary Search Trees – Definition, Operations: Searching, Insertion, Deletion.

Practice:

1. Implement Binary search tree (BST).
   https://leetcode.com/problems/insert-into-a-binary-search-tree/description/
   https://leetcode.com/problems/delete-node-in-a-bst/description/
2. Implement Binary search Tree (BST) Traversals.
   https://www.hackerrank.com/challenges/tree-inorder-traversal/problem
   https://www.hackerrank.com/challenges/tree-preorder-traversal/problem

   https://www.hackerrank.com/challenges/tree-postorder-traversal/problem

UNIT – V

Graphs: Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjaceny list, Graph Traversals (BFS & DFS), Bi-Connected Components.

Practice:

1. Graph Traversal using Breadth First Search (BFS)
   https://www.hackerrank.com/challenges/bfsshortreach/problem
2. Graph Traversal using Depth First Search (DFS)
   https://leetcode.com/problems/number-of-islands/description/

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.
2. Fundamentals of Data Structures in C++,Ellis Horowitz, Sartaj Sahni, DineshMehta, ISBN:

   81-7515-278-8
3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition,ISBN · 9780133522884.
2. Object oriented programming in C++, JoyceeFarrell,Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek,Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

Web Links:

1. http://nptel.ac.in/courses/106105151/
2. https://nptel.ac.in/courses/106102064
3. https://archive.nptel.ac.in/courses/106/105/106105225/
4. https://www.udemy.com/topic/data-structures/
5. https://www.coursera.org/specializations/data-structures-algorithms
6. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
2	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
3	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
4	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
5	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
6	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
7	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
8	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
9	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
10	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
11	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
12	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Code chef	Hacker rank	Leet code	Geek for Geeks
Unit-1	3	0	2	1	0
Unit-2	0	1	3	2	0
Unit-3	0	0	1	5	0
Unit-4	0	0	3	2	0
Unit-5	0	0	1	1	0
Additional Practice	0	0	3	8	1
Total	3	1	13	19	1

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

	L	T	P	C
Course Code: 2501MB01	**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 production and cost behaviour for managerial decision making with Break-Even Point (BEP).
- **CO3:** Make use of financial accounting and capital budgeting techniques for decision making.
- **CO4:** Summarize management and motivational theories to renovate the practice of Management.
- **CO5:** Illustrate the functional management and project management using PERT and CPM.

Mapping of Course Outcomes with Program Outcomes:

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

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

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

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

UNIT-IV

Operations Management :

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

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

UNIT – V

Functional Management And Project Management

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

Text Books:

1 Managerial Economics and Financial Analysis, A. R. Aryasri , McGraw Hill Education, ISBN: 978-07078031
2 Managerial Economics and Financial Analysis', N. Appa Rao, P. Vijay Kumar, Cengage Publications, New Delhi, ISBN: 978-8131515952
3 Management Science by Aryasri; Publisher: Tata McGraw Hill, 209, ISBN: 978-07090279
4 Management by James Arthur, Finch Stoner, R. Edward Freeman, and Daniel R. Gilbert 6th Ed; Publisher: Pearson Education/Prentice Hall, ISBN: 978-0131087477

Reference Books:

1 Principles of Marketing: A South Asian Perspective by Kotler Philip, Gary Armstrong, Prafulla Y. Agnihotri, and Eshanul Haque, 13th Edition, Publisher: Pearson Education/ Prentice Hall of India, ISBN: 9788131731017
2 A Handbook of Human Resource Management Practice by Michael Armstrong, 210; Publisher: Kogan Page Publishers, ISBN: 978-1789661033

Web Links:

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

Ability Enhancement Courses (AEC)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EN01	Essential Cognitive skills for Engineers	FC			1	1	100	-	100	-
2501EN02 2501UC01 2501UC02 2501UC05 2501UC04 2501UC06 2501UC03	Advanced Cognitive Skills for Engineers **(or)** Proficiency in Sanskrit / Hindi / Foreign language (Japanese/German/Spanish/ French)	FC			1	1	100	-	100	-
2501UC07	Design Thinking using AI	FC			1	1	100	-	100	
2501UC08	Universal Human Values	FC	2			2	50	50	100	
2501UC09	Technical Paper Publication	AC			2	2	100	-	100	-
2501EE57	Student Activity Based Learning	AC				2	100	-	100	-
	Total		**02**		**05**	**09**				

Essential Cognitive Skills For Engineers
(Common to all branches)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Practice:

UNIT – I Outstanding people A/B/C/D

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

UNIT – II Survival A/B/C/D

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

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

UNIT – III Talent A/B/C/D

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

UNIT – IV Life Lessons A/B/C/D

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

UNIT – V Chance A/B/C/D

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

Writing	For and against essay, Arguing for and against an idea
Grammar	Future probability, Future perfect and future continuous
Vocabulary	Adjectives describing attitude, The natural world
Pronunciation	Sound and spelling : *th,* Intonation groups

Text Book:

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

Suggested Software:

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

Reference Books:

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

Web links:

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

ADVANCED COGNITIVE SKILLS FOR ENGINEERS
(Common to all branches)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Practice

UNIT – I **Around the globe A/B/C/D**

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

UNIT – II **City living A/B/C/D**

Listening	Interview: 'Smart' cities: Two monologues talking about 'smart' cities, Two monologues: house renovations, Flat hunting, Interviews about a new shopping centre
Speaking	Discussing good and bad points about a city
Reading	Article: *Quick-slow down!*, Article: *Who puts the 'real' in reality* TV? Email: Complaining about an important issue.
Writing	Email of complaint, Using formal language

Grammar	*Too/enough; so/such*, Causative *have/get*
Vocabulary	Describing life in cities, Film and TV; Houses
Pronunciation	Sound and spelling: o, Stress in compound nouns

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

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

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

Text Book:

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

Suggested Software:

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

Reference Books:

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

Web links:

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

Design Thinking using AI

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

	L	T	P	C
Course Code:2501UC07	**0**	**0**	**1**	**1**

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Process of Design Understanding Design thinking: Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping.

UNIT – II

Tools for Design Thinking: Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

Practice using any AI tool:

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

UNIT – III

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

Practice using any AI tool:

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

UNIT – IV

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

Practice using any AI tool:

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

UNIT – V

Design thinking workshop: Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test.

Text Books:

1. Engineering Design byJohn.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, Cengage learning (International edition) Second Edition. ISBN: 9781133708766
2. The Design of Business: Why Design Thinking is the Next Competitive Advantage Roger Martin by Harvard Business Press. ISBN: 9781422177808

Reference Books:

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

Web Links:

1. www.tuto2.u.net/business/presentations/. /Product lifecycle/default.html
2. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf

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

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

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

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

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

UNIT I INTRODUCTION TO VALUE EDUCATION

Lecture 1: Holistic Development and the Role of Education (Right Understanding, Relationship and Physical Facility)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session PS1 - Sharing about Oneself
Lecture 3: Self-Exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 - Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 - Exploring Natural Acceptance.

UNIT II HARMONY IN THE HUMAN BEING

Lecture 7: Understanding Human being as the Co-existence of the self and the body
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 - Exploring the difference of Needs of self and body
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 - Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 - Exploring Harmony of self with the body.

UNIT III HARMONY IN THE FAMILY AND SOCIETY

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 - Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 - Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 - Exploring Systems to fulfil Human Goal

UNIT IV HARMONY IN THE NATURE/EXISTENCE

Lecture 19: Understanding Harmony in Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 - Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 - Exploring Co-existence in Existence.

UNIT V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING A LOOK AT PROFESSIONAL ETHICS

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 - Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 - Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 - Exploring Steps of Transition towards Universal Human Order

Course Outcomes:

Upon successful completion of the course, students will be able to
CO1: Demonstrate an understanding of basic human aspiration and the concept of Natural Acceptance and apply them in personal and professional decision-making.
CO2: Develop self-awareness and practice self-regulation.
CO3: Recognize human-human relationship (Justice) and identify human goals in society.
CO4: Appreciate the harmony in nature and existence.
CO5: Develop as socially and ecologically responsible engineers in handling problems with sustainable solutions (user-friendly and eco-friendly).

Text Books:

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

Reference Books:

1. *Jeevan Vidya: Ek Parichaya,* A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book), Annie Leonard, Free Press, 2010.
4. .*The Story of My Experiments with Truth*, Mohandas Karamchand Gandhi, Fingerprint! Publishing
5. *Small is Beautiful* - E. F Schumacher, Random House, 2011.
6. *Slow is Beautifu*l - 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

Student Activity based Learning

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

	L	T	P	C
CourseCode:2501EE057	0	0	0	2

S.No	Category	Description	Merit/ Participation	Level & Points per event			Minimum Points to earn
				International	National	University	
1	Co-Curricular Activities	Tech Quiz, Coding\Decoding\ poster/ events etc., in technical symposium/ Coding Competition/ SIH	Participation	20	10	5	70
			Merit	40	20	10	
		Projects Developed	-	-	20	10	
		Attending Workshop	Participation	-	10	5	
		Industrial visits	Participation	-	-	5	
2	Extra-Curricular Activities	Cultural Activities Music/ Dance/ Essay Writing/ Painting/ Drawing / Literary Arts etc.	Participation	20	10	5	10
			Merit	40	20	10	
		Sports/ Games	Participation	20	10	5	
			Merit	40	20	10	
3	Outreach Activities	NSS/ Leo Club/ NCC/ eco club / Republic Day/ Viksit Bharat etc,.	Participation	-	10	5	5
4	Entrepreneurship and Innovation	Ideathons/ Hackathons	Participation	20	10	5	5
			Merit	40	20	10	
5	Leadership & Management	Event Volunteer	-	-	10	5	10
		Member of the Organizing Team		-	20	10	
		Coordinator for an Event		-	30	20	
Total							**100**

Award of Grade: (Evaluation will be done in VIII Semester)

Range of Points	Grade	Grade Point
>225	O	10
201-225	A+	9
176-200	A	8
151-175	B+	7
126-150	B	6
100-125	C	5
<100	F	0

Skill Enhancement Courses (SEC)

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	-
2501CS05	Machine Learning with Python	IC			2	2	50	50	100	-
2501EE18	Intelligent Algorithms for Power Systems	AC	2		1	3	50	50	100	-
	Total				**05**	**07**				

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)

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Practice

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

2. Data Analysis with Excel
a. Data manipulation techniques: Sorting, filtering, and grouping data
b. Advanced functions and formulas: INDEX/MATCH, SUMIFS, COUNTIFS, etc.

c. Data visualization with Excel: Creating charts and graphs
d. Using PivotTables for data summarization and analysis

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

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

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

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

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

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

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

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

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

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

Additional Practice:

1. **Basic Data Analysis:** Import a dataset into Excel and perform basic data analysis tasks such as sorting, filtering, and creating simple charts to visualize the data.

2. **Expense Tracker:** Create a spreadsheet to track your expenses. You can have columns for date, item description, category, and amount. Use formulas to calculate totals and analyze your spending habits.

3. **Data modeling and extracting statistics from dataset:** Connecting Power BI to local data files and cloud servers (COVID19 dataset will be imported into the Power BI for visualization).

Text Books:

1 Learn Power BI - Second Edition: A comprehensive, step-by-step guide for beginners to learn real-world business intelligence 2nd Edition,ISBN: 9781801811958.

2 Power BI Beginner: Zero to Hero in Power BI Desktop by Philip Seamark, ISBN 1691641227.

Reference Books:

1 Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life by Devin Knight and Siddharth Mehta.

2 Learn Power BI: A Beginner's Guide to Analyzing Data and Creating Reports with Power BI by Murilo Miranda.

Web Links:

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

Business Intelligence & AI Tools Lab

(Common to CE, EEE, ME, ECE, CSE, AIML, CSE(DS), PT & Min.E)
(Revised Syllabus for batches admitted from 2026 onwards)

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

Course Outcomes

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

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

MODULE A — Spreadsheet Analytics with Microsoft Excel

1. Excel Fundamentals

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

2. Data Analysis in Excel

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

3. PivotTables and Summarization

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

4. Advanced Excel Features

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

MODULE B — Business Intelligence with Microsoft Power BI

5. **Getting Started with Power BI**
    a. Overview of Power BI and its advantages over Excel for large datasets.
    b. Installing Power BI Desktop; understanding the interface (ribbons, panes, views).
    c. Importing data from multiple sources (Excel, CSV, web).
6. **Data Preparation with Power Query**
    a. Cleaning, shaping and filtering data in the Power Query Editor.
    b. Combining data from different sources (append and merge).
    c. Loading the prepared data into the Power BI model.
7. **Data Modeling and DAX**
    a. Creating relationships between tables; star-schema basics.
    b. Calculated columns and measures using DAX.
    c. Key DAX functions: CALCULATE, FILTER, RELATED, and date/time functions.
8. **Visualizations and Interactive Dashboards**
    a. Basic and advanced visuals: bar, line, pie, TreeMap, KPI cards.
    b. Slicers, filters and drill-down for interactivity.
    c. Designing an interactive dashboard with bookmarks and drill-through.

MODULE C — Working with AI Tools

9. **Exploring the AI Tool Landscape**
    a. Introduction to popular AI assistants: ChatGPT, Claude, Gemini, Perplexity.
    b. Comparing tools across tasks — summarizing, simple coding, and reasoning.
    c. Building a comparison matrix and choosing the right tool for a task.
10. **Prompt Engineering Essentials**
    a. Anatomy of a good prompt; clarity, context and constraints.
    b. Prompt patterns: persona, few-shot, chain-of-thought, and structured (JSON) output.
    c. Iterating and refining prompts for better results.
11. **AI for Research and Verification**
    a. Using AI for topic research, explanations and quick literature scans.
    b. Three-step verification chain: cross-check claims against primary sources.
    c. Recognizing hallucinations, bias and link-rot; the limits of AI.
12. **Responsible and Ethical Use of AI**
    a. Academic integrity, plagiarism and proper acknowledgement of AI use.
    b. Privacy, data safety and never sharing sensitive information.
    c. Drafting a simple personal/class “AI use policy”.
13. **AI for Content and Presentations**
    a. Summarizing documents and Q&A over your own notes (e.g., NotebookLM).
    b. Generating outlines, write-ups and email drafts with AI assistance.
    c. Auto-creating slide decks from a brief (e.g., Gamma) and refining them.
14. **AI-Assisted Data Analysis (Capstone)**
    a. Using AI to write/explain Excel formulas and draft DAX measures.
    b. Cleaning and interpreting a dataset and explaining charts with AI help.
    c. Mini-project: clean a dataset in Excel, build a Power BI dashboard, and use AI to generate insights and a short summary report.

Cornerstone projects :

S. No	Project Title	Project Description	Dataset URL
1	**Indian General Election Analytics Dashboard**	Develop an interactive dashboard to analyze election results across all Indian states and union territories. The project includes Spreadsheet Analytics using Microsoft Excel, Business Intelligence using Microsoft Power BI, and AI insights to visualize ruling parties, constituencies won, vote share, voter turnout, alliance performance, and state-wise electoral trends through interactive reports and maps.	https://results.eci.gov.in/
2	**Global Renewable Energy Analytics Dashboard**	Design a Business Intelligence dashboard to analyze renewable energy production across countries. The project focuses on energy generation by source, installed capacity, consumption patterns, and sustainability trends using Excel, Power BI dashboards, and AI-driven insights for comparative analysis.	https://ourworldindata.org/energy
3	**Air Quality Index (AQI) Analytics Dashboard**	Build an interactive dashboard to monitor air pollution levels across cities and regions. Analyze AQI values, pollutant concentrations (PM2.5, PM10, NO_2, SO_2), seasonal trends, and pollution hotspots using Excel, Power BI visualizations, and AI-powered insights.	https://www.kaggle.com/datasets/rohanrao/air-quality-data-in-india
4	**FIFA World Cup Analytics Dashboard**	Create a comprehensive dashboard to analyze FIFA World Cup tournaments by exploring team performance, match results, goals scored, player statistics, venues, and championship history. The project utilizes Excel, Power BI, and AI insights to identify historical trends and performance patterns.	https://www.kaggle.com/datasets/abecklas/fifa-world-cup
5	**Global Earthquake Analytics Dashboard**	Develop a dashboard that visualizes earthquake occurrences worldwide by analyzing magnitude, depth, geographic location, frequency, and affected regions. Excel is used for data preparation, while Power BI and AI	https://earthquake.usgs.gov/earthquakes/feed/v1.0/csv.php

		insights help identify seismic trends and risk-prone areas.	
6	**Flight Delay Analytics Dashboard**	Design an interactive airline performance dashboard to evaluate flight delays, cancellations, airline efficiency, airport performance, and seasonal travel trends. The project combines Excel, Power BI, and AI insights to support operational analysis and decision-making.	https://www.kaggle.com/datasets/usdot/flight-delays
7	**Global CO_2 Emissions Analytics Dashboard**	Analyze global carbon dioxide emissions by country, region, and industry using Power BI. The dashboard presents emission trends, sector-wise contributions, historical comparisons, and sustainability indicators through Excel, interactive visualizations, and AI-generated insights.	https://ourworldindata.org/co2-and-greenhouse-gas-emissions
8	**Olympics Performance Analytics Dashboard**	Create a Power BI dashboard to evaluate Olympic Games performance by analyzing medal counts, athlete achievements, country rankings, sports categories, and historical participation. Excel and AI-powered visualizations are used to generate meaningful sports analytics and comparative insights.	https://www.kaggle.com/datasets/the-guardian/olympic-games
9	**Netflix Content Analytics Dashboard**	Develop an interactive dashboard to analyze Netflix's content library by genre, country, release year, ratings, duration, and content trends. Excel is used for preprocessing, while Power BI and AI insights help identify viewing patterns and content distribution across regions.	https://www.kaggle.com/datasets/shivamb/netflix-shows
10	**Global Education Statistics Dashboard**	Build a Business Intelligence dashboard to analyze global education indicators such as literacy rates, school enrollment, graduation rates, education expenditure, and gender parity. Using Excel, Power BI, and AI insights, the dashboard supports comparative analysis of educational development across countries.	https://data.worldbank.org/topic/education

11	**Global Food Production Analytics Dashboard**	Develop an interactive dashboard to analyze global food production, crop yields, agricultural output, and production trends across countries. The project incorporates Spreadsheet Analytics using Microsoft Excel, Business Intelligence using Microsoft Power BI, and AI-powered insights to identify production patterns, top-producing countries, and long-term agricultural trends through interactive visualizations.	https://ourworldindata.org/food-supply
12	**Road Traffic Fatalities Analytics Dashboard**	Design a Business Intelligence dashboard to analyze road traffic accidents and fatalities across countries. The dashboard visualizes accident rates, fatalities by road users, regional comparisons, and yearly trends using Microsoft Excel, Power BI, and AI insights to support road safety analysis and policy evaluation.	https://www.kaggle.com/datasets/data125661/india-road-accident-dataset
13	**Global Population Demographics Dashboard**	Build a comprehensive dashboard to analyze population growth, age distribution, urbanization, life expectancy, fertility rates, and demographic changes across countries. The project uses Excel for data preparation, Power BI for visualization, and AI insights to identify demographic trends and support population-based decision-making.	https://ourworldindata.org/population
14	**International Tourism Analytics Dashboard**	Create an interactive dashboard to evaluate global tourism trends by analyzing international tourist arrivals, tourism receipts, popular destinations, and regional tourism growth. Using Microsoft Excel, Power BI, and AI-driven insights, the dashboard enables comparative analysis of tourism performance across countries and years.	https://data.worldbank.org/indicator/ST.INT.ARVL

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

Text Books

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

Reference Books

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

Web Links / e-Resources

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

Note:

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

Machine Learning With Python

	L	T	P	C
Course Code:2501CS05	**0**	**0**	**2**	**2**

Course Outcomes:

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

CO1 Underst& the basic concepts of Python language.
CO2 Generate, analyze, & interpret data using Python
CO3 Analyze several problems & apply ML techniques to solve it
CO4 Design prediction & classification models
CO5 Underst& the basic concepts of deep neural network model & design the same.

Mapping of Course Outcomes with Program Outcomes:

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	2	3	1						1	1		
CO2	2	3	1						1	1		
CO3	2	3	1						1	1		
CO4	2	3	1						1	1		
CO5	2	3	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	

PRACTICE:

1. Basic Programs: Introduction to Python- Importing datasets- Reading data from different file formats Data Pre-processing & visualization
2. P&as: Missing Data P&as Overview, Categorical Data, Several other data operations through P&as & Time Series data analysis.
3. Numpy:
   3.1) Creating N-dims arrays Some Mathematical functions, Indexing & slicing.
   3.2) Numeric operations using NumPy
4. Matplotlib & Seaborn: Histogram, Line plot, Scatter plot, bar plot, BoxPlot, Heat Map Xlabel, Ylabel, Xticks, Yticks, title Overview.
5. Regression: Implementation of various types of regression using any dataset.

6. Decision Tree: Implementation of the decision tree based ID3 algorithm using an appropriate data set & verification of inductive bias of decision tree learning algorithm
7. Support Vector Machine: Implementation of SVM for h&written character recognition using MNIST dataset.
8. KNN: Implementation of k-Nearest Neighbor Classification
9. Naive Bayes classification :Implementation of Naive Bayes classification
10. Backpropagation algorithm: Implementation of Backpropagation algorithm for deep neural networks. Study of impact on performance when activation functions are changed. Consider three common activations functions. - Sigmoid, Relu, Tanh

Additional Practice:

1. Implement logistic regression.
2. Implementation of Recommendation systems
3. Implement Applications: Natural Language Processing Projects: Automatic Review Analyzer

Reference Books:

1 Pattern Recognition & Machine Learning by C. M. Bishop. First Edition. Springer (ISBN: 978-149393843)

2 Machine Learning: The Art & Science of Algorithms that Make Sense of Data, P. Flach. First Edition, Cambridge University Press.(ISBN: 978-1107422223)

Web Links:

1 https://ml-course.github.io/master/labs/Lab%201%20-%20Tutorial

2 https://www.nielit.gov.in/calicut/calicut/content/machine-learning-using-python-smart-lab-free-course

3 Machine Learning with MATLAB - MATLAB & Simulink (mathworks.com)

Intelligent Algorithms for Power Systems

	L	T	P	C
Course Code:2501EE18	**2**	**0**	**1**	**3**

Course Outcomes:

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

CO1	Formulate and apply Artificial Neural Networks (ANN) for power system applications.
CO2	Design and apply Fuzzy Logic Controllers (FLC) for power system operational and control problems.
CO3	Implement Genetic Algorithms (GA) to optimize operational parameters in power systems.
CO4	Apply metaheuristic evolutionary techniques (PSO, ACO, BFO) to solve complex power system optimization problems.
CO5	Evaluate and compare the performance of hybrid intelligent techniques (e.g., ANFIS) for dynamic power 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	2	3	2	2					1	1	
CO2	2	3	2	2					1	1	
CO3	2	3	1	1					1	1	
CO4	2	3	2	2					1	1	
CO5	2	3							1	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

Artificial Neural Networks: Artificial neurons, perceptron, multilayer perceptron (MLP), backpropagation algorithm; Probabilistic Neural Networks (PNN); Feedforward vs. recurrent architectures; Hyperparameter tuning, dataset division, and training/validation/testing dynamics in power system applications.

Practice :

1. Perceptron implementation for logic operations and simple pattern classification.
2. Multilayer Perceptron (MLP) for short-term active and reactive power load forecasting.
3. Probabilistic Neural Networks (PNN) for transmission line fault classification (LG, LL, LLG, LLLG).

UNIT - II

Fuzzy Logic Systems: Classical sets vs. Fuzzy sets, membership functions (Gaussian, Triangular, Trapezoidal); Fuzzy set operations and properties; Fuzzification, Rule-base generation, Fuzzy Inference Systems (Mamdani and Sugeno types), Defuzzification methods; Design of Fuzzy Logic Controllers (FLC) for dynamic systems.

Practice :

1. Design and tuning of Membership Functions and Rule-Base using MATLAB Fuzzy Logic Designer tool.
2. Fuzzy Logic Controller (FLC) design for Automatic Voltage Regulator (AVR) of a synchronous generator.
3. Fuzzy-based Maximum Power Point Tracking (MPPT) for Solar PV Systems under varying solar irradiance.

UNIT- III

Genetic Algorithms: Fundamentals of Genetic Algorithm (GA), biological inspiration; Binary and real-coded chromosome representation; Genetic operators: Selection mechanisms (Roulette wheel, Tournament), Crossover techniques, Mutation operators; Fitness function formulation, penalty functions for constraint handling; Elitism and convergence criteria.

Practice :

1. Implementation of Binary and Real-Coded Genetic Algorithms for test function minimization.
2. Optimal placement and sizing of Distributed Generation (DG) units in distribution networks using GA.
3. Optimal Capacitor Placement (OCP) in radial distribution systems for loss reduction and voltage stability using GA.

UNIT- IV:

Evolutionary Techniques & Optimization: Introduction to metaheuristic optimization; Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), Bacterial Foraging Optimization (BFO); Mathematical modelling of swarm behaviour; Constrained and unconstrained power system optimization problems; Convergence metrics and comparison with conventional methods.

Practice:

1. Implementation of Particle Swarm Optimization (PSO) for benchmark mathematical test functions.
2. Economic Load Dispatch (ELD) of multi-generator power plants including valve-point loading effects using PSO.
3. Optimal Reactive Power Dispatch (ORPD) for voltage profile improvement using swarm intelligence.

UNIT -V

Hybrid Intelligent Systems: Limitations of standalone ANN and Fuzzy systems; Introduction to Hybrid Intelligent Systems; Adaptive Neuro-Fuzzy Inference System (ANFIS) architecture; Hybrid learning algorithms (Gradient Descent + Least Squares Estimation); Subtractive clustering and Grid partitioning; Performance evaluation metrics (MSE, RMSE, settling time, overshoot, and convergence rate).

Practice:

1. Design and training of an ANFIS network using MATLAB Neuro-Fuzzy Designer tool.
2. ANFIS-based Load Frequency Control (LFC) in a two-area interconnected power system.
3. Comparative performance analysis of conventional PID, ANN, Fuzzy, and ANFIS controllers for power system stability and tracking accuracy.

Text Books

1. **S. N. Sivanandam & S. N. Deepa**, *Principles of Soft Computing*, 3rd Edition, Wiley India, 2018.

2. **D. P. Kothari & J. S. Dhillon**, *Power System Optimization*, 2nd Edition, PHI Learning Pvt. Ltd., 2011.

Reference Books

1. **Timothy J. Ross**, *Fuzzy Logic with Engineering Applications*, 4th Edition, John Wiley & Sons, 2016.

2. **David E. Goldberg**, *Genetic Algorithms in Search, Optimization, and Machine Learning*, Pearson Education, 2009.

3. **K. Y. Lee & M. A. El-Sharkawi**, *Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems*, IEEE Press / Wiley-Interscience, 2008.

Web Links

1. **NPTEL Course:** *Fuzzy Logic and Neural Networks* — Swayam/NPTEL IIT Kharagpur https://onlinecourses.nptel.ac.in/noc21_ge07/preview

2. **NPTEL Course:** *Fuzzy Sets, Logic and Systems & Applications* — Swayam/NPTEL IIT Kanpur https://nptel.ac.in/courses/108104157

3. **MATLAB Documentation:** *Neuro-Fuzzy Modeling & ANFIS (MathWorks)* https://www.mathworks.com/help/fuzzy/adaptive-neuro-fuzzy-inference-systems.html

Value Added Courses (VAC)

Course Code	Course Name	Level	L	T	P	C	CIE	SE E	Total	Pre-requisite
2501CS04	Internet of Things	FC			1	1	100	-	100	-
2501UC11	Employability skills -1	FC			3	0	100	-	100	-
2501UC13	Employability skills -2	FC			3	0	100	-	100	ES-1
2501CS02	Data Analysis Using Python	IC			2	2	50	50	100	PPSC
2501UC14	Employability skills -3	IC			3	0	100	-	100	ES-2
2501UC15	Employability skills -4	IC			3	0	100	-	100	ES-3
2501UC16	Employability skills -5	AC			3	1	100	-	100	ES-4
2501AC06	Advanced Data Structures & Algorithms	IC	2		1		100	-	100	DS
	Total		**2**		**19**	**04**				

Data Analysis using Python

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

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	1		2			1	1		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 create a simple calculator GUI application using functions for arithmetic operations.

3) Write a Python program to build a todo list GUI application with functions for adding, deleting, and updating tasks.

3.Save a multi-page PDF with different visualizations.

Reference Books:

1. Python for Everybody Exploring Data in Python 3, Charles Russell Severance, SueBlumenberg. ISBN:978-153051120
2. Code with Python: Suresh Sundaradasu,S.Rama Sree ISBN: 978-9355017574
3. Python Programming, Dr.Maganti Venkatesh,Monelli Ayyavaraiah,Niveditha Ravindra
   Pandey, NeethumolSabu,Charulatha Publications ISBN:978-93-5577-695-6

4. Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython, Wes McKinney, O'Reilly Media,**ISBN:** 978-1491957660

Web Links:
1. https://www.hackerrank.com/

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

Internet of Things

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

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

Practice:

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

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

Additional Practice (Any 2 from the following)

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

Reference Books:

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

Web Links:

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

Employability Skills- I

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

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

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

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

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

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

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

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

Aptitude:

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

Reasoning:

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

Verbal:

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

Text Books:

1. Quantitative Aptitude –Dr. R. S. Aggarwal, S CHAND, **ISBN** · 9789355012326.

2. A Modern Approach to Verbal and Non-Verbal Reasoning – Dr. R. S. Aggarwal, **ISBN**-13. 978-9352832163.

3. Quick Learning Objective General English – Dr. R. S. Aggarwal, S CHAND, **ISBN**-13. 978-8121922111.

Reference Books:

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

2.How To Crack Test of Reasoning Verbal , Non-Verbal & Analytical – Jaikishan and Premkishan,Arihant Publications, NEW EDITION 2024,**ASIN : B0CRQ9BVBC**.

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

Web Links:

1. www.indiabix.com

2. www.bankersadda.com

Employability Skills- IV

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

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

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)

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

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

Advanced Data Structures & Algorithms

	L	T	P	C
Course Code:2501AC06	**2**	**0**	**1**	**0**

Course Outcomes:

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

CO1: Analyze the algorithms efficiency and hashing techniques for searching.

CO2: Illustrate the concepts of search trees and operations of Priority Queues.

CO3: Analyze the algorithms of Divide & Conquer and Greedy paradigms.

CO4: Analyze the algorithms of Dynamic Programming paradigm.

CO5: Design the algorithms of Backtracking and Brach & Bound paradigms.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

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

Practice:

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

UNIT – II

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

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

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

Practice:

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

UNIT – III

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

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

Practice:

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

UNIT – IV

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

Practice:

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

UNIT – V

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

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

Practice:

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

Text Books:

1. Fundamentals of Data Structures in C++, Horowitz, Ellis; Sahni, Sartaj; Mehta, Dinesh, 2ndEdition Universities Press.
2. Computer Algorithms in C++, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran,2nd Edition University Press.

Reference Books:

1. Data Structures and program design in C, Robert Kruse, 2nd Edition Pearson Education Asia.
2. An introduction to Data Structures with applications, Trembley& Sorenson, McGraw Hill
3. The Art of Computer Programming, Vol.1: Fundamental Algorithms, Donald E Knuth, Addison - Wesley.
4. Data Structures using C & C++: Langsam, Augenstein &Tanenbaum, Pearson

Web Links:

1. https://archive.nptel.ac.in/courses/106/102/106102064/
2. https://archive.nptel.ac.in/courses/106/106/106106131/
3. http://peterindia.net/Algorithms.html

Mandatory Courses (MC)

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

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

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

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

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

UNIT – III
Environmental Pollution and Solid Waste Management:
Environmental Pollution: Definition, Cause, effects, and control measures of:
a. Air Pollution.
b. Water Pollution
c. Soil Pollution
d. Marine Pollution

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

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

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

Text Books:

1. Textbook of Environmental Studies for Undergraduate Courses, Erach Bharucha for University Grants Commission, Universities Press. ISBN: 9788173718625.
2. Environmental Studies, Palaniswamy – Pearson education. ISBN: 978-9332528277.

Reference Books:

1. Textbook of Environmental Science, Deeksha Dave and E.Sai Baba Reddy, Cengage Publications. ISBN: 978-8131517604.
2. Textbook of Environmental Sciences and Technology by M.Anji Reddy, B.S Publication. ISBN: 9385433385.
3. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications. ISBN: 978-817087380.

Web Links:

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

Constitution of India

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

	L	T	P	C
Course Code: 2501AC02	**2**	**0**	**0**	**0**

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

CO1: Explain historical background of the constitution making and its importance for building a democratic India

CO2: Compare the functioning of three wings of the government i.e.., executive, legislative and judiciary

CO3: Interpret the value of the fundamental rights and duties for becoming good citizen of India

CO4: Compare the decentralization of power between central, state and local self-government

CO5: Extend the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Indian Constitution:

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

UNIT – II

Union Government and its Administration Structure of the Indian Union:

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Text Books:

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

Reference Books:

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

Web Links:

1. nptel.ac.in/courses/109104045/
2. nptel.ac.in/courses/11104065/

Research Methodology

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

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

UNIT – II

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

UNIT – III

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

UNIT – IV

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

UNIT – V

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

Text Books:

1. Research Methodology Methods & Techniques, C.R. Kothari – New Age international Publishers, Reprint. ISBN: 97881225015223.
2. A Hand Book of Methodology of Research, Rajammall, P. Devadoss and K. Kulandaivel, RMM Vidyalaya press. ISBN: 9780367135720.

Reference Books:

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

Web Links:

1. https://nptel.ac.in/courses/127106227
2. https://archive.nptel.ac.in/courses/121/106/12110607/

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

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

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

CO1: Compare various types of Intellectual Property rights.
CO2: Discuss Intellectual Property 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: 978817802774.
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: 978-07077171.
2. Intellectual property rights M.Ashok kumar and Mohd.Iqbal Ali:, Serials Publications. ISBN: 9788183871648.
3. Intellectual Property Rights (Patents & Cyber Law), Dr. A. Srinivas. Oxford University Press, New Delhi. ISBN: 979-8886848229.
4. Intellectual Property- Richard Stim, Cengage Learning, New Delhi. ISBN: 978-0766826656.

Web Links:

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

Indian Knowledge Systems (IKS)

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

	L	T	P	C
Course Code: 2501AC05	**2**	**0**	**0**	**0**

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I
Foundations of Indian Knowledge Systems

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

UNIT – II
Indian Civilization and Philosophical Traditions

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

UNIT – III
Arts, Architecture and Cultural Expressions

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

UNIT – IV
Traditional Knowledge in Health, Environment and Sustainability

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

UNIT – V
Traditional Knowledge and Contemporary Relevance

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

Text Books:

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

Reference Books:

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

Web Links:

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

Minor Stream Courses: Intelligent and Integrated Power Systems

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE22	Electrical Machine Design	FC	3			3	50	50	100	-
2501EE27	Utilization of Electrical Energy	FC	3			3	50	50	100	DCMT
2501EE24	Electrical Distribution System	IC	2	1		3	50	50	100	EPGDS
2501EE26	HVDC Transmission	IC	3			3	50	50	100	PE
2501EE30	Methods & Algorithms for Intelligent Control	IC	2	1		3	50	50	100	-
2501EE23	High Voltage Engineering	IC	3			3	50	50	100	EPTS
2501EE28	Restructured Power Systems	AC	3			3	50	50	100	EPTS
2501EE31	Advance Control Systems	AC	2	1		3	50	50	100	CE
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
2501EE25	Flexible Alternating Current Transmission Systems	AC	3			3	50	50	100	PE
2501EE29	Soft Computing Techniques in Power Systems	AC	2		1	3	50	50	100	PSA
	Total		**28**	**3**	**1**	**32**				

Minor Stream Courses: Power Electronics and Energy Systems

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE13	Electrical Measurements & Instrumentation	IC	2		1	3	50	50	100	-
2501EE34	Alternative Energy Sources	FC	3			3	50	50	100	-
2501EE27	Utilization of Electrical Energy	FC	3			3	50	50	100	DCMT
2501EE35	Special Electrical Machines	IC	2	1		3	50	50	100	ISM
2501EE36	Electric Energy Storage Systems	IC	3			3	50	50	100	AES
2501EE38	Digital Control Systems	AC	2	1		3	50	50	100	CE
2501EE15	Switch Gear & Protection	AC	3			3	50	50	100	EPTS
2501EE33	Energy Audit, Conservation & Management	AC	2	1		3	50	50	100	EPGDS
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
2501EE40	Power Quality	AC	3			3	50	50	100	EPGDS
2501EE37	Hybrid Electric Vehicles	AC	3			3	50	50	100	PE
	Total		**28**	**3**	**1**	**32**				

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

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE43	Electrical safety	FC	3			3	50	50	100	-
2501EE47	Finance for Professionals	FC	3			3	50	50	100	
2501EE41	Foundations of EV & Hybrid Vehicles	FC	3			3	50	50	100	PE
2501EE35	Special Electrical Machines	IC	2	1		3	50	50	100	ISM
2501EE44	EV Power Electronics & Embedded Systems	IC	3			3	50	50	100	EVBT
2501EE42	EV Battery Technology & Power train Development	IC	3			3	50	50	100	PE
2501EE45	EV Design & Analysis	IC	3			3	50	50	100	
2501EE33	Energy Audit, Conservation & Management	AC	2	1		3	50	50	100	EPGDS
2501ME43	EV Charging Infrastructure, Vehicle Testing & Homologation	AC	3			3	50	50	100	-
2501EE46	EV PCB Design & Data Analytics	AC	3			3	50	50	100	
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
	Total		**30**	**2**		**32**				

Minor Stream Courses: Design of Electrical System for Smart Buildings (Industry Integrated Program- L & T)

Course Code	Course Name	Level	L	T	P	C	CIE	SEE	Total	Pre-requisite
2501EE43	Electrical safety	FC	3			3	50	50	100	-
2501EE47	Finance for Professionals	FC	3			3	50	50	100	
2501EC65	Applied Industrial IoT	FC	3			3	50	50	100	IOT
2501EE48	Electrical Power Distribution & Automation	IC	3			3	50	50	100	EPGDS
2501EE35	Special Electrical Machines	IC	2	1		3	50	50	100	ISM
2501EE49	Integrated Approach to Building Services	IC	3			3	50	50	100	-
2501EE33	Energy Audit, Conservation & Management	AC	2	1		3	50	50	100	EPGDS
2501EE50	Building Information Modelling	AC	3			3	50	50	100	-
2501EE51	Advanced Electrical System Design for Builders	AC	3			3	50	50	100	
2501EE52	Extra Low Voltage System Design for Buildings	AC	3			3	50	50	100	
2501EE32	Concept of Smart Grid Technology	AC	2			2	50	50	100	PSA
	Total		**30**	**2**		**32**				

#Syllabus for the industry partner courses will be released in the department as and when required.

Electrical Measurements & Instrumentation

	L	T	P	C
Course Code:2501EE13	**2**		**1**	**3**

Course Outcomes:

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

CO1 Understand different types of instruments for measurement of AC & DC quantities.
CO2 Explain different types of instruments for measurement of power & power factor.
CO3 Identify suitable bridges for measurement of R, L, & C.
CO4 Analyze the effectiveness of Transducers.
CO5 Illustrate the principle of different types of Digital Meters.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	1	0	-	-	-	-	-	-	-
CO2	3	2	1	0	0	-	-	-	-	-	-
CO3	3	2	1	0	0	-	-	-	-	-	-
CO4	2	3	1	0	0	-	-	-	-	-	-
CO5	3	2	1	0	0	-	-	-	-	-	-

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1	-	1
CO2	0	1
CO3	0	1
CO4	0	1
CO5	0	1

UNIT – I

Analog Ammeter & Voltmeters: Classification, Construction of PMMC, Moving Iron and Electrostatic Instruments, deflecting, control and damping torques, Torque equation, Range extension, Errors and compensations.
Instrument transformers: Current and Potential transformers, Construction and Working.

UNIT – II

Measurement of Power & Energy: Electro dynamometer type wattmeter: LPF and UPF, Power factor meters: Dynamometer and MI type (Single phase and Three phase), Single phase induction type energy meters: Construction, theory, torque equation advantages &

disadvantages. Measurement of active & reactive power in single phase & in three phase with balanced loads.

Potentiometers: Introduction to DC & AC Potentiometers – Construction-working.

Practice:

1. Calibration & Testing of single phase energy Meter.
2. Calibration of dynamometer wattmeter using phantom loading.
3. Calibration of PMMC ammeter & voltmeter using Crompton D.C. Potentiometer.
4. Measurement of 3 phase reactive power with single phase wattmeter for balanced Loading.
5. Measurement of 3 phase power with single wattmeter & using two C.Ts.
6. Calibration of LPF wattmeter by direct loading.

UNIT – III

Measurement of Electrical parameters:

DC Bridges - Wheat stone's bridge, Kelvin's double bridge, Loss of charge method, Megger.
AC Bridges - Measurement of inductance and quality factor: Maxwell's bridge, Hay's bridge, Anderson's bridge.
Measurement of capacitance and loss angle: Desauty's bridge, Schering Bridge.

Practice:

1. Measurement of resistance & Determination of Tolerance using Kelvin's double Bridge.
2. Capacitance Measurement using Schering Bridge.
3. Inductance Measurement using Anderson Bridge.

UNIT – IV

Transducers: Definition, Classification, LVDT, Strain Gauge, Thermistors, Thermocouples, Piezo electric and Photo Diode Transducers, Hall effect sensors.

Practice:

1. Determination of the characteristics of a LVDT.

UNIT – V

Digital meters : Digital Voltmeters –Successive approximation DVM, Ramp type DVM and Integrating type DVM, Digital frequency meter, Digital multimeter, Digital tachometer, Digital Energy Meter, CRO- measurement of phase difference and Frequency using lissajious patterns.

Additional practice:

1. Measurement of resistance using Wheatstone bridge.
2. Dielectric oil testing using H.T test Kit.
3. Measurement of Choke coil parameters & single-phase power using three voltmeter & three ammeter method.

Capstone Project:
Design and program a simple digital frequency meter using a low-cost microcontroller (like an Arduino). The microcontroller would count pulses over a fixed time interval and calculate the frequency, displaying it on a small LCD or serial monitor.

Text Books:

1 Electrical Measurements & measuring Instruments by E.W. Golding & F.C.Widdis - 5th Edition - Wheeler Publishing (ISBN: 9780273402022).

2 Modern Electronic Instrumentation & Measurement Techniques by A.D. Helfrick & W.D. Cooper - 5th Edition, PHI (ISBN: 9788120307520).

Reference Books:

1 Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co.Publications (ISBN: 978609578337).

2 Electrical & Electronic Measurements & instrumentation by R.K.Rajput (ISBN: 9788121929899).

Web Links:

1 Electrical Measurements by Buckingham & Price - Prentice – Hall

2 https://archive.nptel.ac.in/courses/108/105/108105153/

3 https://electricalbaba.com/different-types-of-transducers/

Electrical Machine Design

	L	T	P	C
Course Code:2501EE22	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1 Classify the materials used for construction of electrical machines.
CO2: Assess the overall dimensions of transformer.
CO3: Examine the design, performance of transformer.
CO4: Develop the overall dimensions of a rotating machine.
CO5: Analyze the design & performance of rotating machines.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Fundamental Aspects of Electrical Machine Design

Design of machines - design factors - limitation in design - modern trends in electrical machine design – types of magnetic, electric & insulating materials – modes of heat dissipation – cooling of rotating machines – methods of cooling.

UNIT – II

Design of Transformers

Transformer windings – output equation – design of main dimensions-– design of core - choice of flux density – determination of number of turns & length of mean term - resistance & leakage reactance – no load current calculation –cooling of transformers- calculation of number of tubes.

UNIT -III

Design of DC Machines

Output equation –selection of specific magnetic & electric loadings - separation of D & L – estimation of number of conductors, armature slots & conduct dimensions – choice of number of poles & calculation of length of airgap – design of field systems, interpoles & brushes.

UNIT - IV

Design of Induction motors

Output equation -main dimensions – choice of average flux density & ampere conduction for meter — design of stator slots & rotor slots- design of rotor bars end rings– design of wound rotor –calculation of no-load current.

UNIT - V

Design of Synchronous Machines

Types of construction – output equation - main dimensions – short circuit ratio & its effects on the performance – design of rotor –Design of field winding – Design of turbo alternators – Rotor design temperature rise & its effects.

Text Books:

1	A Course in Electrical Machines Design by A.K.Sawhney, Dhan path Rai & Co (ISBN: 97881771013).
2	The Performance & Design of Direct Current Machines by AE Clayton & NN Hancock, CBS Publishers (ISBN-13: 9788123909271).

Reference Books:

1	Performance & Design of A.C. Machines by M.G. Say, ELBS & Pitman & Sons, 4th edition (ISBN:9788123910277).

2 Principles of Electrical Machine Design with computer programmes by S. K. Sen, Oxford & IBH Company Pvt. Ltd. New Delhi (ISBN:9788120415218).

Web Links:

1 https://cusp.umn.edu/electric-machine-design-videos
2 https://nptel.ac.in/courses/108102146
3 https://nptel.ac.in/courses/108/105/108105017

High Voltage Engineering

	L	T	P	C
Course Code:2501EE23	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Recognise the dielectric properties of gaseous materials used in HV equipment.
CO2	Differentiate the break down phenomenon in liquid & solid dielectric materials.
CO3	Acquaint with the techniques of generation of high AC & DC voltages.
CO4	Acquaint with the techniques of generation of high Impulse voltages & currents.
CO5	Getting the knowledge of measurement of high AC - DC - Impulse voltages & current.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Break down phenomenon in Gaseous: Insulating Materials: Types - applications & properties. Gases as insulating media – Collision process – Ionization process – Townsend's criteria of breakdown in gases & its limitations – Streamers Theory of break down – Paschen's law- Paschen's curve.

UNIT – II

Break down phenomenon in Liquids: Liquid as Insulator – Pure & commercial liquids – Breakdown in pure & commercial liquids. Break down phenomenon in Solids: Intrinsic breakdown – Electromechanical breakdown – Thermal breakdown –Breakdown of composite solid dielectrics.

UNIT – III

Generation of High DC voltages: Voltage Doubler Circuit - Voltage Multiplier Circuit – V&e- Graaff Generator. Generation of High AC voltages: Cascaded Transformers – Resonant Transformers –Tesla Coil.

UNIT – IV

Generation of Impulse voltages: Specifications of impulse wave – Analysis of RLC circuit only- Marx Circuit.Generation of Impulse currents: Definitions – Circuits for producing Impulse current waves – Wave shape control - Tripping & control of impulse

UNIT – V

Measurement of High DC & AC Voltages: Resistance potential divider - Generating Voltmeter - Capacitor Voltage Transformer (CVT) - Electrostatic Voltmeters – Sphere Gaps. Measurement of Impulse Voltages & Currents: Potential dividers with CRO - Hall Generator - Rogowski Coils.

Text Books:

1 High Voltage Engineering: Fundamentals by E.Kuffel - W.S.Zaengl - J.Kuffel Elsevier (ISBN: 9780750636346).

2 High Voltage Engineering & Technology by Ryan - IET Publishers (ISBN: 9780852967751).

Reference Books:

1 High Voltage Engineering by M.S.Naidu & V. Kamaraju – TMH Publications (ISBN: 9789383286515).

2 High Voltage Engineering by C.L.Wadhwa - New Age Internationals (P) Limited (ISBN-13: 9781906574727).

Web Links:

1 https://nptel.ac.in/courses/108104048

2 https://bharatsrajpurohit.weebly.com/high-voltage-engineering-course.html

3 http://biet.ac.in/pdfs/EEE-IV-HVE.pdf

Electrical Distribution Systems

	L	T	P	C
Course Code:2501EE24	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Identify various factors of distribution system
CO2	Design the substation & feeders
CO3	Determine the voltage drop & power loss
CO4	Explain the different protection & its coordination
CO5	Explain the effect of compensation for p.f improvement & different methods of voltage control

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

General Concepts: Introduction to distribution systems - Distribution system losses – Coincidence factor – Contribution factor loss factor – Numerical Problems – Load Modelling & Characteristics – Relationship between the load factor & loss factor – Classification & characteristics of loads (Residential, commercial, Agricultural & Industrial)

UNIT – II

Substations & Distribution Feeders: Location of substations: Rating of distribution substation – Service area with 'n' primary feeders – Benefits & methods of optimal location of substations.
Design Considerations of distribution feeders: Radial & loop types of primary feeders – Voltage levels – Feeder loading – Basic design practice of the secondary distribution system.

UNIT – III

System Analysis: Voltage drop & power loss calculations: Derivation for voltage drop & power loss in lines – Uniformly distributed loads & non-uniformly distributed loads - Three phase balanced primary lines.

UNIT – IV

Protection, Coordination & Automation: Objectives of distribution system protection schemes of parallel & Ring main feeders. Coordination of protective devices: General coordination procedure –Various types of coordinated operation of protective devic

UNIT – V
Compensation for Power Factor Improvement & Voltage Control: Capacitive compensation for power factor control – Different types of power capacitors – shunt & series capacitors – Effect of shunt capacitors (Fixed & switched) – Effect of series capacitors – Power factor correction – Capacitor allocation – Procedure to determine the best capacitor location, Voltage Control: Equipment for voltage control– Effect of AVB/AVR – Line drop compensation

Text Books:

1 "Electric Power Distribution system, Engineering" – by Turan Gonen, McGraw hill Book Company. 3rd edition (ISBN: 978148220702).
2 Electric Power Distribution-by A. S. Pabla, Tata McGraw-Hill Publishing Company, 7th edition (ISBN: 9789389538397).

Reference Books:

1 Electrical Distribution Systems by Dale R. Patrick & Stephen W. Fardo, CRC press (ISBN: 9781439804728).
2 Electrical Power Distribution Systems by V. Kamaraju, Right Publishers (ISBN: 9781259081743).

Web Links:
1 nptel.ac.in/courses/108105067/
2 nptel.ac.in/courses/108102047/
3 nptel.ac.in/Clarify_doubts.php?subjectId=108106025

Flexible Alternating Current Transmission Systems

	L	T	P	C
Course Code:2501EE25	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Explain the concepts of FACTS controller & power flow control in transmission lines.
CO2	Explain the operation & control of voltage & current source converters.
CO3	Explain the different methods of compensations using shunt compensators.
CO4	Explain the different methods of compensations using series compensators.
CO5	Analyze the operation of the Unified Power Flow Controller (UPFC) & Interline power flow controller (IPFC).

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to FACTS: Power flow in an AC System – Loading capability limits – Dynamic stability considerations – Importance of controllable parameters – Basic types of FACTS controllers – Benefits from FACTS controllers – Requirements & characteristics of high-power devices – Voltage & current rating – Losses & speed of switching – Parameter trade–off devices.

UNIT – II

Voltage source converters (VSC): Voltage source converter (VSC) – Single phase full-wave bridge converter – Square wave voltage harmonics for a single–phase bridge converter – Three–phase full-wave bridge converter - Transformer connections for 12 pulse operation.

Current Source Converter (CSC): Three–phase current source converter– Comparison of current source converter with voltage source converter.

UNIT – III

Shunt Compensators: Objectives – Mid–point voltage regulation for line segmentation – End of line voltage support to prevent voltage instability – Improvement of transient stability – Power oscillation damping. Variable Impedance Type VAR Generator: Thyristor Switched/Controlled Reactor (TSR/TCR) – Thyristor Switched Capacitor (TSC) –Fixed Capacitor Thyristor Controlled Reactor (FC-TCR) - Thyristor Switched Capacitor & Thyristor Controlled Reactor (TSC–TCR) - Switching Converter type VAR generator. Principle of operation & comparison of SVC & STATCOM.

UNIT – IV

Series Compensators: Concept of series capacitive compensation – Improvement of transient stability Power oscillation damping – Functional requirements. Variable Impedance type series compensators – GTO Thyristor controlled Series Capacitor (GSC) – Thyris

UNIT – V

Combined Compensators: Schematic & basic operating principles of unified power flow controller (UPFC) & Interline power flow controller (IPFC) – Controller applications of transmission lines.

Text Books:

1 “Understanding FACTS” N.G.Hingorani & L.Guygi, IEEE Press. Indian Edition is available:– Standard Publications (ISBN: 9788186308790).

2 Flexible AC Transmission systems, Song.Y. H& Johns. A.T, IET Press (ISBN: 9788190858809).

Reference Books:

1 “Flexible ac transmission system (FACTS)” Edited by Yong Hue Song & Allan T Johns, Institution of Electrical Engineers, London (ISBN: 9788190858809).

2 Thyristor-based FACTS Controllers for Electrical Transmission Systems, by R.MohanMathur & Rajiv k.Varma, Wiley (ISBN: 9788126532247).

Web Links:

1 https://nptel.ac.in/courses/108/102/108102179/

2 https://nptel.ac.in/courses/108/107/108107157/

3 https://nptel.ac.in/courses/108/107/108107114/

HVDC Transmission

	L	T	P	C
Course Code:2501EE26	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Explain different types of HVDC levels & basic concepts
CO2	Explain the operation of converters
CO3	Explain the control concept of reactive power control & AC/DC load flow
CO4	Explain the converter faults & protection methods.
CO5	Explain the generation & calculation of harmonic effects & design low, high pass filters.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission.

UNIT – II

Analysis of HVDC Converters:

Choice of converter configuration – analysis of Graetz – characteristics of 6 pulse & 12 pulse converters –Cases of two 3 phase converters in star–star mode – their performance.

Converter & HVDC System Control:

Principal of DC Link Control – Converters Control Characteristics – Firing angle control – Current & extinction angle control – Effect of source inductance on the system – Starting & stopping of DC link - Power Control.

UNIT – IV

Converter Fault & Protection: Converter faults – protection against over current & over voltage in converter station – surge arresters –smoothing reactors – DC breakers –Audible noise-space charge field corona effects on DC Lines-Radio interference.

UNIT – V

Harmonics & Filters: Generation of Harmonics –Characteristics harmonics, calculation of AC Harmonics, Non Characteristics harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics – Effect of Pulse number on harmonics. Types of AC filters, Design of Single tuned filters –Design of High pass filters

Text Books:

1	"HVDC Power Transmission Systems ", K. R. Padiyar - New Age International (p) Limited – 4th edition, 2024.(ISBN: 978-8122437850)
2	HVDC Transmission by S.Kamakshaiah & V. Kamaraju-Tata McGraw–Hill(ISBN: 978-071072533)

Reference Books:

1	"HVDC Transmission", J. Arrialga - Peter Peregrinus Ltd. – London. (ISBN:978-0852969410)
2	Direct Current Transmission – by E. W. Kimbark, John Wiley & Sons.(ISBN: 978-0471475804)

Web Links:

1	https://nptel.ac.in/courses/108104013
2	http://nptel.ac.in/courses/10811040/22

Restructured Power Systems

Course Code:2501EE28	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1	Illustrate the importance of power system deregulation & restructuring.
CO2	Compute available Transfer Capability
CO3	Analyse transmission congestion & Estimate loss allocation in Power System
CO4	Compute electricity pricing in deregulated environment
CO5	Analyse dem& response in smart grid systems.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction Philosophy of market models, Concepts in micro-economics, Centralized & de-centralized Dispatch Philosophies – Restructuring models – Independent system operator (ISO) – Power Exchange– Market operations – Market Power – St&ard cost – Transmission Pricing – Congestion Pricing – Management of Inter zonal/Intra zonal Congestion, Restructuring Issues in Indian Power Sector, Electricity Regulation Act 203.

UNIT – II

Structure of OASIS – Processing of Information – Transfer capability on OASIS – Definitions Transfer Capability Issues – ATC – Total transfer capability between two points(TTC) – transmission reliability margin(TRM) – Capacity Benefit Margin(CBM) calculations –Methodologies to calculate ATC.

Introduction to congestion management – Methods to relieve congestion, Day Ahead Market- Online power trading.

UNIT – III

Introduction – Electricity price volatility electricity price indexes – Challenges to electricity pricing - Market clearing price– Construction of forward price curves – Short–time price forecasting, Locational Marginal Price (LMP) calculation & properties, Financial Transmission Rights (FTRs), Inverse dem& curves, supply curves, market clearing price, social benefit, deadweight loss, long-run & short-run costs. Transmission Pricing
Cost components, Postage Stamp Method, Megawatt Mile Method, Contract Path Method

UNIT – IV

Introduction – Operational planning activities of ISO – The role of ISO in pool & bilateral markets- experience of deregulation in some of the developed countries & Challenges in deregulating electric markets in developing countries – Operational plan

UNIT – V

Dem& response, Potential benefits of dem& response in smart grid, enabling smart technologies for dem& response, control devices for dem& response, Monitoring & communication system. Dem& response for Electric Vehicles, Examples. Ancillary Services within Smart Grid framework: Reactive power as an ancillary service.

Text Books:

1 Operation of Restructured Power System by Kankar Bhattacharya, Math. Bollen, Jaap E. Daalder, Kluver Academic Publisher .(ISBN: 978-0792373971)

2 Restructured Power Systems: and It's Key Issues by J. Sreenivasulu, V. Sankar, Lambert Academic Publishing, 2022.(ISBN : 978-6139460441)

Reference Books:

1 Power System Deregulation by P Srinivasa Varma & V. Sankar, Lambert Academic Publishing.(ISBN : 978-6202071901)

2 "Power system Restructuring & Deregulation", Loi Lei Lai ,John Wiley & Sons Ltd., England.(ISBN: 978-0471495000)

Web Links:

1 https://archive.nptel.ac.in/courses/108/101/1081105/

2 https://www.yumpu.com/en/document/read/20681876/introduction-to-deregulation-in-power-industry-nptel

3 http://kcg.digimat.in/nptel/courses/video/108102047/L08.html

Soft Computing Techniques In Power Systems

	L	T	P	C
Course Code:2501EE29	**2**	**0**	**1**	**3**

Course Outcomes:

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

CO1 Underst& the concept of Artificial Intelligence
CO2 Analyze & mathematically model Artificial Neural Network.
CO3 Underst& the concept of Fuzzy Systems.
CO4 Analyze the mathematically model & apply it for various optimization algorithms.
CO5 Apply various intelligent algorithms to solve practical power system problems.

Mapping of Course Outcomes with Program Outcomes:

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

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: Concept of artificial intelligence, Problem solving methods & searching techniques, classification of optimization techniques like conventional methods, heusrustic methods & meta- heuristic methods.

UNIT – II

Artificial Neural Networks: Fundamental concepts, basic models, Learning rules, multilayer feed-forward networks, back-propagation training algorithm, radial basis function & recurrent networks, supervised & unsupervised learning.

UNIT – III

Fuzzy control methods: Introduction to fuzzy logic controller, types of fuzzy logic controllers, basic structure of fuzzy knowledge based controllers, fuzzification & defuzzification methods, applications of fuzzy logic control.

UNIT – IV

Optimization algorithms: Search techniques, conventional & nonconventional optimization, implementation of genetic algorithm & particle swarm optimization using conventional & non conventional optimization techniques

UNIT – V

Applications in Power System: Short term & long term load forecasting, economic load dispatch scheduling, hydro thermal scheduling, optimal power flow, identification & classification of faults.

Text Books:

1	Understanding Neural Networks & Fuzzy Logic, Stamatios V. Kartalopoulos. IEEE Press.(ISBN: 9780780311282)
2	Neural Networks, Simon Haykin. Pearson Education Asia.(ISBN: 9789332570313)

Reference Books:

1	Hand book of Genetic Algorithms, L. Davis, Van Nostr& Reinhold.(ISBN: 97804420173)
2	Intelligent Control System, M. M. Gupta IEEE Press.(ISBN: 9780780310636)

Web Links:

1	https://archive.nptel.ac.in/courses/106/105/106105173/
2	https://onlinecourses.nptel.ac.in/noc24_ee32/preview

Methods & Algorithms for Intelligent Control

Course Code:2501EE30	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1	Design feedback controllers for complex dynamic systems using ANN.
CO2	Design fuzzy logic-based controller for dynamic systems.
CO3	Construct TS fuzzy models for complex dynamic systems.
CO4	Formulate hybrid controllers by combining the concepts of Genetic Algorithm & BioInspired algorithms with ANN.
CO5	Formulate hybrid controllers by combining the concepts of Genetic Algorithm & BioInspired algorithms with Fuzzy logic.

Mapping of Course Outcomes with Program Outcomes:

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

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: Introduction to intelligent control, comparison study between conventional & intelligent control, intelligent supervisory control, intelligent adaptive control.

UNIT – II

Neural network based control: Introduction to Neural Network, theory of neural network for classification & function approximation, supervised & unsupervised learning rules, RBF neural network, Support vector machines, intelligent control using Neural Network, Approximation capabilities by feed-forward & recurrent neural network, Neuro-control based on back propagation algorithm, system identification with neural network.

UNIT – III

Fuzzy logic control: Introduction to fuzzy set theory & logic, application of fuzzy logic in control system, fuzzy quantization of knowledge, fuzzy controller design, Fuzzy T-S modelling for dynamic system & stability using Lyapunov theory.

UNIT – IV

Genetic algorithm & control: Basic theory & operations of Genetic algorithm, GA based control system, optimization problem using GA related to control & other engineering problems.

UNIT – V

Bio-inspired evolutionary algorithms: Bio-inspired evolutionary algorithms – like Particle swamp optimization (PSO), simulated annealing, Fire-fly optimization, bacterial foraging etc – only the concepts & case studies related control problems.

Text Books:

1	Intelligent Control: Power Electronic Systems (Monographs in Electrical and Electronic Engineering, Dote, Yasuhiko - Hoft, Richard G.(ISBN: 9780198564669) IEEE Pres.
2	Genetic Algorithms in Search, Optimization, and Machine Learning, Goldberg, Pearson Education.(ISBN : 978-021157673)

Reference Books:

1	Fuzzy logic (intelligence control & information), J. Yen & R. Langari, Pearson, first edition.(ISBN: 978-0135258170)
2	Methods & Applications of Intelligent Control, Spyros G. Tzafestas.

Web Links:

1	https://archive.nptel.ac.in/courses/108/104/108104049/
2	https://archive.nptel.ac.in/courses/106/106/106106126/

Concept of Smart Grid Technology

Course Code:2501EE32	L	T	P	C
	2	0	0	2

Course Outcomes:

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

CO1 Explain the concepts of smart grid & its issues in interconnection.
CO2 Explain various smart grid technologies & its usage in smart applications.
CO3 Describe the concepts of smart substations.
CO4 Analyze micro grids & distributed generation systems.
CO5 Describe the different technologies in smart grid.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction to Smart Grid: Evolution of Electric Grid - Concept of Smart Grid - Definitions - Need of Smart Grid - Functions of Smart Grid - Opportunities & Barriers of Smart Grid - Difference between conventional & smart grid - Concept of Resilient & Self-Healing Grid - Present development & International policies on Smart Grid.

UNIT – II

Information & Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI) - Home Area Network (HAN) - Neighborhood Area Network (NAN) - Wide Area Network (WAN).

UNIT – III

Smart Grid Technologies: Part 1: Introduction to Smart Meters - Real Time Pricing - Smart Appliances - Automatic Meter Reading (AMR) - Outage Management System (OMS) - Plug in Hybrid Electric Vehicles (PHEV) - Vehicle to Grid - Smart Sensors - Home & Building Automation - Net Metering.

UNIT – IV

Smart Grid Technologies: Part 2: Smart Substations - Substation Automation - Feeder Automation. Geographic Information System (GIS) - Intelligent Electronic Devices (IED) & their application for monitoring & protection.

UNIT – V

Micro grids & Distributed Energy Resources: Concept of micro grid - need & applications of microgrid - formation of microgrid - Issues of interconnection - protection & control of microgrid - Integration of renewable energy sources – Demand Response.

Text Books:

1 Integration of Green & Renewable Energy in Electric Power Systems - by Ali Keyhani – Mohammad, N. Marwali - Min Dai Wiley (ISBN: 9780470187760).

2 The Smart Grid: Enabling Energy Efficiency & Demand Response - by Clark W.Gellings – Fairmont Press (ISBN: 9781439815748).

Reference Books:

1 The Advanced Smart Grid: Edge Power Driving Sustainability by andres Carvallo - John Cooper - Artech House Publishers (ISBN: 9781608071272).

2 Smart Grid: Technology & Applications - by Janaka B. Ekanayake - Nick Jenkins -Kithsiri Liyanage - Jianzhong Wu - Akihiko Yokoyama - Wiley publishers (ISBN: 9780470974094).

Web Links:

1 https://nptel.ac.in/courses/108104052/

2 https://nptel.ac.in/downloads/10811040/

3 https://nptel.ac.in/courses/10811040/

Advanced Control Systems

	L	T	P	C
Course Code: 2501EE31	**3**	0	0	**3**

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

CO 1: To familiarize the state space representation in controllable, observable, diagonal & Jordan canonical forms

CO 2: Introduce the concept of controllability & observability tests through canonical forms & design of state feedback controller by pole placement technique & State Observer design.

CO 3: Analysis of a nonlinear system using a describing function approach

CO 4: Illustrate Lypanov'sstability analysis method for linear & non-linear continuous time autonomous systems.

CO 5: Formulation of Euler Lagrange equation for the optimization of typical functional & solutions.

Mapping of course outcomes with program outcomes:

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

Mapping of course outcomes with program Specific Outcomes:

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

UNIT-I: State Space Analysis

State Space Representation – Canonical forms – Controllable canonical form – Observable canonical form - Jordan Canonical Form - Solution of state equation – State transition matrix

UNIT-II: Controllability - Observability & Design of Pole Placement

Tests for controllability & observability for continuous time systems – Time varying case – Minimum energy control – Time invariant case – Principle of duality - Effect of state feedback on controllability & observability – Design of state feedback control through pole placement.

UNIT-III: Nonlinear Systems

Introduction to nonlinear systems - Types of nonlinearities. Introduction to phase plane analysis -Singular points; Describing function - basic concepts - Describing functions of non- linearity's.

UNIT-IV: Stability analysis by Lyapunov Method

Stability in the sense of Lyapunov – Lyapunov's stability & Lyapunov's instability theorems – Direct method of Lyapunov for the linear & nonlinear continuous time autonomous systems.

UNIT-V: Calculus of Variations

Minimization of functional of single function – Constrained minimization – Minimum principle –Control variable inequality constraints – Control & state variable inequality constraints –Euler lagrangine equation

Text Books:

1. Modern Control Engineering – by K. Ogata - Prentice Hall of India - 3rd edition (ISBN :9789332550162).
2. Automatic Control Systems by B.C. Kuo - Prentice Hall Publication (ISBN: 9780471134763).

Reference Books:

1. Modern Control System Theory – by M. Gopal - New Age International Publishers (ISBN: 9780470274248).
2. Control Systems Engineering by I.J. Nagarath&M.Gopal - New Age International (P) Ltd(ISBN: 9788195175581).
3. Digital Control & State Variable Methods – by M. Gopal - Tata Mc Graw–Hill Companies (ISBN: 9781259083174).

Web Links:

1. https://www.slideshare.net/ntpc-project-korbasuper-themal-power-plant
2. https://www.euronuclear.org/1-information/energy-uses.htm
3. https://www.slideshare.net/9anku/electrical-distribution-system

Energy Audit, Conservation & Management

	L	T	P	C
Course Code:2501EE33	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Explain energy efficiency, conservation, & various technologies.
CO2	Design energy efficient lighting systems.
CO3	Calculate power factor of systems & propose suitable compensation techniques.
CO4	Explain energy conservation in HVAC systems.
CO5	Calculate life cycle costing analysis & return on investment on energy efficient technologies. Calculate the Time value of Money.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Basic Principles of Energy Audit:
Energy audit- definitions - concept - types of audit - energy index - cost index - pie charts - Sankey diagrams & load profiles - Energy conservation schemes- Energy audit of industries- energy saving potential - energy audit of process industry - thermal power station - building energy audit - Conservation of Energy Building Codes (ECBC-2017).

UNIT – II

Energy Management: Principles of energy management - organizing energy management program - initiating - planning - controlling - promoting - monitoring -

reporting. Energy manager - qualities & functions - language - Questionnaire – check list for top management.

UNIT – III

Energy Efficient Motors & Lighting: Energy efficient motors - factors affecting efficiency - loss distribution - constructional details - characteristics – variable speed - RMS - voltage variation-voltage unbalance-over motoring-motor energy audit. lighting system design & practice - lighting control - lighting energy audit.

UNIT – IV

Power Factor Improvement & Energy Instruments: Power factor – methods of improvement - location of capacitors - Power factor with non-linear loads - effect of harmonics on power factor – power factor motor controllers – Energy Instruments- watt meter - d

UNIT – V

Economic Aspects & Their Computation: Economics Analysis depreciation Methods - time value of money - rate of return - present worth method - replacement analysis - lifecycle costing analysis – Energy efficient motors. Calculation of simple payback method - net present value method- Power factor correction - lighting – Applications of life cycle costing analysis - return on investment.

Text Books:

1 Energy management by W.R. Murphy & G. Mckay Butter worth - Heinemann publications (ISBN: 9788131207383).

2 Energy management hand book by W.C. Turner - John wiley & sons (ISBN: 978142088700).

Reference Books:

1 Energy efficient electric motors by John. C. andreas - Marcel Dekker Inc Ltd-2nd edition (ISBN: 9781489914675).

2 Energy management by Paul o' Callaghan - Mc-graw Hill Book company-1st edition (ISBN: 978077076788).

Web Links:

1 https://nptel.ac.in/courses/108106022/

2 https://nptel.ac.in/courses/112105221/

3 https://onlinecourses.nptel.ac.in/noc17_mm17/preview

Electric Energy Storage Systems

	L	T	P	C
Course Code:2501EE36	3	0	0	3

Course Outcomes:

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

CO1	Understand the fundamentals, key characteristics, and importance of electrical energy storage (EES) technologies in modern power systems
CO2	Analyze the needs for electrical energy storage.
CO3	Classify and compare different energy storage technologies based on their working principles, characteristics, advantages, and limitations.
CO4	Evaluate electrical energy storage systems for power system applications.
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								

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Electrical Energy Storage (EES) Technologies: Characteristics of electricity, Electricity & the roles of EES, High generation cost during peak-dem& periods, Need for continuous & flexible supply, Long distance between generation & consumption, Congestion in power grids, Transmission by cable.

UNIT – II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT – III

Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG)

UNIT – IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, St&ards for EES, Technical comparison of EES technologies.

UNIT – V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management & control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems & distributed generation (Virtual Power Plant), Battery SCADA aggregation of many dispersed batteries.

Text Books:

1	"Energy Storage Benefits & Market Analysis", 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	"Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits & Market Potential Assessment Guide, Report, S&ia National Laboratories.
2	Energy Storage by Mullick & Garg

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

Energy Converters

	L	T	P	C
Course Code:2501EE39	**2**	**1**	**0**	**3**

Course Outcomes:

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

CO1: Explain the different types of isolated & non isolated converters & their Comparisons.
CO2: Explain the resonant converters.
CO3: Explain the steady state analysis of power factor corrected converter.
CO4: Explain the various modulation techniques for single phase inverter.
CO5: Explain the operation of various Multilevel Inverters & it's comparison.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Switching Voltage Regulators:
Linear power supply (voltage regulators); Switching voltage regulators; Isolated converters dc-dc converters like Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuk converter, Sepic Converter; Comparison of isolated & non-isolated converters; Design criteria for SMPS; Multi-output switch mode regulator.

UNIT – II

Resonant Converters: Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zero voltage switching dc-dc converters, zero current switching dc-dc converters, clamped voltage topologies.

UNIT – III

Power Factor Correction Converters: Single-phase single stage boost power factor corrected rectifier, power circuit principle of operation, & steady state- analysis, three phase boost PFC converter.

UNIT – IV

PWM Inverters: Principle of operation-Voltage control of single-phase inverters - sinusoidal PWM – modified PWM – phase displacement Control – Trapezoidal, staircase, stepped, harmonic injection & delta modulation. Voltage Control of Three-Phase Inverters- Sinusoidal PWM- 60^0 PWM- Third Harmonic PWM- Space Vector Modulation- Comparison of PWM Techniques- Three phase current source inverters Variable dc link inverter.

UNIT – V

Multilevel Inverters: Introduction, Multilevel Concept, Types of Multilevel Inverters- Diode-Clamped Multilevel Inverter, Principle of Operation, Features of Diode-Clamped Inverter, Improved Diode Clamped Inverter- Flying-Capacitors Multilevel Inverter- Principle of Operation, Features of Flying Capacitors Inverter- Cascaded Multilevel Inverter- Principle of Operation- Features of Cascaded Inverter Switching Device Currents-DC-Link Capacitor Voltage Balancing- Features of Multilevel Inverters Comparisons of Multilevel Converters.

Text Books:

1 Power Electronics: Converters, Applications, & Design- Ned Mohan, Tore M. Undeland.(ISBN: 978-8126510900)

2 Power Electronics-Md.H.Rashid –Pearson Education Third Edition- First IndianReprint.(ISBN: 978-93325018445)

Reference Books:

1 Control in power electronics” Marian P. Kaźmierkowski, Ramu Krishnan, Frede Blabjerg Edition illustrated Published by Academic Press.

2 “High Power Converters & AC Drives”, Bin Wu, John Willey & sons, Inc.

Web links:

1 https://onlinecourses.nptel.ac.in/noc24_ee88/preview.

2 https://archive.nptel.ac.in/courses/108/102/108102157/.

Digital Control Systems

	L	T	P	C
Course Code: 2501EE38	**3**	0	0	**3**

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

CO 1: To understand the concepts of digital control systems & assemble various components associated with it. Advantages compared to the analog type.
CO 2: The theory of z–transformations & application for the mathematical analysis of digital control systems
CO 3: To represent the discrete–time systems in state–space model & evaluation of state transition matrix, the design of state feedback control by "the pole placement method.", design of state observers
CO 4: To examine the stability of the system using different tests & study the conventional method of analyzing digital control systems in the w–plane.
CO 5: Design of state feedback controller through pole placement.

Mapping of course outcomes with program outcomes:

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

Mapping of course outcomes with program Specific Outcomes:

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

UNIT-I: Introduction to Signal Processing

Introduction to analog & digital control systems – Advantages of digital systems – Continuous & Discrete Time Signals – Sample & hold devices – Sampling theorem & data reconstruction – Frequency domain characteristics of zero order hold.

UNIT-II: Z–Transformations

Z–Transforms – Theorems – inverse Z–transforms – Formulation of difference equations & solving – Block diagram representation – Pulse transfer functions & finding open loop & closed loop responses.

UNIT-III: State Space Analysis & the Concepts of Controllability & Observability

State space representation of discrete time systems – Solving Discrete Time state space equations – State transition matrix & its properties – Concepts of controllability & observability

UNIT-IV: Stability Analysis

Mapping between the S–Plane & the Z–Plane – Primary strips & Complementary strips – Stability criterion – Modified Routh's stability criterion & Jury's stability -Design using frequency response in the w–plane for lag & lead compensators – Root locus technique in the z–plane

UNIT-V: State Feedback Controllers & State Observers
Design of state feedback controller through pole placement – Necessary & sufficient conditions –Ackerman's formula – Design of state observers

Text Books:

1. Discrete–Time Control systems – K. Ogata - Pearson Education/PHI - 2nd Edition.(ISBN: 978-8120327603)

2. Digital Control & State Variable Methods by M.Gopal - TMH - 4th Edition.(ISBN:978-07133327)

Reference Books:

1. Digital Control Systems - Kuo - Oxford University Press - 2nd Edition.(ISBN: 978-0195120646)

2. Digital Control & State Variable Methods – by M. Gopal - Tata Mc Graw–Hill Companies.(ISBN:978-07133327)

Web Links:

1. https://nptel.ac.in/courses/10810308

2. https://ocw.mit.edu/courses/2-171-analysis-&-design-of-digital-control-systems-fall-206/

Utilization of Electrical Energy

	L	T	P	C
Course Code:2501EE27	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Identify various illumination methods produced by different illuminating sources.
CO2	Identify a suitable motor for electric drives & industrial applications
CO3	Identify most appropriate heating & welding techniques for suitable applications.
CO4	Distinguish various traction systems & determine the tractive effort & specific energy consumption.
CO5	Explain the necessity & usage of different energy storage schemes for different applications & comparisons.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Illumination fundamentals & Methods: Illumination fundamentals Introduction - terms used in illumination–Laws of illumination–Polar curves–Integrating sphere–Lux meter Sources of light. Various Illumination Methods Discharge lamps - MV & SV lamps – Comparison between tungsten filament lamps & fluorescent tubes Basic principles of light control– Types & design of lighting & flood lighting–LED lighting - Energy conservation.

UNIT – II

Selection of Motors: Choice of Motor - Type of Electric Drives - Starting & Running Characteristics – Speed Control–Temperature Rise – Applications of Electric Drives–Types of Industrial Loads–Continuous Intermittent & Variable Loads–Load Equalization - Introduction To Energy Efficient Motors.

UNIT – III

Electric Heating & Welding: Advantages & methods of electric heating–Resistance heating induction heating & di electric heating. Electric Welding. Electric welding–Resistance & arc welding–Electric welding equipment–Comparison between AC & DC Welding.

UNIT – IV

Electric Traction: Traction & electrification– Special features of traction motor– Mechanics of train movement, Speed-time curves, tractive effort, Specific energy consumption, acceleration & retardation–Adhesive weight, coefficient of adhesion.

UNIT – V

Introduction to Energy Storage Systems: Need For Energy Storage - Types of Energy Storage-Thermal - Electrical - Magnetic & Chemical Storage Systems - Comparison of Energy Storage Technologies Applications.

Text Books:

1. Utilization of Electric Power – by Er.R.K Rajput – Lakshmi publications Third edition 2023(ISBN: 9788131808290).
2. Utilisation of Electric Power : Including Electric Drives & Electric Traction – by Suryanarayana N.V, New Age International (P) Limited - Publishers – Third edition 2024 (ISBN: 9788122405460).

Reference Books:

1. Utilization Of Electric Energy: Including Electric Drives & Electric Traction -by Tarlok singh(ISBN: 978938027845).
2. Utilization of Electric power & Electric Traction -by J.B.Gupta S.K.Kataria & Sons (ISBN: 9789350142585).

Web Links:

1. https://nptel.ac.in/courses/108105060
2. https://onlinecourses.nptel.ac.in/noc23_ag06/preview

Alternative Energy Sources

	L	T	P	C
Course Code:2501EE34	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1	Describe the environmental aspects of Renewable Energy Resources.
CO2	Describe the use of Solar Energy & the various components used in the energy production.
CO3	Underst& the conversion principles of Wind & Biomass Energy Resources.
CO4	Acquire the basic knowledge of Ocean Thermal Energy
CO5	Acquire the basic knowledge of energy conversion & Hydrogen Energy.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction: Principles of renewable energy; energy & sustainable development, worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale

UNIT – II

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal & inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Solar Thermal systems: Flat plate collector; Solar distillation; Solar Pond electric power plant. Photovoltaic system for electric power generation.

UNIT – III

Wind Energy: Wind velocity & power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double & multiblade system. Vertical axis- Savonius & darrieus types.

Biomass Energy: Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion.

UNIT – IV

Tidal Power: Tides energy suppliers & their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages & limitations.

Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems as

UNIT – V

Green Energy: Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy (contemporary cases).

Text Books:

1 Non-Conventional energy resources, Khan B.H, Tata Mc-Graw hill, New Delhi, 3rd edition (ISBN: 9789352601882).

2 Non-conventional Energy Sources, G.D.Rai, Khanna Publications, New Delhi, 4th edition (ISBN: 9788174090737).

Reference Books:

1 Renewable energy resources, Twidell, J.W. & Weir, A., BSP Books Pvt.Ltd, UK, 2nd edition (ISBN: 9780415584388).

2 Renewable Energy Technologies, R.Ramesh, Uday kumar, Narosa Publishing House, New Delhi, 1st edition (ISBN:9788173190674).

Special Electrical Machines

	L	T	P	C
Course Code:2501EE35	3	0	0	3

Course Outcomes:

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

CO1 Explain the operation & control of Stepper Motor.
CO2 Describe theory of operation & control of Switched Reluctance Motor.
CO3 Explain the operation & control of Synchronous Reluctance Motor.
CO4 Describe theory of operation & control of Permanent Magnet Brushless D.C. Motors
CO5 Explicate the theory of PMSM & LIM & its applications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

	PSO1	PSO2
CO1		1
CO2		1
CO3		1
CO4		1
CO5		1

UNIT – I

Stepper Motors: Constructional features – Types of Stepper Motors - permanent magnet (PM) type - Hybrid type Stepper Motor - Variable Reluctance Motor (VRM) - Single stack & multiple stack VRM – Characteristics, Modes of Operation & Applications of Stepper Motor.

UNIT – II

Switched Reluctance Motors: Constructional features, Principle of operation, Torque production, Power Converters & their controllers, Methods of Rotor position sensing, Sensor less operation, Closed loop control of SRM, Characteristics.

UNIT – III

Synchronous Reluctance Motor: Construction, Working, Torque Equation, control, Advantages & Applications Synchronous Reluctance Motor

UNIT – IV

Permanent Magnet Brushless D.C. Motors: Principle of Operation, Types, EMF & torque equations, Commutation, Motor characteristics & control, Torque/speed characteristics.

UNIT – V

Permanent Magnet Synchronous Motors: Construction, Principle of Operation, EMF Equation of PMSM, Torque Equation, Comparison of Conventional & PM Synchronous Motors, Application of PMSM

Linear Induction Motors

Linear Induction Motors (LIM)- Construction– principle of operation— Development of one-sided LIM with back iron equivalent circuit of LIM-Applications

Text Books:

1 Brushless Permanent magnet & reluctance motor drives, Clarenden press, T.J.E.Miller, Oxford.

2 Special electrical Machines, K. VenkataRatnam, University press, New Delhi

Reference Books:

1 Special electrical machines, E.G. Janardhanan, PHI learning private limited.

2 Krishnan, R., “Permanent Magnet & BLDC Motor Drives”, CRC Press.

Web Links:

1 https://nptel.ac.in/courses/108102156

2 https://www.monolithicpower.com/stepper-motors-basics-types-uses

3 https://epochautomation.com/synchronous-reluctance-motor-working/

Power Quality

	L	T	P	C
Course Code:2501EE40	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO 1: Differentiate between different types of power quality problems.

CO 2: Explain the sources of voltage sag, voltage swell, interruptions, transients, long duration over voltages & harmonics in a power system.

CO 3: Analyze power quality terms & power quality standards.

CO 4: Explain the principle of voltage regulation & power factor improvement methods

CO 5: Demonstrate the relationship between distributed generation & power quality.

Mapping of Course 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	PO11
CO1	2	3	1								
CO2	3	2									
CO3	2	3	1	1							
CO4	3	2			2						
CO5	3	2									

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I

Introduction: Overview of power quality – Concern about the power quality – General classes of power quality & voltage quality problems – Transients – Long–duration voltage variations –Short–duration voltage variations – Voltage unbalance – Waveform distortion – Voltage fluctuation – Power frequency variations.

UNIT-II

Voltage imperfections in power systems: Power quality terms – Voltage sags – Voltage swells & interruptions – Sources of voltage sag, swell & interruptions – Nonlinear loads – IEEE standard 519-2014 & IEC standard

61000. Source of transient over voltages – Principles of over voltage protection – Devices for over voltage protection –Utility capacitor switching transients

UNIT-III

Voltage Regulation & power factor improvement: Principles of regulating the voltage – Device for voltage regulation – Utility voltage regulator application – Capacitor for voltage regulation – End–user capacitor application–Regulating utility voltage with distributed resources – Flicker – Power factor penalty – Static VAR compensations for power factor improvement.

UNIT-IV

Harmonic distortion & solutions: Voltage distortion vs. Current distortion – Harmonics vs. Transients – Harmonic indices – Sources of harmonics – Effect of harmonic distortion – Impact of capacitors, transformers, motors & meters – Point of common coupling – Passive & active filtering – Numerical problems.

UNIT-V

Distributed Generation & Power Quality: Resurgence of distributed generation – DG technologies – Interface to the utility system –Power quality issues & operating conflicts – DG on low voltage distribution networks.

Monitoring & Instrumentation: Power quality monitoring & considerations – Historical perspective of PQ measuring instruments – PQ measurement equipment – Assessment of PQ measuring data – Application of intelligent systems – PQ monitoring standards.

Text Books:

1. Electrical Power Systems Quality, Dugan R C, McGranaghan M F, Santoso S, & Beaty H W, Second Edition, McGraw–Hill, 3rd edition (ISBN: 978125905572).
2. Electric power quality problems –M.H.J.Bollen IEEE series-Wiley India publications (ISBN: 9780780347137).

Reference Books:

1. Power System Harmonics, Arrillaga J & Watson N R, Second Edition, John Wiley & Sons (ISBN: 9788126560431).
2. Electric Power Quality Control Techniques, W. E. Kazibwe & M. H. Sendaula, Van Nostrad Reinhold, New York (ISBN: 978044210935).
3. Power Quality by C.Shankaran, CRC Press (ISBN:9780849310409).

Web Links:

1. https://en.wikipedia.org/wiki/Electric_power_quality
2. https://www.accessengineeringlibrary.com/browse/power-quality-in-electrical-systems
3. www.p3-inc.com/images/what_is_power_quality.pdf

Hybrid Electric Vehicles

	L	T	P	C
Course Code: 2501EE37	**3**	**0**	**0**	**3**

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

CO 1: Analyze the architectures of HEVs with various components.
CO 2: Illustrate the concept of Electric Vehicle & Hybrid Electric Vehicles.
CO 3: Explain the Plan concept of Plug-in Electrical Vehicles.
CO 4: Analyze the power electronics converters for HEVs.
CO 5: Apply various energy storage technologies in Hybrid Vehicles.

Mapping of course outcomes with program outcomes:

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

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

UNIT-I:
Introduction: History of hybrid vehicles, architectures of HEVs, series & parallel HEVs, complex HEVs.

UNIT-II:
Hybridization of Automobile: Fundamentals of vehicle, components of conventional vehicle & propulsion load; Drive cycles & drive terrain; Concept of electric vehicle & hybrid electric vehicle; Plug-in hybrid vehicle, constituents of PHEV, comparison of HEV & PHEV; Fuel Cell vehicles & its constituents.

UNIT-III:
Plug-in Hybrid Electric Vehicle: PHEVs & EREVs blended PHEVs, PHEV Architectures, equivalent electric range of blended PHEVs; Fuel economy of PHEVs, power management of PHEVs, end-of-life battery for electric power grid support, vehicle to grid technology, PHEV battery charging.

UNIT-IV:

Power Electronics in HEVs: Rectifiers used in HEVs, voltage ripples; Buck converter used in HEVs, non-isolated bidirectional DC-DC converter, regenerative braking, voltage source inverter, current source inverter, isolated bidirectional DCDC converter, PWM rectifier in HEVs, EV & PHEV battery chargers.

UNIT-V:

Battery & Storage Systems: Energy Storage Parameters; Lead–Acid Batteries; Ultra capacitors; Flywheels - Superconducting Magnetic Storage System; Pumped Hydroelectric Energy Storage; Compressed Air Energy Storage - Storage Heat; Energy Storage as an Economic Resource.

Text Books:

1. Advanced Electric Drive Vehicles by Ali Emadi , CRC Press.(ISBN:978-1466597693)

2. Electric & Hybrid Vehicles: Design Fundamentals by Iqbal Hussein , CRC Press.(ISBN: 978-143981175)

Reference Books:

1. Introduction to Hybrid Vehicle System Modelling & Control by Wei Liu, Wiley (ISBN:978-8126556205).

2. “Electric & Hybrid Vehicles Technologies, Modelling & Control: A Mechatronic Approach”, by Amir Khajepour, Saber Fallah& Avesta Goodarzi, John Wiley & Sons Ltd.(ISBN: 978-1118341513)

Web Links:

1. https://archive.nptel.ac.in/courses/108/103/10810309/
2. https://ndl.iitkgp.ac.in/he_document/nptel/nptel/IN__N__1_E_E__12391_I_t_H_a_E_V__14024_D_o_H_E_v__14030_14031

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, TransmissionC Distribution Systems	AC	3	0	0	3	50	50	CE, ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE36	Electric Energy Storage Systems	FC	3	0	0	3	50	50	CE,ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE43	Electrical safety	IC	3	0	0	3	50	50	CE,ME, ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
EEE	2501EE54	Hybrid & Electric Vehicles	IC	3	0	0	3	50	50	CE,ECE, CSE,IT, AIML, CSE(DS) PT,Min.E	
ME	2501ME37	Solar Energy Systems	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME58	Industry 5.0 for Engineers	AC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME73	Organizational Behavior	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	
ME	2501ME36	Sustainable Energy Systems	FC	3			3	50	50	CE,EEE, ECE, CSE,IT, AIML, CSE(DS) PT, Min.E	

ECE	2501EC97	Biomedical Electronics	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC98	Fundamentals of Wireless Communications	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501EC99	Principles of Embedded Systems	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA0	Electronics for Healthcare	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA1	Basics of VLSI Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA2	System on Chip Design	FC	3			3	50	50	CE, EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
ECE	2501ECA3	Introduction to Quantum Computing	FC	3			3	50	50	CE,EEE, ME, CSE, IT, DS, AIML, PT, Min.E, Ag.E	
CSE	2501CS03/ 2601DS02	Data Structures* / Data Structures using C++#	FC	2		2	4	50	50	CE, ME, PT, Min.E	PPSC
CSE	2501CS13	Operating Systems	IC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E, Ag.E	-
IT	2501IT05	Database Management Systems	IC	2		2	4	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	PPSC / CP&DS
IT	2501CS07	Computer Networks	AC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	-
AI&ML	2501AI02	Artificial Intelligence	FC	2		1	3	50	50	CE, EEE, ECE, PT, Min.E	-
AI&ML	2501AI05	Machine Learning	AC	2		2	4	50	50	CE, ECE, PT, Min.E	DAUP
DS	2501CS34	Fundamental of Data Science	FC	2		1	3	50	50	CE, EEE, ME, ECE, PT, Min.E,Ag.E	PPSC / CP&DS

Natural Disaster Management & Mitigation

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

Course Code: 2501CE66	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

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

CO1: Explain the aspects of disaster management and adopt remedial measures.
CO2: Explain disaster risk assessment and coping measures.
CO3: Explain the vulnerability conditions.
CO4: Assess the impact of hazards on structures.
CO5: Adopt the rehabilitation procedures.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I
Introduction:
Introduction Concept of Disaster Management. Types of Disasters. Disaster mitigating agencies and their organizational structure at different levels.

UNIT – II
Overview of Disaster Situations:
Overview of Disaster Situations in India Vulnerability of profile of India and Vulnerability mapping including disaster – prone areas, communities, places. Disaster preparedness – ways and means; skills and strategies; rescue, relief reconstruction. Case Studies: Lessons and Experiences from Various Important Disasters in India and Biological disasters – SARS-spread and transmisstions -pandemic, endemic and epidemic.

UNIT – III
Flood:
Flood and Drought Disaster Raising flood damage, assessing flood risk, flood hazard assessment, flood impact assessment, flood risk reduction options. Drought and development, relief management and prevention, drought mitigation and management-integrating technology and people.

UNIT – IV

Overview of Disaster Situations:

Landslide and Earthquake Disaster Land slide hazards zonation mapping and geo environmental problems associated with the occurrence of landslides. The use of electrical resistivity method in the study of landslide. Causes and effects of earthquakes. Secondary effects. Criteria for earthquake resistant design.

UNIT – V

Cyclone and Fire Disaster:

Cyclone and Fire Disaster Cyclone occurrence and hazards. Cyclone resistant house for coastal areas. Disaster resistant construction role of insurance sector. Types of fire. Fire safety and firefighting method, fire detectors, fire extinguishers. Rehabilitation: Rehabilitation programmes, Management of Relief Camp.

Text Books

1. Disaster Management, RB Singh (Ed), Rawat Publications. (ISBN: 13-978-8131600337).
2. Disaster Management Future Challenges and Opportunities, Jagbir Singh, I.K International publishing house. (ISBN: 13-978-8189866464).

Reference Books:

1. Natural Hazards in the Urban habitat by Iyengar, CBRI, Tata McGraw Hill. (ISBN:13-9780074631881).
2. Natural Disaster management, Jon Ingleton (Ed), Tulor Rose. (ISBN:13-978-0953614011).
3. Anthropology of Disaster management, Sachindra Narayan, Gyan Publishing house. (ISBN: 13-978-8121206839).

Web Links:

1. https://www.iare.ac.in/sites/default/files/lecture_notes/dm%20notes.pdf

Waste Water Management

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

Course Code: 2501CE81	L	T	P	C
	3	0	0	3

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

CO1: Explain the importance of sanitation and wastewater management.
CO2: Explain the various methods of sewage flow estimation and pumping systems.
CO3: Identify the various characteristics of sewage and the treatment system.
CO4: Outline the various secondary treatment technologies for waste water
CO5: Explain the different tertiary and effluent disposal methods.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I
Introduction:
Introduction to sanitation–systems of sanitation–relative merits and demerits –need for waste water management–basic terminology in waste water–generation of waste water–types – collection and conveyance of waste water– classification of sewerage systems.

UNIT – II
Sewage Flow and Pumping:
Estimation of sewage flow and storm water drainage–fluctuations. Types of sewers–hydraulics of sewers– appurtenances in sewerage. Pumping of waste water:pumping stations–location–components– typesofpumpsand their suitability with regards to waste waters.

UNIT – IV
Secondary Treatment:
Aerobic and anaerobic treatment process-comparison. Aerobic units: Activated sludge process, principles, modifications of activated sludge processes–Oxidation ponds–Trickling filters– Rotating biological contactors. Anaerobic units: UASB Reactor, principle and working.

UNIT – V
Tertiary Treatment and Disposal:
Removal of Nutrients–Nitrification and Denitrification–Ion exchange–membrane processes –MF, UF, NF, RO. Disposal of sewage–Methods of disposal–Effluent Standards. Need, Scope and demand for waste water recycling.

Text Books:

1. Wastewater Engineering: Treatment and Resource Recovery, Metcalf & Eddy, McGraw-Hill, New York, 5th Edition. (ISBN: 13-978-0073401188).
2. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill , 2018. (ISBN: 13-978-0070495395).

Reference Books:

1. Environmental Engineering-II: Sewage disposal and Air pollution Engineering, Garg & S.K., Khanna Publications. (ISBN:978-81-7409-230-4)
2. Environmental Engineering by D. Srinivasan, PHI Learning private Limited, New Delhi. (ISBN:13-9788120336001)
3. Elements of Environmental Engineering, K.N. Duggal, S.Chand& Company Ltd. New Delhi. (ISBN: 13-978-8121915472).
4. Wastewater Treatment for pollution control and Reuse, Soli J Areivala, Sham R Asolekar, Mc- GrawHill, New Delhi. (ISBN:9780070620995).

Web Links:

1. https://web.iitd.ac.in/~arunku/files/CVL100_Y16/LecSep1220.pdf
2. http://www.civil.iitm.ac.in/dwwm/sites/default/files/presentations
3. https://www.researchgate.net/publication/221911472_Wastewater_Management

Integrated Solid Waste Management for A Smart City

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

Course Code: 2501CE82	L	T	P	C
	3	0	0	3

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

CO1: Understand Fundamental Concepts of Solid Waste Management
CO2: Analyze Municipal Solid Waste Management Practices
CO3: Evaluate Disposal Methods and Technologies
CO4: Apply Knowledge of Construction and Demolition (C&D) Waste Management
CO5: Examine E-Waste and Hazardous Waste Management

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11
CO1	1					3	2				
CO2	1					3	2				
CO3	1					3	2				
CO4	1					3	2				
CO5	1					3	2				

UNIT – I
Introduction:
Solid Waste Management- Definition, Concept of 4Rs (reduce, reuse, recycle and recover) of waste management, Elements of a waste management system, Issues in Solid Waste Management, Integrated Waste Management Hierarchy: Source reduction, Recycling, Waste-to-Energy and Landfilling, Review of waste management under Swachh Bharat Mission and Smart Cities Program.

UNIT – II
Municipal Solid Waste:
Waste Composition and Quantities, Collection, Transportation, Segregation, and Processing.

UNIT – III
Disposal of Municipal Solid Waste:
Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste, Municipal Solid Waste (MSW) Rules 2016, Current Issues in Solid Waste Management and Review of MSW Management

UNIT – IV
Construction and Demolition (C&D) Waste Management:
Overview, Components; C&D Waste Management Rules 2016, Beneficial Reuse of C & D Waste Materials.

UNIT – V
Electronic Waste (E-Waste) Management:
Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.

Hazardous Wastes:
Definition, Classification, Risk assessment, Transportation of hazardous waste, Current Management Practices: Environmental audit, Containment, Remedial alternatives.

Text Books:

1. Solid Waste Engineering, William A Worrell and P. AarneVeslind, Cengage Learning, 2nd Edition(SI Edition). (ISBN: 13-978-8131520420).
2. Integrated Solid Waste management, George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Tata McGraw Hill. (ISBN: 13-978-0070632370).

Reference Books:

1. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization (CPHEEO), India.
2. MSW Management Rules 2016, Govt. of India, available online at CPCB website
3. Construction and Demolition Waste Management Rules, 2016, MoEF&CC
4. Electronic Waste Management Rules 2016, Govt. of India, available online at CPCB website.

Web Links:

1. https://nptel.ac.in/courses/105/105/105105160/
2. http://swachhbharatmission.gov.in/sbmcms/index.html
3. http://swachhbharaturban.gov.in/

Watershed Management

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

Course Code: 2501CE83

L	T	P	C
3	0	0	3

Course Outcomes:

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

CO1: Explain the objectives and characteristics of watershed management.
CO2: Classify the types of soil erosion and control methods.
CO3: Explain different water harvesting techniques.
CO4: Organize the land and drought management techniques.
CO5: Create hydrological models

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction:

Introduction - Concept of watershed development – objectives of watershed development – need for watershed development - integrated and multidisciplinary approach for watershed management. Characteristics of Watershed: Size – shape – physiography – slope – climate – drainage – land use – vegetation – geology and soils – hydrology and hydrogeology – socio-economic characteristics – Application of artificial intelligence technology for identification of watershed characteristics.

UNIT – II

Principles of Erosion: Types and causes of erosion – factors affecting erosion– estimation of soil loss due to erosion- Universal soil loss equation. Measures to Control Erosion: Contour techniques – ploughing – furrowing – trenching – bunding – terracing – gully control – check dams – rock-fill dams – brushwood dam – Gabion.

UNIT – III

Water Harvesting: Techniques of rainwater harvesting – rainwater harvesting from rooftop – surface flow harvesting – subsurface flow harvesting – stop dams – farm ponds and dugout ponds – percolation tanks.

UNIT – IV

Land Management: Land use and Land capability classification – management of forest – agricultural – grassland and wild land land grading operation –reclamation of saline and alkaline soils. Drought Management: Drought assessment and classification – drought analysis techniques – drought mitigation planning.

UNIT – V

Beyond BIM - Emerging Trends

Watershed Modelling: Data of watershed for modelling – application and comparison of watershed models – model calibration and validation – advances of watershed models.

Text Books:

1. Watershed Management, Das MM and M.D Saikia, PHI Learning Pvt. Ltd.(ISBN:13-978-8120346765).
2. Land and Water Management, Murthy.VVN, Kalyani Publications. (ISBN: 13-978-9327214659)

Reference Books:

1. Water Resource Engineering, Wurbs R A and James R A, Prentice Hall Publishers. (ISBN: 13-978-8120321519).
2. Watershed Hydrology, Black P E, Prentice Hall. (ISBN: 13-978-1575040271).
3. Watershed Management, Murthy J V S, New Age International Publishers. (ISBN:13-978-8122435184).

Web Links:

1. https://www.ct.gov/deep/cwp/view.asp?a=2719&q=325622&depNav_GID=1654
2. http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershedmgt.html
3. https://yourstory.com/2017/11/watershed-management/

Electric Power Generation, Transmission & Distribution Systems

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

Course Code: 2501EE53	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Identify the different components of various power plants.

CO2: Analyze the performance of short, medium and long transmission lines.

CO3: Identify various factors related to sag and corona.

CO4: Distinguish between AC/ DC distribution systems and also estimate voltage drops of distribution systems.

CO5: Analyze the different economic factors of power generation and tariffs.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11
CO1	3	1	-	-	-	2	-	-	-	-	-
CO2	2	3	1	-	-	-	-	-	-	-	-
CO3	2	1	3	-	-	1	-	-	-	-	-
CO4	2	3	1	-	-	1	-	-	-	-	-
CO5	2	3	1	-	-	-	-	-	-	-	-

UNIT – I

Power Stations: Principle of power generation, site selection and layout of Thermal, Nuclear, Hydro power plant, Components of Thermal and Nuclear power plant

UNIT – II

Performance of Transmission Lines: Classification of Transmission Lines –Short, medium, long and their model representations –End condenser method, Nominal-T–Nominal-Pie, and A, B, C, D Constants, Surge Impedance and SIL of Long Lines.

UNIT – III

Corona and Sag: Corona – Description of the phenomenon–Factors affecting corona–Critical voltages and power loss –Radio Interference. Sag and Tension calculations with equal and unequal heights of towers–Effect of Wind and Ice on weight of Conductor

UNIT – IV

Distribution Systems: Classification of distribution systems, design features of distribution systems, radial distribution, ring main distribution, voltage drop calculations: DC distributors for following cases - radial DC distributor fed at one end and at both ends (equal / unequal voltages), ring main distributor, stepped distributor and AC distribution, comparison of DC and AC distribution.

UNIT – V

Economic Aspects of Power Generation and Tariff Methods: Types of load, Load curve, load duration and integrated load duration curves, Important terms and factors in Load Curve. Costs of Generation and their division into Fixed, Semi-fixed and Running Costs, Characteristics and types of Tariff.

Text Books:

1. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar &, A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd (ISBN: 978817700207).
2. Generation, Distribution & Utilization of Electric Energy by C. L. Wadhawa, Newage International (P) Limited, Publishers (ISBN: 9789393159175).

Reference Books:

1. Principles of Power System by V. K. Mehta & Rohit Mehta, S Chand & Company Limited, Publishers (ISBN: 9788121924962).
2. Electrical Power Distribution Systems by V. Kamaraju, Tata McGraw Hill, New Delhi (ISBN: 978070151413).

Web Links:

1. https://www.slideshare.net/ntpc-project-korbasuper-themal-power-plant
2. https://www.euronuclear.org/1-information/energy-uses.html
3. https://www.slideshare.net/9anku/electrical-distribution-system

Electric Energy Storage Systems

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

	L	T	P	C
Course Code:2501EE36	3	0	0	3

Course Outcomes:

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

CO1: Understand the fundamentals, key characteristics, and importance of electrical energy storage (EES) technologies in modern power systems

CO2: Analyze the needs for electrical energy storage.

CO3: Classify and compare different energy storage technologies based on their working principles, characteristics, advantages, and limitations.

CO4: Evaluate electrical energy storage systems for power system applications.

CO5: Identify various real time applications of energy storage systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Electrical Energy Storage (EES) Technologies: Characteristics of electricity, Electricity & the roles of EES, High generation cost during peak-dem& periods, Need for continuous & flexible supply, Long distance between generation & consumption, Congestion in power grids, Transmission by cable.

UNIT – II

Needs for Electrical Energy Storage: Emerging needs for EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

UNIT – III

Features of Energy Storage Systems: Classification of EES systems , Mechanical storage systems, Pumped hydro storage (PHS), Compressed air energy storage (CAES), Flywheel energy storage (FES), Electrochemical storage systems, Secondary batteries, Flow batteries, Chemical energy storage, Hydrogen (H2),Synthetic natural gas (SNG).

UNIT – IV

Types of Electrical Energy Storage systems: Electrical storage systems, Double-layer capacitors (DLC), Superconducting magnetic energy storage (SMES), Thermal storage systems, St&ards for EES, Technical comparison of EES technologies.

UNIT – V

Applications: Present status of applications, Utility use (conventional power generation, grid operation & service), Consumer use (uninterruptable power supply for large consumers), New trends in applications, Renewable energy generation, Smart Grid, Smart Micro grid, Smart House, Electric vehicles, Management & control hierarchy of storage systems, Internal configuration of battery storage systems, External connection of EES systems, Aggregating EES systems & distributed generation (Virtual Power Plant), Battery SCADA aggregation of many dispersed batteries.

Text Books:

1. Energy Storage Benefits & Market Analysis, by James M. Eyer, Joseph J. Iannucci & Garth P. Corey Sandia National Laboratories.
2. The Electrical Energy Storage by IEC Market Strategy Board.

Reference Boks:

1. Energy Storage for the Electricity Grid: Benefits & Market Potential Assessment Guide, Jim Eyer, Garth Corey, Sandia National Laboratories.
2. Energy Storage by Mullick & Garg (ISBN: 9789027719300)

Web Links:

1. https://nptel.ac.in/courses/112/105/112105221/
2. https://nptel.ac.in/courses/112/107/112107283/
3. https://nptel.ac.in/content/storage2/courses/10810309

Electrical Safety

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

	L	T	P	C
Course Code: 2501EE43	**3**	**0**	**0**	**3**

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

CO 1: Describe electrical hazards & safety equipment.
CO 2: Analyze & apply various grounding & bonding techniques
CO 3: Select appropriate safety method for low, medium equipment's & high voltage equipment.
CO 4: Participate in a safety team & Carry out proper maintenance of electrical equipment by underst&ing various St&ards.
CO 5: Analyze the safety method for high voltage equipment's.

Mapping of course outcomes with program outcomes:

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

UNIT-I:
Hazards of Electricity & Electrical Safety Equipment: Primary & secondary hazards- arc, blast, shocks causes & effects-safety equipment flash & thermal protection, head & eye protection-rubber insulating equipment, hot sticks, insulated tools, barriers & signs, safety tags, locking devices-voltage measuring instruments- proximity & contact testers-safety electrical one line diagram-electrician's safety kit.

UNIT-II:
Grounding of Electrical Systems & Equipment: General requirements for grounding & bonding-definitions grounding of electrical equipment-bonding of electrically conducting materials & other equipment connection of grounding & bonding equipment- system grounding- purpose of system grounding-grounding electrode system- grounding conductor connection to electrodes-use of grounded circuit conductor for grounding equipment- grounding of low voltage & high voltage systems.

UNIT-III:
Safety Procedures & Methods: The six step safety methods- pre job briefings - hot-work decision tree-safe switching of power system- lockout-tag out- flash hazard calculation & approach distances-calculating the required level of arc protection-safety equipment, procedure for low, medium & high voltage systems- the one-minute safety audit

UNIT-IV:

Safety Management & Organizing Structure: Electrical safety program structure, development- company safety team- safety policy program implementation- employee electrical safety teams- safety meetings- safety audit accident prevention- first aid- rescue techniques-accident investigation.

UNIT-V:

Electrical Maintenance & Legal Safety Requirements & St&ards: Safety related case for electrical maintenance- reliability centred maintenance (RCM) - eight step maintenance program- frequency of maintenance- maintenance requirement for specific equipment & location- regulatory bodies- national electrical safety code st&ard for electrical safety in work place- occupational safety & health administration st&ards, Indian Electricity Acts related to Electrical Safety

Text Books:

1. 'Electrical Safety Handbook' by John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, Al Winfield, McGraw-Hill Education, 4th Edition (ISBN: 978071745130)
2. "Electric Safety Practice & Standards", Khaled Ismail, CRC Press, Taylor & Francis (ISBN: 9781138073999).

Reference Books

1. 'Electrical Safety- a guide to the causes & prevention of electric hazards', Maxwell Adams.J, The Institution of Electric Engineers, IET (ISBN: 9780852968062).
2. 'Electrical Safety in the Workplace', Ray A. Jones, Jane G. Jones, Jones & Bartlett Learning (ISBN: 9780877655800).

Web Links:

1. http://nptel.ac.in/courses/103106071/5
2. https://www.electricalsafetyfirst.org.uk

Hybrid & Electric Vehicles

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

	L	T	P	C
Course Code:2501EE54	**3**	**0**	**0**	**3**

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

CO1: Describe the History of Hybrid Electric vehicles
CO2: Classify the various electric drivetrain topologies
CO3: Articulate the Energy Storage Requirements in Hybrid & Electric Vehicles
CO4: Illustrate the Charging Infrastructure
CO5: Evaluate Energy Management Strategies used in hybrid & electric vehicle

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I
Introduction:
Introduction to Hybrid Electric Vehicles: History of hybrid & electric vehicles, social & environmental importance of hybrid & electric vehicles, impact of modern drive-trains on energy supplies-Challenges & Key Technologies of EVs – Challenges for EV Industry in India

UNIT – II
Electric Drive-trains:
Basic concept of electric traction - introduction to various electric drivetrain topologies - Power flow control in electric drive-train topologies - fuel efficiency analysis
Electric Propulsion unit:
Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC Motor drives, configuration and control of Induction Motor drives, configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency

UNIT – III
Energy Storage:
Introduction to Energy Storage Requirements in Hybrid & Electric Vehicles -Battery based energy storage & its analysis - Fuel Cell based energy storage & its analysis - Super Capacitor based energy storage- Flywheel based energy storage & its analysis.

UNIT – IV
Sizing the drive system:
Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

UNIT – V
Energy Management Strategies
Introduction to Energy Management Strategies used in hybrid & electric vehicle, Classification of different Energy Management strategies - Comparison of different Energy Management Strategies - Implementation issues of energy strategies - Effect of charging infrastructure on grid protection & control.

Text Books:
1. Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley-Blackwell (ISBN: 9781119942733).
2. Energy Management Strategies for Electric & Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer (ISBN: 9781493955237).

Reference Books:
1. Electric Vehicle Battery Systems, Sandeep Dhameja, Elsevier (ISBN: 9780750699167).
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press (ISBN: 9781138072855).
3. Hybrid electric Vehicles Principles & applications with practical perspectives, Chris Mi,M. Abul Masrur, D. Wenzhong Gao, A Dearborn, John Wiley & Sons Ltd (ISBN: 9781118970560).

Solar Energy Systems

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

Course Code: 2501ME37	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Outcomes:

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

CO1: Explain the concept of solar radiation and its measurement

CO2: Describe the working principle of different types of collectors and its types

CO3: Explain the various solar thermal energy technologies and their applications

CO4: Analyze the various solar PV cell materials and conversion techniques.

CO5: Apply solar passive building techniques for cooling and heating applications.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Solar Radiation and its measurement: Solar angles, Sun path diagrams, Radiation, extra terrestrial characteristics, Solar energy measuring instruments: Pyranometer, Pyrheliometer, Sunshine recorder. Estimation of average solar radiation and estimation on horizontal and tilted surfaces

UNIT – II

Solar Collectors for Industrial process heat: Flat plate collector, Materials for flat plate collector and their properties, classification, evacuated tubular collectors, concentrator collectors, tracking systems, compound parabolic concentrators, parabolic trough concentrators, concentrators with point focus, Heliostats.

UNIT – III

Solar Thermal Technologies: Working principle, types, design, and operation, Solar heating and cooling systems, Thermal Energy storage systems, Solar Desalination, Solar cooker, Solar Pond, Solar drying, Solar chimney, Solar water disinfection (SODIS), Solar furnaces.

UNIT – IV

Solar Cells: Semiconductor materials, Doping, PN junction and characteristics, Photovoltaic effect, Photovoltaic material, Parameters of solar cells, Effects of cell temperature on cell efficiency, Types of solar cells, Solar modules and arrays, Solar cell power plant, Silicon, thin film and polymer processing, Silicon wafer based solar cells, Hybrid organic- inorganic solar cells.

UNIT – V

Solar Passive Architecture: Thermal comfort, bioclimatic classification. Passive heating concepts: direct heat gain, indirect heat gain, isolated gain and sunspaces
Passive cooling concepts: evaporative cooling, Radiative cooling, shading - paints and cavity walls for cooling, roof radiation traps, thermal comfort.

Text Books:

1. Solar Energy-Principles of Thermal Collection and Storage, S P Sukhatme & J K Nayak, McGraw Hill Education, 3rd Edition,2009, ISBN : 9780070142961.
2. Principles of Solar Engineering, D.Yogi Goswami, Frank Krieth and Jan F. Kreider Taylor and Francis, 2nd Edition,2000, ISBN : 9781560327141.

Reference Books:

1. Solar Energy- Fundamentals, Design, Modelling and Applications, G.N.Tiwari, Narosa publishing house. 1st Edition, 2002, ISBN : 9780849325093.
2. Solar Energy and Non-conventional Energy Sources, Domkundwar, Dhanpat Rai & Co, (P) Ltd., 2nd Edition, ASIN : B0BQWR83GF

Web Links:

1. https://archive.nptel.ac.in/courses/115/103/115103123/
2. https://www.nrel.gov/research/re-solar.html

Industry 5.0 for Engineers

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

Course Code: 2501ME58	**L**	**T**	**P**	**C**
	3	**0**	**0**	**3**

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

CO1: Explain the basic concept of Industry 5.0.

CO2: Explain the concepts of Industrial IOT, IOS and Predictive Analytics

CO3: Explain the cyber physical systems and AI technologies

CO4: Analyse the applications of Industry 5.0 in various sectors

CO5: Analyse case studies on automation and healthcare services

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Industry 5.0: Introduction of Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Compelling Forces and Challenges for Industry 5.0, Comparison of Industry 5.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Automation and Transformation Processes.

UNIT – II

Importance of Internet of Things (IOTs): Introduction to Internet of Things (IoT), Industrial Internet of Things (IIoT), Internet of Services, Fundamental of Predictive Analytics, Smart Logistics, Smart Devices and Products.

UNIT – III

Technology Evolution: Basics of cyber Physical Systems, Process Automations and Collaborative robots, Fundamental to artificial Intelligence, Mobile Computing, Cyber Security, Ethical technology, Responsive and distributed supply chain system, Human-centric and Value-oriented approaches.

UNIT – IV

Technology Implementation and Case Studies: 3D printing, Solar energy sector, Healthcare sector, Maintain records related to education, finance, clean bioenergy generation and Intelligent NextG Wireless Networks.

UNIT – V

Case studies on CNC/NC automation - Benefits, challenges, and industry applications. In-house, Healthcare services-Examples of innovations improving patient care and operational efficiency.

Text Books:

1. Uthayan Elangovan, Industry 5.0, "The Future of the Industrial Economy", First Edition, Taylor & Francis, ISBN: 978-1-032-04127-8, 2022.
2. Alessandro Massaro, "Electronics in Advanced Research Industries: Industry 4.0 to Industry 5.0 Advances", Wiley-IEEE Press, 2021, ISBN: 2021028944.

Reference Books:

1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.
2. Lan Gibson, David W. Rosen and Brent Stucker, "Additive Manufacturing Technologies Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
3. Hans Bernhard Kief, Helmut Roschiwal, Karsten Schwarz, "The CNC Handbook: Digital Manufacturing and Automation from CNC to Industry 4.0", Industrial Press Inc., U.S. ISBN 0831136367, Nov 2021.
4. Janya Chanchaichujit, Albert Tan, Fanwen Meng, Sarayoot Eaimkhong, "Healthcare 4.0 Next Generation Processes with the Latest Technologies", Palgrave Pivot, 2019,ISBN978-981-13-8113-3.

Web Links:

1. http://www.mqtt.org/
2. https://opcfoundation.org/about/opc-technologies/opc-ua/
3. https://www.ethercat.org/default.htm

Organizational Behaviour

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

Course Code: 2501ME73	L	P	T	C
	3	0	0	3

Course Outcomes:

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

CO1: Explain the roles, approaches of organizational behaviour models.

CO2: Summarize the behaviour of individuals and groups in organizations in terms of organizational behaviour.

CO3: Illustrate various stress and emotional organizational behaviour concepts, models and theories to real life management situations.

CO4: Analyze the functions of organizational communication and culture for effective communication and managing cultural diversity

CO5: Organize different groups and teams in the organization for better results.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Organizational Behaviour: Concept of Organizational Behaviour (OB)- Importance of Organizational Behaviour- Key Elements of Organizational Behaviour, Role of Managers in OB- Interpersonal Roles-Informational Roles- Decisional Roles, Approaches to Organizational Behaviour

UNIT – II

Interpersonal Behaviour: Nature and meaning of Interpersonal Behaviour, Concept of Self, Transaction Analysis (TA), Benefits and uses of Transactional Analysis, Johari Window Model

Personality: Definition and Meaning of Personality - Importance of Personality, Determinants of Personality, Theories of Personality, Personality Traits Influencing OB.

UNIT – III

Emotions: Nature and Meaning of Emotions - Characteristics of Emotions, Theories of Emotions, Emotions in the Context of OB. Organizational Stress: Definition and Meaning, Sources of Stress, Types of Stress, Impact of Stress on Organizations, Stress Management Techniques.

UNIT – IV

Organizational Communication: Meaning and Importance of Communication, Functions, process, types, Interpersonal Communication, Organizational Communication, Tips for Effective Communication.

Organization Culture: Meaning and Nature of Organization Culture – Origin of Organization Culture, Functions of Organization Culture, Types of Culture, Creating and Maintaining Organization Culture, Managing Cultural Diversity

UNIT – V

Groups and Teams: Meaning and Importance of Groups, Reasons for Group Formation, Types of Groups, Stages of Group Development, Meaning and Importance of Teams, Types of Teams, Creating an Effective Team.

Text Books:

1. Organizational Behaviour, K. Ashwathappa, Himalaya Publishing House, ISBN-13. 978-8184889390.
2. Management and Organizational Behaviour - (Text and Cases), Dr.P.Subba Rao and Prof. N.Sambasiva Rao, Himalaya Publishing House, Mumbai, ISBN: 978-93-5025-951-2.

Reference Books:

1. Understanding Organisational Behaviour, Udai Pareek, Oxford Higher Education, 2nd Edition, ISBN-13: 978-0195690866
2. Mc Shane & Von Glinov, Organisational Behaviour, Tata McGraw Hill, 4th Edition, ISBN-13, 978-1259927676.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc20_mg51/preview
2. https://www.udemy.com/course/organisational-behaviour/

Sustainable Energy Systems

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

Course Code: 2501ME36	L	T	P	C
	3	0	0	3

Course Outcomes:

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

CO1: Demonstrate the various components of solar thermal energy systems.
CO2: Describe the working of Wind turbines.
CO3: Explain the principle and working of Biomass and Geothermal Energy systems
CO4: Explain the Ocean, Tidal, Wave and hydro energy conversion systems.
CO5: Illustrate working of hybrid energy systems.

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

Introduction to Renewable energy sources: Energy demand and availability, energy crisis, renewable and non-renewable energy resources, environmental impact of conventional energy usage.

Solar Energy: Overview of the fundamental physics of solar radiation. Solar energy collectors.

Solar energy storage: Stratified storage, well mixed storage, comparison, Hot water system, solar ponds, non-convective solar pond, extraction of thermal energy and application of solar ponds.

Solar PV systems and its applications. Solar cell, module, and array.

UNIT – II

Wind Energy: Wind data and energy estimation – Betz limit - Site selection for windfarms. Horizontal and vertical axis wind mills, Wind farms- offshore, Onshore, various methods of control, and Environmental issues – Applications.

UNIT – III

Biomass: Bio-resources, Conversion process, Biomass gasifier - Types of biomass gasifiers, Biodiesel production – Ethanol production -Applications.

Geothermal Energy: Origin and types of geothermal energy and utilisation, Power generation from Geothermal energy, Environmental impact.

UNIT – IV

Ocean, Wave & Tidal Energy: Introduction - Resource Assessment - Power generation through OTEC systems. Wave and Tidal energy- Working principle, Availability, and energy conversion systems.

Mini & Micro Hydropower: Introduction, Power from water, System components of Mini and Micro Hydropower, Micro Hydropower plant in India, Potential Hydropower plant projects identified in India.

UNIT – V

Hybrid Energy Systems: Systems for processes and power applications – solar – wind – Biomass hybrid technologies
Fuel cell: Working principle- types - construction and applications. Solar – Fuel cell hybrid systems.

Text Books:

1. Renewable Energy: Power for a Sustainable Future, Boyle, G, Oxford University Press, 3rd Edition,2012, ISBN : 9780199681273.
2. Non-Conventional Energy Sources, G.D.Rai, Khanna Publishers, 6th edition, ISBN : 9788174090737.

Reference Books:

1. Renewable Energy Resources, John Twidell, Tony Weir, and Anthony D. Weir,Taylor & Francis,3rd edition,2015, ISBN : 9780415584388.
2. Non-Conventional Energy Resources, B H Khan, TMH Publishers, 3rd Edition,2017, ISBN : 9789352601882.

Web Links:

1. https://onlinecourses.nptel.ac.in/noc22_ch27/preview
2. https://www.energy.gov/eere/renewable-energy

Biomedical Electronics

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

Course Code: 2501EC97	L	T	P	C
	3	0	0	3

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

CO1: Understand the basic medical instrumentation system and bioelectric potentials.
CO2: Illustrate different types of electrodes to acquire bio-signals.
CO3: Demonstrate clinical laboratory measurements and assistive devices.
CO4: Discuss the latest developments in medical imaging systems.
CO5: Outline patient care and safety while using biomedical equipment.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Components of Medical Instrumentation Systems

Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. Sources of Bioelectric Potentials, Resting and Action Potentials.

UNIT – II

Bio-Potential Electrodes and Physiological Transducers:

Electrode potential and its equivalent circuit, Types of Electrodes: Surface Electrodes, Needle Electrodes, Micro Electrodes. Biochemical Transducers.

Bio-Signal Acquisition:

Electrical Conduction system of the heart, Electrocardiogram, ECG leads, Einthoven triangle, Plethysmography, EEG 10-20 lead system and EMG. basics of biomedical signal acquisition, common signal artifacts and simple noise reduction techniques.

UNIT – III

Clinical laboratory Measurements:

Blood cell Counter, Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter, automated blood pressure measurements.

Physiological Assist Devices & Therapeutic Equipment:

Pacemakers - External & internal, Defibrillators- External & internal, Hemodialysis machine.

UNIT – IV

Monitory and Imaging Equipment:

Spirometry, Ventilators, Arrhythmia Monitor, Foetal Monitor and Incubator. X-ray machine, Computed Tomography (CT), Magnetic Resonance Imaging System, Ultrasound Imaging system.

UNIT – V

Patient Care and Safety:

The elements of Intensive Care Monitor, Diagnosis, Calibration and reparability of Patient Monitoring equipment, Shock Hazards and Prevention, Physiological Effects and Electrical Current, Shock Hazards from Electrical Equipment, Methods of Accident Prevention, and Isolated Power Distribution System.

Text Books:

1. Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, *Biomedical Instrumentation and Measurements.*
   2nd Edition, PHI, 2004.
2. Dr. M. Arumugam, *Biomedical Instrumentation.* 2nd Edition, Anuradha publications, 2002.

Reference Books:

1. R.S. Khandpur, *Hand-book of Biomedical Instrumentation.* 2nd Edition, TMH, 2003.
2. John G. Webster, *Medical Instrumentation, Application and Design.* John Wiley, 3rd Edition, 2009.
3. Onkar N. Pandey, Rakesh Kumar, *Bio-Medical Electronics and Instrumentation.* 3rd Edition, Katson Books, 2002.

Web Links:

1 https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_bt49.

2 https://www.youtube.com/watch?v=Qq3t01LytkU&list=PLnsf_0i_t0FC4EdRdhLwjQgp5cYytJ5Oe.

Fundamentals of Wireless Communications

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

	L	T	P	C
Course Code:2501EC98	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1: Explain the fundamentals of wireless communication systems, spectrum allocation, and wireless standards.

CO2: Understand Analog ,digital and multicarrier OFDM modulation techinqies.

CO3: Compare multiple access techniques used in wireless communication systems.

CO4: Explain the architecture and standards of WPAN, WLAN, and WMAN technologies.

CO5: Compare cellular generations and LTE network architecture for modern mobile communications.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Overview of Wireless Communication:

History of wireless communication, Current Wireless Systems: Cellular Telephone Systems, Generations, Cordless Phones, Wireless LANs, Wide Area Wireless Data Services, Broadband Wireless Access, Paging systems, Satellite Networks, Bluetooth, ZigBee, Ultra-wideband Radios. The Wireless Spectrum: Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems, Standards.

UNIT – II
Modulation for Wireless Communication:

Need for Modulation, Analog Modulation, Amplitude modulation, Double sideband Supressed carrier, single sideband supressed carrier, Angle modulation, Digital modulation: Amplitude Shift Keying, Frequency Shift Keying Techniques, Phase-Shift Keying Techniques,BPSK and QPSK. Multicarrier-Modulation, Orthogonal Frequency Division Multiplexing.

UNIT – III
Multiple Access Techniques:

Contention-free multiple access schemes, Frequency-Division Multiple Access (FDMA),Time-Division Multiple Access (TDMA),Code-Division Multiple Access(CDMA), Space-division, contention-based multiple access schemes (ALOHA and CSMA).

UNIT – IV
Wireless Personal Area Networks:
Bluetooth, UWB and ZigBee, wireless local area networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), wireless metropolitan area networks (WiMAX).

UNIT – V
Wireless Mobile Networks and Applications:
Principles of Cellular Networks, First- Generation Analog, Second- Generation TDMA, CDMA, Third-Generation Systems, Fourth Generation Systems, LTE Architecture, Evolved Packet Core, LTE Resource Management.

Text Books:

1. Wireless communications- Goldsmith Andrea, Cambridge university press, 2005, ISBN: 9780511841224.
2. Wireless communication networks and systems-Cory Beard, and William Stallings, Pearson education (Global Edition), 2015, ISBN: 978-1292108728

Reference Books:

1. Wireless Communication the Fundamental and Advanced Concepts-Sanjay Kumar River Publishers, Denmark, 2015 ISBN: 9781000795325
2. Wireless communications:Principles and Practice,2nd Edition, Theodore S.Rappaport, Pearson education, 2010.
3. Fundamentals of wireless communication.- Tse, David, and Pramod Viswanath. Cambridge university press, 2005.

Web Links:

1. https://nptel.ac.in/courses/106106167 by Prof. David Koilpillai, IIT Madras
2. https://nptel.ac.in/courses/117104115 by Aditya K. Jagannatham, IIT Kanpur

Principles Of Embedded Systems
(CE,EEE,ME,CSE,IT,DS,AIML,PT,Min.E, Ag.E)

	L	T	P	C
Course Code: 2501EC99	**3**	**0**	**0**	**3**

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

CO1: Summarize the building blocks of an embedded system.
CO2: Interpret the hardware modules required to design an embedded system.
CO3: Infer the firmware design approaches for an embedded system.
CO4: Illustrate the hardware integration with firmware.
CO5: Outline the process of embedded system development and choose the tools for embedded system implementation and testing.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Embedded system-Definition, History of Embedded systems, classification of embedded systems, major application areas of embedded systems, purpose of embedded systems, the typical embedded system, core of the embedded system, Memory, Sensors and Actuators, Communication Interface, Characteristics of an embedded system, Quality attributes of embedded systems, Application-specific and Domain-Specific examples of an embedded system.

UNIT – II

Embedded Hardware Design: Analog and digital electronic components, I/O types and examples, Serial communication devices, Parallel device ports, Wireless devices, Timer and counting devices, Watchdog timer, Real time clock, multi processors architectures.

UNIT – III

Embedded Firmware Design: Embedded Firmware design approaches, Embedded Firmware development languages, Interrupt sources, ISR concept, Interrupt servicing mechanism, Multiple interrupts, DMA, Device driver programming, Concepts of C versus Embedded C.

UNIT – IV

RealTime Operating System: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronization.

Hardware Software Co-Design:

Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs, Integration of Hardware and Firmware.

UNIT – V

Embedded System Development: The integrated development environment, Types of files generated on cross-compilation, Deassembler/Decompiler, Simulators, Emulators and Debugging, Target hardware debugging, Boundary Scan, Embedded Software development process and tools. Embedded System Implementation and Testing: The main software utility tool, CAD and the hardware, Translation tools-Pre-processors, Interpreters, Compilers and Linkers, Debugging tools, Quality assurance and testing of the design, Testing on host machine.

Text Books:

1. Introduction to Embedded Systems, Shibu.K.V, Tata McGraw Hill Education Private Limited, 2nd Edition, 2016.
2. Embedded Systems – SoC, IoT, AI and Real-Time Systems, Raj Kamal, McGraw Hill Education India 4th Edition, 2020.

Reference Books:

1. Embedded System Design, Frank Vahid and Tony Givargis, John Wiley Publications, 2013.
2. Hardware Software Co-Design Principles and Practice, J.Staunstrup, Springer Publications, 2013
3. Embedded Systems Architecture, Tammy Noergaard, Elsevier Publications, 3rd Edition,2013.

Web Links:

1. https://www.coursera.org/learn/introduction-embedded-systems
2. https://www.linkedin.com/learning/introduction-to-embedded-systems-with-rust
3. https://www.udemy.com/course/embedded-systems-and-microcontrollers/

Electronics For Health Care

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

	L	T	P	C
Course Code: 2501ECA0	3	0	0	3

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

CO1: Know about health care data and its conversion to information and to knowledge.
CO2: Acquire knowledge on (Electronic Health Records) EHRs and their Implementation.
CO3: Understand the working of electronic devices used for the patient monitoring.
CO4: Know the concepts of Telemedicine and therapeutic devices used inside the human body.
CO5: Understand and analyse the working principles, design, and clinical applications of therapeutic devices.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT-I:

Health care data, Information and Knowledge: Definitions and Concepts, Converting Data to Information to Knowledge, Clinical Data Warehouses, what makes Health Informatics Difficult, Why Health IT fails Sometimes, Terminology of Analytics, Challenges to Data Analytics, Research and application of analytics, Role of Informatics in analytics.

UNIT-II:

Electronic Health Records: Introduction, Need for Electronic Health Records, Institute of Medicine's Vision for EHRs, Electronic Health Record Key Component, Electronic Prescribing, Electronic Health Record Adoption, Electronic Health Record Adoption and Meaningful use Challenges, Electronic Health Record Examples, Logical Steps to Selecting and Implementing an HER.

UNIT-III:

Patient Monitoring Systems: System Concepts, Cardiac Monitor, Bedside Patient Monitoring Systems, Central Monitors, Measurement of Heart Rate, Measurement of Pulse Rate, Blood Pressure Measurement, Measurement of Temperature, Measurement of Respiration Rate, Catheterization Laboratory Instrumentation.

UNIT-IV:

Biomedical Telemetry and Telemedicine: Wireless Telemetry, Single Channel Telemetry Systems, Multi-channel Wireless Telemetry Systems, Multi-patient Telemetry, Implantable Telemetry Systems, Transmission of Analog Physiological Signals, Over Telephone, Telemedicine.

UNIT-V:

Therapeutic Devices: Need for Cardiac Pacemaker, Implantable Pacemakers, DC Defibrillator, Electronics in the Anaesthetic Machine.

Text Books:

1. Robret E. Hoyt MD FACP "Health Informatics" sixth edition 2007.
2. R. S. Kandpur "Biomedical Instrumentation Technology and Applications" second edition Tata McGraw-Hill.

Reference Books:

1. Edward H. Shortlliffe, James J.Cimino "Biomedical Informatics, Computer applications in Health care and Biomedicine" third edition Springer.
2. G.V.R.K. Acharyulu, Bhimaraya Metri, L. Kalyan Viswanath REDDY "Health care and Hospital Management Contemporary Issues and Strategies".

Web Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge25.
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_hs82.
3. https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_bt09.

Basics of VLSI Design

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

	L	T	P	C
Course Code: 2501ECA1	**3**	**0**	**0**	**3**

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

- **CO1:** Outline the fundamental concepts related to MOS and Bi-CMOS Circuits fabrication.
- **CO2:** Analyze the electrical properties of MOS and Bi-CMOS Circuits.
- **CO3:** Make use of design rules for developing stick and layout diagrams.
- **CO4:** Interpret the issues related to subsystem design.
- **CO5:** Interpret FPGA and ASIC design approaches for semi-custom design.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

CO/PSO	PSO1	PSO2
CO1		
CO2		
CO3		
CO4		
CO5		

UNIT – I

Introduction: Introduction to IC Technology, MOS and related VLSI Technology, Basic MOS Transistors, Enhancement and Depletion modes of transistor action, IC production process, MOS and CMOS Fabrication processes, Bi-CMOS Technology, Comparison between CMOS and Bipolar technologies.

UNIT – II

Basic Electrical Properties of MOS and Bi-CMOS Circuits: Ids versus Vds Relationships, Threshold Voltage, MOS transistor Trans-conductance, Output Conductance and Figure of Merit, The Pass transistor, NMOS Inverter, Alternative forms of the pull-up, The CMOS Inverter, Bi- CMOS Inverter, Transistor switches, Schematics of Inverter, NAND, NOR gates using NMOS, PMOS, and CMOS technologies.

UNIT – III

MOS Circuit Design Processes: MOS Layers, Design Rules, General observations of design rules, 2µm Double Metal, Double Poly, CMOS rules, 1.2µm Double Metal, Double Poly CMOS rules, Stick Diagrams, Layout Diagrams of NAND and NOR gates and CMOS inverter.

UNIT – IV

Basic Circuit Concepts: Sheet Resistance, Sheet Resistance concept applied to MOS transistors and Inverters, Area Capacitance of Layers, Standard unit of capacitance, The Delay Unit, Inverter Delays, Propagation Delays, Wiring Capacitances.

UNIT – V

IC Design: PLAs, PLDs, FPGA, ASIC, Selection of an Appropriate Integrated Circuit.
FPGA Design Process: Architectures of Popular FPGAs, Choosing an FPGA, FPGA Design Process, FPGA Families of Different Vendors, FPGA Design Examples.

Text Books:

1. Essentials of VLSI Circuits and Systems by Kamran Eshraghian, Douglas and A. Pucknell, Sholeh Eshraghian, Prentice-Hall of India Private Limited, ISBN: 978-8120327726
2. VLSI Design, Black Book by Dr. K.V.K.K. Prasad, Kattula Shyamala, Kogent Learning Solutions Inc, ISBN: 978-9350048047

Reference Books:

1. **CMOS Digital Integrated Circuits Analysis & Design, Sung-Mo (Steve) Kang, Yusuf Leblebici, Tata McGraw-Hill, 3rd Edition, ISBN: 978-0072460537**
2. **Modern VLSI Design-Wolf Wayne, Pearson Edition, 3rd Edition, ISBN: 978-0130619709**
3. VLSI Design, K. LalKishore, V.S.V.Prabhakar, I.K. International Publishing House Private Limited, 1st Edition, ISBN: 978-9380026671

Web Links:

1. **NPTEL – VLSI Physical Design-** https://nptel.ac.in/courses/106105161
2. **NPTEL – Advanced VLSI Design** https://nptel.ac.in/courses/117/101/117101004.

System on Chip Design

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

	L	T	P	C
Course Code: 2501ECA2	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1: Explain all the building blocks of SoC.
CO2: Classify the concept of processors and instruction handling.
CO3: Analyze vector, VLIW and superscalar processors.
CO4: Develop a Memory as part of SoC.
CO5: Illustrate the concepts of interconnect optimization and configuration in SoC.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Introduction to the System Approach:
System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT – II
Processors:
Introduction , Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers:minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT – III

Memory Design for SOC:

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

UNIT – IV

Interconnect Customization:

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor.

UNIT – V

Interconnect Configuration:

Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor, Reconfiguration – overhead analysis and trade-off analysis on reconfigurable Parallelism.

Text Books:

1. Computer System Design System-on-Chip, Michael J. Flynn and Wayne Luk, Wiley India Pvt. Ltd,ISBN: 978-0470643365.
2. ARM System on Chip Architecture, Steve Furber, Addison Wesley Professional, 2nd Edition, ISBN : 9780201675191 .

Reference Books:

1. Design of System on a Chip: Devices and Components, Ricardo Reis, Springer 1st Edition, ISBN: 978-1441954541.
2. Co-Verificationof Hardware and Software for ARM System on Chip Design (Embedded Technology), Jason Andrews, Newnes, BK and CDROM, ISBN: 978-0750677301.
3. System on Chip Verification–Methodologies and Techniques, Prakash Rashinkar, Peter Paterson and Leena Singh L, Kluwer Academic Publishers, ISBN: 978-0792372790.

Web Links:

1. https://www.peterindia.net/System-On-ChipLinks.html
2. https://www.ieee-socc.org/
3. http://nptel.ac.in/courses/108102045/10 (Prof. Santanu Chaudhary, IIT Delhi)

Introduction to Quantum Computing

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

	L	T	P	C
Course Code: 2501ECA3	**3**	**0**	**0**	**3**

Course Outcomes:

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

CO1: Understand the fundamentals of quantum computing and qubits.
CO2: Build simple quantum circuits.
CO3: Analyze quantum circuits and algorithms.
CO4: Identify different quantum hardware technologies and their challenges.
CO5: Outline real time applications of quantum computing in various fields

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Fundamentals of Quantum Computing:
Evolution from Classical Computing to Quantum Computing, Need for Quantum Computing, Classical Bits vs Qubits, Principles of Quantum Mechanics for Computing, Superposition and Measurement, Quantum States and Bloch Sphere Representation, Introduction to Quantum Gates, Quantum Computing Platforms and Ecosystem.

UNIT – II
Quantum Circuits and Computing Concepts:
Quantum Circuit Model, Single Qubit and Multi-Qubit Systems, Common Quantum Gates: Pauli, Hadamard, Phase, CNOT, Quantum Entanglement, Quantum Parallelism, Quantum

Teleportation (Conceptual Understanding), Basic Quantum Circuit Design, Introduction to Quantum Simulators.

UNIT – III

Quantum Algorithms:

Introduction to Quantum Algorithms, Deutsch–Jozsa Algorithm, Grover's Search Algorithm, Shor's Factorization Algorithm (Overview), Quantum Fourier Transform (Basic Idea), Quantum Speedup and Computational Advantage, Hybrid Quantum-Classical Computing, Introduction to Quantum Machine Learning.

UNIT – IV

Quantum Hardware and Programming:

Overview of Quantum Hardware Technologies: Superconducting Qubits, Trapped Ion Systems, Photonic Quantum Computing. Noise and Decoherence, Quantum Error Correction (Basic Concepts), Introduction to NISQ Devices, Basics of Quantum Programming using Python and Qiskit, Introduction to IBM Quantum Experience.

UNIT – V

Applications of Quantum Computing:

Quantum Cryptography and Cybersecurity, Quantum Computing in Healthcare and Drug Discovery, Optimization Problems and Smart Systems, Quantum in Finance & Logistics, Quantum computing for Industrial Applications and Future Scope, Ethical and Societal Impact of Quantum Technologies.

Text Books:

1. Quantum Computation and Quantum Information – Michael A. Nielsen & Isaac L. Chuang.
2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press, First Edition, 2011.

Reference Books:

1. **Eric R. Johnston, Nic Harrigan, and Mercedes Gimeno-Segovia**, Programming Quantum Computers: Essential Algorithms and Code Samples, O'Reilly Media, First Edition, 2019.

Web Links:

1. https://quantum.cloud.ibm.com/?utm_source=chatgpt.com
2. https://quantum.cloud.ibm.com/docs/en/guides

Data Structures

(CE, ME, PT, Min.E.)

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

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

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

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

Practice:

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

UNIT – II

Introduction to Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation, Overview of time and space complexity analysis for linear data structures.

Sorting Techniques: Quick sort, Merge sort, Radix sort

Practice:

1. Implement Merge sort using arrays.
   https://www.hackerrank.com/contests/hw1/challenges/merge-sort

2. Implement Quick sort using arrays
   https://www.hackerrank.com/challenges/quicksort1/problem
3. Implement Radix Sort using arrays
   https://www.hackerrank.com/contests/hw1/challenges/radix-sort?utm_source

UNIT – III

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

Practice:

1. Single Linked List: Perform different operations in single linked list.
   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
   https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
   https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source

UNIT – IV

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

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

Practice:

1. Stack and its operations using arrays and Linked List
   https://www.hackerrank.com/challenges/balanced-brackets/problem
   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
   https://leetcode.com/problems/evaluate-reverse-polish-notation/description/
3. Queue and its operations using arrays and Linked List
   https://leetcode.com/problems/implement-queue-using-stacks/description/
   https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
   https://leetcode.com/problems/design-circular-queue/description/

UNIT – V

Non-linear Data Structures:

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

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

Practice:

1. Implement Binary search tree (BST).
   https://leetcode.com/problems/insert-into-a-binary-search-tree/description/
   https://leetcode.com/problems/delete-node-in-a-bst/description/
2. Implement Binary search Tree (BST) Traversals.
   https://www.hackerrank.com/challenges/tree-inorder-traversal/problem
   https://www.hackerrank.com/challenges/tree-preorder-traversal/problem
   https://www.hackerrank.com/challenges/tree-postorder-traversal/problem

3. Graph Traversal using Breadth First Search (BFS)
   https://www.hackerrank.com/challenges/bfsshortreach/problem
4. Graph Traversal using Depth First Search (DFS)
   https://leetcode.com/problems/number-of-islands/description/

Text Books:

1. Data Structures using C, Rema Theraja, Oxford University Press, 3rd Edition. ISBN: 978-9354979453

2. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204

2. Fundamentals of data structures in C, Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Silicon Press, ISBN: 978-0716782506

3. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

4. Data Structures Using C, Reema Thareja, Oxford University Press, 2nd Edition. ISBN: 978-0198099307

Web Links:

1. https://nptel.ac.in/courses/106102064
2. https://archive.nptel.ac.in/courses/106/105/106105225/
3. https://www.udemy.com/topic/data-structures/
4. https://www.coursera.org/specializations/data-structures-algorithms
5. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Structs and enums	https://www.hackerrank.com/challenges/too-high-boxes/problem
2	Easy	Structs and enums	https://www.codechef.com/problems/HS08TEST?tab=statement
3	Medium	Structs and enums	https://www.hackerrank.com/challenges/small-triangles-large-triangles/problem
4	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
5	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
6	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
7	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
8	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/

9	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
10	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
11	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
12	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
13	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
14	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
15	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	**Aditya's Internal coding Platform(Maya)**	**Code chef**	**Hacker rank**	**Leet code**	**Geek for Geeks**
Unit-1	3	0	0	0	0	0
Unit-2	0	0	0	3	0	0
Unit-3	0	0	1	0	2	0
Unit-4	0	0	0	1	5	0
Unit-5	0	0	0	4	3	0
Additional Practice	0	0	1	5	8	1
Total	**3**	**0**	**2**	**13**	**18**	**1**

Data Structures using C++

(CE, ME, PT, Min.E.)

(Revised Syllabus for batches admitted from 2026 Onwards)

	L	T	P	C
Course Code: 2601DS02	**2**	**0**	**2**	**4**

Course Outcomes:

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

CO1: Apply C++ features for problem solving.
CO2: Apply various sorting techniques to solve computing problems.
CO3: Make use of linear data structures to solve real time problems.
CO4: Develop applications using Tree data structures.
CO5: Solve problems using Graph algorithms.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

An Overview of C++: Structure of C++ program, Input and output in C++, Class, Objects,Members Functions, Access Specifiers, Introduction to Constructors and Destructor. **Overview of Standard Template Library:** Introduction, STL Programming Model, Containers, Sequence Containers, Associative Containers, Algorithms, Iterators, Vectors, Lists, Maps.

Practice:

1. Find the roots of a quadratic equation.
2. Find factorial of a given number using recursion
3. Palindrome Number
   https://leetcode.com/problems/palindrome-number/description/
4. Class and Objects
   https://www.hackerrank.com/challenges/classes-objects/problem?isFullScreen=true
5. Program to illustrate the use of Constructors and Destructors.
6. C++ Class Templates

https://www.hackerrank.com/challenges/cpp-class-template-specialization/problem?isFullScreen=true

UNIT – II

Data Structures: Introduction to Data Structures, Types of Data Structures.
Linear Data Structures: Definition and importance of linear data structures, Abstract data types (ADTs) and their implementation.
Linked Lists: Singly linked lists: Representation and operations, Doubly linked lists and its operations and Circular linked lists and its operations, applications of linked list

Practice:

1. Single Linked List: Perform different operations in single linked list.
   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Perform different operations in double linked list
   https://leetcode.com/problems/design-linked-list/?utm_source
3. Circular Linked List
   https://www.codechef.com/practice/course/linked-lists/LINKLISTF/problems/PREP58?utm_source
4. Reversing a Linked List

UNIT – III

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

Practice:

1. Stack and its operations using arrays and Linked List
   https://www.hackerrank.com/challenges/balanced-brackets/problem

   https://leetcode.com/problems/design-linked-list/description/?utm_source
2. Implement a program to evaluate a postfix expression.
   https://leetcode.com/problems/evaluate-reverse-polish-notation/description/
3. Queue and its operations using arrays and Linked List
   https://leetcode.com/problems/implement-queue-using-stacks/description/

   https://leetcode.com/problems/design-linked-list/description/?utm_source
4. Implement Circular Queue using Arrays
   https://leetcode.com/problems/design-circular-queue/description/

UNIT – IV

Trees: Definition of tree, Tree Terminology, Representation of tree, Types of trees-Binary Tree, BST, BST, Binary tree traversals-Inorder,Preorder,Postorder Traversals.
Binary Search Trees – Definition, Operations: Searching, Insertion, Deletion.

Practice:

1. Implement Binary search tree (BST).
   https://leetcode.com/problems/insert-into-a-binary-search-tree/description/
   https://leetcode.com/problems/delete-node-in-a-bst/description/
2. Implement Binary search Tree (BST) Traversals.
   https://www.hackerrank.com/challenges/tree-inorder-traversal/problem
   https://www.hackerrank.com/challenges/tree-preorder-traversal/problem

   https://www.hackerrank.com/challenges/tree-postorder-traversal/problem

UNIT – V

Graphs: Definition and Terminology, Types of Graph, Representation of Graphs-Adjacency Matrix and Adjaceny list, Graph Traversals (BFS & DFS), Bi-Connected Components.

Practice:

1. Graph Traversal using Breadth First Search (BFS)
   https://www.hackerrank.com/challenges/bfsshortreach/problem
2. Graph Traversal using Depth First Search (DFS)
   https://leetcode.com/problems/number-of-islands/description/

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH, Fourth Edition, ISBN-10. 0070411832.

2. Fundamentals of Data Structures in C++,Ellis Horowitz, Sartaj Sahni, DineshMehta, ISBN:

   81-7515-278-8

3. Data Structures, KV Sambasivarao, S Rama Sree, S.Chand. ISBN: 978-9358704730

Reference Books:

1. The C++ Programming Language, Bjarne Stroustrup, Pearson, Fourth Edition,ISBN · 9780133522884.
2. Object oriented programming in C++, JoyceeFarrell,Cengage, ISBN : 978-1418836269
3. Data structures and algorithms in C++, 3rd edition, Adam Drozdek,Thomson, ISBN: 9788131521267
4. The Algorithm Design Manual, Steven S. Skiena, Springer Publication, Second Edition. ISBN: 978-1849967204
5. Data Structures and Algorithms by Maganti Venkatesh, Naresh. ISBN: 9780929306407

Web Links:

1. http://nptel.ac.in/courses/106105151/
2. https://nptel.ac.in/courses/106102064
3. https://archive.nptel.ac.in/courses/106/105/106105225/
4. https://www.udemy.com/topic/data-structures/
5. https://www.coursera.org/specializations/data-structures-algorithms
6. https://ds1-iiith.vlabs.ac.in/List%20of%20experiments.html

Additional Practice:

SNO	Difficulty	Problem Name	URL
1	Easy	Arrays and Hashtables	https://leetcode.com/problems/two-sum/description/
2	Easy	Arrays and Pointers	https://leetcode.com/problems/remove-duplicates-from-sorted-array/description/?utm_source
3	Medium	Arrays and Pointers	https://leetcode.com/problems/two-sum-ii-input-array-is-sorted/description/?utm_source
4	Easy	Linked List	https://leetcode.com/problems/merge-two-sorted-lists/description/
5	Medium	Arrays and Matrix	https://leetcode.com/problems/diagonal-traverse/description/
6	Easy	Linked List	https://www.hackerrank.com/challenges/compare-two-linked-lists/problem
7	Medium	Stack applications	https://www.geeksforgeeks.org/problems/tower-of-hanoi-1587115621/1?utm
8	Medium	Binary Tree	https://leetcode.com/problems/binary-tree-right-side-view/description/
9	Medium	Stack applications	https://leetcode.com/problems/remove-k-digits/description/
10	Medium	Graph Theory	https://www.hackerrank.com/challenges/journey-to-the-moon/problem
11	Medium	Graph Traversals	https://leetcode.com/problems/number-of-provinces/description/
12	Medium	Graph Theory	https://www.hackerrank.com/challenges/torque-and-development/problem

	Basic Programs	Code chef	Hacker rank	Leet code	**Geek for Geeks**
Unit-1	3	0	2	1	0
Unit-2	0	1	3	2	0
Unit-3	0	0	1	5	0
Unit-4	0	0	3	2	0
Unit-5	0	0	1	1	0
Additional Practice	0	0	3	8	1
Total	3	1	13	19	1

Operating Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Operating Systems Overview: Operating system functions, Operating system structure, Operating systems operations, Computing environments, Open-Source Operating Systems. System Structures: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, operating system structure, System Boot.

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

Practice:

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

UNIT – II

Process Concept: Process scheduling, Operations on processes, Inter-process communication.

Process Scheduling: Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling, Thread scheduling.
Multithreaded Programming: Multithreading models, Thread libraries, Threading issues
Case Study: The above topics are discussed as case study in Windows/ Unix OS
Practice:
1. Simulate the following CPU scheduling algorithms:FCFS and SJF
2. Simulate the following CPU scheduling algorithms: Priority and Round Robin

UNIT – III
Inter-process Communication: Race conditions, Critical Regions, Mutual exclusion with busy waiting, Sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing, Classical IPC Problems - Dining philosophers problem, Readers and writers problem.
Deadlocks: Resources, Conditions for resource deadlocks, Ostrich algorithm, Deadlock detection and recovery, Deadlock avoidance, Deadlock prevention.
Case Study: The above topics are discussed as case study in Windows/ Unix OS

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

UNIT – IV
Memory-Management Strategies: Introduction, Swapping, Contiguous memory allocation, Paging, Segmentation.
Virtual Memory Management: Introduction, Demand paging, Copy on-write, Page replacement, Frame allocation, Thrashing, Memory-mapped files, Kernel memory allocation.
File Systems: Files, Directories, File system implementation, management and optimization.
Case Study: The above topics are discussed as case study in Windows/ Unix OS

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

UNIT – V
Secondary-Storage Structure: Overview of disk structure, and attachment, Disk scheduling, RAID structure, Stable storage implementation.
System Protection: Goals of protection, Principles and domain of protection, Access matrix, Access control, Revocation of access rights.
System Security: Introduction, Program threats, System and network threats.

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

Text Books:

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

Reference Books:

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

Web Links:

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

Database Management Systems

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

	L	T	P	C
Course Code: 2501IT05	2	0	2	4

Course Outcomes:

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

Data Models : Concepts of Schema, Instance and data independence,Three tier schema architecture for data independence, Database system structure, environment, Centralized and Client Server architecture for the database.

Practice

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

UNIT – II

Relational Model: Introduction to relational model, concepts of domain, attribute, tuple, relation, importance of null values, constraints (Domain, Key constraints, integrity constraints) and their importance

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

Practice

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

UNIT – III

Entity Relationship Model: Introduction, Representation of entities, attributes, entity set, relationship, relationship set, constraints, sub classes, super class, inheritance, specialization, generalization using ER Diagrams.
SQL: Creating tables with relationship, implementation of key and integrity constraints, nested queries, sub queries, grouping, aggregation, ordering, implementation of different types of joins, view(updatable and nonupdatable), relational set operations.
Practice

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

UNIT – IV
Normalization: Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency (1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF), Fifth Normal Form (5NF).
Transaction Concept: Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Storage, Recovery and Atomicity, Recovery algorithm.
Practice
1. Implement SQL queries on a normalized database schema based on the provided schema. For this exampe: use the schema for a university database, which includes:

- Students (StudentID, StudentName, Major)
- Courses (CourseID, CourseName, Credits)
- Enrollments (StudentID, CourseID, EnrollmentDate)
- Instructors (InstructorID, InstructorName, Phone)
- Course_Instructors (CourseID, InstructorID)

2. (A)Implementation of Data Control Language commands – grant and revoke.
(B)Implementation of Transaction Control Language commands - commit, save point, and rollback.

UNIT – V
Indexing Techniques: Introduction, B+ Trees: Search, Insert, delete algorithms, File Organization and Indexing, Cluster Indexes, Primary and Secondary Indexes, Index data Structures, Hash Based Indexing: Tree base Indexing, Comparison of File Organizations.
Database Tuning: Introduction, Database Performance Tuning, Query Optimization: Introduction, Query Optimization algorithms, Backup and Recovery.
Practice

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

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

Text Books:

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

Reference Books:

1. Database Systems, RamezElmasri, Shamkant B. Navathe, 7th Edition, Pearson, ISBN: 978-0137504277.
2. Database Systems, Carlos Coronel, Steven Morris, Peter Rob, 10th Edition, Cengage, ISBN: 978-0357517864.
3. Introduction to Database Systems, C J Date, Pearson, 9th Edition, ISBN: 978-0133970777.

Web Links:

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

Computer Networks

(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

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

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

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

Mapping of Course Outcomes with Program Outcomes:

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

UNIT – I

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

Practice:

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

UNIT – II

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

Practice:

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

UNIT – III

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

Reservation, Polling, Token Passing, Channelization: frequency division multiple Access (FDMA), time division multiple access (TDMA), code division multiple access (CDMA).

Practice:

1. Write a Program to implement Sliding window protocols

UNIT – IV

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

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

Traffic Control Algorithm: Leaky bucket & Token bucket.

Practice:

1. Programs to implements routing protocols like shortest path.

UNIT – V

IP Protocols: IP Addressing, IP & ICMP.

Transmission Control Protocol: UDP & TCP.

Application Layer: World Wide Web, HTTP, Electronic mail, Architecture, web based mail, email security, TELENET, local versus remote Logging, Domain Name System: Name Space, DNS, SNMP.

Practice:

1. NS2 Simulator i. NS2 Simulator-Introduction ii. Simulate to Find the Number of Packets Dropped iii. Simulate to Find the Number of Packets Dropped by TCP/UDP

Capstone Project:

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

Text Books:

1 Computer Networks — Andrew S Tanenbaum and David J Wetherall, Pearson Education, 5th Edition. ISBN: 978-0132126953

2 Data Communications and Networking – Behrouz A.Forouzan, McGraw Hill Education, 5th Edition ISBN: 978-1259064753

Reference Books:

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

2 Computer Networks, Mayank Dave, CENGAGE India, 6th Edition ISBN: 978-8131509869

Web Links:

1 https://nptel.ac.in/courses/106105081

2 https://www.coursera.org/learn/fundamentals-network-communications

Artificial Intelligence
(CE, EEE, ECE, PT, Min.E.)

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

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

CO1: Illustrate the foundations, history, and applications of Artificial Intelligence using modern tools
CO2: Develop AI-based problem-solving models using Python
CO3: Implement search and optimization algorithms using Python libraries
CO4: Apply knowledge representation techniques using Python frameworks
CO5: Design simple intelligent systems and expert systems using Python

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

Unit - I
Introduction to AI & Python Foundations
What is AI? Foundations and History of AI, AI Applications in real-world systems, Intelligent Agents and Environment, Rationality and Types of Agents, Fundamentals of Python for AI applications.

Practice (Python-based):
1. Implement simple AI agent (e.g., vacuum cleaner agent simulation)
2. Rule-Based AI Agent (Weather Decision Agent)

Unit – II
Problem Solving & Search Algorithms
Problem formulation and state space representation, Control strategies, Search strategies, Uninformed Search: BFS, DFS, Uniform Cost Search, Informed Search: Greedy, A* Algorithm, Heuristics and evaluation functions.

Practice (Python):

1. Implement DFS algorithm for Water Jug Problem
2. Solve Tic-Tac-Toe using BFS search strategy.
3. Implement A* Algorithm for pathfinding (e.g., grid navigation)

Unit – III
Optimization & Game Playing
Problem graphs, Matching, Indexing, Local Search Algorithms: Hill Climbing, Simulated Annealing, Optimization Problems, Searching with Nondeterministic Actions, Constraint Satisfaction Problems (CSP), Game Playing: Minimax Algorithm, Alpha-Beta Pruning

Practice (Python):

1. Solve 8-Puzzle using Hill Climbing
2. Implement Travelling Salesman Problem (TSP) using heuristic approach

Unit – IV
Knowledge Representation
Knowledge Representation Techniques, Propositional Logic & Predicate Logic, Inference & Resolution, Semantic Networks and Frames, Representation of knowledge through Planning generation Systems-K Strips Strategic explanations Why, why not and how explanations.

Practice (Python):

1. a) Implement Predicate Logic using Python (SymPy / logic module)
   b) Develop a Semantic Network (e.g., Animals or Transport)
2. Create a Frame-based system (Restaurant domain)

Unit – V
Expert Systems & Modern AI Applications
Expert Systems Architecture, Knowledge Acquisition & Representation, Meta knowledge, Rule-based Systems, Ethics in AI, Typical expert systems – EMYCIN, DART, XOON, Expert systems shells.

Practice (Python):

1. Build a Travel Recommendation Expert System
2. Develop a Student Career Guidance System

Text Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig (need to add details)
2. Artificial Intelligence: Foundations of Computational Agents – Poole & Mackworth

Reference Books

1. Artificial Intelligence with Python – Prateek Joshi
2. Hands-On Machine Learning with Scikit-Learn & TensorFlow – Aurélien Géron
3. Python AI Projects for Beginners – Prateek Joshi

Web Resources

1. https://docs.python.org
2. https://nptel.ac.in/courses/106105077
3. https://nptel.ac.in/courses/106106126

Machine Learning

(CE, ECE, PT, Min.E.)

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

Course Outcomes:

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

CO1: Outline the Concepts of Machine Learning and Statistical Learning

CO2: Build Regression and Classification models for given data.

CO3: Apply Instance based Learning techniques and SVM techniques linear and nonlinear data.

CO4: Apply clustering techniques on high dimensional data to group the similar entities.

CO5: Make use of ensemble learning techniques to improve the performance of a model.

Mapping of Course Outcomes with Program Outcomes:

CO/PO	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2			2	2		1	1		
CO2	2	2	3		2	2		1	1		
CO3	3	2	3		2			1	1		2
CO4	3	2	3		2			1	1		
CO5	2	2	2		2			1	1		2

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I

Introduction:

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

Practice :

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

UNIT – II

Supervised Learning(Regression/Classification):Basic Methods:

Concept Learning: General-to-Specific Hypotheses Ordering, Find-S and Candidate Elimination Algorithm, Version Space, and Inductive Bias.

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

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

Practice :

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

UNIT – III

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

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

Practice :

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

UNIT – IV

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

Unsupervised Learning:

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

Practice :

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

UNIT – V
Ensemble Learning :
Bagging and Boosting, Adaboost and Random Forest ,
Computational Learning Theory : Error and Noise Formalisms, Training vs. Testing, Theory of Generalization,PAC Learnability and VC Dimensions , Overfitting, Regularization and Validation.

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

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

Corner Stone Project:

PROJECT 1: Intelligent Loan Risk Assessment System (End-to-End ML Pipeline)

Project Implementation, Documentation and Viva Voce

- **Implementation mainly focuses on**
  - Collecting and integrating multiple datasets (loan + financial history)
  - Advanced preprocessing (missing values, outliers, feature engineering)
  - Implementing multiple models (Logistic Regression, Random Forest, XGBoost)
  - Handling imbalanced data (SMOTE / resampling techniques)
  - Model evaluation using ROC-AUC, F1-score, cross-validation
  - Building a simple UI (Streamlit/Web app) for predictions
  - Model comparison and optimization
- **Documentation must contain**
  - Objective & real-world problem definition
  - Dataset merging and preprocessing pipeline
  - Feature engineering techniques
  - Model comparison and evaluation metrics
  - System architecture diagram
  - Screenshots (UI + outputs)
  - Enhancements (hyperparameter tuning, deployment)

PROJECT 2: Smart Disease Prediction System with Model Ensemble

• **Implementation mainly focuses on**
  - Using medical datasets (heart disease/diabetes/multi-disease)
  - Data preprocessing and feature selection
  - Applying multiple classifiers (SVM, kNN, Random Forest, Gradient Boosting)
  - Ensemble learning (Voting / Stacking models)
  - Model evaluation using confusion matrix, ROC curves
  - Explainability (feature importance / SHAP basics)
  - Web-based prediction interface

• **Documentation must contain**
  - Objective
  - Dataset and preprocessing steps
  - Model architecture and ensemble approach
  - Evaluation metrics and comparison
  - Screenshots (prediction system)
  - Enhancements (multi-disease prediction)

PROJECT 3: Real-Time Sentiment Analysis System with Web Scraping

• **Implementation mainly focuses on**
  - Scraping live data (Twitter/news using APIs or scraping tools)
  - Text preprocessing (stopwords, stemming, vectorization – TF-IDF)
  - Training models (Naïve Bayes, Logistic Regression, LSTM optional)
  - Real-time sentiment prediction
  - Visualization dashboard (charts for sentiment trends)
  - Handling large-scale streaming data

• **Documentation must contain**
  - Objective
  - Data collection methodology (APIs/web scraping)
  - NLP preprocessing pipeline
  - Model building and evaluation
  - Dashboard explanation
  - Screenshots
  - Enhancements (real-time alerts, topic modeling)

PROJECT 4: Heart Disease Prediction using SVM

• **Implementation mainly focuses on**
  - Loading patient dataset
  - Applying Support Vector Machine (SVM)
  - Data preprocessing and feature scaling
  - Classification of patients (disease/no disease)
  - Model evaluation using confusion matrix

• **Documentation must contain**
  - Objective
  - Dataset description
  - SVM working principle
  - Evaluation metrics
  - Output results
  - Screenshots
  - Enhancements (kernel comparison)

PROJECT 5: Customer Segmentation using Clustering

• Implementation mainly focuses on
  - Loading customer dataset
  - Applying K-Means clustering
  - Identifying groups based on features
  - Visualizing clusters using plots
  - Comparing clustering results

• Documentation must contain
  - Objective
  - Dataset details
  - Clustering technique explanation
  - Cluster visualization
  - Results interpretation
  - Screenshots
  - Enhancements (DBSCAN comparison)

PROJECT 6: Fake News Detection System using Machine Learning

• Implementation mainly focuses on
  - Dataset collection (news datasets / scraping)
  - Text preprocessing (tokenization, TF-IDF, n-grams)
  - Applying classification models (Logistic Regression, SVM, Random Forest)
  - Model evaluation using precision, recall, F1-score
  - Comparing multiple models
  - Building a simple interface for prediction

• Documentation must contain
  - Objective
  - Dataset description
  - NLP pipeline
  - Model comparison
  - Evaluation metrics
  - Screenshots
  - Enhancements (deep learning models)

PROJECT 7: Sentiment Analysis using Ensemble Learning

• Implementation mainly focuses on
  - Collecting dataset (Twitter/Kaggle)
  - Text preprocessing
  - Applying Bagging and Boosting techniques
  - Training ensemble models (Random Forest / AdaBoost)
  - Predicting sentiment (positive/negative)

• Documentation must contain
  - Objective
  - Dataset source
  - Preprocessing steps
  - Ensemble methods explanation
  - Performance comparison
  - Screenshots
  - Enhancements (real-time data analysis)

PROJECT 8: Model Evaluation and Comparison System

• Implementation mainly focuses on
  - Implementing multiple models (kNN, SVM, Regression)
  - Performing cross-validation

- Calculating accuracy, precision, recall, F1-score
- Comparing model performance
- Visualizing results using graphs

• **Documentation must contain**

- Objective
- Models used
- Evaluation metrics explanation
- Comparison results
- Graphs and charts
- Screenshots
- Enhancements (hyperparameter tuning)

Text Books:

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

Reference Books:

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

Web Links:

1 https://www.deeplearning.ai/machinelearningyearning/
2 https://www.cse.huji.ac.il/~shais/UnderstandingMachineLearning/index.html
3 https://onlinecourses.nptel.ac.in/noc21_cs24/preview

Note:

- Students must submit the Certificate of Completion offered by any Industry.
- The capstone project team size shall be four (4) students.
- Students may select any one of the above prescribed projects or a project of their own choice with the prior permission of the Course instructor.
- The SEE – Lab shall be evaluated for 50 marks based on project implementation, oral presentation, 10-minute video presentation, and viva voce.
- The video presentation should consist of the working procedure of the project along with contribution of each student for a minimum of 2 minutes.

Fundamentals of Data Science
(CE, EEE, ME, ECE, PT, Min.E., Ag.E.)

	L	T	P	C
Course Code: 2501CS34	**2**	**0**	**1**	**3**

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

CO1: Explain fundamental concepts of Data Science.
CO2: Implement Data Collection and Preprocessing Techniques.
CO3: Demonstrate Proficiency in Data Loading, Storage, and File Handling
CO4: Conduct Exploratory Data Analysis (EDA) using Visualization and Statistical Techniques.
CO5: Make use of Neo4j, Cypher tools to manage and analyze graph data.

Mapping of Course Outcomes with Program Outcomes:

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

Mapping of Course Outcomes with Program Specific Outcomes:

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

UNIT – I
Introduction To Data Science: Definition and Scope of Data Science, History and Evolution of Data Science, Applications of Data Science, Data Science Lifecycle, Data Types and Structures, Tools and Technologies in Data Science.

Practice:
1. Importing and Exploring Datasets - Loading datasets using libraries and performing basic exploration.
2. Basic Data Structures - Working with data structures such as arrays, lists, data frames, and matrices

UNIT – II
Data Collection and Preprocessing: Data Collection Methods, Data Cleaning and Handling Missing Values, Data Transformation: Normalization and Standardization, Feature Engineering and Feature Scaling, Data Integration and Aggregation.
Practice:

1. Computing summary statistics like mean, median, mode, and standard deviation for a sample dataset.
2. Handling missing values and outliers in a dataset using techniques like imputation and filtering.

UNIT – III

Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats,Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in Mongo DB.

Practice:

1. Read data from a JSON file into a DataFrame using Pandas (pd.read_json) or R (jsonlite). Parse nested JSON structures and convert them into a flat table format.
2. Perform web scraping on an HTML page using BeautifulSoup in Python or rvest in R. Extract data from HTML tables and convert it into a DataFrame.

UNIT – IV

Exploratory Data Analysis (EDA): Descriptive Statistics, Data Visualization Techniques, Correlation and Covariance Analysis, Univariate, Bivariate, and Multivariate Analysis, Pattern Detection and Anomaly Identification.

Practice:

1. Plotting histograms and box plots to understand the distribution of a single variable.
2. Creating scatter plots and calculating correlation coefficients to study the relationship between two variables.

UNIT – V

Data Science Tools: Neo4j for dealing with graph databases, graph query language Cypher, libraries like nltk and SQLite for handling Text mining and analytics.

Practice:

1. Get hands-on experience with Neo4j to understand how to manage and query graph databases.
2. Practice writing Cypher queries to interact with graph data in Neo4j.

Text Books:

1	Python for Data Analysis ,Wes McKinney, O'REILLY, ISBN:978-1-449-31979-3, 1st edition, ISBN · 9781449319793.
2	Doing Data Science ,Rachel Schutt & O'neil, O'REILLY, ISBN:978-1-449-35865-5, 1st edition, ISBN: 9781449358655.

Reference Books:

1	Data Science from Scratch: First Principles with Python ,Joel Grus, O'Reilly Media. ISBN: 9781492041139.
2	Learning the Pandas Library: Python Tools for Data Munging ,Matt Harrison, Analysis, and Visualization , O'Reilly. ISBN: 9781787123137

Web Links:

1	https://onlinecourses.nptel.ac.in/noc24_cs68/preview
2	https://onlinecourses.nptel.ac.in/noc24_cs133/preview
3	https://www.geeksforgeeks.org/how-to-become-a-data-analyst-complete-roadmap/