NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai)

K.R.NAGAR, KOVILPATTI

www.nec.edu.in

REGULATIONS – 2023

CURRICULUM & SYLLABUS

B. TECH. INFORMATION TECHNOLOGY

(Outcome Based Education & Choice Based Credit System)

DEPARTMENT OF INFORMATION TECHNOLOGY

I. VISION

To produce technically competent and value based IT Professionals to meet the current challenges of the modern IT industry.

II. MISSION

- Imparting quality education with innovative components in teaching learning process.
- Conducting student centric programme to enhance communication, team spirit, leadership skills and self learning.
- Motivating the students to realize the need of ethics and human values.
- Developing a conducive environment for collaborative research.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Excel in IT, ITES industries and higher education by applying the principles and practices of computing

PEO 2: Maintain professionalism and adapt to emerging technologies

PEO 3: Equip themselves as a leader and capable of managing Multidisciplinary environment.

IV. PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1: Analyze and suggest the appropriate IT infrastructure required for the implementation of a project.

PSO 2: Design, develop and test interdisciplinary software systems to meet the industry demands.

V. PROGRAM OUTCOMES (POs)

PO 1: Apply **knowledge** of mathematics, natural science, computing and engineering **fundamentals**, with **specializations** in computational intelligence, web development, business intelligence, and cyber security to develop solutions to **complex engineering problems**

PO 2: Identify, formulate, research literature and analyze **complex engineering problems** reaching substantiated conclusions using **first principles** of mathematics, natural sciences and engineering sciences with holistic considerations for sustainable development

PO 3: **Design creative solutions** for **complex engineering problems** anddesign systems, components or processes to meet identified needs with appropriate consideration for public health and safety, whole-life cost, net zero carbon as well as resource, cultural, societal, and environmental considerations as required

PO 4:	Conduct **investigations** of **complex engineering problems** using research methods including **research-based knowledge, design of experiments, analysis and interpretation of data, and synthesis of information** to provide valid conclusions
PO 5:	**Create, select and apply, and recognize** limitations of appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to **complex engineering problems**
PO 6 :	When solving complex engineering problems, analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment
PO 7:	Apply ethical principles and commit to professional ethics and norms of engineering practice and adhere to relevant national and international laws. Demonstrate an understanding of the need for diversity and inclusion
PO 8:	Function effectively as an individual, and as a member or leader in diverse and inclusive teams and in multi-disciplinary, face-to-face, remote and distributed settings
PO 9:	Communicate effectively and inclusively 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, taking into account cultural, language, and learning differences
PO 10:	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments
PO 11:	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change

REGULATIONS 2023

CURRICULUM AND SYLLABUS

SEMESTER – I

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Induction Programme – 2 weeks									**0**
Theory Courses									
1.	23SH11C	தமிழர்மரபு/ Heritage of Tamils	HSMC	1	0	0	0	1	1
2.	23SH12C	Mathematical Foundation for Engineers	BSC	3	1	0	0	4	4
3.	23SH13C	Introduction to Engineering	ESC	1	0	0	0	1	1
Integrated Courses									
4.	23SH14C	Technical English	HSMC	1	0	2	0	3	2
5.	23SH15C	Engineering Physics	BSC	2	0	2	0	4	3
6.	23SH16C	Engineering Chemistry	BSC	2	0	2	0	4	3
7.	23ME11C	Engineering Graphics	ESC	2	0	4	0	6	4
8.	23CS11C	Problem Solving Techniques	ESC	3	0	2	0	5	4
			TOTAL	**15**	**1**	**12**	**0**	**28**	**22**

SEMESTER – II

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23SH21C	தமிழரும்தொழில்நுட்பமும் / Tamils and Technology	HSMC	1	0	0	0	1	1
2.	23GN05C	Professional Ethics and Human values	HSMC	2	0	0	0	2	2
3.	23IT21C	Discrete Mathematics	BSC	3	1	0	0	4	4
Integrated Courses									
4.	23SH22C	Professional English	HSMC	1	0	2	0	3	2
5.	23IT22C	Semiconductor Physics and Digital Electronics	ESC	2	0	2	0	3	3
6.	23EE11C	Basic Electrical and Electronics Engineering	ESC	3	0	2	0	5	4
7.	23IT23C	Object Oriented Programming using C++	PCC	2	0	2	2	6	4
8.	23GN02C	Innovation through Design Thinking	EEC	0	0	0	4	4	2
Practical Courses									
9.	23GN01C	Aptitude Essentials	EEC	1	0	0	0	1	1
			TOTAL	**15**	**1**	**8**	**6**	**29**	**23**

SEMESTER – III

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23IT31C	Software Engineering	PCC	3	0	0	0	3	3
2.	23IT32C	Data Structures	PCC	3	0	0	0	3	3
3.	23IT33C	Computer Organization and Architecture	PCC	3	0	0	0	3	3
4.	23IT34C	Operating Systems	PCC	2	1	0	0	3	3
5.	23IT38C	Probability and Statistics	BSC	3	1	0	0	4	4
6.	23MC01C	Constitution of India	MAC	2	0	0	0	2	0
Integrated Courses									
7.	23IT35C	Computer Networks	PCC	3	0	2	0	5	4
Practical Courses									
8.	23IT36C	Data Structures Laboratory	PCC	0	0	4	0	4	2
9.	23IT37C	Linux System Administration	PCC	0	0	2	0	2	1
10.	23GN03C	Intellectual Property Rights Study	EEC	0	0	0	4	4	2
			TOTAL	**19**	**2**	**8**	**4**	**33**	**25**

SEMESTER – IV

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23XXXXC	Elective – Science Stream	BSC	3	0	0	0	3	3
2.	23IT41C	Java for Developers	PCC	3	0	0	0	3	3
3.	23IT42C	Business Process Modeling	PCC	2	0	0	0	2	2
4.	23IT43C	Signals and Systems	ESC	3	1	0	0	4	4
5.	23MC02C	Environmental Science and Engineering	MAC	2	0	0	0	2	0
Integrated Courses									
6.	23IT44C	Design and Analysis of Algorithms	PCC	3	0	0	2	5	4
7.	23IT45C	Database Management Systems	PCC	3	0	2	0	5	4
Practical Courses									
8.	23IT46C	Java Programming Laboratory	PCC	0	0	2	2	4	2
9.	23IT47C	System Modeling Projects	EEC	0	0	2	2	4	2
10.	23GN04C	Aptitude Excellence	EEC	0	0	2	0	1	1
			TOTAL	**19**	**1**	**8**	**6**	**33**	**25**

SEMESTER – V

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23GN06C	Project Management and Finance	HSMC	2	0	0	0	2	2
2.	23XXXXE	Program Elective Course – I	PEC	3	0	0	0	3	3
3.	23XXXXN	Open Elective Course – I	PEC	3	0	0	0	3	3
Integrated Courses									
4.	23IT51C	Cryptography and Network Security	PCC	3	0	2	0	5	4
5.	23IT52C	Artificial Intelligence	PCC	3	0	2	0	5	4
6.	23IT53C	Modern Web Technologies	PCC	1	0	2	4	7	4
7.	23XXXXE	Program Elective Course – II	PEC	2	0	2	0	4	3
Practical Courses									
8.	23IT54C	Simulation using Modern Tools	EEC	0	0	2	2	4	2
			TOTAL	**17**	**0**	**10**	**6**	**33**	**25**

SEMESTER – VI

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23IT61C	Machine Learning	PCC	3	0	0	0	3	3
2.	23IT62C	Cloud Computing	PCC	3	0	0	0	3	3
3.	23XXXXE	Program Elective Course – III	PEC	3	0	0	0	3	3
Integrated Courses									
4.	23IT63C	Big Data Analytics	PCC	3	0	2	0	5	4
5.	23IT64C	Essentials of Mobile App Development	PCC	2	0	2	0	4	3
6.	23XXXXE	Program Elective Course – IV	PEC	2	0	2	0	4	3
Practical Courses									
7.	23IT65C	Product Development Practice	EEC	0	0	2	2	4	2
8.	23IT66C	Machine Learning Laboratory	PCC	0	0	4	0	4	2
9.	23IT67C	Cloud Computing Laboratory	PCC	0	0	2	0	2	1
			TOTAL	**16**	**0**	**12**	**2**	**32**	**24**

SEMESTER – VII

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Theory Courses									
1.	23XXXXE	Program Elective Course – V	PEC	3	0	0	0	3	3
2.	23XXXXN	Open Elective Course – II	OEC	3	0	0	0	3	3
3.	23XXXXN	Open Elective Course – III	OEC	3	0	0	0	3	3
Practical Courses									
4.	23XXXXE	Program Elective Course – VI	PEC	0	0	0	6	6	3
5.	23IT71C	Internship	EEC	-	-	-	-	-	2
6.	23IT72C	Mini Project	EEC	0	0	0	6	6	3
			TOTAL	**9**	**0**	**0**	**12**	**21**	**17**

SEMESTER – VIII

S. No	Course Code	Course Title	Category	Periods Per Week				Total Contact Periods	Credits
				L	T	P	E		
Practical Courses									
1.	23IT81C	Capstone Project/Industry Practice	EEC	0	0	0	12	12	6
			TOTAL	**0**	**0**	**0**	**12**	**12**	**6**

Total Number of credits: 167

Structure of Curriculum:

Category	I	II	III	IV	V	VI	VII	VIII	Credits	Percentage of credits
HSMC	3	5			2				10	5.98
BSC	10	4	4	3					21	12.57
ESC	9	7		4					20	11.97
PCC		4	19	15	12	16			66	39.52
PEC					6	6	6		18	10.77
OEC					3		6		9	5.38
EEC		3	2	3	2	2	5	6	23	13.77
Total	22	23	25	25	25	24	17	6	167	

VERTICALS AND PROGRAME ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	Course Name	L	T	P	E	C
BLOCKCHAIN TECHNOLOGY								
1.	PEC	23IT01E	BlockchainArchitectureand Design	3	0	0	0	3
2.	PEC	23IT02E	Smart Contract and DAPP	2	0	2	0	3
3.	PEC	23IT03E	AdvancedEthereum	3	0	0	0	3
4.	PEC	23IT04E	Cyber SecurityinBlockchain	3	0	0	0	3
5.	PEC	23IT05E	BlockchainusingHyperledger	2	0	2	0	3
6.	PEC	23IT06E	BlockchainUseCasesandapplications	3	0	0	0	3
7.	PEC	23IT07E	BlockchaininFinTech	3	0	0	0	3
8.	PEC	23IT08E	BlockchainGaming	2	0	2	0	3
9.	PEC	--	Mini-Capstone Project	0	0	0	6	3
FULLSTACK DEVELOPMENT								
1.	PEC	23IT11E	WebFrameworksusing python	2	0	2	0	3
2.	PEC	23IT12E	NoSQLDatabases	3	0	0	0	3
3.	PEC	23IT13E	OpenSourceTechnologiesforWebDevelopment	3	0	0	0	3
4.	PEC	23IT14E	PostgreSQLDatabaseManagement	2	0	2	0	3
5.	PEC	23IT15E	MobileApplicationDevelopment	2	0	2	0	3
6.	PEC	23IT16E	MERN stack	2	0	2	0	3
7.	PEC	23IT17E	FullstackTesting	3	0	0	0	3
8.	PEC	23IT18E	FlutterandFirebase	2	0	2	0	3
9.	PEC	23IT32E	UI/UXDesign	2	0	0	2	3
10.	PEC	--	Mini-Capstone Project	0	0	0	6	3
COMPUTATIONAL INTELLIGENCE								
1	PEC	23IT21E	Computer Vision and Image Processing	2	0	2	0	3
2	PEC	23IT22E	Machine Learning Techniques	2	0	2	0	3
3	PEC	23IT23E	AItoolsforNaturalLanguageProcessing	2	0	2	0	3
4	PEC	23IT24E	IntroductiontoComputational Intelligence	3	0	0	0	3
5	PEC	23IT25E	Fundamentalsof Deep Learning	1	0	0	4	3
6	PEC	23IT26E	TimeSeries Analysis	2	0	2	0	3
7	PEC	23IT27E	Natureand Bio-inspired Computing	3	0	0	0	3
8	PEC	23IT28E	Reinforcement Learning	3	0	0	0	3
9	PEC	23IT29E	FeatureEngineering	3	0	0	0	3
10	PEC	--	Mini-Capstone Project	0	0	0	6	3
AUGMENTED REALITY / VIRTUAL REALITY								
1	PEC	23IT31E	Computer Graphics	3	0	0	0	3
2	PEC	23IT32E	UI/UX Design	2	0	0	2	3
3	PEC	23IT33E	Blockchain Gaming	2	0	2	0	3
4	PEC	23IT34E	3D Modeling and Design	2	0	2	0	3
5	PEC	23IT35E	Augmented Reality and Virtual Reality	3	0	0	0	3
6	PEC	23IT36E	Human Computer Interaction	3	0	0	0	3

S. No	Course Category	Course Code	Course Name	L	T	P	E	C
7	PEC	23IT37E	Design of VR Systems	1	0	0	4	3
8	PEC	23IT38E	Metaverse Development	3	0	0	0	3
9	PEC	23IT01E	Blockchain Architecture and Design	3	0	0	0	3
10	PEC	--	Mini-Capstone Project	0	0	0	6	3
INDUSTRIAL AI								
1	PEC	23IT41E	Generative AI	3	0	0	0	3
2	PEC	23IT42E	AIforIndustrialapplications	3	0	0	0	3
3	PEC	23IT43E	Reinforcement Learning	3	0	0	0	3
4	PEC	23IT44E	AI for Robotics	3	0	0	0	3
5	PEC	23IT45E	AI in Supply Chain	3	0	0	0	3
6	PEC	23IT46E	Ethical AI	3	0	0	0	3
7	PEC	23IT47E	Responsible AI	3	0	0	0	3
8	PEC	--	Mini-Capstone Project	0	0	0	6	3
BUSINESS ANALYTICS								
1	PEC	23IT62E	Data Mining	3	0	0	0	3
2	PEC	23IT63E	Data Engineering	2	0	2	0	3
3	PEC	23IT64E	Image and Video Analytics	3	0	0	0	3
4	PEC	23IT65E	Healthcare Analytics	3	0	0	0	3
5	PEC	23IT66E	Principles of Business Analytics	3	0	0	0	3
6	PEC	23IT67E	Business Intelligence	3	0	0	0	3
7	PEC	23IT68E	Feature Engineering	2	0	0	2	3
8	PEC	23IT69E	Predictive Analytics	3	0	0	0	3
9	PEC	23IT70E	Bio Informatics	3	0	0	0	3
10	PEC	23IT71E	Prescriptive Analytics and optimization	3	0	0	0	3
11	PEC	--	Mini-Capstone Project	0	0	0	6	3
CYBER SECURITY								
1	PEC	23IT51E	Network Security	3	0	0	0	3
2	PEC	23IT52E	Information Security	2	0	2	0	3
3	PEC	23IT53E	Cloud Security	3	0	0	0	3
4	PEC	23IT54E	IoT and Hardware Security	3	0	0	0	3
5	PEC	23IT55E	Social Network Security	3	0	0	0	3
6	PEC	23IT56E	CyberSecurityand Ethical Hacking	2	0	2	0	3
7	PEC	23IT57E	Firewalls and Intrusion Detection Systems	3	0	0	0	3
8	PEC	23IT58E	Threat Intelligence and Risk Management	3	0	0	0	3
9	PEC	23IT59E	Digital Forensics	3	0	0	0	3
10	PEC	23IT60E	Malware Analysis	0	0	0	6	3
11	PEC	--	Mini-Capstone Project	0	0	0	6	3

DIVERSIFIED TECHNOLOGIES

S. No	Course Category	Course Code	Course Name	L	T	P	E	C
1	OEC	23CS01N	Python Programming	2	0	2	0	3
2	OEC	23CS02N	FoundationsofObjectOrientedProgramming	2	0	2	0	3

ELECTIVE COURSES (SCIENCE STREAM)

S. No	Course Category	Course Code	Course Name	L	T	P	E	C
MATHEMATICS								
1.	OEC	23SH01E	Linear Algebra, Mathematical Logic and Set Theory	2	1	0	0	3
2.	OEC	23SH02E	Linear Structures and Transformations	2	1	0	0	3
3.	OEC	23SH03E	Number Theory	2	1	0	0	3
4.	OEC	23SH04E	Numerical Analysis	2	1	0	0	3
5.	OEC	23SH05E	Optimization Techniques	2	1	0	0	3
6.	OEC	23SH06E	Principles of Discrete Mathematics	2	1	0	0	3
7.	OEC	23SH07E	Random Processes and Queuing Theory	2	1	0	0	3
8.	OEC	23SH08E	Statistical Techniques and Numerical Methods	2	1	0	0	3
9.	OEC	23SH09E	Transforms, Mathematical Logic and Set Theory	2	1	0	0	3
PHYSICS								
10.	OEC	23SH10E	Fundamentals of Laser Technology	3	0	0	0	3
11.	OEC	23SH11E	Nanomaterials for Engineers	3	0	0	0	3
12.	OEC	23SH12E	Photonics	3	0	0	0	3
CHEMISTRY								
13.	OEC	23SH13E	Biology for Computing	3	0	0	0	3
14.	OEC	23SH14E	Biological systems for Engineers	3	0	0	0	3
15.	OEC	23SH15E	Polymer Science and Technology	3	0	0	0	3
16.	OEC	23SH16E	Sensors for Engineering Applications	3	0	0	0	3

Course Code	**தமிழர் மரபு(HERITAGE OF TAMILS)**	**L**	**T**	**P**	**E**	**C**
23SH11C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

இப்பாடம்முடிந்ததும் மாணவர்களிடம் வளரும் திறன்

CO1:தமிழ் மொழியின் இலக்கிய வளம்,ஓவிய,சிற்பக் கலையின் பரிணாமவளர்ச்சிநாட்டுப்புறக் கலைமற்றும் வீரவிளையாட்டுக்கள் பற்றியஅறிவுமற்றும் விளக்கும் திறன்

CO2:தமிழர்களின் திணைசார் கோட்பாடுகள் மற்றும் இந்தியபண்பாட்டில் தமிழர்களின் பங்குபற்றியஅறிவுமற்றும் விளக்கும் திறன்

Upon the successful completion of the course, the student will be able to

Theory Component

CO1:know andexplain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

CO2: know andexplain about Tamils Thinaiconcepts, contribution of Tamils in Indian National Movements and Indian Culture

CO1:தமிழ் மொழியின் இலக்கிய வளம்,ஓவிய,சிற்பக் கலையின் பரிணாமவளர்ச்சிநாட்டுப்புறக்கலைமற்றும் வீரவிளையாட்டுக்கள் பற்றியஅறிவுமற்றும் விளக்கும் திறன் **L:9**

இந்தியமொழிக்குடும்பங்கள் - திராவிடமொழிகள் - தமிழ் ஒருசெம்மொழி–தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்றதன்மை–சங்க இலக்கியத்தில் பகிர்தல் அறம் - திருக்குறளில் மேலாண்மைக் கருத்துக்கள் - தமிழ்க் காப்பியங்கள்,தமிழகத்தில் சமணபௌத்தசமயங்களின் தாக்கம் - பக்தி இலக்கியம்,ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் - தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கியவளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு - நடுகல் முதல் நவீனசிற்பங்கள் வரை–ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்,பொம்மைகள் - தேர் செய்யும் கலை -சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக் கருவிகள் - மிருதங்கம்,பறை,வீணை,யாழ்,நாதஸ்வரம் - தமிழர்களின் சமூகபொருளாதாரவாழ்வில் கோவில்களின் பங்கு - தெருக்கூத்து,கரகாட்டம்,வில்லுப்பாட்டு,கணியான் கூத்து,ஒயிலாட்டம், தோல்பாவைக் கூத்து,சிலம்பாட்டம்,வளரி,புலியாட்டம்,தமிழர்களின் விளையாட்டுகள்.

CO1:know andexplain about Tamil literary resources, Dimensional growth of painting and sculpture arts, folk art and martial arts.

Language Families in India - Dravidian Languages – Tamil as a Classical Language – ClassicalLiterature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature- Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land- Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modernliterature in Tamil - Contribution of Bharathiyar and Bharathidhasan - Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple carmaking - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari,Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role ofTemples in Social and Economic Life of Tamils - Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam,Valari, Tiger dance - Sports and Games of Tamils.

CO2:தமிழர்களின் திணைசார் கோட்பாடுகள் மற்றும் இந்தியபண்பாட்டில் தமிழர்களின் பங்குபற்றியஅறிவுமற்றும் விளக்கும் திறன் **L:6**

தமிழகத்தின் தாவரங்களும்,விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றியஅறக்கோட்பாடு–சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும்,கல்வியும் - சங்ககாலநகரங்களும் துறைமுகங்களும் - சங்ககாலத்தில் ஏற்றுமதிமற்றும் இறக்குமதிகடல்கடந்தநாடுகளில் சோழர்களின் வெற்றி - இந்தியவிடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம் - இந்தியமருத்துவத்தில்,சித்தமருத்துவத்தின் பங்கு–கல்வெட்டுகள்,கையெழுத்துப் படிகள் - தமிழ்ப் புத்தகங்களின் அச்சுவரலாறு.

CO2: know andexplain about Tamils Thinaiconcepts, contribution of Tamils in Indian National Movements and Indian Culture

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature -Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports ofSangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas - Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the otherparts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems ofMedicine – Inscriptions & Manuscripts – Print History of Tamil Books.

REFERENCES:

1. தமிழகவரலாறு–மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு:தமிழ்நாடுபாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர். இல.சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி–வைகைநதிக்கரையில் சங்ககாலநகரநாகரீகம் (தொல்லியல் துறைவெளியீடு)
4. பொருநை–ஆற்றங்கரைநாகரீகம். (தொல்லியல் துறைவெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

L: 15; TOTAL: 15 PERIODS

Course Code	MATHEMATICAL FOUNDATIONS FOR ENGINEERS	L	T	P	E	C
23SH12C	(Common to all B.E. / B.Tech. Degree Programmes)	**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: interpretthe nature of quadratic form by orthogonal transformation.
CO2: identify the maxima and minima of functions.
CO3: solve ordinary differential equations.
CO4: find the solution of partial differential equations.
CO5: evaluate integrals of multivariate calculus.

Soft skill Component

CO6 : develop communication, problem solving and interpersonal skills

CO1: interpret the nature of quadratic form by orthogonal transformation. **L:9, T:3**

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors – Diagonalisation of a matrix by orthogonal transformation – Quadratic forms – Reduction of quadratic form to canonical form by orthogonal transformation and its nature; Cayley – Hamilton theorem (excluding proof) - Application: Stretching of a elastic membrane.

CO2: identify the maxima and minima of functions. **L:9, T:3**

Functions of two variables: Limit, continuity and partial derivatives; Total derivative, Jacobian, Taylor series- Application : Linearization of Non Linear systems using Taylor Series - Maxima and minima - Method of Lagrange multipliers.

CO3: solve ordinary differential equations. **L:9, T:3**

Solutions of first order ordinary differential equations - Equations solvable for ‘p’, equations solvable for ‘y’, equations solvable for ‘x’ - Solutions of higher order linear differential equations with constant coefficients – Cauchy’s and Legendre’s linear equations - Method of variation of parameters – Solution of simultaneous linear differential equation. Application RCL – circuit and Mass Spring System.

CO4: find the solution of partial differential equations. **L:9, T:3**

Formation of partial differential equations – Solutions of standard types of first order partial differential equations - Lagrange’s linear equations - Solutions of homogeneous and Non homogeneous linear partial differential equations of second and higher order with constant coefficient – Application - Shallow wave equations of first order PDE.

CO5 : evaluate integrals of multivariate calculus **L:9, T:3**

Double integration – Cartesian and polar coordinates - Change of order of integration - Change of variables - Cartesian to polar coordinates - Area as double integral - Triple integration - Cartesian and polar coordinates – Change of Variables- Cartesian to spherical and cylindrical coordinates. Application – Moments and centers of mass.

TEXT BOOKS:

1. Grewal.B.S., Higher Engineering Mathematics, Khanna Publications, 44th Edition, 2021.
2. James E. Gentle, Matrix Algebra, Springer International Publishing, 2nd Edition, 2017
3. Shanker Rao.G., Linear Albebra, WileyIndia, 1st Edition , 2017

REFERENCES:

1. Bali.N.P. and Manish Goyal, A Textbook of Engineering Mathematics, Laxmi Publications Private Limited, 10th Edition, 2016.
2. ErwinKreyszig, AdvancedEngineeringMathematics, WileyIndia, 10th Edition, 2017.
3. Kenneth B. Howell, Ordinary Differential Equations, CRC Press, 2020.
4. James Strewart, Daniel Clegg, Saleem Watson, Essential Calculus EarlyTrancendentals, Cengage Learning, 9th Edition, 2021.
5. Nanda Kumar A.K, P.S.Datti: Raju.K.George, Ordinary Differential Equations, Cambridge University press, 2017.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	INTRODUCTION TO ENGINEERING	L	T	P	E	C
23SH13C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: articulate the importance of Engineering and its role in society through OBE framework
CO2: identify and describe academic pathways towards career settlement

CO1: articulate the importance of Engineering and its role in society through OBE framework **L:9**

Engineering – An introduction, Classification of different Engineering Disciplines, Role of Engineers in Society. Graduate Attributes (GA), Program Specific Criteria (PSC)- Program Educational Objectives (PEO), Program Outcomes (PO), Course Outcomes (CO), Choice Based Credit System (CBCS), course categories, teaching and learning process, active and passive learning, project / problem based learning, different assessments process.

CO2: identify and describe academic pathways towards career settlement **L:6**

Curriculum, cafeteria curriculum and self learning big picture of the Program and the significance of each course in the undergraduate Engineering Program, Discuss the different career paths for an engineering graduate. Career objective, competency requirement.

Case study: Each student has to interact with alumni mentors/seniors/faculty members/surf the internet and present a career path that inspires him/her at the end of the course

REFERENCES:

1. Quamrul H. MazumderIntroduction to Engineering, An Assessment and Problem Solving Approach, CRC Press, 1st Edition, 2016.
2. Saeed Moaveni, "Engineering Fundamentals an Introduction to Engineering", Cengage Learning, USA, 4th Edition, 2011.

L: 15; TOTAL: 15 PERIODS

Course Code	TECHNICAL ENGLISH	L	T	P	E	C
23SH14C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply the fundamental grammar rules in writing

CO2: utilizing phonetic transcription for pronunciation

Practical Component

CO3: apply the basic language skills in various aspects of communication

CO4: utilize technical terms and phrases in specific contexts

CO5: develop the pronunciation skill through various language components

CO6: distinguish different writing forms and interpret text through divergent thinking

CO7: develop effective reports with grammatical and language components

Soft skill Component

CO8: develop communication, team spirit, creativity and time management

CO1: apply the fundamental grammar rules in writing **L:13, P:26**

Parts of Speech - Word Formation using Prefix and Suffix - Sentence formation (Kinds of Sentences) - Tenses (Present, Past & Future tense) – Concord

CO3: apply the basic language skills in various aspects of communication

Diary Writing - Greeting and Self Introduction

CO4: utilize technical terms and phrases in specific contexts

Technical terms and extended definition - Essay Writing (Argumentative Essay and Analytical Essay) - Situational phrases & Conversation - Formal Letter Writing (Permission & Requisition letters)

CO6: distinguish different writing forms and interpret text through divergent thinking

Picture Description, Introduction to Reading Techniques (Skimming, scanning, inferring, predicting, Reading and Reviewing a book (Sci – Fi), E Mail Writing

CO7: develop effective reports with grammatical and language components
Listening and responding to general information (Business context) - Report Writing (Types, Structure, and Stages of report writing) - Checklist

CO2:utilizing phonetic transcription for pronunciation **L:2, P:4**

Phonetics (Vowels & Consonants)

CO5: develop the pronunciation skill through various language components

Word Transformation from one form to another - Letter Writing (Informal) - Listening and responding to general information (General context)

TEXT BOOKS:

1. Paul V. Anderson, Technical Communication: A Reader - Centered Approach, Cengage Learning, 9th Edition, 2017.
2. Ravindra Nath Tiwari, Technical English-II, Shashwat Publication, 1st Edition, 2020.
3. Stephen D. Krashen, Principles and Practice in Second LanguageAcquisition. Pergamon, 1987.
4. Lester Kaufman and Jane Straus, The Blue Book of Grammar and Punctuation: An Easy-to Use Guide with Clear Rules, Real-World Examples, and Reproducible Quizzes, Wiley, 2021.
5. Wells H. G., The Time Machine, Penguin Classics, 2012.

REFERENCES:

1. Michael McCarthy, English Grammar: The Basics, Taylor & Francis, 2021.
2. Peter Lucantoni and Lydia Kellas, Cambridge IGCSE(TM) English as a Second Language Workbook, Cambridge University Press, 6th Edition, 2022.

L: 15; P: 30; TOTAL: 45 PERIODS

Course Code	ENGINEERING PHYSICS	L	T	P	E	C
23SH15C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to:

Theory Components:

CO1: identify the structural properties of crystalline materials

CO2: comprehend and apply the concepts of centre of mass and elasticity

CO3: explain thermodynamic parameters and fundamental laws and their application in various processes

CO4: illustrate the applications of different lasers and optical fibers

CO5:interpret the quantum concepts, to illustrate the quantization of energy, and computation

Practical Components:

CO6: compare the mechanical properties of the materials due to bending and torsion

CO7: analyze thermal conductivity of different bad conducting materials

CO8: explore the light-matter interaction by the phenomenon of interferenceand diffraction and photoelectric effect

Soft skill Component:

CO9: develop the team spirit and communication skill through group activities

CO1: identify the structural properties of crystalline materials **L:10**

Crystalline and amorphous materials - unit cell - primitive cell - crystal systems, Bravais lattices - Miller indices – interplanar distance – Characteristics of SC, BCC, FCC, HCP structures - Bragg's law - X-ray diffraction and its applications - Synthesis of crystalline materials

CO2: comprehend and apply the concepts of centre of mass and elasticity **L:6,**
CO6: compare the mechanical properties of the materials due to bendingand torsion **P:10**

Multi-particle dynamics - Introduction - Center of mass (CM) – CM of continuous bodies -

Introduction to rigid bodies - translation - rotation – moment of inertia – theorems of moment of inertia – Torsional pendulum.

Elasticity – Stress - strain diagram and its applications - Moduli of elasticity and its relation - bending of beams - Bending moment – cantilever - theory and experiment - Uniform bending - theory and experiment – Non Uniform bending - I-shaped girders

CO3: explain thermodynamic parameters and fundamental laws and their application in various processes **L:6, P:8**

CO7: analyse thermal conductivity of different bad conducting materials.

Laws of thermodynamics –Thermo dynamical processes – Introduction to heat transfer – conduction - convection and radiation – thermal conductivity of good conductor –Radial flow of heat - Spherical shell method and cylindrical shell method – Thermal conductivity of poor conductor- Lee's disc method– Applications - heat exchangers - refrigerators and ovens

CO4: illustrate the applications of different lasers and optical fibers **L:6, P:6**

CO8: explore the light-matter interaction by the phenomenon ofInterference and diffraction and photoelectric effect

Lasers: Interaction of light with matter - Einstein coefficients and their relations – characteristics of laser - components of laser – Lasing action – Pumping methods – Types of Laser - Nd-YAG laser -semiconductor laser- Applications

Fiber optics: principle and classification of optical fibers – propagation of light in optical fiber - Numerical aperture and Acceptance angle – losses associated with optical fibers (Qualitative) – Fiber optic communication system - Applications - Displacement and pressure sensors – Endoscopy

CO5: interpret the quantum concepts, to illustrate the quantization of energy, and computation **L:6, P:2**

CO8: explore the light-matter interaction by the phenomenon of interference and diffraction and photoelectric effect

Planck's radiation law - de-Broglie hypothesis – Matter waves - Heisenberg's uncertainty principle – elementary proof – applications – Schrödinger's time-dependent and time-independent wave equation – physical significance of wave function – Introduction to quantum tunneling - applications - particle in a one-dimensional box – tunneling microscope – quantum confinement in 0D, 1D, 2D systems - quantum computation

TEXT BOOKS:

1. AvadhanuluM. N., KshirsagarP.G and Arun MurthyT.V.S, A Text book of Engineering Physics, S.Chand&Co, 11th Edition, 2018.
2. Kleppner D and Kolenkow R. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017.
3. Kenneth S Krane, Modern Physics, Wiley, 4thEdition, 2021.

REFERENCES:

1. WolfsonR., Essential University Physics, Volume 1 & 2, Pearson Education, 2ndIndian Edition, 2009.
2. Hitendra K. Malik, A.K.Singh, Engineering Physics, McGraw Hill Education, 2nd Edition, 2017.
3. Kyungwon An, Fundamentals of Laser Physics, World Scientific Publishing Company, 2023
4. HallidayD, Resnick RandWalker J, Principles of Physics, Wiley, 12thEdition, 2021.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING CHEMISTRY	L	T	P	E	C
23SH16C	(Common to all B.E. / B.Tech. Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explain the suitable water treatment technologies for domestic and industrial applications

CO2: apply the knowledge of corrosion to solve the industrial problems

CO3: describe the preparation, properties and their applications of smart materials in various sectors

CO4: describe the basic components and performance analysis of batteries

CO5: predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

Practical Component

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Soft skill Component

CO8: develop interpersonal, work ethics and communications skills for career settlement

CO1: explain the suitable water treatment technologies for domestic andindustrial applications

CO6: estimate the amount of Ca^{2+}/ Mg^{2+}, alkalinity and Chloride ion present in the water sample.

Introduction, sources and impurities in water, potable water specifications (as per WHO and BIS) - hardness-types-estimation of $Ca^{2+}$and Mg^{2+} ion in water by EDTA method. Alkalinity-types-determination of alkalinity of water -chronic daily intake - incremental life time risk - hazard quotient, hazard index, contamination factor - determination of chloride ion in water using Argentometric method-municipal water treatment- physical methods and chemical methods. Disinfection-internal conditioning - calgon and carbonate conditioning. Desalination-types-Reverse Osmosis (RO) process- Forward osmosis (FO) - electro dialysis - demineralization. **L:6, P:12**

CO2: apply the knowledge of corrosion to solve the industrial problems.

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques

Corrosion – mechanism of dry and wet corrosion-forms of corrosion– galvanic corrosion and differential aeration corrosion, crevice corrosion, pitting corrosion, microbial corrosion-stress corrosion, intergranular corrosion - determination of rate of corrosion by weight loss method. **L:6, P:6**

Protection: cathodic protection, surface coatings, corrosion inhibitors. Corrosion of industrial components: corrosion and its control in power industries, automotive industries, chemical processing industries and marine industries.

CO3: describe the preparation,properties and their applications of smart materials in various sectors

Polymers: introduction - classification - functional polymers: electroluminescence polymer, biodegradable polymers, fire retardant polymer, thermo responsive polymer - piezo, ferro and pyroelectric polymer - nanocomposites: introduction, synthesis, **L:6**

properties & applications- synthesis of nanocomposites using sol -gel process

CO4: describe the basic components and performance analysis of batteries

Introduction - components - operation principle - Lead acid – Nickel metal hydride batteries- Lithium ions batteries: Lithium polymer battery, Lithium sulphur battery - fabrication and performance evaluation- safety issues - battery management system - recycling of lithium batteries. **L:6**

CO5:predict the mechanical, electrical and electronics properties of materials using various instrumentation techniques

CO7: quantify the amount of acid and metal ion in the given samples by different analytical techniques.

Spectroscopy methods: Beer-Lambert's law and its limitations– UV-visible spectroscopy and IR spectroscopy – principle - instrumentation– applications. Estimation of copper. Electro analytical methods: potentiometric titration - Estimation of Fe^{2+} ion by potentiotometric method. Conductometric method- estimation of HCl by conductometric titration- pH metric method-Estimation of HCl by pH metric titration- applications. Thermal analytical methods: Thermal Gravimetric Analysis (TGA) and Differential Thermal Analysis (DTA)- Thermo Mechanical Analysis (TMA) –principle - instrumentation - Thermo gravimetric analysis of $CuSO_4.5H_2O$- applications. **L:6, P:12**

TEXT BOOKS:

1. Jain P.C. and Jain M, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 17th Edition, 2021.
2. Dara S.S and Umare S.S, A Text Book of Engineering Chemistry, S.Chand& Company Limited, 20th Edition, 2018.
3. Agarwal S, Engineering Chemistry, Cambridge Publishing Company, 2ndEdition, 2019

REFERENCES:

1. Benjamin M. M, Water Chemistry, Waveland Press, 2nd Edition, 2019.
2. Cicek V, Corrosion Engineering, Springer Publishing, 1st Edition, 2021.
3. Shahinpoor. M, Fundamentals of Smart Materials, Publisher: Royal Society of Chemistry, 1st Edition, 2020.
4. Berg H, Bernhardsson S, and Johansson P, Electric Vehicle Batteries: Moving from Research towards Innovation, Publisher: Springer, 1st Edition, 2019.
5. Crouch S, Skoog D, Holler F, Principles of Instrumental Analysis, 2017.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ENGINEERING GRAPHICS	L	T	P	E	C
23ME11C	(Common to MECH, CIVIL, AIDS, EEE, IT)	2	0	4	0	4

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: Construct the Engineering Curves and Perform Freehand Sketching.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina

CO3: Draw the Projections of Simple Solids in Different Positions.

CO4: Visualize the Sectional Views and Surface of Various Solids.

CO5: Draw the Isometric and Perspective Projections of Various Solids.

CO1: Construct the Engineering Curves and Perform Freehand Sketching. **L:9, P:8**

Principles of Engineering Graphics – significance. Usage of Drawing Instruments. Lettering and dimensioning exercise Construction of ellipse, parabola and hyperbola using eccentricity method– Construction of cycloids, Epi and Hypo-cycloids. Orthographic views of simple components by Free hand drawing - Transferring measurement from the given object to the free hand sketches.

CO2: Construct the Orthographic Projections of Points, Straight Lines and Lamina **L:6, P:11**

Principle of orthographic projections – Conventions - First angle and third angle projections. Projections of points placed in all quadrants – projections of straight lines – inclined to both reference planes - determination of true length and inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes.

CO3: Draw the Projections of Simple Solids in Different Positions. **L:7, P:10**

Projections of simple solids like prisms, pyramids, cylinder and cone - axis inclined to one reference plane - change of position method.

CO4: Visualize the Sectional Views and Surface of Various Solids. **L:8, P:9**

Sectioning of simple solids – Axis perpendicular to horizontal plane- Drawing sectional views with true shape of the section. Development of lateral surfaces of truncated solids – Prisms, pyramids, cylinder and cone.

CO5: Draw the Isometric and Perspective Projections of Various Solids. **L:5, P:12**

Principles of isometric projection – Isometric scale – Isometric projections of simple solids like prism, pyramid, cone and cylinder – Combination of solids. Perspective projections of simple solids by visual-ray method

TEXT BOOKS:

1. Bhatt N.D, "Engineering Drawing", 54th Edition, Charotar Publishing House, 2023.
2. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2nd Edition, 2009.

REFERENCES:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Agrawal B. & Agrawal C.M., "Engineering Graphics", TMH Publication,2nd Edition, 2013
3. Narayana K.L. &Kannaiah P, "Text book on Engineering Drawing", Scitech Publishers, 2011.
4. Gopalakrishna K.R, "Engineering Drawing", Subhas Publications, 32nd Edition, 2017.

L: 30; P: 60; TOTAL: 90 PERIODS

Course Code	PROBLEM SOLVING TECHNIQUES	L	T	P	E	C
23CS11C	(Common to all B.E. / B.Tech. Degree Programmes)	**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theroy Component

CO1: apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and

logical problems

CO2:apply fundamental, sequential, conditional logic statements and arrays for solving basic problems

CO3: implement modular programming concept using user defined functions

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions

CO5: develop file processing application programs

Practical Component

CO6: develop programs for simple algorithms using sequential and Control structures

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

CO8: develop application programs using structures and files concept.

CO1: apply fundamentals of problem solving techniques to develop simple algorithms for arithmetic and logical problems **L:6**

Overview of programming: Problem Solving in Everyday Life, Types of Problem, Computer-based problem solving, Algorithms - Building blocks of algorithms (statements, control flow, functions) - Notation (pseudo code, flow chart) – Problem solving aspect – Top down design – Implementation of algorithms – Program Verification – Efficiency of algorithms – Analysis of algorithm.

CO2: apply fundamental, sequential, conditional logic statements and arrays for solving basic problems **L:12, P:10**

Data Types - Constants – Variables - Keywords – Operators– Problem Solving using fundamental algorithms. Control Statements: Branching and Looping - Algorithms Using Selection and Repetition - Summation of a set of numbers, Reversing Digits of an Integer - Implementation of fundamental algorithms and factoring methods - Array Techniques - Array order reversal, Array Counting, Finding maximum and the minimum value in a set

CO6: develop programs for simple algorithms using sequential and Control structures

Solve problems using control statements (Decision making and Looping)

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Problem solving based on Array Handling(1D and 2D, Multi-dimensional arrays, traversal, rotation) - Solve problems to handle strings

CO3: implement modular programming concept using user defined functions **L:10, P:8**

Modular Programming approach: Modularization and recursion - Bubble Sort, Selection Sort, Linear Search, Binary Search, Implementation of sorting and searching

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Solve problems by using modular approach (Functions and Recursion)

CO4: inscribe programs using pointers and to allocate memory for user defined data types using dynamic memory management functions **L:12, P:10**

Pointer Concept – add numbers using call by reference – finding maximum number from list of numbers - permutations of a given string using pointers – Implementation of function returns a pointer;

Structures &Union - finding the largest element of an array using Dynamic Memory

Allocation – Implementation of Student database in structure using Dynamic Memory Allocation;

CO7: inscribe programs using arrays, functions and pointers to work with multiple data items.

Build efficient solutions to manage memory efficiently through Pointers.

CO8: develop application programs using structures and files concept.

Develop applications using Structures

CO5: Develop file processing application programs **L:5, P:2**

File Handling: Files - Introduction, Types of file processing: Sequential access, Random access – Implementation of word count, copy file, Voter's age validation, Marks range validation

CO8: Develop application programs using structures and files concept.

Develop appliactions using Files

TEXT BOOKS:

1. Maureen Sprankle and Jim Hubbard, Problem Solving and Programming Concepts, Prentice Hall, 9th Edition, 2012.
2. R.G Dromey, How to solve it by Compute, Pearson education, Delhi, 2nd Edition, 2021.

REFERENCES:

1. Behrouz A. Forouzan, Richard F.Gilberg, P.GoldaJeyasheeli, G.Priyanka,S.T.Veena , Problem solving Using C A Structured Programming Approach, Volume I &II, 1st Edition, Cengage Publication, 2022
2. Karl Beecher, Computational Thinking: A Beginner's Guide to Problem Solving and Programming, BCS Learning & Development Limited, 1stEdition, 2017.
3. Byron S. Gottfried, Jitendar Kumar Chhabra, Programming with C, Tata McGraw Hill Publishing Company, New Delhi, 4th Edition, 2018.
4. Kernighan B.W., Ritchie D.M., C Programming Language (ANSI C), Prentice Hall of India Private Limited., New Delhi, 2nd Edition, 2010.
5. PradipDey and Manas Ghosh, Programming in C, Oxford University Press, New Delhi, 2018.
6. Yashavant P. Kanetkar, Let Us C, BPB Publications,16th Edition, 2020
7. H. M.Deitel, P. J. Deitel, C How to Program, Pearson Education., New Delhi, 7th Edition, 2016.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	தமிழரும் தொழில்நுட்பமும் (TAMILS AND TECHNOLOGY)	L	T	P	E	C
23SH21C	(Common to all B.E. / B.Tech. Degree Programmes)	1	0	0	0	1

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1:தமிழர்களின் நெசவுமற்றும் பானைத் தொழில்நுட்பம்,வடிவமைப்புமற்றும் கட்டிடத் தொழில்நுட்பம்,உற்பத்தித் தொழில்நுட்பம் பற்றியஅறிவுமற்றும் விளக்கும் திறன்.

CO2: தமிழர்களின் வேளாண்மைமற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்,அறிவியல் தமிழ் மற்றும் கணினித் தொழில்நுட்பம் பற்றியஅறிவுமற்றும் விளக்கும் திறன்.

Upon the successful completion of the course, the student will be able to

CO1: Know and explain about Tamils weaving and Pottery technology, Designand construction Technology and Manufacturing Technology.

CO2:Know and explain about Tamils Agriculture and irrigation technology, Scientific Tamil and Tamil computing

CO1:தமிழர்களின்நெசவுமற்றும்பானைத்தொழில்நுட்பம், வடிவமைப்புமற்றும்கட்டிடத்தொழில்நுட்பம்மற்றும்உற்பத்தித்தொழில்நுட்பம்பற்றிய அறிவுமற்றும்விளக்கும்திறன் **L: 9**

சங்ககாலத்தில்நெசவுத்தொழில் - பானைத்தொழில்நுட்பம் - கருப்புசிகப்புபாண்டங்கள் - பாண்டங்களில்கீறல்குறியீடுகள்-
சங்ககாலத்தில்வடிவமைப்புமற்றும்கட்டுமானங்கள்&சங்ககாலத்தில்வீட்டுப்பொருட்களில்வடிவமைப்பு - சங்ககாலத்தில்கட்டுமானபொருட்களும்நடுகல்லும் - சிலப்பதிகாரத்தில்மேடைஅமைப்புபற்றியவிவரங்கள் - மாமல்லபுரச்சிற்பங்களும்கோவில்களும் - மாதிரிகட்டமைப்புகள்பற்றிஅறிதல், மீனாட்சிஅம்மன்ஆலயம்மற்றும்திருமலைநாயக்கர்மஹால் - செட்டிநாடுவீடுகள் - பிரிட்டிஷ்காலத்தில்சென்னையில்இந்தோ-சாரோசெனிக்கட்டிடக்கலை- கப்பல்கட்டும்கலை - உலோகவியல் - இரும்புத்தொழிற்சாலை - இரும்பைஉருக்குதல், எஃகு - வரலாற்றுச்சான்றுகளாகசெம்புமற்றும்தங்கநாணயங்கள் - நாணயங்கள்அச்சடித்தல் - மணிஉருவாக்கும்தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடிமணிகள் - சுடுமண்மணிகள் - சங்குமணிகள் - எலும்புத்துண்டுகள் - தொல்லியல்சான்றுகள் - சிலப்பதிகாரத்தில்மணிகளின்வகைகள்.

CO1:KNOW AND EXPLAIN ABOUT WEAVING AND CERAMIC TECHNOLOGY, DESIGN AND CONSTRUCTION TECHNOLOGY,MANUFACTURING TECHNOLOGY

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries- Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age — Details of Stage Constructions in Silappathikaram- Sculptures and Temples of Mamallapuram- Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo –Saracenic architecture at Madras during British Period- Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold Coins as source of history - Minting of Coins — Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences – Gemstone types described in Silappathikaram.

CO2:தமிழர்களின்வேளாண்மை, நீர்ப்பாசனத்தொழில்நுட்பம், அறிவியல்தமிழ்மற்றும்கணினித்தமிழ்பற்றியஅறிவுமற்றும்விளக்கும்திறன். **L: 6**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக்குமுழித்தூம்பின்முக்கியத்துவம்- கால்நடைபராமரிப்பு - கால்நடைகளுக்காகவடிவமைக்கப்பட்டகிணறுகள் - வேளாண்மைமற்றும்வேளாண்மைச்சார்ந்தசெயல்பாடுகள் - கடல்சார்அறிவு - மீன்வளம் - முத்துமற்றும்முத்துக்குளித்தல் - பெருங்கடல்குறித்தபண்டையஅறிவு - அறிவுசார்சமூகம்- அறிவியல்தமிழின்வளர்ச்சி - கணினித்தமிழ்வளர்ச்சி- தமிழ்நூல்களைமின்பதிப்புசெய்தல் - தமிழ்மென்பொருட்கள்உருவாக்கம் - தமிழ்இணையக்கல்விக்கழகம் - தமிழ்மின்நூலகம் -

இணையத்தில்தமிழ்அகராதிகள் - சொற்குவைத்திட்டம்.

CO2: KNOW AND EXPLAIN ABOUT AGRICULTURE TECHNOLOGY, IRRIGATION TECHNOLOGY, SCIENTIFIC TAMIL&TAMIL COMPUTING

Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing – Knowledge of Sea - Fisheries — Pearl - Conche diving - Ancient Knowledge of Ocean – Knowledge Specific Society- Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books –Development of Tamil Software –Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries– Sorkuvai Project.

REFERENCE BOOKS:

1. தமிழகவரலாறு–மக்களும் பண்பாடும் - கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடுபாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி–வைகைநதிக்கரையில் சங்ககாலநகரநாகரிகம் (தொல்லியல் துறைவெளியீடு)
4. பொருநை–ஆற்றங்கரைநாகரிகம் (தொல்லியல் துறைவெளியீடு)
5. Social Life of Tamils(Dr.K.K.Pillay)A joint publication of TNTB & ESC and RMRL
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International InstituteofTamilStudies.)
9. Keeladi-Sangam City Civilization on the banks of river Vaigai (Jointly Published by: Department of Archaeology &Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to TamilNadu (Dr.K.K.Pillay) (Published by: The Author)

L: 15; TOTAL: 15 PERIODS

Course Code	APTITUDE ESSENTIALS	L	T	P	E	C
23GN01C	(Common to all B.E. / B.Tech. Degree Programmes)	**1**	**0**	**0**	**0**	**1**

COURSE OUTCOMES:

Upon the completion of the course the students will be able to

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly

CO2: Develop problem solving skills on Numbers and enhance arithmetic ability

CO3: Infer appropriate comparison and distribution methods using ratio and to form equations

CO4: Improve quantitative skills and solve problems on percentages and profit loss

CO5: Calculate data interpretation and data sufficiency in quantitative aptitude

CO1: Recall the fundamentals in quantitative techniques and solve Number series problems quickly **L : 3**

Numeric series – Finding missing numbers – Odd number out series - Letter series – Symbol series - Alphanumeric series

CO2: Develop problem solving skills on Numbers and enhance arithmetic ability **L : 3**

Number Types - HCF & LCM – Square root- Cubic root - divisibility criteria- Unit digit calculation- Prime factors

CO3: Infer appropriate comparison and distribution methods using ratio and to form equations **L : 3**

Ratio & Proportion: Comparison of Ratios - Variations: Direct and indirect proportionAges: Present Age, Past Age & Future calculation

CO4: Improve quantitative skills and solve problems on percentage and profit loss **L : 3**

Concept of Percentage – Percentage calculation - Calculation of Percentage on Population Results on Depreciation .Profit and Loss –Percentage of Profit and Loss – Discount

CO5: Calculate data interpretation and data sufficiency in quantitative aptitude **L : 3**

Data Interpretation – Pie Chart – Bar Chart – Table Chart .Data Sufficiency in Logical Reasoning : Numbers, Ratio, Ages, Percentage and Profit Loss

REFERENCES:

1. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017
2. R.V.Praveen, "Quantitative Aptitude and Reasoning" , 3rd Edition , Eastern Economy Edition, PHI Learning 2016

Video Materials

Profit Loss

https://youtu.be/PpVO7I8dx6U

https://youtu.be/_cW7_BUDYcw

Number series

https://youtu.be/_4ZJFkFE2XU

https://youtu.be/83nJmniFmNk

Numbers

https://youtu.be/81pwuMJ8OIU

https://youtu.be/VT_N9cacgl4

Square root and Cube root

https://youtu.be/nJSqsaT0AgU

https://youtu.be/_HyhwS8P9KY

Problems on Ages

https://youtu.be/6PCTRVmu-ek

https://youtu.be/eAl3BvO_Ipw

Data Interpretation

https://youtu.be/s99rda8e0vc

23GN05C	Professional Ethics and Human Values	L	T	P	E	C
	(Common to all B.E. / B.Tech. Degree Programmes)	2	0	0	0	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: Recognize and practice the core human values and theories related to ethical behavior.

CO2: Analyze the engineering ethical breach from past study.

CO3: Distinguish and apply safety, responsibility and rights in workplaces.

CO1: Recognize and practice the core human values and theories related to ethical behavior **L: 10**

Moral dilemmas and moral autonomy - Kohlberg's theory - Gilligan's theory - Consensus and

controversy –Case studies: Vigil mechanism, Whistle blowing - Protected disclosures - Personal ethics, work ethics and human values - Governing Regulation.

CO2 : Analyze the engineering ethical breach from past study **L: 10**

Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - Case study: The challenger disaster

CO3 : Distinguish and apply safety, responsibility and rights in workplaces **L: 10**

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - Collegiality and loyalty - respect for authority – confidentiality; Collective bargaining, Conflicts of interest - Case study; Occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination. Case studies: The Three mile island and Chernobyl disaster

TEXT BOOK

1. Mike W Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York,5th Edition, 2022

REFERENCES

1. BehnamTaebi, "Ethics and Engineering: An Introduction", Cambridge University Press, 2021
2. AjeshFaizal, Aswathy S U, Roy V I, "Professional Ethics in Engineering: an Industry Perspective", Noor Publishing, 2021
3. R.S.Naagarazan, "A Textbook on Professional Ethics and Human Values", New age International Pvt. Ltd; 3rdEdition, 2022
4. Dr. P. Elamurugan, "Professional Ethics in Engineering", Notion Press, 2021

L:30; TOTAL:30 PERIODS

Course Code	DISCRETE MATHEMATICS	L	T	P	E	C
23IT21C	(Common to CSE & IT)	3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: illustrate the validity of the arguments.
CO2: analyze the concepts of Sets, Relations and Functions.
CO3: perform the principles of counting and solve recurrence relations.
CO4: interpret the basic concepts of graphs.
CO5: compute minimum Spanning trees and shortest routefor the graph.

CO1: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms –Predicate Calculus and Quantifiers - Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:9,T:3**

CO2: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Partial Ordering Relation - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of **L:9,T:3**

functions.

CO3: perform the principles of counting and solve recurrence relations.

Mathematical induction - Strong induction and well ordering -The basics of counting – The pigeonhole principle - Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions - Inclusion and exclusion principle. **L:9,T:3**

CO4:interpret the basic concepts of graphs

Graphs and their properties - Special types of graphs – Matrix representation of graphs and graph isomorphism- connectivity, Cut vertex and cut edge - Euler and Hamiltonian graphs. **L:9,T:3**

CO5: compute minimum Spanning Trees and shortest route for the graph

Trees – Some properties of Trees – Pendant vertices in a Tree – Distance and centers in a Tree – Rooted and Binary Trees - Spanning Trees- minimum spanning tree–Prim's algorithm- shortest route - Dijkstra's algorithm **L:9,T:3**

TEXT BOOKS:

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 7th Edition, 2017.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2017.
3. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, 1st Edition, Dover Publications Inc., 2016.

REFERENCES:

1. Ralph .P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson Education Asia, Delhi, 2019.
2. Bondy,J.A., Murty.U.S.R., Graph Theory with applications, North Holland publication, 2008.
3. V.K.Balakrishnan, Schaum's Outline of Graph Theory, Tata Mc Graw-Hill Pub, 2020.

L: 45; T: 15; TOTAL: 60 PERIODS

Course Code	PROFESSIONAL ENGLISH	L	T	P	E	C
23SH22C	(Common to all B.E. / B.Tech. Degree Programmes)	1	0	2	0	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: extend the primary language skills to develop critical thinking

CO2: build the secondary language skillsfor professional competence

Practical Component

CO3: apply the vital sub-functions of listening in particular context

CO4: take part in propagating ideas through effective oral communication

CO5: inferring information using various reading techniques

CO6: construct professional content via distinct methods of writing

Soft skill Component

CO7: develop interpersonal, communicational and behavioral attributes

CO1:extend the primary language skills to develop critical thinking

CO3: apply the vital sub-functions of listening in particular context **L:6,P:16**

CO4: take part in propagating ideas through effective oral communication

If Conditionals – Standard Abbreviations –Types of Listening (Comprehensive, Informational, Critical Listening) –One Word Substitution, Components of Speaking

Listening for Specific Information –Listening to Speech (Oxford Union Society) – Listening to Science Talks or Theories

Product Description – Chart Description – Process Description – Group Discussion (Uses – Structure – Strategies – Team Work – Positive & Negative Body Languages – Samples – Demo)

CO2:build the secondary language skills for professional competence **L:5,P:18**

CO5: inferring information using various reading techniques

CO6: construct professional content via distinct methods of writing

Synonyms – Intensive and Extensive Reading –Error Spotting (Based on Concord, Pronoun, Articles & Adverb Placement) – Writing Style (Persuasive, Expository & Descriptive)

Newspaper Reading – Reading Comprehension (Fiction &NonFiction)

Business Letters for Quotations and Clarification, Placing Orders and Making Complaints – Proposal Writing – Job Application Letter & Resume Preparation – Paragraph Writing – Content Writing

TEXT BOOKS

1. Lucantoni,Peter& Lydia Kellas. "English as a Second Language Workbook", 6th Edition, Cambridge University Press, 2022.
2. Twain, Mark. "The Adventures of Tom Sawyer", 1st Edition, Pegasus, 2012.
3. Clear, James. "Atomic Habits", 1st Edition, Dreamliners, 2022.
4. Garcia, Hector & Francesc Miralles. Ikigai: The Japanese Secret to a long and Happy Life. 1st Edition, Tuttle Publishing, 2021.
5. Elbow, Peter, "Writing with Power" 2nd Edition, Oxford University Press, 1998.

REFERENCES

1. Butterfield, Jeff. "Soft Skills for Everyone". 2nd Edition, Cengage, 2020
2. Raman, Meenashi& Sangeetha Sharma. Professional English. 1st Edition, Oxford University Press, 2018

L: 11; P: 34; TOTAL: 45 PERIODS

Course Code	SEMICONDUCTOR PHYSICS AND DIGITAL ELECTRONICS (Common to IT and AI& DS)	L	T	P	E	C
23IT22C		2	0	2	0	3

COURSE OUTCOMES:

Upon successful completion of the course, the students will be able to

Theory Components:

CO1: Explain the basics of semiconductor.

CO2: Describe the characteristics and applications of pn junction diodes.

CO3: Apply the concepts of Boolean algebra for simplification of logic function.

CO4: Apply the digital concepts to design combinational logic circuits.

CO5: Illustrate the applications of sequential logic circuits.

Lab Components:

CO6: Demonstrate the I-V characteristics of pn junction diodes.

CO7: Demonstrate the verification of Boolean theorem and logic gates.

CO8: Construct basic combinational circuits and verify their functionalities

CO9: Demonstrate the verification of Flip flops.

Soft skill Component:

CO10: Enhance the team work and communication skill through group activities

CO1: Explain the basics of semiconductors.

Band theory of solids– Intrinsic Semiconductors - Carrier concentration and Fermi level in an intrinsic semiconductor – Extrinsic semiconductors - Carrier concentration and Fermi level in N-type and P-type semiconductors. **L:6**

CO2: Describe the characteristics and applications of pn junction diodes.

CO6: Demonstratethe I-V characteristics of pn junction diodes.

Introduction to semiconductor junction - Characteristics and Applications of PN Junction Diode -Experimental characteristics of pn junction diode - Rectifiers – Zener Diode –Experimental characteristics of zener diode - Regulators - Bipolar Junction Transistor – Field Effect Transistor – Optoelectronic device – LED- Experimental characteristics of LED. **L:6 P:8**

CO3: Apply the concepts of Boolean algebra for simplification of logic function.

CO7:Demonstrate the verification of Boolean theorem and logic gates.

Review of number systems – Binary numbers – Binary arithmetics - Complements – Digital Logic Gates -Experimental verification of logic gates - Basic Theorems and Properties of Boolean Algebra – Boolean Function –Verification of Boolean theorem using logic gates - Simplification of logic functions using Karnaugh Map. **L:5 P:6**

CO4: Apply the digital concepts to design combinational circuits.

CO8: Construct basic combinational circuits and verify their functionalities

Introduction to combinational logic circuits - Analysis and design- Half adder- Full adder -Design and implementation of binary adder - BCD adder - Half subtractor - Full subtractor - Design and implementation of binary subtractor -Decoder – Encoder - Multiplexers – Demultiplexer – Parity checker - Parity generator. **L:7 P:8**

CO5: Illustrate the applications of sequential logic circuits.

CO9: Demonstrate the verification of Flip flops.

L:6
P:8

Sequential logic circuit and their operation – Conceptual view of sequential circuits, state tables and diagrams - Latches – Different types of Flip Flops and their state tables, timing diagrams - verification of flip flops - Registers – shift registers – Counters - Applications.

TEXTBOOKS:

1. S. M. Sze and M. K. Lee, Semiconductor Physics and Devices,Wiley, 2021.
2. M. Morris Mano, Michael D. Ciletti, "Digital Design with an Introduction to Verilog HDL", PHI, 6th Edition, 2018
3. Charles Roth, L.K.John, B.K.Lee, "Digital System Design using Verilog", Cengage, 1st Edition, 2016.

REFERENCES:

1. S.O.Kasap, Principles of Electronic Materials and Devices, McGraw Hill Education, 2017.
2. Thomas L.Floyd, "Digital Fundamentals", PHI, 11th Edition, 2017
3. Donald P.Leach, A.P.Malvino, GoutamSaha, "Digital Principles and Applications", Tata Mc-Graw Hill, 8th Edition, 2014.
4. Charles Roth, L.K.John, B.K.Lee, "Digital System Design using Verilog", Cengage,1stEdition, 2019.

L: 30; P : 30; TOTAL : 60 PERIODS

Course Code	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	E	C
23EE11C		3	0	2	0	4

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Demonstrate and explain the characteristic parameters of DC and AC circuits.
CO2: Explain the working of AC and DC machines.
CO3: Describe analog and digital instruments for monitoring and control.
CO4: Demonstrate the operation of electronic devices for applications.
CO5: Describe the purpose of safety standards and equipment.

Practical Component

CO6: Analyze the basic electric circuits and characteristics of electrical machines.
CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.
CO8: Perform residential wiring and measure earth resistance.

CO1: Demonstrate and explain the characteristic parameters of DC and AC circuits **L:9, P:6**

Sources - Passive Elements – Electrical Quantities: Voltage, Current, Power and Energy. DC circuits: Ohms Law – Kirchhoff's Laws – Mesh analysis. AC Circuits: Waveforms, RMS, Peak, real power, reactive power and apparent power, power factor.

CO6: Analyze the basic electric circuits and characteristics of electrical machines

1. Verification of Ohms law & Kirchhoff law.
2. Measurement of power and power factor for R, L load

CO2: Explain the working of AC and DC machines **L:9, P:6**

Machines: Construction, Types of DC motors – Working Principles – Need for Starters - AC Motors: Construction and Working of Single Phase and Three Phase Induction Motor– Servomotor -Stepper motor.

CO6: Analyze the basic electric circuits and characteristics of electrical machines

1. Analyze the characteristics of DC Shunt Motor and DC series motor
2. Distinguish the operation of single phase and three phase induction motor

CO3: Describe analog and digital instruments for monitoring and control **L:9, P:6**

Analog instruments: Functional Elements, Principles: PMMC, MI, Electrodynamometer wattmeter – Digital voltmeter - multimeter – DSO – Digital Energy meter - Multifunction meter.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

1. Calibration of single phase energy meter using wattmeter
2. Measurement of AC signal parameter (Peak-Peak, RMS, Period and Frequency) using DSO

CO4: Demonstrate the operation of electronic devices for applications **L:9, P:6**

Characteristics and applications: Diode – Rectifiers, Zener Diode – Regulators, BJT - Configuration, Amplifier – LEDs – Photo Diodes, Opto-Isolators.

CO7: Demonstrate the functionality of instruments and characteristics of electronics devices.

1. Experimental Verification of PN Junction diode as rectifier.
2. Experimental Verification of Zener Diode as Voltage Regulators.
3. Input and Output Characteristics of BJT in CE Configuration.

CO5: Describe the purpose of safety standards and equipment **L:9, P:6**

Electric shock -Protection: PPE, Switches, Plug and Socket, Fuse, MCB, ELCB, MCCB and Earthing - Types of wires and cables - Energy storage devices - Inverters – UPS - Energy Consumptions and Battery Charging system – Electrical safety standards in IT industry – Schematic Electrical Layout of Computer Lab with battery backup.

CO8: Perform residential wiring and measure earth resistance

1. Measurement of Earth Resistance using Electrical Equipment.
2. Harness residential house wiring, staircase wiring and fuse connections

TEXT BOOKS:

1. D.P. Kothari and I J Nagrath, “Basic Electrical and Electronics Engineering”, Tata Mc-Graw Hill, 4th Edition, 2019.
2. R.K.Rajput, “Basic Electrical and Electronics Engineering”, University Science Press, 2017.

REFERENCES:

1. Lionel Warnes, “Electrical and Electronics Engineering: Principles and Practice, Palgrave Macmillan publication, 3rd Edition, 2003.
2. D.C.Kulshreshtha, “Basic Electrical Engineering”, Tata McGraw Hill, Revision 1stEdition, 2011.

3. David Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, 2008.
4. Mohamed A. El-Sharkawi, "Electric Safety Practice and Standards", Taylor & Francis, 2013.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	OBJECT ORIENTED PROGRAMMING USING C++	L	T	P	E	C
23IT23C	(Common to CSE, IT & ECE)	2	0	2	2	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply the object oriented programming constructs to solve known applications

CO2: design effective application with inheritance, compile time and run time polymorphism

CO3: develop real-world applications by using files, streams, and exceptions

CO4: construct well-defined, efficient data handling strategies using templates and STL

Practical Component

CO5: demonstrate the basic OO principles such as class, objects, and constructors

CO6: implement code reusability through overloading, inheritance and polymorphism

CO7: solve problems using files and exception handling

CO8: employ problem solving skill using templates and STL

Experiential Component

CO9: create efficient solutions for solving real-world OOP applications

Soft Skill Component

CO10: demonstrate diversity and inclusive attitude while practicing project component as a team

CO1: apply the object oriented programming constructs to solve known applications **L:8;**
CO5: demonstrate the basic OO principles such as class, objects, and constructors **P:8;**
Introduction- Comparison between procedural programming paradigm and object-oriented programming paradigm. Features of object-oriented programming. Functions - Inline functions- Friend functions. Arrays -Array of objects. Pointer - Function pointer. Memory management: New and Delete. Classes and Objects - Access specifiers, Types of classes- Constructor and destructor - Types of constructor - Static members **E:8**

CO2:design effective application with inheritance, compile time and run time polymorphism **L:8;**
CO6:implement code reusability through overloading, inheritance and polymorphism **P:8;**
Function Overloading, Overloading Constructors, Ambiguity in Overloading. Operator overloading - Overloading Using Friend Function- Overloading New and Delete- Overloading Special Operators. Inheritance – Types of Inheritance - Typing Conversions and Visibility – Code Reuse- Aggregation. Polymorphism- Virtual Functions – Pure Virtual Functions – Early vs. Late Binding. Run-Time Type ID and Casting Operators: RTTI – Casting Operators – Dynamic Cast. **E:10**

CO3: develop real-world applications by using files, streams, and exceptions **L:7;**
CO7: solve problems using files and exception handling **P:6;**
Streams and Files: Streams classes - Sequential Input and Output operations – Random **E:4**

Access - File pointers - Error handling in file I/O with member function - command line arguments. Exception handling – expected and unexpected exceptions - uncaught exception - resource captures and release. Case study with real time applications.

CO4:construct well-defined, efficient data handling strategies using templates and STL **L:7; P:8;**
CO8: employ problem solving skill using templates and STL **E:8**

Templates- Generic programming - variadic templates – template compilation model – Generic Classes. Standard Template Library: Iterators – Auxiliary Iterator function – Algorithms – Non-modifying sequence operations – mutating sequence operations – Containers: Sequence and associative containers - Algorithms, string class – explicit, mutable and operator keywords. Namespaces: user defined namespaces, namespaces provided by library

TEXT BOOKS:

1. Bjarne Stroustrup, "A Tour of C++", 3rd Edition, Pearson Education, April 2023.
2. Herbert Schildt, "C++: The Complete Reference", 4th Edition, Tata McGraw Hill Publishers, 2017.

REFERENCES:

1. Reema Thareja, "Object oriented programming with C++", Revised 1st Edition, Oxford University Press, 2018.
2. E.Balagurusamy, "Object oriented programming with C++", 8th Edition, McGraw Hill Education (India) Private Limited, September 2020.
3. Ivor Horton, Peter van, "Beginning C++ 20 from novice to professional", 6th Edition, APRESS media, 2020.
4. Bjorin Andrist, Viktor Sehr, "C++ High Performance: Master the art of optimizing the functioning of your C++ code", 2nd Edition, Packt Publishing Limited, December 2020.
5. Nicoloai.MJosuttis and Doug Gregor, "C++Templates: The complete guide", 1st Edition, Addison Wesley, 2020

ONLINE COURSES:

1. https://onlinecourses.nptel.ac.in/noc23_cs78/preview
2. https://www.udemy.com/course/oops-and-c-from-basic-to-advanced
3. https://www.udemy.com/course/crash-course-on-cpp-stl/
4. https://www.coursera.org/lecture/c-plus-plus-b/1-3-standard-template-library-o3v9K
5. https://www.coursera.org/learn/object-oriented-cpp

L:30; P:30; E:30; TOTAL: 90 PERIODS

Course Code	**INNOVATION THROUGH DESIGN THINKING**	**L**	**T**	**P**	**E**	**C**
23GN02C	(Common to all B.E. / B.Tech. Degree Programmes)	**0**	**0**	**0**	**4**	**2**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Experiential Component

CO1: Analyse the impact of design thinking process.

CO2: Practice design thinking process through real world problems.

Soft skill Component

CO3: Present survey conclusions on selected real-world problems.

CO1: Analyse the impact of design thinking process **30**

Design thinking process: history and phases -Ideation tools: brainstorming, mind mapping, scrambler method, six thinking hats -case studies.

CO2: Practice design thinking process through real world problems **30**

Real world problem selection-Practicing the preliminary stages of design thinking process - work presentation.

TEXT BOOKS:

1. Falk Uebernickel, Li Jiang, Walter Brenner, Britta Pukall, Therese Naef, "Design Thinking: The Handbook", WS Professional, 2020
2. PavanSoni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem solving", Penguin Random House, 2020

REFERENCES:

1. Michael Lewrick, "The Design Thinking Playbook", Wiley, 2019
2. Kathryn Christopher, "Design Thinking in Engineering", Kendall Hunt Publishing Company,2019
3. Robert Curedale, "Design Thinking Process & Methods" Design Community College Inc, 5th Edition, 2019
4. David Lee, "Design Thinking in the Classroom", Ulysses Press, 2018
5. Jimmy Jain, "Design Thinking for Startups", Notion Press, 2018
6. Monika Hestad Silvia Rigoni Anders Grnli, "The Little Booklet on Design Thinking: An Introduction", Zaccheus Entertainment, 2nd Edition, 2017
7. Scott Swan, Michael G.Luchs and Abbie Griffin, "Design Thinking: New Product Development Essentials", Wiley-Blackwell, 2016
8. D.M. Arvind Mallik, "Design Thinking for Educators", Notion Press, 2019

E:60; TOTAL:60 PERIODS

Course Code	SOFTWARE ENGINEERING	L	T	P	E	C
23IT31C		3	0	0	0	3

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1:elicit the significance of software development and the stages of the SoftwareDevelopment Life Cycle.

CO2: acquire the knowledge required for adapting agility in software development.

CO3: apply software design principles, utilize architectural styles, and employ UML for design phase.

CO4: develop competence in comprehensive testing and quality assurance techniques.

CO5: apply the appropriate project management methods for streamlining efficiency of a software project.

CO6: effectively collaborate, communicate, and adapt in a dynamic software engineering environment through real-time projects.

CO1: elicit the significance of software development and the stages of theSoftwareDevelopment Life Cycle. **L:9**

Software Engineering Principles - Importance and Challenges in Software Development- Software Development Life Cycle (SDLC) - Software Process Models - Requirements Engineering- Software Requirements Specification.

CO2:acquire the knowledge required for adapting agility in software development. **L:9**

Principles and Manifesto- Agile Process Framework- Extreme Programming- Scrum:- Practices – Ceremonies - Agile metrics and communication - Tools and Techniques Managing Changing Requirements - Case Studies:- Growth of Spotify, Innovation of Netflix and Success of Salesforce.

CO3:apply software design principles, utilize architectural styles, and employUML for design phase. **L:9**

Kanban Design Principles and Concepts- Architectural Styles and Patterns - Unified Modeling Language- Design Patterns and Anti-patterns - Progressive elaboration- Product roadmap.

CO4: develop competence in comprehensive testing and quality assurance techniques. **L:9**

Software Implementation and Coding Practices- Code Quality and Best Practices- Software Testing Fundamentals - Types of Testing- Test Case Design, Test Automation, and Test Management - Quality Assurance and Software Metrics- Selenium basics.

CO5:apply the appropriate project management methods for streamlining efficiency of asoftware project. **L:9**

Software Project Planning - Estimation - Project Scheduling - Risk Management – DevOps - Continuous Integration and Deployment- Software Maintenance - Evolution-Software Engineering Ethics - Emerging Technologies- Project Management using Git.

CO6: effectively collaborate, communicate, and adapt in a dynamic software engineering environmentthrough real-time projects.

TEXT BOOKS

1. BruceR.Maxim and Roger S.Pressman, "Software Engineering - A Practitioners Approach", Eighth Edition, McGraw Hill, 2019.
2. Mike Cohn, "Agile Estimating and Planning", Third Edition,Pearson,2017.

REFERENCE BOOKS

1. Erich Gamma, Richard Helm and Ralph Johnson, "Design Patterns: Elements of Reusable Object-Oriented Software",5th Edition,Addison-Wesley Professional,2018.
2. Gene Kim, "The Phoenix Project",2nd Edition,IT Revolution Press,2018.
3. Shari Lawrence Pfleeger and Joanne M. Atlee, "Software Engineering: Theory and Practice", Third Edition,Pearson,2019.
4. Steve Mcconnell,"Code Complete",3rd Edition,Dreamtech Press,2016.
5. Nicole Forsgren, Jez Humble and Gene Kim, "Accelerate: The Science of Lean Software and DevOps", 1st Edition, IT Revolution Press,2018.
6. Rajesh Kumar, "Software Engineering – Concepts and Implementation", Special Edition, CITE-MS University, 2015.

L: 45; TOTAL: 45 PERIODS

Course Code	DATA STRUCTURES	L	T	P	E	C
23IT32C	(Common to CSE & IT Degree Programmes)	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: apply appropriate sorting and searching algorithms using list for solving real world problems.
CO2: apply appropriate linear data structures for different applications.
CO3: implement various tree operations that handle non linear data organization.
CO4: employ suitable indexing and hashing techniques for optimal data accessing.
CO5: implement various graph and its traversal techniques for solving network problems.

CO1: apply appropriate sorting and searching algorithms using list for solving real world problems. **L:10**

List ADT – Array based Implementation - Linked List Implementation – Singly linked list - Doubly linked list - Circular linked list – Sorting –Insertion Sort – Merge Sort – Quick Sort – Searching – Linear Search – Binary Search – Fibonacci Search.

CO2: apply appropriate linear data structures for different applications. **L:9**

Stack ADT – Operations (using Array and Linked List) – Applications of Stack – Balancing symbols – Infix to postfix conversion – Evaluating postfix expression.

Queue ADT – Operations (using Array and Linked List) – Circular Queue – De-Queue – Application of Queues.

CO3: implement various tree operations that handle nonlinear data organization. **L:10**

Tree ADT – Basic Tree Terminologies – Types of Trees – Binary tree ADT – Operations – Tree Traversals – Expression Trees - Binary search Tree ADT – Threaded Binary Tree - AVL Trees - Priority Queue(Heaps)

CO4: employ suitable indexing and hashing techniques for optimal data accessing. **L:7**

Indexing: B Tree and B+ Tree: Definitions – algorithms - Hashing: Hash Function – Separate chaining – Open Addressing – Rehashing – Extendible hashing - Dictionary: Dictionary ADT - Implementation

CO5: implement various graph and its traversal techniques for solving network problems. **L:9**

Graphs: Basic Terminologies and Representation – Types of graphs – Breadth first search – Depth first search – Bi-connectivity – Topological sort – Dijkstra's algorithm- Minimum Spanning Tree – Prim's algorithm – Kruskal's algorithm –Applications of Graphs

TEXT BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson Education, 2017.
2. R.G. Dromey, "How to Solve it by Computer", 1st Edition, Prentice Hall International, 2011.

REFERENCES

1. Langsam, Augenstein and Tanenbaum, "Data Structures Using C and C++", 2nd Edition, Pearson Education, 2015.
2. Alfred V. Aho, Jeffrey D. Ullman,John E. Hopcroft, "Data Structures and Algorithms", 5th Edition, Pearson, 2008.

3. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press, 2022.
4. Kamthane, "Introduction to Data Structures in C", 1stEdition, Pearson Education, 2007.
5. Kruse, "Data Structures and Program Design in C", 2nd Edition, Pearson Education, 2006.

ONLINE SOURCES:

1. https://people.ok.ubc.ca/ylucet/DS/Algorithms.html - Data Structure Visualization tool
2. https://nptel.ac.in/courses/106/102/106102064/ - NPTEL Lecture series

L: 45; TOTAL: 45 PERIODS

Course Code	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	E	C
23IT33C	(Common to CSE, IT and AI&DS)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

Theory Component

CO1: apply the fundamental design techniques of a digital computer to execute simple arithmetic operations

CO2: relate the execution sequence of an instruction to design the datapath and control unit for a processor

CO3: analyze the hierarchical structure of various memory systems and assess the performance

CO4: relate various types of I/O interfaces and their functionalities

CO5: analyze the impact of hazards in pipeline performance by utilizing the different stages of instruction execution in a pipelined processor

CO1: apply the fundamental design techniques of a digital computer to execute simple arithmetic operations **L:10**

Functional units – Basic operational concepts – Bus Structures – Performance – Memory locations and addresses – Instructions and instruction sequencing – Addressing modes. Arithmetic: Addition and Subtraction of Signed Numbers – Design of fast adders – Multiplication of unsigned and signed numbers – Fast Multiplication – Integer division.

CO2: relate the execution sequence of an instruction to design the datapath and control unit for a processor **L:8**

Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Instruction Fetch and Execution Steps – Control Signals – Hardwired control – Micro programmed control.

CO3: analyze the hierarchical structure of various memory systems and assess the performance **L:8**

Basic concepts – RAM – ROM – Cache memories – Improving cache performance – Virtual memory – Memory management requirements – Secondary storage devices.

CO4: relate various types of I/O interfaces and their functionalities **L:8**

Accessing I/O devices – Interrupts – Direct Memory Access – Buses – Interface circuits – Standard I/O Interfaces – PCI, SCSI, SATA, USB – Advanced IO interfaces.

CO5: analyze the impact of hazards in pipeline performance by utilizing the different stages of instruction execution in a pipelined processor **L:11**

Basic concepts – Parallel processing – Instruction pipeline – Data hazards – Instruction

hazards – Influence on instruction sets – datapath and control consideration – Super scalar operation – RISC vs CISC processors – Instruction Level Parallelism – Parallel IO Organization – IO in Multicore Computers.

TEXT BOOKS

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, and Naraig Manjikian, "Computer Organization and Embedded Systems", McGraw Hill Higher Education, 6th Edition, 2022.
2. William Stallings, "Computer Organization and Architecture - Designing for Performance", Pearson Education, 6th Edition, 2021.

REFERENCES

1. David A. Patterson, John L.Hennessy, "Computer Organization and Design, The Hardware / Software Interface", 6th Edition, Morgan Kaufmann/Elsevier, 2020.
2. M. Morris Mano, "Computer System Architecture", 3rd Edition, Pearson Education, 2017.
3. John P. Hayes, "Computer Architecture and Organization", 3rd Edition, Tata Mc-GrawHill, 2017.
4. Yan Solihin, "Fundamentals of Parallel Multicore Architecture", CRC Press, 2015.
5. V.P. Heuring, H.F. Jordan, T.G.Venkatesh, "Computer Systems Design and Architecture", 2nd Edition, Pearson Education, 2008.

ONLINE SOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_cs64/preview
2. https://www.udemy.com/course/computer-organization-and-architecture-j/

L: 45; TOTAL: 45 PERIODS

Course Code	OPERATING SYSTEMS	L	T	P	E	C
23IT34C	(Common to CSE, IT and AI&DS)	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: conceive the basic components and working principles of operating systems.
CO2: analyze CPU scheduling mechanisms for diverse scheduling criteria
CO3: devise the solutions for process synchronization issues.
CO4: relate various techniques for handling memory management.
CO5: apply file management and I/O management techniques.

CO1:conceive the basic components and working principles of operating systems. **L:6; T:1**

Introduction to operating systems - Types of operating system - structure of OS – system calls and its types – system programs – Processes: Concept – Process scheduling – operations on processes – Threads : concept – multithreading models – Inter process communication – Processes and threads in Linux os-Free and Open source-***Overview: Windows, Linux, Mobile, Real-Time, and Robotic Operating Systems.***

CO2: analyze CPU scheduling mechanisms for diverse scheduling criteria **L:6; T:3**

CPU Scheduling – basic concepts – scheduling criteria – Preemptive and non preemptive

scheduling algorithms: FCFS, SJF, Priority, Round Robin – scheduling in Real Time Operating System (RTOS) – Rate Monotonic (RM) scheduling algorithm – Least Laxity First (LLF) scheduling algorithm **– *Simulation of process scheduling.***

CO3: devise the solutions for process synchronization issues. **L:6; T:3**

Process Synchronization – The Critical – Section problem – Peterson's solution – Mutex locks –concurrency - Semaphores – Classic problems of synchronization – monitors. Deadlock: System model – deadlock characterization – Methods for handling deadlock – deadlock prevention – deadlock avoidance – banker's algorithm – deadlock detection – recovery from deadlock.

CO4: relate various techniques for handling memory management. **L:6, T:4**

Memory management – Background – Swapping – Contiguous memory allocation – Segmentation – Paging – Segmentation with paging – Intel 32 and 64 bit Architectures-Virtual memory: Background – Demand paging – page replacement – algorithms: FIFO, LRU,Optimal-allocation of frames – thrashing-***Case Study on Redis page replacement approach.***

CO5: apply file management and I/O management techniques. **L:6, T:4**

File concept – Access methods – directory and disk structure – file system mounting – protection – File system implementation: Directory implementation – Allocation methods – Free space management. Disk scheduling – Algorithms: FCFS, SSTF, SCAN, CSCAN, LOOK, CLOOK – disk management.

TEXT BOOKS

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, "Operating System Concepts", Enhanced eText, 10th Edition, Wiley Asia Student Edition, 2018.

REFERENCES

1. William Stallings, "Operating Systems: Internals and Design Principles", 9th Edition, Prentice Hall of India, 2018.
2. Andrew S. Tanenbaum, Modern Operating Systems, Pearson, 4th Edition (2016).
3. Anderson, Thomas, and Dahlin, Michael. Operating Systems: Principles and Practice",2nd Edition, United Kingdom, Recursive Books, 2014.
4. https://onlinecourses.nptel.ac.in/noc22_cs104/preview

L: 30; T: 15; TOTAL:45 PERIODS

Course Code	**PROBABILITY AND STATISTICS**	**L**	**T**	**P**	**E**	**C**
23IT38C		**3**	**1**	**0**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: perform basic probability concepts and standard distributions.
CO2: find the correlation and regression of two dimensional random variables.
CO3: calculate the various measures of dispersion.
CO4: apply the concept of testing of hypothesis for small and large samples.
CO5: apply the basic concepts of classifications of design of experiments.

CO1:perform basic probability concepts and standard distributions

Discrete and continuous random variables - Moments - Moment generating functions and their properties. Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, and Normal distributions. **L:9,T:3**

CO2: find the correlation and regression of two dimensional random variables

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and regression - Transformation of random variables – Central limit theorem. **L:9,T:3**

CO3: calculate the various measures of dispersion

Central tendencies - Mean, median, mode - Measures of Dispersion –Mean deviation, and Quartile deviation–Moments– Skewness –Kurtosis - Correlation and Regression. **L:9,T:3**

CO4: apply the concept of testing of hypothesis for small and large samples

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t and Chi-square distribution - Contingency table for independent of attributes – Goodness of fit. **L:9,T:3**

CO5: apply the basic concepts of classifications of design of experiments

Tests based on F distributions for mean, variance and proportion- One way and two way classifications - Completely randomized design – Randomized block design– Latin square design – 2^2 factorial design. **L:9,T:3**

TEXT BOOKS:

1. Richard A. Johnson, Irwin Miller, John Freund, Miller & Freund's, Probability and Statistics for Engineers, 9th Edition, Pearson Education Limited, Global Edition, 2017.
2. Grewal.B.S., Higher Engineering Mathematics, 44th Edition, Khanna Publications, Delhi, 2017.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley India, 2017.

REFERENCES:

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, Probability and Statistics for Engineers and Scientists, Pearson Education, Asia, 9thEdition, 2016.
2. M.R. Spiegel, J.Schiller and R.A. Srinivasan, Schaum Outlines, Probabilityand Statistics, Tata McGraw Hill Edition, 2017.
3. Chapra, S.C and Canale, R. P. Numerical Methods for Engineers, 7th Edition, Tata McGraw Hill, New Delhi, 2016.
4. Jain R.K. and Iyengar S.R.K.,Advanced Engineering Mathematics, 5thEdition, Narosa Publishing House Private Limited, 2016.

L: 45; T: 15; TOTAL: 60 PERIODS

23MC01C	**CONSTITUTION OF INDIA**	**L**	**T**	**P**	**E**	**C**
		2	**0**	**0**	**0**	**0**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Describe the salient features of the Indian Constitution.
CO2: Discuss the structure and functions of parliament.
CO3: Elaborate the structure and functions of state legislature.
CO4: Explain the fundamentals of organization and working of the Judiciary.
CO5: Discuss the foreign policy of India.

CO1: Describe the salient features of the Indian Constitution **6**

Salient Features – Preamble-Pillars of constitution - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

CO2: Discuss the structure and functions of parliament **6**

Powers and Functions of President and Prime Minister - Council of Ministers – The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

CO3: Elaborate the structure and functions of state legislature **6**

Features of Federal System - Administrative Relationship between Union and States - Powers and Functions of Governor and Chief Minister – Council of Ministers –State Legislature.

CO4: Explain the fundamentals of organization and working of the Judiciary **6**

Organization and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

CO5: Discuss the foreign policy of India **6**

Foreign Policy of India – VISA Application Process- International Institutions like UNO, WTO, SAARC and Environmentalism.

TEXT BOOKS

1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India,2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, 2010.

REFERENCES

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, 2011.
2. Kashyap S, "Our Constitution", National Book Trust,2010.
3. Shukla V N, "Constitution of India", Eastern Book Company Ltd., 2011.

L: 30; TOTAL: 30 PERIODS

Course Code	**COMPUTER NETWORKS**	**L**	**T**	**P**	**E**	**C**
23IT35C	(Common to CSE, IT and AI&DS)	**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: analyze the functionalities of various layers and network components

CO2: evaluate various access control mechanisms for error free data communication.

CO3: apply various flow, congestion control and routing algorithms for optimal path detection

CO4: analyze the performance of various application layer protocols

Practical Component

CO5: design different network topologies using network simulation tool.

CO6: implement the various services of the data link and network layer.

CO7: demonstrate the protocols in application layer

CO1: analyze the functionalities of various layers and network components **L:9;**

Introduction– Networks Types – connection-transfer modes-Network Components: Devices and medium - Topology – Protocol Layering – TCP/IP protocol suite –OSI Model - Switching Networks – Network operating system: modes of operation **P:6**

CO5: design different network topologies using network simulation tool

Representing a network- configure a network switch – Network troubleshooting Commands- implement basic connectivity

CO2:evaluate various access control mechanisms for error free data communication **L:12;**

Data Link Layer – Framing – Flow control – Error control – Data Link Layer Protocols and standards – HDLC –PPP - Ethernet Basics-Media Access Control: Addresses-CSMA/CA-CSMA/CD – Virtual LAN – Wireless LAN (IEEE802.11). **P:8**

CO6: implement the various services of the data link and network layer.

Implementation of Error Detection Techniques and framing methods-simulation of VLAN

CO3: apply various flow, congestion control and routing algorithms for optimal path detection **L:15; P:10**

Introduction - IPV4 Addresses –CIDR - Address Mapping - ARP, RARP, and DHCP-ICMP-NAT- IPv6 Addresses -Transition from IPV4 to IPV6 - Distance Vector Routing: RIP - Link State Routing: OSPF-TCP- Congestion control - Congestion avoidance-UDP-Datagram -Services- Applications.

CO6: implement the various services of the data link and network layer

Configuration of router interfaces -Demonstrate the ARP & RARP process in local and remote network-Implement routing protocols

CO4: analyze the performance of various application layer protocols **L:9;**

Introduction to Sockets - Application Layer protocols: HTTP – FTP – Email protocols (SMTP - POP3 - MIME) – DNS – SNMP **P:6**

CO7: demonstrate the protocols in application layer

analyze the network traffic - Implement Chat application

TEXT BOOKS

1. Behrouz A. Forouzan, Data Communication and Networking with TCP/IP suite, 6th Edition, McGraw Hill, 2022.
   Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, 6th Edition, Morgan Kaufmann Publishers Inc., 2021.

REFERENCES

1. Andrew S. Tenenbaum, Nick feamster, David J. wetherall, Computer Networks, 6th Edition, Pearson Education, New Delhi, 2022

2. James F. Kurose, Keith W.Ross, Computer Networking A Top-down Approach, 8th Edition, Pearson Education., New Delhi, 2022
2. William Stallings, "Data and Computer Communications", 10th Edition, Pearson Education, 2017.

ONLINE SOURCES

1. https://nptel.ac.in/courses/106/105/106105081/www.nptel.ac.in

https://www.udemy.com/course/computer-networks-for-beginners-it-networking-fundamentals/

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	DATA STRUCTURES LABORATORY	L	T	P	E	C
23IT36C	(Common to CSE, IT)	**0**	**0**	**4**	**0**	**2**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Practical Component

CO1: develop suitable sorting, searching, linear and nonlinear data structures for efficient data handling.

CO2: perform hierarchical searching problems using hash, heaps and graph algorithms.

CO1: develop suitable sorting, searching, linear and nonlinear data structures for efficient data handling. **P:40**

1. Implementation of Sorting and searching for various applications.
2. Implementation of Stack and Queue using Array and Linked List.
3. Applications of stack, Queue and Linked List.
4. Construction of Expression Tree.
5. Implementation of Binary Search Tree.
6. Implementation of Dictionary operations using AVL Tree.

Mini project

CO2: perform hierarchical searching problems using hash, heaps and graph algorithms. **P:20**

1. Implementation of Priority Queue using Heap structures.
2. Applications of Hashing techniques.
3. Applications of Graph algorithms.

Mini project

Software Requirements

- GNU C/C++ Compiler
- OS - Linux

P: 60; TOTAL: 60 PERIODS

Course Code	**LINUX SYSTEM ADMINISTRATION**	**L**	**T**	**P**	**E**	**C**
23IT37C	(Common to CSE, IT and AI&DS)	**0**	**0**	**2**	**0**	**1**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1:demonstrate the basic knowledge of Linux commands and file handling utilities by using Linux shell environment

CO2:implement Shell Scripting

LIST OF EXPERIMENTS

Explore the LINUX Commands **P:6**

a. Directory
b. File Manipulation
c. General-purpose
d. Network utilities
e. Disk utilities
f. Backup utilities and Filters

Shell Programming - Develop Shell script programs for the following: **P:10**

a. Interactive shell script
b. Positional parameters
c. Arithmetic
d. If-then-fi, if-then-else-fi, & nested if-else
e. Logical operators
f. Else + if equals elif, case structure
g. While & for loop
h. Meta characters

Shell scripting for - Real world problem solving **P:14**

a. File Backup
b. Text File Search
c. Password Generator
d. Disk Cleanup
e. Memory Leak Detection
f. Cache Management
g. Swap Space Optimization

SOFTWARE REQUIREMENTS

Operating System: Linux (Ubuntu).

REFERENCES

1. Venkateshmurthy, "Introduction To Unix And Shell Programming", 1st Edition,Pearson Publisher India, 2016.
2. Behrouz A. Forouzan, Richard F. Gilberg, Unix and shell Programming, 1st Edition Thomson Publisher, 2013.
3. Andrew S. Tanenbaum, Modern Operating Systems, 4th Edition, Pearson Education, 2014.
4. Robert Love, Linux System Programming - Talking Directly to the Kernel and C Library, O'Reilly Media, 2013.

P: 30 TOTAL: 30 PERIODS

Course Code	INTELLECTUAL PROPERTY RIGHTS STUDY	L	T	P	E	C
23GN03C	*(Common to all B.E. / B.Tech. Degree Programmes)*	0	0	0	4	2

COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1:Understand the basic concepts and types of Intellectual Property Rights

CO2: Outline the Indian position of the patent law (1970)

CO3:Identify and investigate the state of art technologies through effectual IP search

CO1 : UnderstandthebasicconceptsandtypesofIntellectualPropertyRights **20**

IntroductiontoIntellectualPropertyRights – ConceptandTheories – KindsofIntellectualProperty Rights – EconomicanalysisofIntellectualPropertyRights –NeedforPrivateRightsversusPublicInterests-Advantages and Disadvantages of IPR.

CO2 : OutlinetheIndianpositionofthepatentlaw (1970) **20**

PatentAct1970–amendmentsof1999,2000,2002and2005 – Patentablesubjectmatter, Patentabilitycriteria,non-patentableinventions – Pharmaceuticalproductsandprocessandpatentprotection – SoftwarePatents

CO3 : Identifyandinvestigatethestateofarttechnologiesthrough effectual IPsearch **20**

ImportanceofIPsearch – factorstobeconsidered foreffectiveIPsearch-Hands-on Practice.

P:30;E:30; TOTAL:60PERIODS

REFERENCE BOOKS

1.D.P.Mittal(TaxmanPublication), IndianPatents LawandProcedure(2002)

2.B.L.Wadera,Patents,trademarks,copyright,DesignsandGeographicalJudications(2010)

3.P.Narayanan(EasternLawHouse), IntellectualPropertyLaw(2022)

4.N.S.Gopalakrishnan&T.G.Agitha,PrinciplesofIntellectualProperty(2009),EasternBook Company,Lucknow.

Course Code	JAVAFOR DEVELOPERS	L	T	P	E	C
23IT41C	(**Common to CSE, IT Degree Programmes)**	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components:

CO1: employ object-oriented language principles to solve known applications (CDL1)

CO2: apply string handling, I/O streams and exception handling methods for developing text based applications(CDL1)

CO3: apply the principles of multithreading and collections to solve complex problems (CDL2)

CO4: explore Maven, Gradle and REST API for project management (CDL3)

CO5:build robust and efficient enterprise and web applications using Spring Boot.(CDL3)

CO1: employ object-oriented language principles to solve known applications. **L:10**

Introduction to Java – OOPS Concepts: Classes and Objects – Methods – Inheritance – Polymorphism – Constructors– Abstract class and Interface - Packages and AccessModifiers

CO2: apply string handling, I/O streams and exception handling methods fordeveloping text based applications **L:8**

Arrays - String Handling: Immutable – Comparison – StringBuffer and StringBuilder - String Tokenizer - File Handling: I/O Stream – Buffered Reader/Writer – Exception Handling – Built in and Custom Exception

CO3: apply the principles of multithreading and collections to solve complex problems L:9

Multithreading: Thread Life Cycle –Thread Creation – Thread Priorities – Synchronization - Collections Framework: Collection Class – List – Queue – Map – Set – SortedSet – Deque – Comparator – Iterator in Java.

CO4: explore Maven, Gradle and REST API for project management L:7

Maven: POM.XML, Maven Repositories- Gradle: Repositories and plugins – REST API – HTTP Requests and Responses – Annotations – Lombok.

CO5: build robust and efficient enterprise and web applications using Spring Boot L: 11

Spring Core Framework – Features – Dependency Management –Spring Data –Spring Boot – JDBC Overview & Architecture –JDBC Driver Types–CRUD Operations – JPA – RESTful web services with Spring Boot.

TEXT BOOKS:

1. Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java – A Learner's Guide to Real World Programming", 3rd Edition, O'Reilly Media, Inc., May 2022.
2. Craig Walls, "Spring in Action", 6th Edition, Manning Publications, January 2022

REFERENCE BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 13th Edition, McGraw Hill, 2024.
2. Maurice Naftalin, Philip Wadler, "Java Generics and Collections", 2nd Edition, O'Reilly Media, Inc., June 2024.
3. Cay S.Horstmann, "Core Java, Volume I: Fundamentals", 12th Edition, Oracle Press, December 2021.

L: 45; TOTAL: 45 PERIODS

Course Code	BUSINESS PROCESS MODELLING	L	T	P	E	C
23IT42C		2	0	0	0	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: analyze the required processes and able to identify process improvement opportunities and strategies. (CDL1)

CO2: plan a BPM strategy for an organization.(CDL2)

CO3: apply business process modeling techniques to create models that are formally correct and meet the purpose of modeling in specific situations.(CDL2)

CO4: design effective implementation strategies for business process automation projects basedon research on automation.(CDL2)

CO5: Use simulation software as a tool for analyzing business processes. (CDL2)

CO1: analyze the required processes and able to identify process improvement opportunities and strategies. L:6

Business Process, The Essence of Business Process Design, Business Process Design,

Overall Business Performance, and Strategy, BPM Life Cycle, Process Identification – The context of process identification, Definition of the process architecture, process selection.

CO2: plan a BPM strategy for an organization. **L:6**

Essential Process Modeling – First Steps with BPMN, Branching and merging, Business Objects, Resources, Process decomposition, Process model reuse.

L:6

CO3: apply business process modeling techniques to create models that are formally correct and meet the purpose of modeling in specific situations.

Rework and repetition, Handling events, Handling exceptions, Process and Business rules. Process Discovery - The setting of process discovery, process discovery methods, process modeling methods.

L:6

CO4: design effective implementation strategies for business process automation projects based on research on automation

Case for Action and Vision Statements, Process Identification and Selection, Obtaining Management Commitment, Evaluation of Design Enablers, Acquiring Process Understanding, Creative Process Design. Basic Tools for Process Design – Process Flow Analysis, Workflow Design Principles and Tools, Additional Diagramming Tools.

Case Study – New Technology as a Change Enabler in the Grocery Industry.

Case Study - From Theory to Practice: Designing an Order-Picking Process

L:6

CO5: Use simulation software as a tool for analyzing business processes.

Simulation Models, Monte Carlo Simulation, Discrete-Event Simulation, Getting Started in Simulation Modeling, Developing a Simulation Model—Principles and Concepts, ExtendSim Elements and Tutorials. **Case Study – Build an ExtendSim simulation model for an insurance company.**

TEXT BOOKS:

1. Manuel Laguna, Johan Marklund, "Business Process Modeling, Simulation and Design", 3rd Edition, CRC Press, 2019.
2. Marlon Dumas, Marcello La Rosa, Jan Mendling, Hajo A. Reijers, "Fundamentals of Business Process Management", 2nd Edition, Springer,2018.

REFERENCES:

1. Akhil Kumar, "Business Process Management", 1st Edition, Routledge, 2018.
2. Carl F. Lehmann, "Strategy and Business Process Management: Techniques for Improving Execution, Adaptability, and Consistency", CRC Press, 2016.
3. John Jeston, Johan Nelis, "Business Process Management", 3rd Edition, Routledge, 2014.
4. Vander Aalst, Wil, "Process Mining: Data Science in Action", 2nd Edition, Springer 2016

L: 30; TOTAL: 30 PERIODS

Course Code	SIGNALS AND SYSTEMS	L	T	P	E	C
23IT43C		3	1	0	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explore the types of signals, their responses and its properties. (CDL1)

CO2: analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis. (CDL2)

CO3: examine systems based on their properties and determine the response of LTI system using convolution. (CDL2)

CO4: analyze the DT signals using various transformation techniques. (CDL2)

CO5: apply the concepts of sampling and analyze the signals. (CDL2)

CO1: explore the types of signals, their responses and its properties. **L:8; T:3**

Introduction to Continuous time signals (CT signals), Discrete time signals (DT signals), Step, Ramp, Pulse, Impulse, Exponential Signals. Classification of CT and DT signals, periodic and aperiodic, random signals. CT systems and DT systems, Basic properties of systems, Linear Time Invariant systems and properties.

CO2: analyze the spectral characteristics of continuous-time periodic and aperiodic signals using Fourier analysis. **L:10; T:3**

Fourier series analysis-trigonometric, cosine and Exponential Fourier series, Spectrum of CT signals, Fourier Transform properties, Fourier Transform signal analysis, Laplace Transform properties, Laplace Transform Signal Analysis.

CO3: examine systems based on their properties and determine the response of LTI system using convolution. **L:9; T:3**

Differential equation, Block diagram representation, Impulse response, Convolution, frequency response, LTI systems analysis using Fourier and Laplace transforms.

CO4: analyze the DT signals using various transformation techniques. **L:8, T:3**

Discrete Time Fourier Transform (DTFT)-signal analysis, properties, Z-transform - signal analysis, properties, Inverse Z transform.

CO5: apply the concepts of sampling and analyze the signals. **L:10, T:3**

Sampling Theorem, Reconstruction of signal from its samples, Effect of under sampling – Aliasing, Correlation: Cross Correlation and Auto Correlation of Functions, Properties of Correlation Functions, Energy Density Spectrum, Parseval's Theorem, Power Density Spectrum, Relation between Convolution and Correlation, Detection of Periodic Signals in the presence of Noise by Correlation.

CASESTUDY: Perform the various basic processing steps at the receiver to retrieve the binary data from the PAM modulated transmitted signal.

TEXT BOOKS

1. Alan V.Oppenheim, Alan S. Willsky and S.H.Nawab, "Signals and Systems", 2nd Edition, Pearson Education, 2015.
2. Edward W Kamen and Bonnie S. Heck, "Fundamentals of Signals and Systems using the Web and MATLAB", 3rd Edition, Pearson Education, 2013.

REFERENCES:

1. Rodger E.Ziemer, William H.Tranter and D.Ronald Fannin, "Signals & Systems Continuous and Discrete", 4th Edition, Pearson Education, 2014.
2. SimonHaykin&BarryVan Veen, "Signals & Systems", 2nd Edition, Willey Publication, 2010.
3. HweiP.Hsu, "Signals and Systems-Schaum's Outline Series", 3rd Edition, Tata McGraw Hill, 2013.

L: 45; T: 15; TOTAL:60 PERIODS

Course code	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	E	C
23MC02C		2	0	0	0	0

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: explain the structure and functions of an ecosystem and the importance of biodiversity.

CO2: interpret the causes, effects of air and water pollution.

CO3: comprehend the causes, impacts and management of e-waste and municipal waste.

CO4: apply the knowledge of sustainability practices in the environment.

CO1: explain the structure and functions of an ecosystem and the importance of biodiversity. **L-6**

Introduction to Environment**,** scope and importance of environment – need for public awareness. Eco-system: structure and function. Biodiversity: Introduction - types – values of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India. Conservation of biodiversity: In-situ and ex-situ - Biodiversity index calculation (Simpson and Shannon diversity Index, Sorenson coefficient)

CO2: interpret the causes, effects of air and water pollution. **L-6**

Air pollution - Classification of air pollutants – sources – Effects - Measurements: dust monitor – gas analyzer, particle size analyzer. Water pollution – Classification – health hazards – sampling and analysis of water. Waste water treatment – different industrial effluents and their treatment – Measurement: BOD and COD – atomic absorption spectrometer. Case study (Okhla sewage water treatment plant)

CO3: comprehend the causes, impacts and management of e-waste and municipal waste. **L-12**

Integrated Waste Management: Introduction – Generation and types of solid waste – Swachh Bharat Mission – Solid waste management: collection, transportation, segregation and processing – Disposal: landfill – biochemical processes and energy recovery - Municipal solid waste management rules 2016.

e-Waste Management: Introduction – Composition - Types – Generation – Environmental and health hazards of e-waste – Recycling - Recovery of metals: pyrometallurgical, hydrometallurgical, and biometallurgical process – e-waste management and handling rules 2016 – e-waste management companies in India.

CO4: apply the knowledge of sustainability practices in the environment. **L-6**

Sustainability and Management**:** Introduction - concept, needs and challenges –economic and social aspects of sustainability – unsustainability to sustainability –millennium development goals and protocols – Sustainable Development Goals-targets, indicators and intervention areas – Climate change – Global, Regional and local environmental issues and possible solutions – case studies. Concept of Carbon Credit – Carbon Footprint – Environmental management in industry – A case study – Zero waste and R concept – Circular economy – ISO 14000 Series – Material Life cycle assessment.

TEXT BOOKS:

1. Miller. G.T and Spoolman. S, 'Environmental Science', 16th Edition, Brooks/Cole Publishing Co., 2018.
2. Peavy. H.S, Rowe. D.R and Tchobanoglous. G, "Environmental Engineering", 2nd Edition, McGraw Hill Education, 2020.
3. Benny Joseph, 'Environmental Engineering', Tata-Mc-Graw Hill, New Delhi, 2016.
4. Gilbert M. Masters, 'Introduction to Environmental Science and Engineering', 2nd Edition, Pearson Education, 2016.

REFERENCES:

1. Kaushik. A and Kaushik. C.P, 'Environmental Science and Engineering', 6th Edition, New Age International Publishers, 2018.
2. Weller. K, 'Environmental Science and Biological Engineering', 1st Edition, WIT Press, 2015.

L:30; TOTAL : 30 PERIODS

Course Code	DESIGN AND ANALYSIS OF ALGORITHMS	L	T	P	E	C
23IT44C	(Common to CSE, IT Degree Programmes)	3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: apply algorithmic analysis techniques to evaluate the efficiency of algorithms in terms of time and space complexities.

CO2: analyze algorithmic design using divide and conquer/greedy approach to solve complex problems.

CO3: derive optimal solutions for complex problems using dynamic programming.

CO4: use branch and bound and backtracking strategies along with the state space tree method to solve complex problems.

CO5: apply polynomial time algorithms to solve problems efficiently within reasonable time bounds.

Practical Component

CO6: design and implement efficient algorithms to produce optimal solutions for solving real world use cases.

CO1: apply algorithmic analysis techniques to evaluate the efficiency of algorithms in terms of time and space complexities **L:10 P:3**

Notion of an Algorithm - Time and Space Complexity - Asymptotic notation and its

properties - Recurrence Relations - The substitution method for solving recurrences - The master method for solving recurrences - Algorithm Analysis: Sorting Techniques - Towers of Hanoi, Sieve of Eratosthenes

CO6: design and implement efficient algorithms to produce optimal solutions for solving real world use cases.
Implement sorting algorithms and recursive algorithms.

CO2: analyze algorithmic design using divide and conquer/greedy approach to solve complex problems **L:9 P: 8**

Divide-and-Conquer: Introduction - Algorithm Analysis: Binary Search, Merge sort, Quick sort - Strassen's algorithm for matrix multiplication - Closest pair of points - Randomized Quick Sort.
Greedy Method: Introduction - Activity Selection Problem - Huffman Trees - Minimum spanning tree: Prim's and Kruskal's - Knapsack problem

CO6: design and implement efficient algorithms to produce optimal solutions for solving real world use cases.
Solve problems using divide and conquer / greedy approaches.

CO3:derive optimal solutions for complex problems using dynamic programming **L:10 P: 8**

Approaches of dynamic programming - Principle of Optimality - Computing Binomial Coefficient - Multi-stage graph - Floyd-Warshall algorithm - Matrix chain multiplication - 0/1 Knapsack problem - Optimal binary search tree - Longest common subsequence.

CO6: design and implement efficient algorithms to produce optimal solutions for solving real world use cases.
Solve problems using dynamic programming approach.

CO4: use branch and bound and backtracking strategies along with the state space tree method to solve complex problems **L:9 P: 8**

Back tracking: Introduction to backtracking - N-Queens Problem - Hamiltonian Circuit Problem - Graph coloring problem - Knight's tour Problem.
Branch and Bound: Introduction - Classification of Branch and Bound Problems: FIFO, LIFO, LC - 0/1 Knapsack problem - Solving 8-Puzzle problem

CO6: design and implement efficient algorithms to produce optimal solutions for solving real world use cases.
Solve problems using branch & bound and backtracking approaches.

CO5: apply polynomial time algorithms to solve problems efficiently within reasonable time bounds **L:7 P: 3**

Tractable and Intractable Problems - Complexity Classes - NP hardness: Clique decision problem - NP Completeness - Concept of Cooks Theorem - Proof of NP Completeness: CNF-SAT, Vertex Cover, Subset-Sum Problem

CO6: design and implement efficient algorithms to produce optimal solutions for solving real world use cases.
Solve NP hard and NP complete problems using suitable approaches.

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 4th Edition, Prentice Hall of India, 2022.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2019.

REFERENCE BOOKS:

1. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms" Orient Blackswan, 2nd Edition, 2019.
2. Sandeep Sen, Amit Kumar, "Design and Analysis of Algorithms A Contemporary Perspective, 1st Edition, Cambridge University Press, 2019.
3. Jon Kleinberg and Eva Tardos, "Algorithm Design", 1st Edition, Pearson/Addison-Wesley, 2014.
4. Dave, P. H, "Design and Analysis of Algorithms", 1st Edition, Pearson Education Canada, 2007.

L: 45; P: 30; TOTAL: 75 PERIODS

Course Code	DATABASE MANAGEMENT SYSTEMS	L	T	P	E	C
23IT45C	(Common to CSE,IT and AI&DS Degree Programmes)	3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components:

CO1: design ER model and apply the SQL concepts to perform various operations in a relational database (CDL2)

CO2: apply normalization concept to remodel the database and maintain consistency with suitable transaction management. (CDL2)

CO3: apply the intermediate query concept to retrieve data from multiple relations. (CDL2)

CO4: apply PL/SQL constructs to enhance the database activities and develop application using database connectivity drivers. (CDL2)

CO5: apply the query evaluation plan and optimize the query to reduce complexity. (CDL1)

Practical Components:

CO6: demonstrate database normalization using appropriate tool for enhancing data integrity (PDL2**)**

CO7: design and implement SQL queries for data manipulation. (PDL2)

CO8: build applications using database connectivity drivers and implement programming concepts using PL/SQL constructs. (PDL2)

CO9: demonstrate indexing and partitioning concepts using Common Table Expression. (PDL1)

CO1: design ER model and apply the SQL concepts to perform various operations in a relational database **L:19; P:8**

CO2: apply normalization concept to remodel the database and maintain consistency with suitable transaction management.

CO6: demonstrate database normalization using appropriate tool for enhancing data integrity

Introduction to Database System-Views of data - Database System Architecture – ER

Models – Enhanced-ER Model - Relational Model- ER-to-Relational Mapping. SQL: Keys - DDL Statements - DML Statements – DCL & TCL Statements - SQL Aggregate Functions.

Functional Dependencies –Non loss Decomposition–Normalization: First, Second, Third Normal Forms, Dependency Preservation –Boyce/Codd Normal Form. Denormalization Techniques: Horizontal, Vertical and Mixed. Transaction: Basic Concepts -Transaction Recovery –ACID Properties - Concurrency – Deadlock

Develop Database Design using ER Diagram and Perform Database Manipulations operations using DDL, DML, TCL and DCL commands.Perform normalization for the given schema using appropriate tool.

CO3:apply the intermediate query concept to retrieve data from multiple relations **L:8;**
CO7: design and implement SQL queries for data manipulation **P:7**

SQL Clauses - Group By – Having - Sub Query – Nested Sub Query -Null Functions – Indexes - Sequences – SQL Joins - Types – Views - SQL Injections - SQL Window functions -Types: Aggregate- Value- RankingWriting SQL Queries to retrieve data from multiple relations.

CO4: implement PL/SQL constructs to enhance the database activities and develop application using database connectivity drivers. **L:9; P:10**
CO8: build applications using database connectivity drivers and implement programming concepts using PL/SQL constructs.

PL/SQL Introduction - Control statements –Procedures - Functions – Cursors – Triggers – Exceptions – Embedded SQL - ODBC Connectivity- Case Study: CRUD operations in Industry specific application.

Develop PL/SQL Programs to demonstrate the concept of Control statements –Procedures - Functions – Cursors – Triggers – Exceptions.

Develop application to perform CRUD operations using ODBC connectivity.

CO5: apply the query evaluation plan and optimize the query to reduce complexity. **L:9;**
CO9: demonstrate indexing and partitioning concepts using Common Table Expression. **P:5**

Query Processing: Parsing and Translation, Optimization, Evaluation; Measures of Query Cost. Query Optimization: Query Evaluation Plan (QEP), cost based query optimization, Estimation of QEP cost. Indexing concepts– CTE– Partitioning.

Create indexing and implement partitioning concepts using Common Table Expression (CTE) for the given schema.

TEXT BOOKS

1. Silberschatz, A, Henry F. Korth, and S. Sudharshan, “Database System Concepts”, 7th Edition, Tata McGraw Hill, 2019.
2. David M. Kroenke, David J. Auer, Scott L. Vandenberg, Robert C. Yoder, “Database Concepts”, 9thEdition, Pearson Education, 2020.

REFERENCE BOOKS

1. Ramez Elmasri and Shamkant B. Navathe, “Fundamentals of Database Systems”, 7th Edition, Pearson/Addisionwesley, 2019.
2. Wilfried Lemahieu, KU Leuven, BelgiumSeppevandenBroucke, KU Leuven,

BelgiumBartBaesens, KU Leuven, Belgium, "Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data",August 2018

3. C.J.Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.

L:45; P:30; TOTAL: 75 PERIODS

Course Code		L	T	P	E	C
23CS46C / 23IT46C	**JAVA PROGRAMMING LABORATORY (Common to CSE, IT Degree Programmes)**	0	0	2	2	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Practical Components:

CO1: develop modular and scalable programs by applying object-oriented programming concepts for different scenarios. (PDL2)

CO2: build simple and robust applications using Spring Boot (PDL2)

Experiential Component:

CO3: synthesize and articulate the ideas and experiences for solving known applications(PDL3)

Soft Skill Component:

CO4: function effectively in heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

List of Experiments

CO1: develop modular and scalable programs by applying object-oriented programming concepts for different scenarios. (PDL2) **P: 20; E:10**

1. Implementation of OOPS concepts.
2. Exercises on abstract class, interfaces and package concepts.
3. Exercises on array and string manipulation
4. Exercises on file and exception handling.
5. Implementation of Multithreading concept
6. Implementation of collection classes.

CO2: build simple and robust applications using Spring Boot (PDL2) **P: 10; E:20**

1. Implementation of Spring Boot with JPA.
2. Mini Project

SOFTWARE REQUIREMENTS

- Front end: JAVA, IDE: Net beans / Eclipse
- Back end: Oracle

TEXT BOOKS:

1. Kathy Sierra, Bert Bates, Trisha Gee, "Head First Java – A Learner's Guide to Real World Programming", 3rd Edition, O'Reilly Media, Inc., May 2022.
2. Craig Walls, "Spring in Action", 6th Edition, Manning Publications, January 2022

REFERENCE BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 13th Edition, McGraw Hill, 2024.

2. Kishori Sharan, Peter Spath, "Learn JavaFX 17: Building User Experience and Interfaces with Java", 2nd Edition, APress, 2022.
3. Maurice Naftalin, Philip Wadler, "Java Generics and Collections", 2nd Edition, O'Reilly Media, Inc., June 2024.
4. Cay S.Horstmann, "Core Java, Volume I: Fundamentals", 12th Edition, Oracle Press, December 2021.

P:30; E:30; TOTAL:60 PERIODS

Course Code	SYSTEM MODELING PROJECTS	L	T	P	E	C
23CS47C/ 23IT47C/	*(Common to CSE and IT Degree Programmes)*	0	0	2	2	2

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Practical component:

CO1: Apply basic mathematics, science, and engineering concepts to develop models for systems or products across various domains.

Experiential component:

CO2: Develop and analyze models using fundamental principles to solve real-life problems.

Soft skill component:

CO3: Develop the ability to work collaboratively in teams to model and simulate systems while effectively communicating technical results using suitable tools and techniques.

COURSE OVERVIEW

This course is designed to equip students with the skills to develop and analyze mathematical models for various systems across different domains. It focuses on applying fundamental principles of mathematics, science, and engineering to represent and predict the behaviour of these systems. Through hands-on experience, students will learn to create robust models that address real-world challenges, ranging from system optimization to problem-solving in practical applications. The course emphasizes integrating theoretical concepts with practical solutions, preparing students to design efficient and effective models while promoting technical excellence and professional growth.

P: 30; E: 30; TOTAL: 60 PERIODS

Course Code	APTITUDE EXCELLENCE	L	T	P	E	C
23GN04C		0	0	2	0	1

COURSE OUTCOMES

Upon the completion of the course the students will be able to

CO1: Infer appropriate methods to simplify computation
CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability
CO3: Interpret fundamentals in quantitative techniques and solve problems quickly
CO4: Improve quantitative skills and solve problems on permutation and Combination
CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

CO1: Infer appropriate methods to simplify computation

Simplification: Nested Series simplification(fraction) -BODMAS rule –Viraculum (or Bar) rule – Modulus of a real number –Multiplication shortcuts-Comparing Fractions-Data Sufficiency **P:6**

CO2: Develop problem solving skills on Time and Work and enhance arithmetic ability

Time and Work: Work Done - Days from Work:- Ratio – Efficiency –Work and wages - Data Sufficiency **P:6**

CO3: Interpret fundamentals in quantitative techniques and solve problems quickly

Time Speed Distance: Body moving in the same direction- Body moving in the opposite direction-Average speed- Meeting point- Data Sufficiency **P:6**

CO4: Improve quantitative skills and solve problems on permutation and Combination

Probability Permutation Combination: Fundamental Counting Principle – Computing Permutation – Circular Permutation – ComputingCombinations- Data Sufficiency **P:6**

CO5: Acquire the knowledge of Cognitive ability and solve puzzles effectively

Abstract reasoning: Mirror and water image – Figure Matrix –Pattern Completion – Logical puzzles –Dot situation - Ranking ordering.**Cognitive ability:** Blood Relation - Direction Sense Test-Data Sufficiency **P:6**

REFERENCE BOOKS:

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" , 3rd Edition , Eastern Economy Edition, PHI Learning 2016
2. Arun Sharma," Quantitative Aptitude for CAT", McGraw Hill Edge, 10th Edition 2022
3. Dr.R.Aggarwal, " Quantitative Aptitude", S Chand Publishing, Revised Edition 2017

P:30; TOTAL: 30 PERIODS

Course Code	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	E	C
23IT51C		3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component:

CO1: Examine security principles and classical encryption techniques to assess and mitigate various threats. (CDL2)

CO2: Implement symmetric and asymmetric cryptographic techniques to ensure data security. (CDL2)

CO3: Apply cryptographic techniques to ensure data integrity, secure communication, and authentication in network systems. (CDL2)

CO4: Utilize security techniques to detect and prevent network intrusions to provide a safe environment. (CDL1)

CO5: Identify and mitigate cyber threats through incident response strategies and secure coding practices. (CDL2)

Practical Component:

CO6: Implement classical encryption techniques to secure communication and analyze their

performance against common cryptographic attacks. (PDL2)
CO7: Demonstrate an understanding of symmetric and asymmetric cryptographic algorithms including their strength, weaknesses, and appropriate application. (PDL2)
CO8: Apply hash functions and authentication mechanisms to real-world scenarios to enhance security. (PDL2)
CO9: Analyze various cyber threats and develop effective incident response strategies to combat cyber threats. (PDL2)

CO1: Examine security principles and classical encryption techniques to assess and mitigate various threats. (CDL2) **L:10 P:8**

Security Trends - OSI Security Architecture - Principles of Security: Confidentiality, Integrity, Authentication - Security Attacks: Passive and Active Attacks, Security Services and Mechanisms - Classical Encryption Techniques: Substitution Ciphers (Caesar, Vigenère), Transposition Ciphers (Rail Fence, Columnar Transposition) – Basics of Numbe theory.

CO6: Implement classical encryption techniques to secure communication and analyze their performance against common cryptographic attacks. (PDL2)

CO2: Implement symmetric and asymmetric cryptographic techniques to ensure data security. (CDL2) **L:10 P:8**

Stream and Block Ciphers – Modes of operation - Data Encryption Standard (DES) and Triple DES - Advanced Encryption Standard (AES) - RSA and Challenges with Large Key Sizes - Elliptic Curve Cryptography (ECC) – AES-GCM - Chinese Remainder theorem -distribution of Private key.

CO7: Demonstrate an understanding of symmetric and asymmetric cryptographic algorithms including their strength, weaknesses, and appropriate application. (PDL2)

CO3: Apply cryptographic techniques to ensure data integrity, secure communication, and authentication in network systems. (CDL2) **L:9 P:9**

Cryptographic Hash functions: Message Digest 5(MD5) – Secure Hash Algorithm (SHA512) – Message Authentication Code (MAC): HMAC – CMAC - Digital signatures - Diffie Hellman key Exchange - Authentication Applications: Kerberos-X.509 Authentication Service - Public key infrastructure.

CO8: Apply hash functions and authentication mechanisms to real-world scenarios to enhance security. (PDL2)

CO4: Utilize security techniques to detect and prevent network intrusions to provide a safe environment. (CDL1) **L:8**

TLS/SSL, S/MIME - IP Security - VPN Technologies: Next-Generation Firewalls (NGFW): Features and Capabilities - Network intrusion detection and prevention systems (NIDS/NIPS).

CO5: Identify and mitigate cyber threats through incident response strategies and secure coding practices. **L:8 P:5**

Types of Cyber threads – Phishing attacks-threat Intelligence and Incident Response – OWASP top 10 vulnerabilities- Common web vulnerabilities - Cross-site scripting (XSS), Cross-site request forgery (CSRF)-exploitations - Internal and external Risk-Ransomware - Threads and Attacks: Password Cracking – Keyloggers Spywares.

CO9: Analyze various cyber threats and develop effective incident response strategies to combat cyber threats. (PDL2)

TEXTBOOKS

1. William Stallings, "Cryptography and Network Security - Principles and Practice," 8th Edition, Pearson Education, 2024.
2. Johann Rehberger, "Cybersecurity Attacks - Red Team Strategies," 1st Edition, Packt Publishing, 2020.
3. Behrouz A. Forouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security," 3rd Edition, Tata McGraw Hill, 2016.

REFERENCES

1. Atul Kahate, "Cryptography and Network Security," 4th Edition, McGraw Hill Education, 2019.
2. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, "Security in Computing," 5th Edition, Pearson Education, 2015.
3. Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman. "An Introduction to Mathematical Cryptography," 2nd Edition, Springer, 2014.
4. Nina Godbole, Sunit Belapure "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives," 1st Edition, Wiley, 2011.

L:45; P:30; TOTAL:75 PERIODS

Course code	ARTIFICIAL INTELLIGENCE	L	T	P	E	C
23CS55C/ 23IT52C	(Common to CSE, IT degree Programmes)	3	0	2	0	4

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: apply the suitable agent strategy to solve a combinatorial problem (CDL1)
CO2: analyze the appropriate search algorithms for solving goal-oriented problems (CDL2)
CO3: build logical reasoning models using propositional and first order logic (CDL1)
CO4: analyze planning and acting principles with uncertainty in robot environments(CDL2)
CO5: apply emerging capabilities of AI based tools to automate tasks (CDL2)

Practical Components

CO6: develop solutions for AI problems using problem solving agents (PDL1)
CO7: apply various AI search strategies to solve goal-oriented problems (PDL1)
CO8: implement real time applications using probabilistic reasoning (PDL2)
CO9: design and develop a mini project using GPT-based AI tool for real world applications (PDL2)

CO1: apply the suitable agent strategy to solve a combinatorial problem **L:11,**
CO6: develop solutions for AI problems using problem solving agents **P:10**

Introduction to Intelligent Agents: Definition – Foundations of Artificial Intelligence – Future of Artificial Intelligence – Characteristics of Intelligent Agents. Typical Intelligent Agents – Problem Solving Approach to Typical AI problems - Search algorithms - Uninformed Search Strategies – Informed Search Strategies

Solve basic search strategies – 8-Puzzle, N-Queens problem. Implement BFS, DFS, A* algorithms

CO2: analyze the appropriate search algorithms for solving goal-oriented problems **L: 9,**
CO7: apply various AI search strategies to solve goal-oriented problems **P: 6**

Problem solving: Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games.

Solve constraint satisfaction problems. Implement Minmax algorithm for game playing (Alpha-Beta pruning).

CO3: build logical reasoning models using propositional and first order logic **L: 7**

Knowledge based agents – Propositional Logic– Propositional theorem proving-First order Logic: Representation – Syntax and Semantics – Inference in First order Logic: Unification-Forward Chaining – Backward Chaining – Resolution.

CO4: analyze planning and acting principles with uncertainty in robot environments **L: 9,**
CO8: implement real time applications using probabilistic reasoning **P: 6**

Preferences and Utility – One-off decisions – Sequential decisions – Value of Information and Control – Decision processes: Markov Decision Process (MDP) - Fully observable MDP – partially observable MDP

Implement decision tree for a delivery robot. Solve uncertainty using belief network.

CO5: apply emerging capabilities of AI based tools to automate tasks **L: 9;**
CO9: design and develop a mini project using GPT-based AI tool for real world applications **P: 8**

AI Concerns - AI Bias, Regulations, and Trustworthy AI – Ethical considerations of AI. Prompt Engineering: Five Principles of Prompting - GPT-based AI tool - Naive Prompting Approach – Persona pattern - Chain-of-Thought – Free-of-Thought.

Develop real time applications using GPT – based AI tools.

SOFTWARE REQUIREMENTS:

1. Python 3.7x/4.0, Jupiter NoteBook / Google Colab

TEXT BOOKS:

1. S.Russel, P.Norvig, "Artificial Intelligence - A Modern Approach", Pearson Education, New Delhi, 4th Edition, 2022.

REFERENCES:

1. David L. Poole, Alan K. Mackworth, "Artificial Intelligence - Foundations of Computational Agents", 3rd Edition, Cambridge University Press, 2023.
2. James Phoenix, Mike Taylor, "Prompt Engineering for Generative AI", 1st Edition, O'Reilly Media, 2024.
3. Paula Boddington, "AI Ethics: A Textbook (Artificial Intelligence: Foundations, Theory, and Algorithms)", 1st Edition, Springer Verlag, Singapore, 2023

L: 45; P: 30; TOTAL: 75 PERIODS

Course code		L	T	P	E	C
23CS54C/	**MODERN WEB TECHNOLOGIES**					
23IT53C	**(Common to CSE, IT degree Programmes)**	**1**	**0**	**2**	**4**	**4**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: build interactive and dynamic website using MVC architecture and DOM (CDL2)

CO2: design a modular and component-based application using React. (CDL 2)

CO3: apply Redux and styling frameworks to create user interfaces using React (CDL2)

CO4: build high performance and scalable web applications with Node.js (CDL2)

Practical Components

CO5: construct a dynamic webpage using HTML, CSS and javascript (PDL2)

CO6: design a client-side interactive application using React (PDL2)

CO7: develop and manage robust web applications using node.js (PDL2)

Experiential Component

CO8: design and develop a MERN Stack application for real world scenarios

Soft skill Component

CO9: cultivate effective communication, collaboration, and problem-solving skills to thrive in diverse professional settings

CO1: build interactive and dynamic website using MVC architecture and DOM

CO5: construct a dynamic webpage using HTML, CSS and javascript

MVC Architecture – Javascript: Datatypes – Control statements– Functions – Hoisting – Objects and Arrays – Array static and instance methods – Immutable arrays– Event handling– Form Validation – Document Object Model (DOM) – Arrow function - Promises – Async/Await – Modules. **L:6, P:6, E:4**

A simple application using forms – Design a client side interactive website.

CO2: design a modular and component-based application using React

CO6: design a client-side interactive application using React

Introduction to React – React DOM and Virtual DOM – JSX – Components: Functional and Class components – Components Lifecycle – Event Handling - React Hooks : useState, useEffect, and custom hooks **L:8, P:8, E:8**

Components and Prop – State Management – Hooks

CO3: apply Redux and styling frameworks to create user interfaces using React

CO6: design a client-side interactive application using React

Conditional rendering - List and Keys – Routing – Redux: State - Action - Reducers- Color Reducers – Sort Reducers – Store - Action Creators –Passing the store - API calls – Error Handling – Styling Frameworks **L:7, P:8, E:8**

Conditional rendering - Routing - API calls - Styling Frameworks

CO4: build high performance and scalable web applications with Node.js

CO7: develop and manage robust web applications using node.js

Introduction to Nodejs - Event driven Architecture – Event Loop – Modules - Node Package Manager (NPM) - Understanding callbacks –REST API architecture –Rest Methods - Introduction to Express framework –Server side rendering with Template engines – static files – Fetching JSON from Express.js – Mongo db – CRUD operation – **L:9, P:8, E:10**

Container – Docker.

Setup an Express.js application – Implement CRUD Operation using Mongo DB

TEXT BOOKS

1. Mario Casciaro and Luciano Mammino: Node.js Design Patterns, 3rdEdition, O'Reilly Media, 2022.
2. Alex Banks,Eve Porcello, Learning React – Modern Patterns for developing React apps, O'Reilly,2020, 2nd Edition

REFERENCE BOOKS

1. Paul Deitel, Harvey Dietel and Abbey deitel, "Internet and World Wide Web-How to Program", Prentice Hall, 5th Edition, 2018.

L:15; P:30; E:60; TOTAL: 105 PERIODS

23CS56C/ 23IT54C/ 23AD56C	**SIMULATION USING MODERN TOOLS (Common to CSE,IT& AIDS)**	**L**	**T**	**P**	**E**	**C**
		0	**0**	**2**	**2**	**2**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Practical Component:

CO1: apply appropriate simulation tools to address simple system dilemmas. (PDL2)

Experiential Component

CO2: simulate and validate models to solve real world problems using modern tools.(PDL3)

Soft skill Component:

CO3: communicate effectively and work collaboratively as a team to develop projects and present simulation findings.

COURSE OVERVIEW

This course helps students learn how to use simulation tools to understand and solve real-world problems in modern and emerging areas such as Computational Intelligence, Augmented and Virtual Reality (AR/VR), Blockchain Technology, Business Analytics, Internet of Things (IoT), Robotics Design, and Industrial AI. The course follows a hands-on, project-based approach where students gradually build their skills through exploration, experimentation, and application. Students will begin by exploring widely used simulation tools such as MATLAB, Simulink, Python libraries, and other domain-specific platforms. They will practice basic simulations using built-in templates to observe system behaviors and understand the fundamentals of modeling. These initial activities will help students become comfortable with tool functionalities and how different elements within a system interact. Once familiar with the tools, students will select a real-world problem aligned with their domain or interest. They will conduct a feasibility study to determine if simulation is a suitable approach, compare different tools based on key criteria (ease of use, performance, support), and design an initial model for the selected problem. Through instructor guidance and peer feedback, students will refine their model, incorporate real-world data, and validate their simulation results using appropriate metrics.

P:20; E:40; TOTAL:60 PERIODS

Course Code	MACHINE LEARNING	L	T	P	E	C
23IT61C		3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: explore the basic concepts and techniques of Machine Learning (CDL1)
CO2: apply supervised learning algorithms to perform classification (CDL2).
CO3: apply supervised learning algorithms to perform regression and tree – based models (CDL2)
CO4:implement unsupervised algorithms for different types of applications (CDL2)
CO5: apply neural network concepts and optimization techniques to enhance model performance (CDL2)

CO 1: explore the basic concepts and techniques of Machine Learning (CDL1) **L: 6**

Introduction to Machine Learning - Types of Machine learning - Applications - Advantages, Disadvantages - Challenges. Design a Learning System - Concept Learning – Hypothesis space. Training, Testing, Validation Sets – Generalization - Over fitting, Under fitting - Bias and Variance. Different Performance Measures: Accuracy, Confusion Matrix, ROC.

CO2: apply supervised learning algorithms to perform classification (CDL2) **L:10**

Probability and Bayes learning - Naive Bayes Classification – Support Vector Machines - K nearest Neighbour Learning.

CO 3: apply supervised learning algorithms to perform regression and tree – based models (CDL2) **L:10**

Linear Regression - Multivariate Regression - Logistic Regression - Learning with Trees - Decision Trees - ID3 - CART -Boosting - Bagging - Random Forests.

CO 4: implement unsupervised algorithms for different types of applications (CDL2) **L: 10**

Clustering Algorithms: Partitional Clustering - Hierarchical Clustering - Density based Clustering - Cluster Validity - Self Organizing Feature Map - Dimensionality Reduction: Principal Component Analysis (PCA) - Linear Discriminant Analysis (LDA) - Expectation Maximization algorithm.

CO5: apply neural network concepts and optimization techniques to enhance model performance (CDL2) **L: 9**

Introduction to Neural Networks – training a multilayer network - Loss functions- activation functions- Optimizers: Gradient Descent,stochastic gradient descent - hyperparameter tuning, batch normalization, regularization, dropout.

TEXT BOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, CRC, Press, 2014.

REFERENCE BOOKS

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition, 2018
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine

Learning", 2nd Edition, MIT Press, 2018.
4. Charu C. Aggarwal,"Neural Networks and Deep Learning: A Textbook"Springer Nature; 2nd Edition, 2024.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23IT62C	**CLOUD COMPUTING**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: explore the core concepts, models, and key applications of cloud computing. (CDL1)

CO2: apply virtualization techniques to assess resource utilization and service delivery in cloudcomputing systems. (CDL1)

CO3: analyze infrastructure services and apply strategies for efficient cloud resource management.(CDL2)

CO4: evaluate platform and software services for application development and delivery. (CDL2)

CO5: apply cloud security measures for efficient cloud application. (CDL2)

CO 1: explore the core concepts, models, and benefits of cloud computing **L:9**

Definition of Cloud Computing – Evolution of Cloud Computing – Characteristics of Cloud – Benefits and Challenges – Cloud Computing Service Models: IaaS, PaaS, SaaS – Deployment Models: Public, Private, Hybrid,Ploy, Multi cloud- Community – Cloud Architecture and Components – Key Use Cases: Business, Research, Education.

CO2:apply virtualization techniques to assess their role in optimizing resource utilization and service delivery in cloud computing systems. **L:9**

Virtualization Concepts – Types of Virtualization – Virtual Machines – Hypervisors: Bare Metal and Hosted – Storage Virtualization – Network Virtualization – Cloud Resource Provisioning and Management – Multi-tenancy and Isolation – Scalability and Elasticity in Cloud – Cloud Standards and Protocols (SOAP, REST, JSON).

CO3:analyze infrastructure services and apply strategies for efficient cloud resource management **L:9**

IaaS Providers Overview – Virtual Machine Lifecycle – VM Provisioning and Configuration – Load Balancing Techniques – Auto-Scaling Mechanisms – Storage Solutions in Cloud (Block, Object, File) – Disaster Recovery and Backup Strategies – Cost Optimization and Billing Models

CO4: evaluate platform and software services for application development and delivery. **L:9**

PaaS Fundamentals – Application Development Platforms – Development Tools and Frameworks – Database as a Service (DBaaS) – SaaS Delivery Models – Licensing and Pricing Models – Benefits and Limitations of SaaS – MBaaS-Firebase-Anaka- Docker (Mobile Backend as a Service) – Case Study: Microsoft Azure PaaS, Google App Engine, Salesforce, Building a Scalable Mobile Health App Using Firebase, Anaka, and Docker.

CO5:apply cloud security measures, manage risks, and enforce governance policies to maintain secure and compliant cloud systems. **L:9**

Security Challenges in the Cloud – Cloud Threats and Vulnerabilities – Data Confidentiality, Integrity and Availability – Data Protection Techniques – Identity and Access Management (IAM) – Security Policies and Compliance – SLA (Service Level Agreements) Management – Cloud Governance – Emerging Trends: Serverless Computing, Edge Computing, Cloud Native Development.

TEXT BOOKS

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture,2nd Edition, Prentice Hall, 2023.
2. Rajkumar Buyya, James Broberg, Andrzej Goscinski, Mastering Cloud Computing, 2nd Edition, Wiley,2024.

REFERENCE BOOKS

1. Judith Hurwitz, Marcia Kaufman, Fern Halper, Robin Bloor, Cloud Computing For Dummies, 2nd Edition, Wiley, 2020.
2. Dan C. Marinescu, Cloud Computing: Theory and Practice, Morgan Kaufmann, 3rd Edition, 2022.
3. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st Edition, 2020.

L: 45; TOTAL: 45 PERIODS

Course Code	**ESSENTIALS OF MOBILE APPDEVELOPMENT**	**L**	**T**	**P**	**E**	**C**
23IT64C		**3**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

Theory Component

CO1:examine mobile application architecture and android development tools for building customized
applications (CDL1)

CO2:design intuitive and responsive user interfaces using material design principles (CDL2)

CO3:integrate mobile apps with REST APIs and various backend data services for dynamic content management (CDL2)

CO4:utilize device features like camera, location, notifications, and implement asynchronous tasks (CDL2)

Practical Component

CO5: design and develop functional Android user interfaces and layouts using Android development tools(PDL2)

CO6:build and test robust cross-platform mobile apps using React Native and native Android APIs (PDL2)

CO1:explore mobile application architecture and Android development tools for building customized applications **L:9 P:6**

Mobile App Development Overview – Native Cross-platform - Android Architecture, Lifecycle, and Tools - Introduction to Android Studio and Kotlin Basics - Kotlin:

Variables, Control Flow, OOP Concepts- Kotlin (KMP)- Android Project Structure, Gradle, and Build Process – APK Versioning - Design and implement a single-screen Android app using Kotlin and Android UI components.

CO5: design and develop functional Android user interfaces and layouts using Androiddevelopment tools

Use Kotlin control flow statements (if-else, when, loops) to create interactive app logic responding to user actions.

CO2:design intuitive and responsive user interfaces using Material Design principles **L:12 P:7**

UI/UX Principles and Material Design Standards - Jetpack Compose: Composable, Modifiers, State - Layouts: Column, Row,Scaffold,LazyColumn-Forms: TextField, Button, CheckBox, RadioButton, Dropdown- Input Components, Navigation, and Theming -Error Handling -Event Handling and Recomposition- Material Design Colors, Typography, Shapes.

CO5: design and develop functional Android user interfaces and layouts using Android development tools

Create a dynamic UI for a product catalog screen using Compose, with filtering options and responsive layouts.

CO3:integrate mobile apps with REST APIs and various backend data services for dynamic content management **L:12 P:8**

Local Storage: SharedPreferences, Room DB (with DAO &ViewModel)- JSON Parsing, API Consumption using Retrofit,Coroutines- Integration with backend services: Flask (Python), Express (Node.js)- Introduction to SQLite access via APIs - Build an app that fetches and stores data via REST API.

CO6: build and test robust cross-platform mobile apps using React Native and native Android APIs

Asynchronous data handling with coroutines – Node.js Express as backend and stores data in SQLite

CO4:utilize device features like camera, location, notifications, and implement asynchronous tasks **L:12 P:9**

Accessing Device Features: Camera, Location (Fused API), Sensors - Permissions (runtime), Notifications, File I/O- Multithreading with Coroutines - Debugging & Performance Optimization Tools- Unit Testing with JUnit, UI Testing with Espresso - App Signing, Versioning, ProGuard, Obfuscation - Publishing to Google Play Store.

CO6: build and test robust cross-platform mobile apps using React Native and native Android APIs

API with push notifications – real world mobile applications development – test application.

TEXT BOOKS

1. Neil Smyth, “Android Studio Development Essentials – Kotlin”, 1st Edition, Techotopia, 2023.
2. Mark L. Murphy, “The Busy Coder’s Guide to Android Development”, CommonsWare,3rd Edition, 2019.

REFERENCES

1. Valentino Lee, Heather Schneider, Robbie Schell, "Mobile ApplicationDevelopment: Android and iOS", 2nd Edition, McGraw-Hill Education, 2023.
2. Reto Meier & Ian Lake, “Professional Android”, Wiley,4th Edition, 2022.
3. Bonnie Eisenman, “Learning React Native”, 2nd Edition,O'Reilly Media,2020.

4. Bill Phillips, Chris Stewart, Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", 4th Edition, Pearson, 2019.

L: 45; P: 30; TOTAL:75 PERIODS

Course Code	MACHINE LEARNING LABORATORY	L	T	P	E	C
23IT66C		0	0	4	0	2

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

Practical Component

CO1:Apply fundamental machine learning algorithms to analyze and interpret data. (PDL2)

CO2: Design and implement advanced machine learning models to solve real-world problems. (PDL3)

CO1: Apply fundamental machine learning algorithms to analyze and interpret data. (PDL2) **P:20**

1. Apply supervised learning algorithms to perform classification using Naive Bayes Classification.
2. Implement KNN and experiment with different values of K on a classification dataset.
3. Implement Support Vector Machine for Classification
4. Implement and visualize decision trees using ID3 and CART algorithms.
5. Apply supervised learning algorithms for regression.

CO2: Design and implement advanced machine learning models to solve real-world problems. (PDL3) **P:40**

1. Apply PCA for dimensionality reduction and visualize the results.
2. Apply LDA for dimensionality reduction and classification.
3. Design and implement a Multilayer Perceptron (MLP) neural network on the real-world dataset.
4. Mini Project.

Software Requirements

- Software: Jupiter Notebook – Anaconda, Google Colab

TEXT BOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, CRC, Press, 2014.

REFERENCE BOOKS

1. Charu C. Aggarwal,"Neural Networks and Deep Learning: A Textbook"Springer Nature; 2ndEdition, 2024.
2. Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning: An Introduction", 2nd Edition, 2018.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", 2nd Edition, MIT Press, 2018.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.

P :60; TOTAL : 60 PERIODS

Course Code	CLOUD COMPUTING LABORATORY	L	T	P	E	C
23IT67C		0	0	2	0	1

COURSE OUTCOMES:

Upon the successful completion of the course, the student will be able to

CO1: configure and manage virtualized cloud infrastructure. (PDL1)

CO2: develop, deploy, and secure cloud applications on public and private platforms. (PDL2)

List of Experiments **P :10**

CO1: configure and manage virtualized and cloud infrastructure (PDL1)

1. Configure OpenStack for Private Cloud Deployment (using DevStack)
2. Create and Manage Virtual Machines using VirtualBox.
3. Configure and Operate KVM Hypervisor for Bare-Metal Virtualization
4. Implement Load Balancing Between Web Servers using HAProxy
5. Configure Auto-Scaling in Docker Swarm to Manage Service Scaling Dynamically.
6. Deploy and Access Cloud Storage Services using MinIO.

CO2: develop, deploy, and secure cloud applications on public and private platforms (PDL2) **P :20**

7. Host a Web Application on GCP Free Tier or OpenShift
8. Deploy a Cloud-Native Application using Heroku Platform-as-a-Service (PaaS)
9. Create and Use Managed Database Services (DBaaS) with PostgreSQL or MySQL on a Cloud Platform.
10. Configure Identity and Access Management (IAM) and Perform Security Analysis using OWASP ZAP.

P :30; TOTAL :30 PERIODS

Course code	BLOCKCHAIN ARCHITECTURE AND DESIGN	L	T	P	E	C
23CS01E/ 23IT01E/ 23AD01E	(Common to CSE, IT and AI & DS degree Programmes)	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: analyze cryptographic primitives and their roles in ensuring blockchain security. (CDL2)

CO2: evaluate Bitcoin's transaction lifecycle and the Proof of Work consensus mechanism for securing the network. (CDL2)

CO3: develop Ethereum smart contracts and token standards, including their role in the mining process.(CDL2)

CO4: analyze various consensus mechanisms in permissioned blockchains for their effectiveness and applicability. (CDL2)

CO5: develop blockchain solutions using Hyperledger frameworks, focusing on enterprise applications. (CDL2)

CO1: analyze cryptographic primitives and their roles in ensuring blockchain security.

Cryptographic Hash Function - Properties of Hash Function – Digital Signature – Blockchain: Introduction – Types of Blockchain - Block in a Blockchain: Structure of a Block – Block Header – Transactions in a Block - Hash Pointer – Merkle Tree - Blockchain as a Hash chain – Accepting the longest chain – Orphaned Blocks – Blockchain Forks – UTXO and Account/Balance Models **L:9**

CO2: evaluate Bitcoin's transaction lifecycle and the Proof of Work consensus mechanism for securing the network.

Basics - History – Technology behind Bitcoin – Bitcoin Transaction Life Cycle - Creation of Coins – Sending Payments - Transaction in Bitcoin Network – Double Spending - Bitcoin Scripts - Hashcash PoW - Consensus in Bitcoin: Proof of Work (PoW) – Mining in a Bitcoin network - Mining difficulty - Bitcoin Wallets. **L:9**

CO3: develop Ethereum smart contracts and token standards, including their role in the mining process.

Ethereum Blockchain - Ethereum Virtual Machine - Ethereum Accounts - Transactions in Ethereum - Ethereum Wallets - Ethereum Gas - Gas Price - Gas Limit - Mining in Ethereum - Ether Tokens – ERC 20 - Ethereum Improvement Proposals (EIP) **L:9**

CO4: analyze various consensus mechanisms in permissioned blockchains for their effectiveness and applicability.

Basics - Consensus - State Machine Replication - Distributed Consensus - Consensus Algorithms - PAXOS - RAFT - Byzantine General Problem - Practical Byzantine Fault Tolerance. **L:9**

CO5: develop blockchain solutions using Hyperledger frameworks, focusing on enterprise applications.

Introduction to Hyperledger - Hyperledger frameworks - Hyperledger Fabric Architecture - Hyperledger fabric transaction flow - Chaincode in Hyperledger Fabric - Hyperledger Composer - Hyperledger Indy

TEXT BOOKS:

1. Kumar Saurabh, Ashutosh Saxena, “Blockchain Technology concepts and applications”, Wiley. 2020.
2. Caitlin Long, Antony Lewis, “The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them”, Mango Media, 2020.

REFERENCE BOOKS:

1. Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the open blockchain”, 2nd Release, 2017.
2. Andreas M. Antonopoulos and Wood M., “Mastering Ethereum: Building Smart Contracts and DApps”, O'Reilly Media, 2018.
3. Xun (Brian) Wu, Chuanfeng Zhang, and Andrew Zhang, “Hyperledger Cookbook: Over 40 recipes implementing the latest Hyperledger blockchain frameworks and tools”, Packt Publishing, 2019.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, Kindle Edition, 2016.

5. Imran. Bashir. Mastering block chain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained. Packt Publishing, 2nd Edition, 2018.
6. Roger Wattenhofer, "The Science of the Blockchain, 1st Edition, Inverted Forest Publishing, 2016.

L: 45; TOTAL: 45 PERIODS

Course Code	SMART CONTRACT AND DAPP	L	T	P	E	C
23IT02E/ 23CS02E/ 23AD02E	(Common to CSE, IT and AI & DS degree Programmes)	2	0	2	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components:

CO1: apply blockchain terminologies and concepts to effectively design and implement smart contract solutions. (CDL1)

CO2: design and develop efficient smart contracts for decentralized application through utilizing Ethereum's higher-level programming languages. (CDL2)

CO3:implement and deploy Solidity smart contracts, using key language constructs and leveraging development tools like IDEs and compilers.(CDL2)

CO4:write, deploy, and evaluate smart contracts, considering factors like cost, performance, and appropriate blockchain platform selection.(CDL2)

CO5:design, develop, and deploy decentralized applications (DApps) within a private blockchain network environment.(CDL2)

Practical Components:

CO6: develop, deploy, and interact with Ethereum smart contracts using Solidity (PDL2)

CO7: write, deploy, and manage smart contracts, and assess the cost and efficiency of running smart contracts on various blockchain platforms. (PDL2)

CO8: configure and deploy DApps in a private blockchain environment. (PDL2)

CO1: apply blockchain terminologies and concepts to effectively design and implement smart contract solutions. **L:6 P:3**

Introduction to Smart Contracts- Definitions – Features - Life Cycle - Smart Contract execution- Virtual Machine of a Block chain- Source code of a Smart Contract- Wallets – Types – Wallets interaction with Blockchains - Useful Terminologies

CO6: develop, deploy, and interact with Ethereum smart contracts using Solidity.

Write a simple smart contract - Deploy the contract on a testnet - Interact with the deployed smart contract using a wallet (e.g., MetaMask)

CO2: design and develop efficient smart contracts for decentralized application through utilizing Ethereum's higher-level programming languages. **L:6 P:6**

Ethereum Smart Contracts - Ethereum Higher-Level Languages -Developing Smart Contracts - The Solidity language: An object-oriented, high-level language for implementing smart contract - Designing a Solidity Smart Contract- Ether and Gas – Mining Ethereum.

CO6: develop, deploy, and interact with Ethereum smart contracts using Solidity.

Smart contract for transferring Ether between two accounts - Solidity contract that implements a simple auction system - Identify the gas feesinvolved in the contract execution.

CO3: implement and deploy Solidity smart contracts, using key language constructs and leveraging development tools like IDEs and compilers. **L:6 P:6**

Solidity – Contracts- Constructors – Functions- Variables-Getters – Setters- Arrays - Memory vs Storage - Mappings in Solidity – Structs - Error Handling and Restrictions – Libraries - Global Variables - Abstract Contracts – Inheritance- Interfaces-Events Installing Solidity - Solc Compiler - Ethereum Contract Application Binary Interface - Remix-IDE for Smart Contract Development.

CO6: develop, deploy, and interact with Ethereum smart contracts using Solidity.

Write a Solidity contract that implements constructor, arrays, mappings, structs, libraries and error handling

CO4: write, deploy, and evaluate smart contracts, considering factors like cost, performance, and appropriate blockchain platform selection. **L:6 P:6**

Smart Contract programming languages - Execution Environments - Environment Setup for Truffle and Ganache - Truffle Project Creation - Writing Smart Contracts - Developing Smart Contract - Programmer's responsibility - Cost of running smart Contracts - Smart Contract development platforms

CO7: write, deploy, and manage smart contracts, and assess the cost and efficiency of running smart contracts on various blockchain platforms.

Deploying the smart contract with Truffle and Ganache- Interacting with the deployed contract–Estimate the cost of running smart contracts

CO5:design, develop, and deploy decentralized applications (DApps) within a private blockchain network environment. **L:6 P:9**

DApp – Metamask - Setting up a Private Ethereum Network: Install go-etherum – Create geth Data directory – Create a geth account – create genesis.json configuration File – Run the first Node of the Private Network – Run the second node of the Network – Creating Smart Contract – Deploying the Smart Contract – Client Application.

CO8: configure and deploy DApps in a private blockchain environment.

Setting up a private Ethereum network using geth - Running and connecting two nodes - Interacting with the network using Metamask - Creating a DApp to interact with the private Ethereum network

TEXT BOOKS:

1. Ritesh Modi, "Solidity Programming Essentials", 2nd Edition, Packt Publishing, 2022.
2. Gavin Zheng, Longxiang Gao, Liqun Huang, Jian Guan, "Ethereum Smart Contract Development in Solidity", Springer Verlag Publisher, 2020.
3. Andreas Antonopoulos and Gavin Wood, "Mastering Ethereum: Building Smart Contracts and Dapps", Shroff /O′Reilly Publisher, 2018
4. Michael J. Casey and Paul Vigna, "The Truth Machine: The Blockchain and the Future of Everything", Kindle Edition,St. Martin's Press, 2018.

REFERENCE BOOKS:

1. Kevin Solorio, Randall Kanna, David Hoover, "Hands-On Smart Contract Development with Solidity and Ethereum: From Fundamentals to Deployment", 1st Edition, Shroff /

O'Reilly Publisher, 2019.
2. Wei-Meng Lee, "Beginning Ethereum Smart Contracts Programming", 2nd Edition, Apress, 2023

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	ADVANCED ETHEREUM	L	T	P	E	C
23CS03E/ 23IT03E/ 23AD03E	(Common to CSE, IT and AI & DS degree Programmes)	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Demonstrate understanding of Ethereum's upgrade history and architecture by explaining the Ethereum 2.0 roadmap, finality mechanisms, and Layer 2 scalability solutions. (CDL1)
CO2: Analyze the execution layer of Ethereum's Proof of Stake by explaining the functioning of Engine API, DevP2P networking and Ethereum standards. (CDL2)
CO3: Analyze the consensus and validation layer of Ethereum's Proof-of-Stake by analyzing the fork choice rules, validator roles, and the functions of consensus clients. (CDL2)
CO4: Demonstrate understanding of smart contract security vulnerabilities by referencing real-world incidents and applying best practices. (CDL1)

CO1: Demonstrate understanding of Ethereum's upgrade history and architecture by explaining the Ethereum 2.0 roadmap, finality mechanisms, and Layer 2 scalability solutions. **L:12**

Ethereum Hard Forks and Upgrade History - Ethereum 2.0 Roadmap: Phases and Goals - Finalization: Checkpoints, Supermajority Link, Justification, Finality - Epochs and Slots: Concepts and Purpose - Maximal Extractable Value (MEV): Risks and Implications - Types of Ethereum Nodes: Archive, Full Node, Snap Node - Beacon Chain Overview – Rollups

CO2: Analyze the execution layer of Ethereum's Proof of Stake by explaining the functioning of Engine API, DevP2P networking and Ethereum standards **L:11**

Ethereum Virtual Machine (EVM): Architecture and Functioning - Gossip Protocols - DevP2P Networking - Engine API: Execution - Consensus Layer Communication - Ethereum Transaction Lifecycle - Ethereum Standards: EIPs (Ethereum Improvement Proposals) - ERC (Ethereum Request for Comments) Standards

CO3: Analyze the consensus and validation layer of Ethereum's Proof-of-Stake by analyzing the fork choice rules, validator roles, and the functions of consensus clients. **L:12**

GASPER Fork Choice Rule: Overview and Importance - Casper FFG - LMD GHOST - Consensus Clients: Prysm, Lighthouse - LibP2P Networking - Validator Clients: Roles and Responsibilities – RANDAO Algorithm - Attestations: Purpose and Process - Slashing Mechanisms: Conditions and Implications

CO4: Demonstrate understanding of smart contract security vulnerabilities by referencing real-world incidents and applying best practices. **L:10**

Security Vulnerabilities in Smart Contracts : Reentrancy Attacks, Integer Overflow/Underflow, Front-running - Mainnet Incidents and Case Studies - Security Best Practices in Solidity - Bug Bounty Platforms and Responsible Disclosure

REFERENCE BOOKS

1. Ben Edgington, "Upgrading Ethereum A technical handbook on Ethereum's move to proof of stake and beyond", 3rd Edition, Capella Publisher, 2025.
2. Vitalik Buterin. "Proof of Stake: The Making of Ethereum and the Philosophy of Blockchains", 1st Edition, Seven Stories Press, 2022.
3. Andreas M. Antonopoulos, Gavin Wood, "Mastering Ethereum: Building Smart Contracts and DApps", 1st Edition, O'Reilly Media, 2018.
4. Bruno Skvorc, Mateja Kendel, David Attard, Mislav Javor, Tonino Jankov, Chris Ward, "A Developer's Guide to Ethereum", 1st Edition, SitePoint Publisher, 2018.

L:45 ;TOTAL:45 PERIODS

Course Code	PERMISSIONED BLOCKCHAIN	L	T	P	E	C
23CS05E/ 23IT05E/ 23AD05E	(Common to CSE, IT and AI & DS degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Demonstrate an understanding of Hyperledger Fabric architecture and components, and execute transaction flows across single and multi-channel networks (CDL2)

CO2: Execute Hyperledger Fabric Chaincode using Go programming constructs and apply it to real-world use cases (CDL2)

CO3: Demonstrate a Hyperledger Fabric business network by defining various components and generating required certificates and artifacts (CDL2)

CO4: Demonstrate the decentralized identity management concepts using Hyperledger Aries and Indy (CDL2)

Practical Component

CO5: Develop a Hyperledger Fabric network, deploy Chaincode, and connect the DApp frontend to the Fabric network for transaction processing (PDL2)

CO6: Develop a local Aries and Indy network and register a Decentralized Identifiers on the Aries and Indy network (PDL2)

CO1: **Demonstrate an understanding of Hyperledger Fabric architecture and components, and execute transaction flows across single and multi-channel networks** **L:8 P:6**

Introduction to Hyperledger - Hyperledger Fabric: Architecture – Peers – Ledger – Assets – Ordering Service - Channels - Kafka Consensus - Certificate Authority - Events - Certificate Authority - Membership Service Provider – Transaction Flow – Single Channel Network – Multi-Channel Network – Membership and Identity Management – Endorsement Policies – New User Registration and Enrollment

CO5:Develop a Hyperledger Fabric network, deploy Chaincode, and connect the DApp frontend to the Fabric network for transaction processing

Setup and build a Hyperledger Fabric network using Docker Compose, CLI and SDK.

CO2:Execute Hyperledger Fabric Chaincode using Go programming constructs and apply it to real-world use cases **L:8 P:9**

Go Programming Language: Introduction – Fundamentals – Control Statements - Functions & Methods - Structure - Arrays - Slices –Strings - Pointers - Concurrency - Chaincode: Introduction - Lifecycle - Chaincode vs Smart Contract - Chaincode API - System Chaincode - Collections - RICH queries – Chaincodeusecases: Supply Chain

CO5:Develop a Hyperledger Fabric network, deploy Chaincode, and connect the DApp frontend to the Fabric network for transaction processing

Develop and deploy simple Chaincode - Implement access control policies using collections - Perform RICH queries on ledger data stored in CouchDB.

CO3: Demonstrate a Hyperledger Fabric business network by defining various components and generating required certificates and artifacts **L:8 P:9**

Designing a business network structure - Define organizations - Identifying participants - Channel name identification - Rule definition – Generate certificates using cryptogen and Fabric CA - Certificate expiry - Generate channel artifacts - Creating genesis block - Creating channel - Creating anchor peers - Setting up ordering node - Create peer nodes - Deploying Chaincodes on Fabric network – DApp development usecases: Supply chain, Enterprise workflows

CO5:Develop a Hyperledger Fabric network, deploy Chaincode, and connect the DApp frontend to the Fabric network for transaction processing

Build frontend of DApps using React - Connect the frontend of DApp to the Hyperledger Fabric blockchain - Communication for data retrieval and transaction processing

CO4:Demonstrate the decentralized identity management concepts using Hyperledger Aries and Indy **L:6 P:6**

Decentralized Identity Management - Self-Sovereignty Identity - Hyperledger Aries: Introduction - Architecture - Hyperledger Indy: Introduction - Architecture – Decentralized Identifiers (DIDs) - Verifiable Credentials: Issuing and verifying credentials, Zero Knowledge Proofs - Creating and managing DIDs - Amazon managed blockchain service

CO6: Develop a local Aries and Indy network and register a Decentralized Identifiers on the Aries and Indy network

Build a local Aries and Indy network - Create and register a DID and Credentials on a local Aries and Indy network.

REFERENCE BOOKS

1. Nitin Gaur, Luc Desrosiers, Venkatraman Ramakrishna, Petr Novotny, Salman A. Baset, Anthony O'Dowd, "Blockchain with Hyperledger Fabric", 2nd Edition, Packt. Publishers, 2020.
2. Nakul Shah, "Blockchain for Business with Hyperledger Fabric: A complete guide to enterprise Blockchain implementation using Hyperledger Fabric", 1st Edition, BPB Publications, 2019

3. Bhagvan Kommadi, "Go Lang in Depth: Guide to program microservices, networking, database and APIs using Go Lang",1st Edition, BPB Publications, 2024

L: 30 P: 30 TOTAL: 60 PERIODS

Course Code	MINI - CAPSTONE PROJECT	L	T	P	E	C
23CS09E/ 23IT09E/ 23AD09E	(Common to CSE, IT and AI & DS degree Programmes)	0	0	0	6	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: analyze real-world problems that can be addressed using blockchain technology, and formulate an appropriate project proposal. (PDL2)

CO2: design blockchain system architecture by selecting suitable platforms and defining smart contract logic aligned with project objectives. (PDL2)

CO3: develop and deploy smart contracts on blockchain test networks using industry-standard tools and frameworks. (PDL2)

CO4: integrate blockchain-based smart contracts with decentralized applications (DApps) using Web3 technologies and demonstrate end-to-end functionality. (PDL2)

Softskill component

demonstrate and defend the completed blockchain project through technical discussions, comprehensive reporting, and viva-voce.

CO1: analyze real-world problems that can be addressed using blockchain technology, and formulate an appropriate project proposal. (PDL2)

Module 1: Introduction & Project Ideation — **E:15**

1. Overview of Blockchain project types:
   - Cryptocurrency
   - NFT platforms
   - Supply chain tracking
   - Healthcare records
   - Voting systems
2. Brainstorming real-world problems
3. Finalizing project title & scope
4. Submission of Project Proposal and Problem Statement

Deliverable: Guide approved project proposal document.

CO2: design blockchain system architecture by selecting suitable platforms and defining smart contract logic aligned with project objectives. (PDL2)

Module 2: Blockchain Design & Architecture — **E:20**

1. Public vs private blockchains
2. Choosing a blockchain platform:
   - Ethereum
   - Hyperledger Fabric
   - Corda
3. Smart contract design basics

4. Data models: on-chain vs off-chain

Deliverable: Project Architecture & Technology Stack document.

Module 3: Smart Contract Development — **E:20**

1. Writing smart contracts using Solidity or Chaincode
2. Deployment on testnets (e.g., Ropsten, Mumbai, Sepolia)
3. Security best practices (reentrancy, overflows, access control)
4. Tools:
   - Remix, Truffle, Hardhat, Ganache
   - Block explorers: Etherscan, Polygonscan

Deliverables:

- Smart contract code
- Deployed contract addresses

CO3: develop and deploy smart contracts on blockchain test networks using industry-standard tools and frameworks. (PDL2)

Module 4: DApp Frontend & Integration — **E:20**

- Building user interface (React, Next.js, or simple HTML/JS)
- Integrating with blockchain via Web3.js or Ethers.js
- Using wallets (Metamask)
- Backend API (if off-chain data involved)
- IPFS/Pinata for file storage (for NFTs or documents)

Deliverable: Working DApp connected to deployed smart contract.

Module 5: Final Demo & Report Submission — **E:15**

- Live demonstration (functional DApp)
- Project Report
- Code repository (GitHub)
- Optional: Publish smart contract on Etherscan

Deliverables:

- Live demo session
- Project report
- Code submission

E: 90; TOTAL: 90 PERIODS

Course code		L	T	P	E	C
23CS11E/ 23IT11E/ 23AD11E	**WEB FRAMEWORKS USING PYTHON** (Common to CSE, IT and AI & DS degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: demonstrate the use of Django's core programming constructs to design and implement structured solutions. (CDL1)

CO2: apply MVC architecture and CRUD opeartions of Django to develop simple applications. (CDL2)

CO3: design and develop UI for dynamic web applications using Flask. (CDL2)

CO4: analyze and implement data management strategies in Flask applications. (CDL2)

Practical Components

CO5: develop applications using Django for real-world scenarios. (PDL2)
CO6: develop applications using Flask for real-world scenarios. (PDL2)

CO1: demonstrate the use of Django's core programming constructs to design and implement structured solutions.

Working with APIs: RESTful architecture - Request library. Developer Tools and SQL: Assert statements **L: 7,**

Web development using Django: Models – Basic data access – Forms; Getting data from the Request object - Custom Views- GET and POST methods -URL shortener -User model -Logic in templates – Static files **P: 6**

CO2: apply MVC architecture and CRUD opeartions of Django to develop simple applications.

CO5: develop applications using Django for real-world scenarios.

MVC and MTV architecture in Django – Core files of Django -Object-Relational Mapping - CRUD operations using Django's ORM - JSON Building- Filtering Models -Working with Images- Authentication with tokens- Postman- Content types app **L: 8, P: 8**

Develop applications using CRUD operations and JSON objects using Django.

CO3: design and develop UI for dynamic web applications using Flask

CO6: develop applications using Flask for real-world scenarios.

Flask Fundamentals – Back-End Web Development using Flask – URL Routing – Rendering Templates – Static Files: Document Object Model – CSS and DOM – HTTP Objects: Request and Response Object – Web Forms – Redirects and User session – Cookies – Sessions. **L: 8, P: 8**

Build simple web page using Flask Core programming constructs.

CO4: analyze and implement data management strategies in Flask applications.

CO6: develop applications using Flask for real-world scenarios.

Databases – Python Database frameworks – Object Relational Model – Flask-SQLAlchemy – CRUD operations – NoSQL Databases – Flask-PyMongo – Integrating Email with application – Web API with Flask – Deploying Flask App. **L: 7, P: 8**

Develop applications using CRUD operations and JSON objects using Flask.

TEXT BOOKS:

1. W. S. Vincent, *Django for Professionals*, 1st Edition, Still River Press, 2022.
2. M. Lathkar, *Building Web Apps with Python and Flask, 1stEdition paperback, BPB Publications, 2021.

REFERENCES:

1. Nigel George, "Mastering Django: Core", 1st Edition Packt, 2016
2. Miguel Grinberg, "Flask Web Development", 2nd Edition, O'Reilly Media, Inc., 2018

L:30; P:30; TOTAL: 60 PERIODS

Course code	NO SQL DATABASES	L	T	P	E	C
23CS12E/ 23IT12E/ 23AD12E	(Common to CSE, IT and AI & DS degree Programmes)	3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: explore NoSQL databases, focusing on scalability, efficiency, and data challenges compared to relational databases. (CDL1)

CO2: apply replication, sharding, and distribution models to balance consistency, durability, and performance in databases. (CDL1)

CO3: apply document-oriented databases to address real-world challenges in e-commerce, content management, and real-time analytics.(CDL2)

CO4: develop solutions using column-oriented NoSQL databases, focusing on scalability, consistency, and real-world applications. (CDL2)

CO5:apply graph databases to develop scalable solutions for recommendation engines and location-based services. (CDL1)

CO1: explore NoSQL databases, focusing on scalability, efficiency, and data challenges compared to relational databases.

NoSQL Databases -Value of Relational Databases- Getting at Persistent Data – Concurrency – Integration - Impedance Mismatch- Application and Integration Databases - Attack of the Clusters -Emergence of NoSQL- Aggregate Data Models: Consequences of Aggregate Orientation- Key-Value and Document Data Models, Column-Family Stores- Aggregate-Oriented Databases. **L: 10**

CO2: apply replication, sharding, and distribution models to balance consistency, durability, and performance in databases.

Replication and sharding- MapReduce on databases - Distribution Models - Single Server – Sharding- Master-Slave Replication- Peer-to-Peer Replication- Combining Sharding and Replication- Consistency - The CAP Theorem- Relaxing Durability- Quorums. **L: 9**

CO3: apply document-oriented databases to address real-world challenges ine-commerce, content management, and real-time analytics.

NoSQL Key/Value databases using MongoDB - Document Databases - Document oriented Database Features: Consistency, Transactions, Availability, Query Features –Scaling - Suitable Use Cases: Event Logging, Content Management Systems, Blogging Platforms, Real-Time Analytics, E-Commerce Applications, Complex Transactions Spanning Different Operations, Queries against Varying Aggregate Structure **L: 9**

CO4: develop solutions using column-oriented NoSQL databases, focusing on scalability, consistency, and real-world applications.

Column- oriented NoSQL databases using Apache HBASE, Column-oriented NoSQL databases using Apache Cassandra, Architecture of HBASE, Column-Family Data Store Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Event Logging, Content Management Systems, Blogging Platforms, Counters, Expiring Usage. **L: 9**

CO5:apply graph databases to develop scalable solutions for recommendation engines and location-based services.

Graph Databases: Features, Consistency, Transactions, Availability, Query Features, Scaling, Suitable Use Cases, Connected Data, Routing, Dispatch, and Location-Based Services, Recommendation Engines. **L: 8**

TEXT BOOKS:

1. Sadalage, P. & Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Wiley Publications, 1st Edition,2019.
2. Adam Fowler, "NoSQL for Dummies", Wiley Publications, 2nd Edition, 2020.

REFERENCE BOOKS:

1. Dan Sullivan, "NoSQL For Mere Mortals", 2nd Edition, Addison-Wesley, 2021.
2. Dan McCreary and Ann Kelly, "Making Sense of NoSQL: A Guide for Managers and the Rest of Us", 2nd Edition, Manning Publications, 2020.
3. Kristina Chodorow, "MongoDB: The Definitive Guide - Powerful and Scalable Data Storage", 4th Edition, O'Reilly Media, 2020.

L: 45; TOTAL: 45 PERIODS

Course code		L	T	P	E	C
23CS13E/ 23IT13E/ 23AD13E	**OPEN SOURCE TECHNOLOGIES FOR WEB DEVELOPMENT** (Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: analyze the principles, benefits, and global impact of open source software. (CDL1)
CO2: apply version control principles using Git and Demonstrate repository management andcollaboration (CDL2)
CO3: develop dynamic web applications that provide various functionalities (CDL2)
CO4: apply MySQL database management and PHP integration to create dynamic applications (CDL3)
CO5: analyze different open source ecosystems and adopt the most suitable solution for specificscenario(CDL2)

CO1: analyze the principles, benefits, and global impact of open source software.

Need of Open Sources – Advantages of Open Sources – OpenSource Applications - FOSS usage - Free Software Movement - Commercial aspects of Open Source movement - Open Source Software Development Model - Comparison with close source / Proprietary software - open source software licenses - Copy right - Copy left – Patent - Zero Marginal Technologies - Income generation opportunities – Internalization. **L: 8**

CO2: apply version control principles using Git and Demonstrate repository management and collaboration

Git and version control - Getting oriented with Git - Making and using a Git repository – Command line interface - Using Git with a GUI - Tracking and updating files in Git - Committing parts of changes – Cloning - Collaborating with remotes - Pushing changes - Working with GitHub **L: 8**

CO3: develop dynamic web applications that provide various functionalities of PHP

Open-Source Programming: PHP -Introduction - LAMP/WAMP installation -PHPScript Elements: operators -Statements -Loops; Working withArrays – Functions - Global variables - Exception Handling -Session Handling – Form Processing and Validation. **L: 10**

CO4: apply MySQL database management and PHP integration to create dynamic applications.

Open-Source Database: MySQL - Introduction - Features – Account Setup and Commands –String Handling - Date and Time – Metadata. PHP and MySQL: database connection through PHP -Data Objects (PDO) -Handling Errors in MySQL - Transaction management. **L: 10**

CO5: analyze different open-source ecosystems and adopt the most suitable solution for specific scenario

Open-Source Ecosystem: Open-Source Operating Systems: GNU/Linux – Android – Free BSD – Open Solaris. Open-Source Hardware: Virtualization Technologies. Containerization Technologies: Docker – Development tools: IDEs – Debuggers. **L: 9**

TEXT BOOKS:

1. Chris DiBona, Sam Ockman, and Mark Stone, "Open Sources 2.0: The Continuing Evolution", 1st Edition, O'Reilly Media, May 2021.
2. Scott Chacon & Ben Straub, "Pro Git", 2nd Edition, Apress, March 2020.
3. Tom Butler, "PHP & MySQL: Novice to Ninja", 6th Edition, SitePoint, July 2020.
4. Todd McLeod, "Docker: Up & Running", 2nd Edition, O'Reilly Media, January 2022.

REFERENCES:

1. Joseph Feller and Brian Fitzgerald, "Understanding Open Source Software: A Guide to Open Source Development, Business, and Law", 1st Edition, Addison-Wesley, January 2021.
2. Mark L. Shapiro, "Open Source Licensing: Software Freedom and Intellectual Property Law", 2ndEdition, Prentice Hall, June 2021
3. Chris Shiflett, "PHP Solutions: Dynamic Web Design Made Easy", 2nd Edition, Friends of ED, June 2020.
4. Ben S. Collins-Sussman, Brian W. Fitzpatrick, & Jason J. Merkey, "Version Control with Git", 1st Edition, O'Reilly Media, October 2020.
5. David Sklar, "PHP & MySQL: The Missing Manual", 3rd Edition, O'Reilly Media, September 2022.Ethan Brown, "Docker Deep Dive", 3rd Edition, Leanpub, February 2021.

L: 45; TOTAL: 45 PERIODS

Course Code	POSTGRESQL DATABASE MANAGEMENT	L	T	P	E	C
23CS14E/ 23IT14E/ 23AD14E	(Common to CSE, IT, AI&DS Degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: utilize PostgreSQL for database design, data manipulation, and management using basic data types, JSON/JSONB, and GUI tools. (CDL2)
CO2: apply advanced querying, normalization, indexing, and transaction techniques for database optimization. (CDL2)
CO3: build PostgreSQL-based applications using stored procedures, functions, and cloud integration with Java. (CDL3)

Practical Component

CO4: implement data manipulation, advanced querying, and optimization using postgreSQL.(PDL2)
CO5: design PostgreSQL solutions with data aggregation, automation, cloud deployment, and Java integration for efficient database management.(PDL2)

CO1: utilize PostgreSQL for database design, data manipulation, and management using basic data types, JSON/JSONB, and GUI tools. **L: 10 P: 10**

CO4: implement data manipulation, advanced querying, and optimization using postgreSQL.

Introduction to PostgreSQL - Database Models and Query Languages - PostgreSQL Architecture - Data Access and Manipulation with PostgreSQL - Storing and Accessing Data in a Database - Working with Multiple Tables and Join Operations - Designing Tables and Working with Basic Data Types - GUI Tools (pgAdmin, DBeaver) - Data Types and Creating User Records - JSON and JSONB Data Types

- Create Databases and Tables using PostgreSQL
- Perform Basic Data Manipulation operations.
- Perform Data Retrieval and Querying: using WHERE, ORDER BY, and GROUP BY also implement filtering with JSONB fields.
- Connect to the database using pgAdmin/DBeaver and Perform CRUD operations through the graphical interface.

CO2: apply advanced querying, normalization, indexing, and transaction techniques for database optimization. **L: 10 P: 10**

CO4: implement data manipulation, advanced querying, and optimization using postgreSQL.

Advanced Data Selection and Aggregate Functions - Complex Query Techniques: Subquery, Union Join, Self Join, Outer Join - Views- Normalization -Transaction and Locking Mechanisms: ACID Rules, Logs, and Multi-User Transactions - Locking Techniques: Avoiding Deadlocks - Indexing Techniques for Performance Optimization: B-Tree, Hash, GIN, and BRIN Indexes

- Implement advanced query techniques using SUBQUERY, UNION, SELF JOIN, and OUTER JOIN.
- Implement aggregate functions like SUM, AVG, MIN, and MAX.
- Normalize a database to the 3NF level and Implement FOREIGN KEY constraints to ensure data integrity.
- Implement transaction handling using BEGIN, COMMIT, and ROLLBACK and resolve deadlocks using explicit locking mechanisms.
- Implement indexing techniques using (B-Tree/ GIN/ BRIN / Hash).

CO3: build PostgreSQL-based applications using stored procedures, functions, and cloud integration with Java. **L: 10 P: 10**

CO5: design PostgreSQL solutions with data aggregation, automation, cloud deployment, and Java integration for efficient database management.

Operators and Built-in Functions - Procedural Languages in PostgreSQL (PL/pgSQL) - Creating and Using Stored Procedures - SQL Functions and Triggers - Accessing PostgreSQL from Java using JDBC - Database Connections, JDBC Result Sets, and Creating JDBC Statements - Cloud Deployment and Hosting: Heroku and AWS RDS

- Create stored procedures for data aggregation and develop SQL functions for data transformation.
- Establish database connectivity using the PostgreSQL JDBC driver and perform CRUD operations from a Java application.
- Implement triggers to log data changes and automate data update tasks using triggers.
- Deploy PostgreSQL on Heroku or AWS RDS and connect a Java application to the cloud database and perform operations.

TEXT BOOKS

1. H.J. Schönig, Mastering PostgreSQL 15: Advanced Techniques to Build and Manage Scalable, Reliable, and Fault-Tolerant Database Applications, 5th edition Birmingham, UK: Packt Publishing, 2022
2. R. Obe and L. Hsu, PostgreSQL: Up and Running, 3rd Edition, Sebastopol, CA, USA: O'Reilly Media, 2020.

REFERENCE BOOKS

1. V.Vadlamani, PostgreSQL Skills Development on Cloud. Cham, Switzerland: Springer, 2023.
2. L. Ferrari and E. Pirozzi, Learn PostgreSQL: Use, Manage, and Build Secure and Scalable Databases with PostgreSQL 16, 2nd Edition. Birmingham, UK: Packt Publishing, 2023.

L: 30; P:30 TOTAL: 60 PERIODS

Course Code	MOBILE APPLICATION DEVELOPMENT	L	T	P	E	C
23CS15E/ 23IT15E/ 23AD15E	(Common to CSE, IT, AI&DS Degree Programmes)	**2**	**0**	**2**	**0**	**4**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

Theory Component

CO1:examine mobile application architecture and android development tools for building customizedapplications (CDL1)

CO2:design intuitive and responsive user interfaces using material design principles (CDL2)

CO3:integrate mobile apps with REST APIs and various backend data services for dynamic content management (CDL2)

CO4:utilize device features like camera, location, notifications, and implement asynchronous tasks (CDL2)

Practical Component

CO5:design and develop functional Android user interfaces and layouts using Android development tools (PDL2)

CO6:build and test robust cross-platform mobile apps using React Native and native Android APIs (PDL2)

CO1:explore mobile application architecture and Android development tools for building customized applications **L:6**

P:6

Mobile App Development Overview – Native Cross-platform - Android Architecture, Lifecycle, and Tools - Introduction to Android Studio and Kotlin Basics - Kotlin: Variables, Control Flow, OOP Concepts- Kotlin (KMP) - Android Project Structure, Gradle, and Build Process – APK Versioning - Design and implement a single-screen Android app using Kotlin and Android UI components.

CO5: design and develop functional Android user interfaces and layouts using Android development tools

Use Kotlin control flow statements (if-else, when, loops) to create interactive app logic responding to user actions.

CO2:design intuitive and responsive user interfaces using Material Design principles **L:8**

UI/UX Principles and Material Design Standards - Jetpack Compose: Composable, Modifiers, State - Layouts: Column, Row, Scaffold, LazyColumn-Forms: TextField, Button, CheckBox, RadioButton, Dropdown- Input Components, Navigation, and Theming - Error Handling -Event Handling and Recomposition- Material Design Colors, Typography, Shapes. **P:7**

CO5: design and develop functional Android user interfaces and layouts using Android development tools

Create a dynamic UI for a product catalog screen using Compose, with filtering options and responsive layouts.

CO3:integrate mobile apps with REST APIs and various backend data services for dynamic content management **L:8**

Local Storage: SharedPreferences, Room DB (with DAO &ViewModel)- JSON Parsing, API Consumption using Retrofit,Coroutines- Integration with backend services: Flask (Python), Express (Node.js)- Introduction to SQLite access via APIs - Build an app that fetches and stores data via REST API. **P:8**

CO6: build and test robust cross-platform mobile apps using React Native and native Android APIs

Asynchronous data handling with coroutines – Node.js Express as backend and stores data in SQLite

CO4:utilize device features like camera, location, notifications, and implement asynchronous tasks **L:8**

Accessing Device Features: Camera, Location (Fused API), Sensors - Permissions (runtime), Notifications, File I/O- Multithreading with Coroutines - Debugging & Performance Optimization Tools- Unit Testing with JUnit, UI Testing with Espresso - App Signing, Versioning, ProGuard, Obfuscation - Publishing to Google Play Store. **P:9**

CO6: build and test robust cross-platform mobile apps using React Native and native Android APIs

API with push notifications – real world mobile applications development – test application.

TEXT BOOKS

1. Neil Smyth, "Android Studio Development Essentials Kotlin", 1st Edition, Techotopia, 2023.
2. Mark L.Murphy, "The Busy Coder's Guide to Android Development", CommonsWare,3rd Edition 2019.

REFERENCES

1. Valentino Lee, Heather Schneider, Robbie Schell, "Mobile Application Development: Android and iOS", 2nd Edition, McGraw-Hill Education, 2023.
2. Reto Meier & Ian Lake, "Professional Android", Wiley,4th Edition, 2022.
3. Bonnie Eisenman, "Learning React Native", 2nd Edition,O'Reilly Media,2020.
4. Bill Phillips, Chris Stewart, Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", 4th Edition, Pearson, 2019.

L: 30; P: 30; TOTAL:60 PERIODS

Course Code	**MINI – CAPSTONE PROJECT**	**L**	**T**	**P**	**E**	**C**
23CS19E/ 23IT19E/ 23AD19E	(Common to CSE, IT and AI & DS degree Programmes)	**0**	**0**	**0**	**6**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: apply client-side (HTML, CSS, JavaScript) and server-side (Node.js, Express) technologies to design and implement responsive, scalable full-stack web applications. (PDL2)

CO2: design and integrate RESTful APIs with relational and NoSQL databases (e.g., MySQL, MongoDB) to enable efficient data exchange and persistence in full-stack systems. (PDL2)

CO3: develop and deploy secure, performance-optimized full-stack applications using CI/CD pipelines, containerization (Docker), and cloud platforms (Heroku, AWS). (PDL2)

CO4: create and evaluate real-world full-stack applications that incorporate user authentication, role-based access control, and real-time data updates using technologies like WebSockets. (PDL3)

Soft Skill Component

CO5: demonstrate and present a full stack web application through effective team collaboration, technical and oral communication.

Module 1: Problem identification, technology selection and project ideation: E:15

1. Overview of full stack architecture
   - Role of frontend, backend, and databases
   - RESTful services and APIs
   - Tools and technologies stack
2. Project Ideation
   - Introduction to user-centered design principles
   - Wireframing and prototyping tools
   - UI/UX Design

Deliverable: A design prototype ready for development.

Module 2: Frontend Development **E: 20**

For Web Applications (MERN Stack / Python Web Frameworks):

- HTML5, CSS3, JavaScript
- Frontend frameworks: React.js or Django Templates
- State management: Context API / Redux
- Routing, component-based UI, API integration

For Mobile Applications (React Native):

- Layout using Flexbox
- Navigation and routing
- Form inputs, lists, custom widgets

Deliverable: Fully developed frontend with interactive UI and data binding.

Module 3: **E: 15**

Backend Development & API Integration

- REST API fundamentals and Frameworks
- Routing, middleware, and controllers
- CRUD operations, API error handling
- Authentication with JWT / OAuth or Firebase Auth
- Database Management
    - MongoDB (NoSQL) for MERN, PostgreSQL/MySQL for Django.
    - Database normalization, indexing and optimization

Deliverable: RESTful APIs to support frontend interactions.

Module 4: **E: 20**

Authentication & Security

- Firebase Authentication or manual setup using Auth modules
- Role-based access control
- Input validation and secure API design
- Data encryption and session/token management

Testing & Debugging

- Unit testing (frontend and backend)
    - React Testing Library / Jest / React Native Testing Library
    - Backend: PyTest, Jest, Mocha
- Integration testing using Postman or Swagger
- Debugging tools and console tracing

Deliverable: Secure login, registration and protected routes, Tested and verified components ensuring reliability.

Module 5: **E:20**

Deployment & Version Control

- Version control with Git and GitHub
- CI/CD pipeline basics : GitHub Actions / Firebase CI
- Deployment platforms:
    - Web: Vercel, Netlify, Render, Firebase Hosting
    - Mobile: APK build, Play Store Publishing
- Hosting backend servers and databases

Deliverable: Deployed application accessible via web or mobile platform.

E: 90; TOTAL: 90 PERIODS

Course code	COMPUTER VISION AND IMAGE PROCESSING	L	T	P	E	C
23CS21E/ 23IT21E/ 23AD21E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: apply principles of image formation, Geometric transformations, and color image processing techniques to augment the visual of the image. (CDL1)

CO2: apply image transforms, filtering, and morphological operations for image enhancement. (CDL1)

CO3: implement feature extraction, edge detection, and shape representation methods for image processing. (CDL1)

CO4: analyze classification, clustering, and neural network methods for pattern recognition. (CDL2)

CO5: analyze and apply segmentation, and tracking techniques in image processing. CDL2)

CO1: apply principles of image formation, Geometric transformations, and color image processing techniques to enhance the visual of the image.

Introduction to Computer Vision - Image Formation and Radiometry-Geometric Transformation-2D transformations-3D transformations-Geometric Camera Models-Image formation in a stereo vision setup-Image Reconstruction from a Series of Projections-Inverse Radon transform - back-projection -Fourier transform – Color models-Color constancy- Color Image Processing **L: 9**

CO2: apply image transforms, filtering, and morphological operations for image enhancement.

Fundamentals of Image Processing-Image Transforms-Discrete Fourier transform-Discrete cosine transform-K-L transform-Wavelet transform-Image Filtering-Spatial domain filtering-Frequency domain filtering-Homomorphic filtering-Wiener filter for image restoration- -Mathematical Morphology **L: 9**

CO3: implement feature extraction, edge detection, and shape representation methodsfor image processing.

Image Descriptors and Features-Texture Descriptors- Color Features-Edge Detection-Object Boundary and Shape Representations-SUSAN edge and corner point detector-Moravec corner detector-Histogram of Oriented Gradients-Scale Invariant Feature Transform-Speeded up Robust Features. **L: 9**

CO4:analyze classification, clustering, and neural network methods for pattern recognition

Introduction to Pattern Recognition-Linear Regression-Basic Concepts of Decision Functions-Elementary Statistical Decision Theory-Gaussian Classifier-Parameter Estimation-Clustering for Knowledge Representation-Dimension Reduction-Template Matching-Artificial Neural Network for Pattern Classification-Convolutional Neural **L: 9**

Networks-Autoencoder.

CO5: analyze and apply segmentation, and tracking techniques in image processing.

Clustering for image segmentation-Graph partitioning methods-Image segmentation by neural networks-Probabilistic models for image segmentation-Motion Estimation and Object Tracking-Face and Facial Expression Recognition-Gesture Recognition-Image Fusion. **L: 9**

TEXT BOOKS:

1. Manas Kamal Bhuyan, "Computer Vision and Image Processing Fundamentals and Applications", CRC Press Taylor & Francis Group, Paperback, 2020.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Texts in Computer Science, 2nd Edition, 2022.
3. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2nd Edition, 2015.

REFERENCE BOOKS:

1. Yu-Jin Zhang, "3-D computer vision principles and algorithms", Springer Singapore,1st Edition, 2023
2. Sonka, Hlavac, and Boyle. Thomson, "Image Processing, Analysis, and Machine Vision", Cengage Learning, 4th Edition, 2017.
3. D. Forsyth and J. Ponce, "Computer Vision - A modern approach", Pearson Education, Inc., 2nd Edition, 2015.
4. B. K. P. Horn, "Prentice Hall Robot Vision", McGraw-Hill, 1st Edition, 2015.

L: 45; TOTAL: 45 PERIODS

Course code	**MACHINE LEARNING TECHNIQUES**	**L**	**T**	**P**	**E**	**C**
23CS22E/ 23IT22E/ 23AD22E	(Common to CSE, IT and AI & DS degree Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: understand the foundations and mathematics of machine learning. (CDL1)
CO2: apply supervised learning algorithms to solve classification and regression problems. (CDL1)
CO3: apply the core concepts of deep neural networks and optimization techniques to enhance model performance. (CDL1)
CO4: apply unsupervised learning and dimensionality reduction to analyze and interpret data. (CDL1)

Practical Components

CO5: implement and evaluate supervised learning models to solve classification and regression problems. (PDL1)
CO6: design, implement, and optimize deep learning models for solving real-world problems. (PDL1)
CO7: implement and evaluate unsupervised models to enhance model performance and accuracy. (PDL1)

CO1: understand the foundationsand mathematics of machine learning.

Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off. **L: 8**

CO2: apply supervised learning algorithms to solve classification and regression problems.

CO5: implement and evaluate supervised learning modelsto solve classification and regression problems.

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests **L:11**

P: 9

Implement linear regression to predict house prices based on a dataset (e.g., Boston Housing).

Implement an SVM classifier on a dataset (e.g., Iris or MNIST) and evaluate the model's accuracy and performance

Apply K-fold cross-validation and bootstrapping to evaluate Logistic Regression and SVM on a dataset.

CO3: apply the core concepts of deep neural networks and optimization techniques to enhance model performance.

CO6:design, implement, and optimize deep learning models for solving real-world problems.

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation – ReLU, hyperparameter tuning, batch normalization, regularization, dropout. **L: 7**

P:12

Implement an MLP for classification on a dataset (e.g., MNIST) and experiment with various activation functions (sigmoid, tanh, ReLU).

Train a deep network using gradient descent and stochastic gradient descent (SGD). Tune hyperparameters such as learning rate, batch size, and number of epochs to optimize the model's performance on a dataset.

Apply advanced techniques like dropout, batch normalization and regularization to a deep neural network trained on a dataset to prevent overfitting and improve generalization.

CO4: apply unsupervised learning and dimensionality reduction to analyze and interpret data.

CO7: Implement and evaluate unsupervised models to enhance model performance and accuracy. **L: 4**

P: 9

Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization, Principal Component Analysis

Implement K-means clustering to group data points into clusters and apply PCA for

dimensionality reduction.

Implement K-Nearest Neighbors (KNN) for classification on a dataset (e.g., Wine Quality). Compare its performance with Gaussian Mixture Models (GMM) for the same dataset.

TEXT BOOKS

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 4th Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", 2nd Edition, CRC Press, 2014.

REFERENCE BOOKS

1. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", 2nd Edition, MIT Press, 2012, 2018.
4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
5. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing 3rd Edition, 2019.

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code 23CS23E/ 23IT23E	**AI TOOLS FOR NATURAL LANGUAGE PROCESSING** (Common to B.E. CSE and B.Tech.IT Programmes)	**L**	**T**	**P**	**E**	**C**
		2	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: Comprehend the fundamental concepts, architectures, and challenges in NLP(CDL1)

CO2: Apply AI-based NLP tools for tasks such as text processing, sentiment analysis,and language modeling. (CDL1)

CO3: Apply ML and deep learning models for NLP, fine-tune transformers, and evaluate model performance (CDL1)

CO4: Integrate AI-driven NLP systems into real-world tasks, measure their impact, and address ethical concerns. (CDL2)

Practical Components

CO5: Implement text preprocessing, POS tagging, and text similarity analysis through word embeddings (PDL1)

CO6: Develop and deploy NLP and AI-based applications for sentiment analysis, chatbots, and APIs.(PDL2)

CO1:Comprehend the fundamental concepts, architectures, and challenges in NLP

Basics of Natural Language Processing:Components of NLP, Morphology, Syntax, Semantics, Pragmatics - AI in NLP: Machine Learning vs. Deep Learning Approaches - Challenges in NLP (Ambiguity, Context Understanding, etc.) - Overview of AI-based NLP Tools (NLTK, SpaCy) **L:5**

CO2: ApplyAI-based NLP tools for tasks such as text processing, sentiment analysis, and language modeling.

Text Preprocessing: Stopword Removal, Lemmatization, And Stemming - Named Entity Recognition (NER) and Part-of-Speech (POS) Tagging Word Embedding's: Word2Vec, GloVe, FastText - Text Classification and Sentiment Analysis - Implementing NLP pipelines using AI tools **L: 7**

P:10

CO5: Implement text preprocessing, POS tagging, and text similarity analysis through word embeddings.

Install and set up NLP libraries:(NLTK, SpaCy), Implement basic text preprocessing (tokenization, stemming, and lemmatization),Perform Part-of-Speech (POS) tagging,Apply word embeddings (Word2Vec, GloVe) to analyze text similarity.

CO3:Apply ML and deep learning models for NLP, fine-tune transformers, and evaluate model performance

Traditional ML Models for NLP (Naïve Bayes, SVM, etc.) - Deep Learning for NLP: RNN, LSTM, GRU- Transformer Models: BERT, GPT, T5, etc. - Fine-tuning Pretrained Models for NLP Tasks - Comparing AI-based NLP models using performance metrics. **L: 9**

CO4: Integrate AI-driven NLP systems into real-world tasks, measure their impact, and address ethical concerns.

AI-powered Chatbots and Virtual Assistants - Machine Translation (Google Translate, DeepL, etc.) - Speech-to-Text and Text-to-Speech Applications - Ethical Considerations in AI-based NLP (Bias, Fairness, Privacy) - Case Studies of AI-driven NLP Systems- Customizing AI Models - Deploying AI-based NLP Systems (API, Cloud, etc.) **L: 9**

CO6: Develop and deploy NLP and AI-based applications for sentiment analysis, chatbots, and APIs.

Implement a text and spam classifier using Naïve Bayes, Scikit-Learn and TF-IDF, Build a rule-based chatbot using NLTK,Implement a text-to-speech system using Google, Text-to-Speech (gTTS), **P: 20**

Develop a social media sentiment analysis tool using BERT, Build and deploy a chatbot using Rasa or Dialog flow, Train a custom NLP model and deploy it as an API using FastAPI.

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Pearson Education, 3rd Edition, 2024.
2. Deep Learning for Natural Language Processing, by PalashGoyal et al., 2018

REFERENCES:

1. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, OReilly Media publications, 2nd Edition,2023.
2. Natural Language Processing with Python (NLTK Book) - Steven Bird, Ewan Klein, Edward Loper-2009.
3. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow Aurélien Géron,2nd Edition,2019.

L: 30;P:30; TOTAL: 60PERIODS

Course Code	Fundamentals of Deep Learning	L	T	P	E	C
23CS25E/ 23IT23E	(Common to B.E. (CSE) and B.Tech.(IT) Programmes)	**2**	**0**	**2**	**0**	**3**

COURSE OUTCOMES

Upon completion of this course, the student will be able to

Theory Component

CO1: Apply neural network and machine learning optimization techniques to build, optimize, and evaluate predictive models. (CDL2)

CO2: Implement and analyze convolutional and recurrent neural network architectures for processingimage and sequence data. (CDL2)

CO3: Optimize and fine-tune deep neural networks by applying advanced strategies to improve trainingefficiency, generalization, and performance. (CDL2)

CO4: Apply advanced deep learning models, including attention mechanisms and generative architectures, for complex data representation and generation. (CDL2)

Practical Component

CO5: Implement and evaluate deep learning models (pre-trained) for real-world tasks involving classification, image analysis, and sequence generation. (PDL2)

CO6: Develop and optimize advanced deep learning models for object detection, graph-based learning, and natural language processing applications using MLOps framework. (PDL2)

CO1: Apply neural network and machine learning optimization techniques to build, optimize, and evaluate predictive models. **L:9**

Machine Learning optimization techniques – Underfitting and Overfitting – Hyper parameters and validation sets – Estimators – Maximum Likelihood Estimation - Optimization – Evaluating the models - Introduction to Neural Networks – Perceptron – Multilayer Feed forward networks – Back propagation – Activation functions – Loss Function – Regularization. Data Augmentation - Noise Robustness – Early Stopping – Bagging – Dropout – batch normalization.

CO2: Implement and analyze convolutional and recurrent neural network architectures for processing image and sequence data. **L:7**

CO5: Implement and evaluate deep learning models (pre-trained) for real-world tasks involving classification, image analysis, and sequence generation. **P:15**

Convolutional Neural Networks – Convolution Operation – Architecture Overview – Input layers – Convolutional layers – pooling layers – fully connected layers Recurrent Neural networks – LSTM – Bidirectional RNNs – RNN Language model – Word Level RNN - Deep Recurrent Networks – Recursive Neural Networks.

Implementation of Linear and Logistic regression models, Create a simple classifier using Feed forward network, Implement CNN for image classification, Implement a language model using RNN, Mini Project - Facemask Detection using CNN , Text Generation using RNN , Text to Speech using LSTM

CO3:Optimize and fine-tune deep neural networks by applying advanced strategies to improve training efficiency, generalization, and performance. **L:7**

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks Tuning

Deep Networks – Basic Concepts – Matching input data and network architecture – relating model goal and output layers – Working layer count, parameter count and Memory – weight initialization strategies – using activation functions – applying loss function – Dealing with overfitting.

CO4: Apply advanced deep learning models, including attention mechanisms and generative architectures, for complex data representation and generation. **L:7**

CO6: Develop and optimize advanced deep learning models for object detection, graph based learning applications using MLOps framework. **P:15**

Encoder Decoder Models - Attention Mechanism - Attention over images – Hierarchical Attention – Variational auto encoders – Autoregressive models – NADE – MADE - PixelRNN – Generative Adversarial Networks (GANs) – Graph Convolution Network – Deep Belief Network.

Implement optimization techniques for CNN and RNN models, Implementation of Encoder Decoder model, Implementation of Graph Convolution network, Implement Faster RCNN, Implementation of object tracking. Mini Project - Object detection using Yolo algorithms, Diseases prediction using GCN models, Sentiment analysis using BERT models.

TEXT BOOKS

1. Francois Chollet, "Deep Learning With Python", Manning Publications, 3rd Edition, 2024.
2. Josh Patterson, Adam Gibson," Deep Learning: A Practitioner‟s Approach", 1st Edition,O'Reilly Media, Inc, 2017

REFERENCES

1. Bengio, Yoshua, Ian J. Goodfellow and Aaron Courville, "Deep learning" An MIT Press book in preparation, 2016.
2. Vinita silaparasetty, "Deep Learning Projects TensorFlow 2", Apress 2020.
3. Antonio Gulli, Amita Kappor, Sujit Pal, " Deep Learning with TensorFlow 2 and Keras", Pack Publishers, 2nd Edition, 2019
4. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
5. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.
6. Dr.Adrian Rosebrock, Deep Learning for Computer Vision with Python: Starter Bundle,PyImage Search, 1st Edition, 2017.
7. AurelienGeron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow:Concepts, Tools, and Techniques to Build Intelligent System", 2ndEdition,O'Relly,2017

L: 30; P: 30; TOTAL:60 PERIODS

Course Code	MINI-CAPSTONE PROJECT	L	T	P	E	C
23CS29E/ 23IT29E	(Common to B.E. (CSE) and B.Tech.(IT) Programmes)	0	0	0	6	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: Analyze real-world problems and preprocess relevant data to identify suitable applications of deep learning, reinforcement learning, and natural language processing. (PDL2)

CO2: Design and develop intelligent systems using appropriate models and algorithms from deep learning, reinforcement learning, and NLP to address identified problems. (PDL2).
CO3: Evaluate the performance of developed intelligent systems and optimize them using suitable metrics and tuning techniques.(PDL3)

Soft skill Component

Enhance problem-solving and adaptability skills by navigating complex tasks and applying innovative solutions in team-oriented environments.

Each student individually selects any project in their area of interest in engineering design and work under the supervision of their allotted guide approved by Head of the department.

Module 1: Problem Identification & Data Preparation Understand the scope of computational intelligence in solving real-world problems **E: 20**

1. Brainstorm and finalize problem statements across domains (healthcare, finance, education, etc.)
2. Data acquisition and preprocessing (cleaning, normalization, feature extraction)
3. Submission of project proposal including objectives, data description, and expected outcomes

Deliverable: Approved project proposal document with data plan

Module 2: System Design & Model Development

Select appropriate computational techniques (DL, RL, NLP) **E:25**

1. Design model architecture based on the problem domain
2. Train initial models using tools like TensorFlow, Py-Torch, OpenAI Gym, Hugging-Face, etc.
3. Implement smart (automate and optimize) training pipelines

Deliverable: Model design document and training scripts

Module 3: System Integration & Performance Evaluation

1. Integrate model with end-user applications or pipelines **E: 25**
2. Evaluate using performance metrics (accuracy, precision, reward score, BLEU score, etc.)
3. Perform model tuning (hyperparameter optimization, regularization, fine-tuning)
4. Conduct comparative analysis and validation

Deliverable: Working intelligent system with evaluation report

Module 4: Final Demonstration & Reporting

Live demonstration of the system (input to intelligent output) **E:20**

1. Technical documentation and final project report
2. Code repository submission (e.g., GitHub)
3. Viva-voce and Q&A based on COs

Deliverables:

- Live demo session
- Final project report
- Code submission

E: 90; Total: 90 PERIODS

Course code	COMPUTER GRAPHICS	L	T	P	E	C
23CS31E/ 23IT31E/ 23AD31E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1**:** apply the basic of computer graphics, line and shape drawing algorithms in computer applications. (CDL1)

CO2: analyze 2D and 3D transformations and perform clipping operations using various algorithms for efficient viewing and rendering in computer graphics. (CDL2)

CO3: analyze and apply object representation methods, and visible surface detection algorithms. (CDL2)

CO4: implement 3D viewing techniques and rendering algorithms for effective visualization. (CDL2)

CO5: apply animation principles, design sequence in gaming scenarios. (CDL2)

CO1: apply the basic of computer graphics, line and shape drawing algorithms in computer applications.

Introduction to Computer Graphics - Application areas of Computer Graphics - Overview of graphics systems - Video display devices -Raster-scan systems - Random scan systems - Graphics monitors - Work stations - Input devices- Principles of Modeling. **L:9**

Output primitives - Points and lines - Line drawing algorithms - Mid- point circle and Ellipse algorithms.

Filled area primitives - Scan line polygon fill algorithm - Boundary-fill and Flood-fill algorithms.

CO2: analyze 2D and 3D transformations and perform clipping operations using various algorithms for efficient viewing and rendering in computer graphics.

2D and 3D Geometric Transformations – Scaling - Shearing - Rotation - Reflection, Translation - Composite Transformations - Ray and Path Tracing. **L:9**

2D Viewing - Viewing Pipeline - Window to view-port coordinate Transformation. Clipping Operations - Point Clipping - Cohen Sutherland Line Clipping - Sutherland Hodgeman Polygon Clipping.

CO3: analyze and apply object representation methods and visible surface detection algorithms.

3-D object representation: Polygon surfaces - Quadric surfaces - Spline representation - Hermite curve - Bezier curve and B-Spline curve - Bezier and B-Spline surfaces - Basic illumination models - Polygon rendering methods. **L:9**

3-D viewing: Viewing pipeline - Viewing coordinates and clipping - Visible surface detection methods- Classification - Back-face detection - Depth-buffer scan-line - depth sorting - BSP-tree methods.

CO4: implement 3D viewing techniques and rendering algorithm for effective visualization.

Projections-Parallel and Perspective Projection -Bezier Curves and Surfaces - B-Spline Curves and Surfaces - Visible Surface Detection Algorithms - Back-Face Detection Algorithm - Depth Buffer Method - Scan line Method. **L:10**

Color Models - RGB Color Model - YIQ Color Model -CMY Color Model - HSV Color Model - Conversion Between HSV and RGB Models and HLS Color Model

CO5: apply animation principles, design sequence in gaming scenarios.

Animation: Principles of animation - Design of Animation Sequences - Animation Functions - Raster Animations - Key-Frame Systems - Motion Specifications - Computer Graphics in games. **L:8**

TEXT BOOKS

1. Peter Shirley, Fundamentals of Computer Graphics, A K Peters/CRC Press, 5th Edition, 2022.
2. Edward Angel and Dave Shreiner: Interactive Computer Graphics: A Top-Down Approach with WebGL, Addison-Wesley, 8th Edition, 2020.
3. Sumanta Guha, Computer Graphics through OpenGL: from theory to experiments, 4th Edition, CRC Press, 2023.
4. Hamza Zubair, Computer Graphics, Toronto Academic Press, 2024.
5. John F. Hughes, Computer Graphics: Principles and Practice, Addison-Wesley, 3rd Edition, 2014.

REFERENCE BOOKS

1. Eric Lengyel, 3D Graphics for Game Programming, A K Peters/CRC Press, 2nd Edition, 2023.
2. Roger D. Rogers and David F. McLain: Computer Graphics: A Programmed Approach, Prentice Hall, 3rd Edition, 2019.
3. Donald Hearn and M. Pauline Baker: Computer Graphics Using OpenGL, Prentice Hall, 6th Edition, 2014.

L: 45; TOTAL: 45 PERIODS

Course code	UI/UX DESIGN	L	T	P	E	C
23CS32E/ 23IT32E/ 23AD32E	(Common to CSE, IT and AI & DS degree Programmes)	**2**	**0**	**0**	**2**	**3**

COURSEOUTCOMES

Upon the successful completionofthecourse,thestudentwillbeableto

Theory Components

CO1:analyze UX principles and processes to create user-centered solutions. (CDL1)

CO2: apply User research and UI design principles for user friendly interface. (CDL2)

CO3: utilizeinteractive design techniques for an engaging UI design. (CDL2)

CO4: apply responsive design principles to create adaptable digital interfaces.(CDL2)

Experiential component

CO5: design user-friendly, visually appealing interfaces and provide industry-relevant insights by applying UX design principles.(PDL1)

Softskill component

CO6: demonstrate creativity, diverse and inclusive attitude while practicing project component.

CO1: analyze UX principles and processes to create user-centered solutions. (CDL1). **L:8**

Introduction about UX - Five Main Ingredients of UX - Three "Whats" of User Perspective -Pyramid of UX Impact - UX Is a Process - UX - Not an Event or Task.Behaviour Basics: Psychology versus Culture - User Psychology - Experience - Conscious vs Subconscious Experience - Emotions - Gain and Loss – Motivations.

CO2: apply User research and UI design principles for user friendly interface. (CDL2) **L:10**

User research: Design thinking process –Conduct research methodologies - Interviews - Surveys -Card Sorting - Creating User personas- Basic of Information Architecture - UI design principles- Creating UI Design – User Centered Design – site mapping and wireframe techniques – UI Aesthetics – Introduction to Design Tools. **E:8**

CO3: utilize interactive design techniques for an engaging UI design. (CDL2) **L:8**

Designing Web Interfaces – Grid and Layout – DesignPattern -Visual Hierarchy-Basics of Interaction design – structure and navigation - UI animation: Loading progress-state changes-structure and navigations Micro interaction – Branding - iterative design - Interactive prototypes **E:12**

CO4: apply responsive design principles to create adaptable digital interfaces.(CDL2) **L:4**

ResponsiveDesign -Adaptive design - Understanding user diversity - Adaptive and Fluid layouts - Performance optimization - Future trends and updates-Create a responsive design for various devices and screen sizes. **E:10**

CO5: design user-friendly, visually appealing interfaces and provide industry-relevant insights.

TEXT BOOKS

1. JoelMarsh,"UXforBeginners",O'Reilly, Media,Inc.,1st Edition, 2015.
2. Alvin Albuero De Luna - Essentials of User Interface Design :E-book Edition,2022
3. XiaJiajia, "UI UX Design",O"Reilly, Art power International, 2016.

REFERENCE BOOKS

1. David Travis, "Fundamentals of Creating a Great UI/UX", Creative Tim, 2022.
2. Raywenderlich Tutorial Team, Prateek Prasad – "App Design Apprentice A Non-designer's Guide to Making Better Mobile UI &UX":E-book Edition,2022
3. AlanDix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", Pearson Education, 3rd Edition, 2004.
4. Alan Cooper, "The Essential of User Interface Design", Wiley Dream Tech Ltd., 2002.

L: 30; E: 30; TOTAL:60 PERIODS.

Course code	**BLOCKCHAIN GAMING**	**L**	**T**	**P**	**E**	**C**
23CS33E/	(Common to CSE, IT and AI & DS degree Programmes)					
23IT33E/		**2**	**0**	**2**	**0**	**3**
23AD33E						

COURSEOUTCOMES

Upon the successful completionofthecourse,thestudentwillbeableto

Theory Components

CO1: develop foundational skills for Game Development. (CDL1)

CO2: demonstrate proficiency in 2D & 3D graphics by applying Physics, Materials, 3D Character Control and Particle Systems. (CDL2)

CO3: apply 3D Animation, Camera Control, Audio management and UI design for Game Development. (CDL2)

CO4: integrate the concepts of Non-Fungible Tokens to a game using Blockchain. (CDL1)

CO5: design a Blockchain game using backend & frontend tools and frameworks. (CDL1)

Practical Components

CO6: develop games using 2D & 3D graphics with animation techniques and interactions in Unity.(PDL2)

CO7: design and Demonstrate User Interface, Audio in gaming environment. (PDL2)

CO8: create and deploy an NFT Smart Contract on a Blockchain within a Game. (PDL1)

CO1: develop foundational skills for Game Development.

CO6: develop games using 2D & 3D graphics with animation techniques and interactions in Unity.

Introduction to Game Development – Working in Unity: Game Objects – Components – Prefabs – Scenes – Assets - Building Unity Projects - Unity Packages – Scripting: life cycle of a script - Accessing Components - Finding Objects – Singletons - Using Coroutines – Managing Objects – Scriptable Object – Input: Keyboard Input – Unity Input system – Input Actions – Locking and Hiding the Mouse Cursor – Mouseover and Click Events. **L:5 P:6**

Develop a Script for 2D games using Unity.

CO2: demonstrate proficiency in 2D & 3D graphics by applying Physics, Materials, 3D Character Control and Particle Systems.

CO6: develop games using 2D & 3D graphics with animation techniques and interactions in Unity.

2D Graphics: Creating a Sprite with 2D Physics – Customizing Sprite Collision Shapes – Composite Collider – Sprite Packer – Applying Forces to 2D Objects - 3D Graphics: Creating a Simple Material - Controlling a Material's Property - Creating an Unlit Material - Setting Up a Material Using Textures – Understanding Fixed Update – Mouse Look – Controlling a 3D Character - Interacting with Switches and Objects - Picking Up and Putting Down Objects - Particle system. **L:6 P:8**

Develop a Script for 3D games using Unity.

Create a Unity project to apply animation techniques and particle system.

CO3: apply 3D Animation, Camera Control, Audio management and UI design for Game Development.

CO7: design and Demonstrate User Interface, Audio in gaming environment. **L:7 P:8**

Animating an Object - Basic Character Movement - Inverse Kinematics – Masked

Movement - Blended Movement - Tracking and switching Camera - Keeping Multiple Objects in View – Dollying a camera - Audio: Playing Sounds – Mixer – Audio Effects – Ducking – Multiple Audio Zones – Playing Audio with Scripts - User Interface: Working with UI Controls – Animating the UI.

Design an animated game to adopt better UI experience.

CO4: integrate Non-Fungible Token (NFT) concepts into a game using Blockchain.

CO8: create and deploy an NFT Smart Contract on a Blockchain within a Game.

Introduction to Blockchain Game Development – Decentralized Game Architecture – Benefits of Blockchain Games - Challenges of Blockchain Games - Non-Fungible Tokens (NFTs) in Gaming – NFT Standards (ERC-721, ERC-1155) - Designing and Minting NFTs – Creating a Mint Site – Create an NFT Smart Contract - Implementing Smart Contracts for Games - NFTs in Unity - NFT Trading and Royalties **L:6 P:8**

Creating a Mint Site and NFT Smart Contract using Blockchain.

CO5: design a Blockchain game using backend & frontend tools and frameworks.

Blockchain Game Backend Development - Setting Up Game Servers - Integrating Blockchain Nodes - Blockchain Game Development Tools and Frameworks (Unity, Unreal Engine, Web3.js) - Frontend Development for Blockchain Games - Web3-Enabled User Interfaces - Wallet Integration and Management - Play-to-Earn Mechanisms - Real-World Examples of Blockchain Games. **L:6**

TEXT BOOKS:

1. Paris Buttfield-Addison, Jon Manning, and Tim Nugent, "Unity Game Development Cookbook: Real-Time Solutions from Game Development to AI", 2nd Edition, O'Reilly Media, 2023.
2. Ashley Godbold, "Mastering UI Development with Unity", 2nd Edition, Packt Publisher, 2024.
3. Victor G Brusca, "Advanced Unity Game Development", 1st Edition, Apress Publisher, 2022.

REFERENCE BOOKS:

1. Ryley James, "NFT for Beginners", 1st Edition, ISBN-13: 9798502200295, 2021.
2. John P.Doran, "Unity 2022 Mobile Game Development", 3rd Edition, Packt Publisher, 2023.
3. Franz Lanzinger, "3D Game Development with Unity", 1st Edition, CRC Press – Taylor & Francis Group, 2022.
4. Anthony Davis, Travis Baptiste, Russell Craig, "Unity 3D Game Development", 1st Edition, Packt publisher, 2022
5. Swayam NPTEL Course on "Making Learning Engaging Through Interactive Games", Swayam NPTEL Course on "Blockchain Architecture Design and Use Cases".

L:30; P:30; TOTAL:60 PERIODS

Course Code	**AUGMENTED REALITY AND VIRTUAL REALITY**	**L**	**T**	**P**	**E**	**C**
23CS35E/ 23IT35E/ 23AD35E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: utilize the foundations and trends of immersive technologies in relevant applications (CDL1)

CO2: apply appropriate AR tools to highlight interactivity in applications. (CDL1)

CO3: apply VR technologies in emerging applications. (CDL1)

CO4: apply rendering and modeling techniques in VR distributed architectures (CDL2)

CO5: analyze various frameworks and development tools in VR domain. (CDL2)

CO1: utilize the foundations and trends of immersive technologies in relevant applications. (CDL1)

Introduction to Immersive Technologies - Historical evolution of immersive technologies –AR, VR- Key characteristics and taxonomy -Technological Foundations - Current Trends and Future Directions **L:4**

CO2: apply appropriate AR tools to highlight interactivity in applications. (CDL1)

Augmented reality: Introduction – Types of AR targets –components – User experience - Field of view – visual perception – Degree Of Freedom (DOF) - 3D formats - applications of AR – AR concepts: sensors - processor – display- Ingredients of AR experience- SDK Tools: Vuforia – AR Toolkit – AR core - AR foundation – AR algorithm: SLAM - AR devices. **L:9**

CO3: apply VR technologies in emerging applications. (CDL1)

Virtual reality: Introduction-The Three I's of VR- Input devices - Trackers, Navigation, Gesture, Output devices – Graphic displays - Human vision System - Gaze interaction - Characteristics -technologies (LCD,LED,OLED,AMOLED),HMDs,3D sound, Haptic Displays-Human Auditory System- Emerging applications (e.g., metaverse, digital twins) – VR HMD devices. **L:10**

CO4: apply rendering and modeling techniques in VR distributed architectures. (CDL2)

Fundamentals of Computer Graphics-Rendering and graphics pipeline- Modern graphics and haptic rendering pipeline -Gaming desktop architecture -Distributed VR architectures-cloud rendering- Geometric modelling - 3D authoring software and scanners - scene illumination - Texture mapping - Transformation invarients - behaviour modelling – Level of detail management (LOD). **L:10**

CO5: analyze various frameworks and development tools in VR domain. (CDL2)

VR tools: XR interaction toolkit - OpenXR - Meta XR All-in-one SDK – HP VR launch kit - SteamVR plugin - Amazon Sumerian - Godot Engine - A-Frame(webVR) – CoSpaces Edu - Three.JS – WebGL - Babylon.js. **L:12**

TEXT BOOKS:

1. Jonathan Linowes, "Augmented Reality with unity AR foundation", 1st Edition, Packt publishing, 2021
2. Jonathan Linowes and Krystian Babilinski,"Augmented Reality for Developers",1st Edition, Packt publishing,2017.
3. GrioreC.Burdea and Philippe Coiffet,"Virtual Reality Technology",3rdEdition,IEEE press-wiley, 2024.

4. Steven M. LaValle, "Virtual Reality," 1st Edition, Cambridge University Press, 2017

REFERENCE BOOKS:

1. Micheal Lanham. "Learn ARCore – Fundamentals of Google ARCore", 1st Edition, Packt publishing, 2018.
2. Paul Mealy, John Carucci, "Virtual & Augmented Reality for Dummies," 1st Edition, For Dummies, 2017.
3. Tomas Akenine-Möller, Eric Haines, "Real-Time Rendering," 4th Edition, A K Peters, CRC Press, 2018.

L:45; TOTAL: 45 PERIODS

Course Code	**DESIGN OF VIRTUAL REALITY SYSTEMS**	**L**	**T**	**P**	**E**	**C**
23CS37E/ 23IT37E/ 23AD37E	(Common to CSE, IT and AI & DS degree Programmes)	**1**	**0**	**0**	**4**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: Apply foundational principles of Virtual Reality (VR) Systems. (CDL2)

CO2: Design prototypes with interactive VR experiences for improving usability. (CDL2)

Experiential Component

CO3: Deploy customizable immersive solutions for real-world applications.(PDL3)

Soft Skill Component

Demonstrate effective communication and teamwork (Multi-disciplinary) in VR project development.

CO1: Apply foundational principles of Virtual Reality (VR) Systems. (CDL2) L:8

Introduction – Threes I's of VR – History of VR –AR/VR/MR/XR Difference –Types of VR experience – Types of HMD –VR Input Devices and Tracking - Output Devices – Google Cardboard, Daydream – Gear VR – HTC Vive – Oculus HMD – HoloLens – Apple Vision Pro – VR SDK Packages- Navigation, Teleportation and Locomotion techniques

CO2: Design prototypes with interactive VR experiences for improving usability. (CDL2) L:7

Lighting and Rendering Strategies - Create menu panel UI Design – Light Probes and Reflection Probes - Physics Particle system – GameObject Life Cycle – Terrain - ProBuilder and ProGrids - Skyboxes – Animation – Audio – Frame rates - Optimizing performance – LOD – Lighting and baking – Occlusion culling – Rendering pipeline

CO3: Deploy customizable immersive solutions for real-world applications. (PDL3) E:45

Setting up VR Project (Unity/Unreal) – World Space UI Design – Interaction with UI elements - Applications of VR in various industries.

REFERENCE BOOKS

1. Grigore C.Burdea and Philippe Coiffet, "Virtual Reality Technology", Wiley-IEEE Press, 3rd Edition, 2024.
2. Steven M. LaValle, "Virtual Reality", Cambridge University Press, 2016.
3. Jason Jerald, "The VR Book Human-Centered Design for Virtual Reality", ACM Books, 2016.
4. William R Sherman and Alan B Craig, "Understanding Virtual Reality", Morgan Kaufma, 2nd Edition, 2018.
5. Alvin Albuero De Luna, "Introduction to Virtual Reality", Arcler Press, e-book Edition, 2022.
6. Jonathan Linowes, "Unity 2020 Virtual Reality Projects", Packt Publication, 3rd Edition, 2020.
7. Kevin Mack and Robert Ruud, "Unreal Engine 4 Virtual Reality Projects", Packt Publication, 2019.
8. Jessica Plowman, "Unreal Engine Virtual Reality Quick Start Guide", Packt Publication, 2019.
9. Charles Plamer John Williamson, "Virtual Reality Blueprints", Packt Publication, 2018.
10. Philippe Fuchs, Guillaume Moreau, Pascal Guitton, "Virtual Reality: Concepts and Technologies", CRC Press, 2011.

L:15; E:45; TOTAL: 60 PERIODS

Course Code	MINI – CAPSTONE PROJECT	L	T	P	E	C
23CS39E	(Common to CSE, IT and AI & DS Programmes)	**0**	**0**	**0**	**6**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component

CO1: Apply real-time modeling and optimization techniques to create spatially efficient 3D assets suitable for AR/VR applications. (PDL2)

CO2: Design and prototype immersive user interfaces for AR/VR applications. (PDL2)

CO3: Develop and deploy Augmented Reality mobile application in real-world applications. (PDL2)

CO4: Create and Evaluate Real-time Virtual Reality Scenarios with Environmental Feedback. (PDL3)

Soft Skill Component

CO5: Demonstrate effective communication and Collaboration across Multi-disciplinary teams, integrating 3D Modeling, UI/UX design for AR and VR projects

Module 1: Real-Time 3D Modeling and Optimization for AR/VR

Introduction to 3D Modeling Techniques:

- Basics of 3D modeling for AR/VR applications.
- Understanding polygon count and optimization strategies.

E: 15

Optimization Techniques:

- Low-polygon modeling.
- Texture compression and efficient asset management.

Best Practices for Asset Creation:

- Real-time rendering considerations.
- Use of LOD (Level of Detail) and efficient memory usage.

Creating Spatially Efficient 3D Assets:

- Hands-on with creating and optimizing 3D models for AR/VR.

Deliverable: Submission of optimized 3D assets and asset management documentation.

Module 2: Immersive User Interface Design for AR/VR

Principles of AR/VR User Interface Design:

- Understanding the difference between traditional UI and AR/VR UI.
- Interaction techniques for AR/VR (e.g., gaze, gesture, voice).

Prototyping AR/VR Interfaces:

- Tools and software for AR/VR UI prototyping (e.g., Unity, Unreal Engine).
- Design considerations for AR/VR interaction flows.

E: 15

Usability in AR/VR:

- Accessibility and inclusivity in AR/VR interfaces.
- Immersion and user experience principles.

Deliverable: Submission of a UI prototype, including interaction flows and design documentation.

Module 3: Developing Augmented Reality Mobile Applications

Overview of AR Technologies:

- Introduction to ARCore, ARKit, and Vuforia.
- Understanding the differences in AR platforms.

Integrating 3D Models into AR:

- Steps for importing and positioning 3D models in AR environments.

Real-time Tracking & Interaction:

E: 20

- Implementing object recognition and tracking in AR.
- Interaction mechanisms: touch, gaze, and gesture.

Deploying AR Applications:

- Testing on AR-capable mobile devices.
- Troubleshooting deployment issues.

Deliverable: Deployment of an AR mobile application with functional real-time interactions.

Module 4: Virtual Reality Scenario Creation with Environmental Feedback

Introduction to VR Technologies:

- Overview of VR platforms and hardware (e.g., Oculus, HTC Vive).
- VR interaction models: hand tracking, room-scale VR, and controllers.

Environmental Feedback in VR:

E: 20

- Designing haptic feedback, spatial sound, and physical interactions.
- Creating reactive virtual environments based on user actions.

Real-Time Interaction in VR:

- Implementing physics-based interactions and dynamic environmental changes.

Evaluating VR Scenarios:

- Methods for testing and improving the effectiveness of VR feedback.
- Conducting user testing for environmental immersion.

Deliverable: Submission of a VR scenario with environmental feedback, including user feedback analysis.

Module 5: Integration and Final Evaluation

Integrating AR/VR Elements:

- Merging AR and VR systems into cohesive experiences.
- Synchronizing AR/VR applications across platforms.

Final System Evaluation:

- Assessing the effectiveness of the AR/VR system through user testing.
- Performance evaluation and optimization strategies.

E: 20

Final Presentation and Demo:

- Showcasing the fully developed AR/VR application with functional user interface and environmental feedback.

Deliverable:

- Live demonstration of the AR/VR system.
- Final project report and code repository (GitHub).
- To Publish AR/VR application for public access is preferable.

E:90; TOTAL: 90 PERIODS

Course code	**GENERATIVEAI**	**L**	**T**	**P**	**E**	**C**
23CS41E/ 23IT41E/ 23AD41E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Uponthesuccessfulcompletion of thecourse, thestudentswillbeableto

TheoryComponents

CO1:understandtheconceptsofGenerativeModeling. (CDL 1)
CO2:applylanguage models for generating Texts. (CDL 2)
CO3: apply GenAI concepts for generating images. (CDL 2)
CO4: apply variants of GAN models for painting, music and play. (CDL 2)
CO5: apply Prompt engineering concepts using GenAI tools. (CDL 2)

CO1: understand the concepts of Generative Modeling. (CDL 1)

Overview of Generative modeling - Gen AI Vs Discriminative Modeling–Generative models in AI and ML – Types of Generative models – GANs – Challenges of Generative Modeling – Future of Gen AI. **L:9**

CO2: apply language models for generating Texts. (CDL 2)

Language Models Basics – Building blocks of Language models - Transformer Architecture – Encoder and Decoder – Attention mechanisms - Generation of Text – Models like BERT and GPT models - Autoencoding – Exploring ChatGPT – Multimodal LLM – Issues of LLM like hallucination. **L:9**

CO3: apply GenAI models for generating images. (CDL 2)

Introduction to Generative Adversarial Networks – Adversarial Training Process – Nash Equilibrium – Variational Autoencoders – Encoder-Decoder Architectures – Transformer-based Image Generation– Visual Transformers ViT- Dall-E2 and Dall-E3, GPT-4V– Issues of Image Generation models like Mode Collapse and Stability. **L:10**

CO4: apply variants of GAN models for painting, music and play.(CDL 2)

Variants of GAN – Types of GAN - Cyclic GAN – Using Cyclic GAN to Generate Paintings – Neural Style Transfer – Style Transfer - Music Generating RNN – MuseGAN **L:8**

CO5: Apply Prompt engineering concepts using GenAI tools. (CDL 2)

Prompt Engineering– Designing Prompts – Revising Prompts using Reinforcement Learning from Human Feedback (RLHF) – Retrieval Augmented Generation. **L:9**

Open source tools: GPT4All – LangChain – Llama – Hugging Face.

TEXTBOOK

1. Denis Rothman,"Transformers for Natural Language Processing and Computer Vision", 3rd Edtion, PacktBooks,2024.

REFERENCES

1. David Foster, "Generative Deep Learning", O'Reily Books, 2024.
2. Altaf Rehmani,"Generative AIforEveryone",Blue Rose One, 2024

L: 45; TOTAL: 45 PERIODS

Course code	**AI FOR INDUSTRIAL APPLICATIONS**	**L**	**T**	**P**	**E**	**C**
23CS42E/ 23IT42E/ 23AD42E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Uponthesuccessfulcompletion of thecourse, thestudentswillbeableto

Theory Components

CO1: analyze the concepts and applications of industrial AI (CDL 1)
CO2: analyze the development of industrial revolutions and its applications (CDL 1)
CO3: analyze and apply digital twin technology for smart manufacturing and other industrial applications. (CDL 1)
CO4: apply Edge Computing concepts in IoT Devices (CDL 2)
CO5: evaluate real-world case studies to explore IoT applications in various industries. (CDL 2)

CO1: analyze the concepts and applications of industrial AI

Introduction: IndustrialAI - Scope and challenges -Applications – IMS architecture for **L: 9**

industrial AI-Visible and Invisible issues – Building the future with AI–Killer ApplicationsofIndustrialAI.

CO2: analyzethe development of industrial revolutions and its applications

Introduction: Industrial revolutions 1.0 to 4.0 - Technological advancement in Industry 4.0- Potential Benefits and drawbacks in Industrial 4.0 - Applications of Industry 4.0- Impact on Society - Introduction to Industrial 5.0 - Industrial 4.0 Vs Industrial 5.0. **L: 9**

CO3: analyze and apply digital twin technology for smart manufacturing and other industrial applications.

Data Analytics InIndustry 4.0: Digital Twins (DT)- Characteristics- Evolution- Data twin - physical world and digitalworld Classifications-Levelofintegration – Modelling digital twins – Smart manufacturing and Applications- Digital twins maintenance -predictive maintenance- Planning and operation phase- HybridanalysisandFleetdata. **L: 9**

CO4: Apply Edge Computing concepts in IoT Devices

Edge Computing:EdgeComputing Architecture - IoT Devices - Networking Architecture- Network Management and control - Interfaces and devices- Simulators. **L: 9**

CO5: Evaluate real-world case studies to explore IoT applications in various industries.

Case Studies: Healthcare -Manufacturing Industries - Supply chain Management - Inventory Management - Quality Control. **L: 9**

TEXT BOOKS:

1. Ramin Karim, Diego Galarand Uday Kumar, “AI Factory Theories, Applications and case Studies”, CRC Press, 2023
2. K.Anitha Kumari, G.Sudha Sadasivam, D. Dharani, M. Niranjanamurthy, "Edge Computing Fundamentals, Advances and Applications", CRC Press, 2022

REFERENCE BOOKS:

1. Ella Hassanien, Jyotir MoyChatterjee andVishalJain, “Artificial Intelligence and Industry4.0”, CRC Press, 2022.
2. Stevan Lawrence Fernandes TarunK.Sharma “Artificial Intelligence in Industrial Applications”, Springer publication,2022.
3. UtpalChakraborty,Amitbanerjee,JayantaKumarSaha, NiloySarkar,ChinmayChakraborty,“ArtificialIntelligenceandthe FourthIndustrialRevolution”,2022.

L: 45; TOTAL: 45 PERIODS

Course Code	REINFORCEMENT LEARNING	L	T	P	E	C
23AD43E		2	0	2	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1:explore the basic concepts of Reinforcement Learning(CDL1)

CO2:illustrate the Markov Decision Process to model reinforcement learning problems.(CDL1)

CO3:apply dynamic programming techniques to solve Monte Carlo problems. (CDL1)

CO4:implement Time Difference learning for real-world problems**. (CDL1)**

Practical Component

CO6:apply the fundamentals concepts of Reinforcement Learning(PDL1)

CO7:design and implement the Markov Decision Process & Monto Carlo techniques for real world application. **(PDL1)**

CO8: implement TD Learning and Q-Learning techniques for real time applications**. (PDL1)**

CO1:explore the basic concepts of Reinforcement Learning(CDL1) **L: 5**

Introduction–Elements of Reinforcement Learning–Scope–Agent–Environment Interface–Examples –Need of Reinforcement Learning –Challenges –Multi-Arm Bandit Problem. **P: 6**

CO6: apply the fundamentals concepts of Reinforcement Learning(PDL1)

- Installation of code standards and libraries used in RL(Python/Keras/Tensorflow)
- Implement Tic-tac-toe and Armed Bandit Problem.

CO2:illustrate the Markov Decision Process to model reinforcement learning problems(CDL1) **L: 7**

Overview of Markov Chain-Overview of Markov Decision Process-Model Reinforcement Learning- Problem using MDP–Bellman Equation for value functions–Optimal policy and optimal value functions – Policy Evaluation – Policy Improvement – Policy Iteration – Value Iteration. **P: 8**

CO7:design and implement the Markov Decision Process & Monto Carlo techniques for real world application. (PDL1)

- Find the optimal policy (sequence of actions) that minimizes the number of steps to reach the goal.
- Implement a robot control strategy to navigate a maze, collect a diamond, and avoid fire hazards.

CO3:apply dynamic programming techniques to solve Monte Carlo problems. (CDL1) **L: 8**

Monte Carlo Introduction – Policy Evaluation – Incremental Update – Exploration Vs Exploitation – Policy Improvement – Temporal Differencing Learning – TD Policy Evaluation – Epsilon-Greedy policy – On-policy Vs Off-policy – Q-Learning – SARSA Learning – Double Q-Learning – Applications of Q-Learning **P: 8**

CO7:design and implement the Markov Decision Process & Monto Carlo techniques for real world application. (PDL1)

- Implement **Monte Carlo Prediction** to estimate the **state-value function.**
- Implement **On-Policy Monte Carlo Control** to find the **optimal policy** that minimizes the number of steps to the goal and avoids penalties.

CO4:implement Time Difference learning for real-world problems.(CDL1)

Linear value function approximation–Challenges of Large-scale MDP–Value Function approximations–Stochastic Gradient Descent–Linear value and non-linear value approximation–Naïve Deep-Q Learning–Experience Replay-Advanced Deep RL: Actor-Critic Methods, AlphaZero **L: 10 P: 8**

CO8:implement TD Learning and Q-Learning techniques for real time applications.(PDL1)

Implement a **TD-learning based agent** (e.g., Q-learning or SARSA) to control the robotic arm and learn the **best sequence of actions** to complete the pick-and-place task.

Implement a **temporal-difference (TD) learning agent** to play Connect Four and learn the **optimal policy**

Text Books:

1. Maxim Lapan; "Deep Reinforcement Learning Hands-On: Apply modern RL algorithms to practical problems using Python and PyTorch", 2nd Edition, Packt Publishing, 2024.
2. Dimitri P. Bertsekas; "Reinforcement Learning and Optimal Control"; 1st Edition, Athena Scientific, 2024.

References:

1. Laura Graesser and Wah Loon Keng, "Foundations of Deep Reinforcement learning: theory and Practice in Python", Pearson India, 2022.
2. Richard S. Sutton and Andrew G. Barto; "Reinforcement Learning: Introduction"; 2nd Edition, MIT Press, 2020.

L: 30; P:30;TOTAL: 60 PERIODS

COURSECODE	ETHICAL AI	L	T	P	E	C
23AD46E		3	0	0	0	3

COURSE OUTCOMES

Uponthesuccessfulcompletionofthecourse,thestudentwillbeableto

TheoryComponents

CO1:explorethefoundational concepts ofethics related toAI.**(CDL1)**

CO2:applytheprinciplesoftrustandfairnessinAIsystemswithreal-worldexamples.**(CDL1) CO3:** analyze various risks associated with AI and strategies for managing risks. **(CDL 1)**

CO4:explorethechallengesandopportunitiesinAIethics,withafocusonsocietalissuesandusecases. **(CDL1)**.

CO1:explorethefoundational conceptsofethicsrelatedtoAI.(CDL1) **L:10**

Introduction to AI - Descriptive Ethics - Normative Ethics- Meta ethics - Applied ethics - Ethics Vs Law - Introduction to Machine Ethics and Robot Ethics- Ethical dilemmas in AI: Trolley problem and Beyond - Importance of ethics in AI design and deployment.

CO2:apply theprinciples of trust andfairnessinAIsystemswith real-world examples.(CDL1) **L:10**

User Acceptance and Trust - Functional Elements of Trust - Ethical Principles for Trustworthy and Fair AI - Responsibility and Liability in AI Systems: Use cases - Strict Liability - Complex Liability- Consequences of Liability.

CO3: analyze various risks associated with AI and strategies for managing risks. (CDL1) **L:10**

Business Ethics for AI Companies - General Business Risks - Ethical Risks – Managing Risk - Risks of AI to Workers- Psychological Aspects of AI: Problems of Anthropomorphisation - Persuasive AI -PrivacyIssues-DataCollectionanditsDangers.

CO4: explore the challenges and opportunities in AI ethics, with a focus on societal issues and use cases. (CDL 1) **L:15**

Challenges and opportunities in implementing ethical AI - Ethical issues in AI across domains- Societal implications: AI in healthcare, education and environment - AI in banking - Judicial AI - Ethical concerns in cyber security: ethical hacking, surveillance, facial recognition - National and international AI strategies and governancepolicies-RoleofAIinindustrialdecisionmakingandfuturetrends.

TEXTBOOKS

1. SeanWelsh,AlanR.Wagner,ChristophLutge,ChristophBartneck,"AnIntroductiontoEthicsin Robotics andAI",SpringerBriefsinEthics,2019.
2. MarkCoeckelberg,"AIEthics",TheMITPressEssentialKnowledgeseries,2020.

REFERNCES

1. S.MatthewLiao, "EthicsofArtificial
2. Intelligence",OxfordUniversityPress,2020.
3. EleanorBird,JasminFox-Skelly,NicolaJenner,RuthLarbey,EmmaWeitkampandAlanWinfield,"The ethics of artificial intelligence: Issues and initiatives", Springer, 2020.

L:45;TOTAL:45PERIODS

CourseCode	MINI CAPSTONE PROJECT	L	T	P	E	C
23AD50E		0	0	0	6	3

COURSEOUTCOMES

Upon the completion of this course, the students will be able to

Experiential Component :

CO1: formulate problem statements in the Artificial Intelligence domain, perform a feasibility studyand design a suitable AI-based solution. (PDL1)

CO2: develop a functional prototype using the forward engineering process. (PDL2)

Soft skill Component:

CO3: demonstrate effective collaboration with peers by exhibiting strong communication, teamwork and problem-solving abilities to improve employability.

The project work shall be undertaken either individually or in a team comprising a maximum of four students, In the case of team projects, each student must submit an individual project report clearly indicating their specific contributions to the work. The project assessment will be based on the presentation, demonstration, and quality of the report. The project progress will be evaluated through three periodic reviews:

- Review I: Evaluation of problem identification, literature survey, and feasibility analysis of the proposed project.
- Review II: Assessment of design methodology, model/framework/prototype development.
- Review III: Final evaluation involving demonstration of the developed prototype/product and report submission.

E: 90; TOTAL: 90 PERIODS

Course code	**DATA MINING**	**L**	**T**	**P**	**E**	**C**
23CS62E/ 23IT62E/ 23AD62E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Components

CO1: explore the data mining process and apply techniques to mine diverse forms of knowledge.

CO2: apply pattern mining techniques in various applications for the discovery of patterns.

CO3: apply classification techniques for real-world problems.

CO4:design and implement clustering in resource-constrained environments.

CO5: develop practical solutions to implement outlier detection in various applications.

CO1: design and implement data mining projects and model data using schema.

Data mining: an essential step in knowledge discovery - Diversity of data types for data mining - Mining various kinds of knowledge - Data mining: confluence of multiple disciplines – Application. Data, measurements, and data preprocessing: Data types - Statistics of data - Similarity and distance measures - Data quality, data cleaning, and data integration - Data transformation - Dimensionality reduction. Data warehouse: Modeling - schema and measures - OLAP operations - Data cube computation. **L: 9**

CO2: apply pattern mining techniques in various applications for the discovery of patterns.

Pattern mining: basic concepts and methods - Frequent itemset mining methods —Pattern evaluation methods - Mining various kinds of patterns - Mining compressed or approximate patterns - Constraint-based pattern mining - Mining sequential patterns - Mining subgraph patterns – Pattern mining: application examples. **L: 9**

CO3: apply classification techniques for real-world problems.

Classification: basic concepts - Decision tree induction - Support vector machines - Rule-based and pattern-based classification – C4.5 algorithm- Classification with weak supervision – Classification with rich data type. **L: 9**

CO4: design and implement clustering in resource-constrained environments.

Cluster analysis: basic concepts and methods – k-means clustering - agglomerative clustering – DBSCAN and STING - Biclustering - Semisupervised clustering. **L: 9**

CO5: develop practical solutions to implement outlier detection in various applications.

Outliers and Outlier Analysis - Outlier Detection Methods - Statistical Approaches - Proximity-Based Approaches - Clustering-Based Approaches - Classification-Based Approaches - Mining Contextual and Collective Outliers - Outlier Detection in High-Dimensional Data. **L: 9**

TEXT BOOKS:

1. Jiawei Han, Jian Pei, Hanghang Tong, "Data Mining: Concepts and Techniques" 4th Edition, Elsevier, 2023.
2. Parteek Bhatia, "Data Mining and Data Warehousing: Principles and Practical Techniques", 1st Edition, Cambridge University Press, 2019.

REFERENCE BOOKS:

1. Charu C. Aggarwal, "Data Mining: The Textbook", Springer International Publisher, 2015.
2. Pawel Cichosz, "Data Mining Algorithms: Explained Using R", John Wiley & Sons, 2015.
3. Pang-Ning Tan,VipinKumar,Michael Steinbach, "Introduction to Data Mining", Pearson Education India, 2012.

L: 45; TOTAL: 45 PERIODS

Course code	**DATA ENGINEERING**	**L**	**T**	**P**	**E**	**C**
23CS63E/ 23IT63E/ 23AD63E	(Common to CSE, IT and AI & DS degree Programmes)	**2**	**0**	**2**	**0**	**2**

COURSE OUTCOMES

Upon completion of this course, the students will be able to

Theory Component

CO1: apply data engineering principles for data management and integration (CDL2)

CO2: analyze data modeling methodologies to design precise and efficient database solutions (CDL2)

CO3: apply resource management techniques for file-oriented systems (CDL2)

Practical Component

CO4: implement data extraction, transformation, and loading processes in database systems (PDL2)
CO5: demonstrate the OLAP modeling techniques (PDL2)
CO6: build data handling solutions for the real-life scenarios (PDL2)

CO1:apply data engineering principles for data management and integration

CO4:implement data extraction, transformation, and loading processes in databasesystems

Introduction to Data Engineering - Big Data and its characteristics - Data Lifecycle – Data Pipeline – Components – ETL process – ELT process – Containers – VM vs Container. **L:8**

Extract data from a CSV file, clean and transform it by removing duplicates, standardizing formats, and aggregating relevant metrics. Load the transformed data into a relational database (e.g., MySQL) for structured reporting and a NoSQL database (e.g., MongoDB) for flexible analytics. Verify data integrity by querying both databases and deploy this application in container **P:6**

CO2:analyze data modeling methodologies to design precise and efficient database solutions

CO5: demonstrate the OLAP modeling techniques

Introduction to analytical data modeling methodologies -ER modeling- Dimensional modeling Star schema-Snowflake schema-Data Vault - One Big table modeling- data lakes- data warehouse. **L:11,**

For a dataset in repository list down the data sources and model the data with the appropriate schema. Model the aggregate tables. Populate the aggregate tables with the metrics for a specific time period. Drilldown the metrics using the SQL operators such as Grouping sets, Cube, Roll up, Pivot. Bonus points if a metric uses time windows. **P:8**

CO3: apply resource management techniques for file-oriented systems

CO6: build data handling solutions for the real-life scenarios

HDFS- Map Reduce- Spark- Advantages of spark over map reduce-Spark's application execution mechanism - Narrow and wide transformation in spark.-Shuffles in spark- ACID properties to file systems- introduction on Apache Hudi, Apache Iceberg and Delta lake. **L:7,**

Setup and configure spark and read the tables. Replicate the metrics table from the previous experiment in PySpark/Scala/Java. Write the output table back to a file system as parquet. Recreate the tables from previous experiments as Hudi/Iceberg tables in a file system. **P:12**

SOFTWARE REQUIREMENTS

- MS-SQL / Oracle SQL / PostgreSQL
- Python 3.7+ / 4.0 IDLE,
- APACHE SPARK
- APACHE HUDI, APACHE ICEBERG

TEXT BOOKS:

1. I. Triguero and M. Galar, "Large-Scale Data Analytics with Python and Spark: A Hands-on Guide to Implementing Machine Learning Solutions", Cambridge: Cambridge University Press, 2023.
2. Paul Krickard, "Data Engineering with Python", Packt Publishing, 2020.
3. Andreas Kretz, "The Data Engineering Cookbook", 2019.

REFERENCE BOOKS:

1. Wilfried Lemahieu, Seppe vandenBroucke, Bart Baesens," Principles of Database Management: The Practical Guide to Storing, Managing and Analyzing Big and Small Data", Cambridge University Press, 2018.
2. Silberschatz, Korth, Sudarshan, "Database System Concepts", McGraw Hill Education, 7th Edition,2020.
3. Ralph Kimball Margy Ross ,"The Data Warehouse toolkit by Ralph Kimball",Wiley Computer Publishing,2013

L: 30; P: 30; TOTAL: 60 PERIODS

Course code	**IMAGE AND VIDEO ANALYTICS**	**L**	**T**	**P**	**E**	**C**
23CS64E/ 23IT64E/ 23AD64E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSEOUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Components

CO1: utilize the fundamentals of digital image processing.(CDL1)

CO2**: a**pply the knowledge of various techniques in image enhancement and frequency transform. (CDL1)

CO3: apply the restoration and boundary detection techniques to restore images and extract edges. (CDL2)

CO4: elaborate on deep learning based video analytics (CDL2)

CO5**:** develop image and video analytics models for real time application (CDL2)

CO1: utilize the fundamentals of digital image processing.

Digital Image fundamentals -Components of Image Processing-Image Sensing and Acquisition-Image Sampling and quantization-Relationship between pixels-Distance Measures-Colour Fundamentals and Models **L: 8**

CO2: apply the knowledge of various techniques in image enhancement and frequency transform.

Discrete Fourier Transform – Fast Fourier Transform – Wavelet Transforms - Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing –Spatial Filtering – Smoothing And Sharpening – Filtering in Frequency Domain **L: 9**

CO3: apply the restoration and boundary detection techniques to restore images and extract edges. **L: 9**

Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters - Morphological Operations- Dilation-Erosion-Opening-Closing- Edge Detection-Detection Of Discontinuities Edge Linking and Boundary Detection

CO4: elaborate on deep learning based video analytics

Video Processing – use cases of video analytics-Vanishing Gradient and exploding gradient problem-RestNet and skip connections - Inception Network - GoogleNet architecture-Improvement in Inception v2-Video analytics-RestNet and Inception v3. **L: 9**

CO5: develop image and video analytics models for real time application (CDL2)

YOLO,R-CNN,U-Net,CBVR(Content Based Video Retrieval)-Industrial- Transportation & Travel- Remote Sensing - Surveillance- Example based video search-Intelligent traffic video analytics **L: 10**

TEXT BOOKS:

1. EI-Sayed M EL-Alfy, GeorageBebis, MengChu Zhou, "Intelligent Image and Video Applications",1st Edition, 2023.
2. Rafael C Gonzalez, Richard E Woods, "Digital Image Processing", Pearson Education, 4th Edition,2018.

REFERENCE BOOKS:

1. Wilhelm, Mark J. Burge, "Digital Image Processing An Algorithmic Introduction", Springer; 3rd Edition, 2022.
3. VaibhavVerdhan, "Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras" 1st Edition, Springer 2021.
4. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, "Video Analytics for Business Intelligence", 1st Edition, Springer, 2016.

L: 45; TOTAL: 45 PERIODS

Course code	**HEALTHCARE ANALYTICS**	**L**	**T**	**P**	**E**	**C**
23CS65E/ 23IT65E/ 23AD65E	(Common to CSE, IT and AI & DS degree Programmes)	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Uponthesuccessfulcompletion of thecourse, thestudentswillbeableto

TheoryComponents

CO1: explore various sources of healthcare data and perform basic analytics on those data.(CDL 1)
CO2: analyze various biomedical modalities and Biomedical Signals. (CDL 2)
CO3: apply sensor data for healthcare analytics. (CDL 1)
CO4: apply advanced data analytics concepts for healthcare. (CDL 2)

CO1: explore the various sources of healthcare data and perform basic analytics on those data.

Overview of Healthcare Data Sources: Electronic Health Records (EHR), Biomedical Images, Senor Data, Biomedical signals, Genomic data, Clinical Data, Social Media data, and its analysis – EHR: Components, Benefits, Barriers to Adopting EHR, Challenges – Phenotyping Algorithms – Overview of Coding Systems: ICD, ICF, UMLS, DICOM – Introduction to Data Analytics for Healthcare: Clinical prediction, Temporal and visual **L: 12**

analytics, Clinic – Genomic Data Integration, Privacy Preservation – Data Publishing.

CO2: analyze various biomedical modalities and Biomedical Signals.

Overview of Biomedical Imaging Modalities: CT, PET, MRI, Ultrasound, Microscopy, Biomedical Imaging Standards and Systems – Object Detection: Template Matching, Model – Based Detection, Data – Driven Detection Methods – Image Segmentation - Introduction to biomedical signals – Types of Biomedical Signals – Denoising of Signals – Multivariate Biomedical Signal Analysis – Recent Trends in Biomedical image and Signal Analysis **L: 12**

CO3: apply sensor data for healthcare analytics.

Sensor Data in Medical Informatics: Scope – Challenges – Sensor Data Mining Applications: Intensive Care Data Mining – Nonclinical Healthcare Applications: Chronic Disease and Wellness Management, Activity Monitoring and Reality Mining – Data Analytics for Pervasive Health: Body area Networks, Dense/Mesh Sensor Networks, Sensor Technology –Applications: Continuous Monitoring, Assisted Living **L: 9**

CO4: apply advanced data analytics concepts for healthcare.

Introduction to Clinical Prediction Models: Basic Statistical Prediction Models, Alternative Clinical Prediction Models, Survival Models, Evaluation and Validation – Visual Analytics for Healthcare: Introduction, Public Health and Population Research, Clinical Workflow, Clinicians, Patients – Legal and Ethical Issues in Clinical Decision Support Systems – Fraud Detection in Healthcare. **L: 12**

TEXT BOOKS:

1. Chandan K. Reddy and Charu C. Aggarwal, "Healthcare Data Analytics", CRC Press, 2020.
2. Jaya, K. Kalaiselvi, Dinesh Goyal, "Handbook on Intelligent Healthcare Analytics: Knowledge Engineering with Big Data", Wiley publications, 2022.

REFERENCE BOOKS:

1. Pantea Keikhosrokiani, "Big Data Analytics for Healthcare: Datasets, Techniques, Life Cycles, Management, and Applications", Academic Press, Elsevier publications,2022

L: 45; TOTAL: 45 PERIODS

Course Code	PRINCIPLES OF BUSINESS ANALYTICS	L	T	P	E	C
23CS66E / 23IT66E / 23AI66E	**Common to CSE, IT and AI&DS Degree Programmes**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: recognize the role of analytics in business for problem solving and decision-making. (CDL1)
CO2: apply hypothesis testing and non-parametric tests for decision-making. (CDL2)
CO3: analyze data distributions using statistical measures for effective data interpretation. (CDL2)
CO4: apply regression modeling to perform hypothesis testing, and predictive analytics in real-world applications. (CDL2)
CO5: apply Prescriptive Analytics Techniques to Optimize Business Processes. (CDL1)

CO1:recognize the role of analytics in business for problem solving and decision-making (CDL1) **L:9**

Introduction to Business Analytics: Evolution of Business Analytics – Scope – Data for Business analytics - Models in Business Analytics: Decision models- Uncertainty and Risk- Prescriptive Decision Models- Problem solving with Analytics: Recognizing and defining the problem – Structuring and analyzing the problem – Interpreting results and making a decision.

CO2: apply hypothesis testing and non-parametric tests for decision-making (CDL2) **L:9**

Hypothesis Testing – One- Sample Hypothesis test – Two tailed test of Hypothesis for the mean- Two sample hypothesis tests- One way and two way analysis of variance(ANOVA)- Non parmetric Tests: Chi-Square Goodness of Fit Tests – Choice of Number of Intervals in Chi- Square- Chi-Square test for Independence.

CO3: analyze data distributions using statistical measures for effective data interpretation (CDL2) **L:9**

Introduction – Data types and Scales – Types of Data measurement scales- Population and sample – Measures of central tendency – Percentile, Decile and Quartile – Measures of variation: Range – Inter-Quartile Distance – Variance and standard Deviation- Chebyshev's Theorem- Measures of shape – skewness.

CO4: apply regression modeling to perform hypothesis testing, and predictive analytics in real-world applications (CDL2) **L:9**

Modeling relationships and Trends in data – Simple linear regression: Finding best fitting regression line – Least squares regression – Testing hypotheses for regression coefficients – Multiple linear regression – Correlation and multi-collinearity. Case Study: Application of predictive analytics in customer retention or sales forecasting.

CO5: apply Prescriptive Analytics Techniques to Optimize Business Processes (CDL1) **L:9**

Introduction to prescriptive analytics –Linear programming model building – Sensitivity analysis in Linear programming problem – Solve the problem using Graphical method – Range of optimality – Range of shadow price- Dual linear programming – Primal Dual relationships – Multi-period models.

TEXT BOOKS

1. U Dinesh Kumar, "Business Analytics: The Science of Data-Driven Decision Making," 2nd Edition, Wiley, 2021.
2. R. Evans James, "Business Analytics", 2nd Edition, Pearson, 2017

REFERENCES:

1. Foster Provost and Tom Fawcett, "Data Science for Business," O'Reilly Media, 2021.
2. Randy Bartlett, "Business Analytics: A Practitioner's Guide," McGraw-Hill Education, 2013.
3. Galit Shmueli, Peter C. Bruce, Nitin R. Patel, "Data Mining for Business Analytics: Concepts, Techniques, and Applications in R," Wiley, 2018.
4. Eric Siegel, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die," Wiley, 2016.

L: 45; TOTAL: 45 PERIODS

Course Code	FEATURE ENGINEERING	L	T	P	E	C
23CS67E/ 23IT67E/ 23AI67E		**2**	**0**	**0**	**2**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: recognize the importance of key feature engineering and data preprocessing techniques for data preparation. (CDL2)

CO2: apply various feature encoding methods to build machine learning models. (CDL2)

CO3:analyze the impact of density-based outlier detection methods to improve model performance. (CDL2)

CO4: apply feature selection and dimensionality reduction techniques to solve real-world problems. (CDL2)

Experiential Component

CO5: Design and implement data preparation and feature engineering techniques to enhance model performance on real-world datasets. (PDL3)

CO1: recognize the importance of key feature engineering and data preprocessing techniques for data preparation. **L:7**

Overview – Importance of Feature Engineering in Data Science – Feature Engineering Pipeline – Feature Engineering in Data Science. Types of data – Levels of data – Types of Feature Engineering – Evaluation metrics. Data preprocessing Techniques for handling missing data. Handling noisy data: Smoothing filters, Denoising algorithms.

CO2: apply various feature encoding methods to build machine learning models. **L:7**

Feature Extraction – Temporal Features – Textual Features – Numeric Features – Categorical Features – Types of Feature Creation – Polynomial features and interaction terms – Binning and discretization techniques – Feature Encoding – Feature hashing and feature embedding – Function, Exponential, Quantile transformations – Feature Scaling – Standardization – Normalization.

CO3: analyze the impact of density-based outlier detection methods to improve model performance. **L:8**

Outlier and Outlier Detection: Univariate and Multivariate Outlier – Distributions to detect Outliers - Techniques for Removal of Outliers: Z-score, Trimming, Capping, Discretization Techniques, Mahalanobis distance. Density-based methods: DBSCAN, HDBSCAN, LOF, HDIOD, TPOD, Isolation Forests, One-class SVM for outlier detection.

CO4: apply feature selection and dimensionality reduction techniques to solve real-world problems. **L:8**

Classes of feature selection methodologies – Effect of irrelevant features – Filter Methods: Chi-square test, Fisher's Score, Correlation coefficient – Wrapper Methods: Forward Selection, Bi-directional Elimination, Recursive Feature Elimination (RFE).

CO5:Design and implement data preparation and feature engineering techniques to enhance model performance on real-world datasets. (PDL3) **E:30**

Analyze real-world datasets and perform the following:

- **Load and Explore Data:** Import the dataset, identify data types (numeric, categorical, text, temporal) and check for missing or noisy data.
- **Handle Missing and Noisy Data:**Apply imputation (mean, median, KNN), smoothing filtersor denoising techniques to clean the dataset.

- **Conduct Review I meeting for evaluating the performance.**
  - **Feature Extraction:** Extract features from textual, temporal, numeric and categorical data using suitable methods.
  - **Feature Encoding:**Use techniques like one-hot encoding, feature hashing or embeddings to convert categorical/textual data into numerical form.
  - **Apply Feature Transformations:** Use transformations such as logarithmic, quantile or exponential to adjust data distribution.
- **Conduct Review II evaluation.**
  - **Scale Features:**Normalize or standardize numerical features using min-max scaling, z-score normalization or robust scaling.
  - **Detect and Handle Outliers:** Identify outliers using statistical (Z-score, IQR) or density-based methods (LOF, Isolation Forest) and assess their impact.
  - **Feature Selection & Model Evaluation:**Use techniques like correlation, PCA or Lasso for feature selection and evaluate model performance using appropriate metrics.

Conduct Review III evaluation.

Text Books:

1. Sinan Ozdemir, "Feature Engineering Bookcamp", 1st Edition, Manning Publications, 2022.
2. Max Kuhn and Kjell Johnson, “Feature Engineering and Selection: A Practical Approach for Predictive Models”, CRC PressTaylor& Francis Group, 2020.

References:

1. Alice Zheng and Amanda Casari, "Feature Engineering for Machine Learning: Principles and Techniques", 1st Edition, O'Reilly Media, 2018.
2. Sinan Ozdemir and Divya Susarla, "Feature Engineering Made Easy: Identify Unique Features from Your Dataset in Just 30 Minutes", 1st Edition, Packt Publishing, 2018.

L: 30; E: 30; TOTAL: 60 PERIODS

CourseCode	PREDICTIVE ANALYTICS	L	T	P	E	C
23CS68E / 23IT68E / 23AI68E		3	0	0	0	3

COURSEOUTCOMES

Uponthesuccessfulcompletion of thecourse, thestudentswillbeableto

TheoryComponent

CO1: Explain the foundational concepts of predictive analytics and their role in business decision-making. **(CDL 1)**

CO2: Identify components of time series data and apply decomposition methods for business

forecasting. **(CDL 1)**

CO3: Construct statistical forecasting models and apply discriminant analysis techniques for classification in business scenarios**. (CDL 2)**

CO4: Apply predictive and discriminant analytic techniques in real-world business cases for planning and decision-making.**(CDL 2)**

CO1: Explain the foundational concepts of predictive analytics and their role in business decision-making. (CDL 1) **L:12**

Overview of Predictive Analytics: purpose and scope - Descriptive vs. Predictive vs. Prescriptive Analytics - Predictive Analytics vs. Business Analytics - Data-Driven Decision Making in Business - Applications in finance, HR, marketing, and operations - Role of Predictive Analysts in Organizations.

CO2: Identify components of time series data and apply decomposition methods for business forecasting. (CDL 1) **L:12**

Structure and types of time series data - Components: Trend, Seasonality, Cyclical, Irregular-Additive vs. Multiplicative decomposition - Smoothing techniques: moving average, exponential smoothing - Seasonally adjusted series and business use cases - Evaluation of Forecast Accuracy - Graphical Analysis and Visualization of Time Series Data.

CO3: Construct statistical forecasting models and apply discriminant analysis techniques for classification in business scenarios. (CDL 2) **L:12**

Naïve, average, and trend models - Holt and Holt-Winters exponential smoothing - ARIMA - Fisher's Linear Discriminant Function - Prior probabilities, misclassification costs - Performance evaluation of discriminant analysis - Prior probabilities and misclassification costs - Classification with more than two groups

CO4:Apply predictive and discriminant analytic techniques in real-world business cases for planning and decision-making. (CDL 2) **L:12**

Demand Forecasting for Inventory and Supply Chain - Credit Risk Prediction using Discriminant Logic - Sales and Revenue Forecasting - HR Analytics: Employee Attrition Forecasting - Ethical issues and limitations in prediction - Case study discussion and model interpretation - Communicating analytical results to business stakeholders - Report structuring and presentation best practices - Business use-case simulation in Excel.

TEXTBOOKS:

1. Dean Abbott, "Applied Predictive Analytics: Principles and Techniques for the Professional Data Analyst", Wiley, 2014.
2. Rob J. Hyndman & George Athanasopoulos, "Forecasting: Principles and Practice", 3rd Edition, OTexts, 2021.
3. J. Holton Wilson & Barry Keating, "Business Forecasting", McGraw-Hill Education, 2009.
4. Lind, Marchal, Wathen, "Statistical Techniques in Business and Economics",McGraw-Hill College, 2020.

REFERENCES:

1. Max Kuhn, Kjell Johnson, "Applied Predictive Modeling", Springer publications,2013.

L:45;TOTAL:45PERIODS

Course Code	**MINI - CAPSTONE PROJECT**	**L**	**T**	**P**	**E**	**C**
23YYXXE		**0**	**0**	**0**	**6**	**3**

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Experiential Component:

CO1: Apply data preprocessing for effective data modeling. (PDL2).

CO2: Apply feature engineering & data mining techniques to discover hidden patterns that supports strategic decision making in business. (PDL2).

CO3: Develop predictive models solutions for the text/image/video analytics based applications. (PDL2).

CO1: Applydata preprocessing for effective data modeling. (PDL2).

Module 1: **E:20**

- Define the business objective and identify KPIs & success metrics. Collect structured/semi-structured/unstructured data.
- Understand distribution, trends, patterns, correlations, and outliers in data.
- Clean the data, handle missing values, normalize, and resolve inconsistencies.

Deliverables:

- Confirming business objective & key performance indicators.
- Guide approved project proposal document.

CO2: Apply feature engineering & data mining techniques to discover hidden patterns that supports strategic decision making in business. (PDL2).

Module 2: **E:20**

- Apply feature engineering, to derive new attributes.
- Encode categorical variables and reduce dimensionality if needed.

Deliverables:

- Reduced dimensionality data sheet after applying feature engineering.

Module 3: **E:20**

- Apply classification/clustering/association techniques to explore hidden patterns in the data.
- Train classification or regression models for future prediction or decision support.
- Measure performance using various metrics.

Deliverables:

- Trained model training using R/Python code report
- Insights and business interpretation.

CO3: Develop predictive model solutions for the text/image/video analytics based applications. (PDL2)

Module 4: • Apply techniques such as CNNs, motion tracking to extract insights for the image/video analysis projects with machine learning or deep learning. **E:15**

Deliverables:

- Architecture model and visual demonstration.

Module 5: • Present insights using dashboards, graphs, and visual reports. **E:15**

- Relate patterns andpredictions to high-level decisions.

Deliverables:

- Interactive dashboard with identified business decision demonstration.

Example Project titles:

1. Sentiment analysis of customer reviews in text analytics.
2. Fraud detection in financial transactions.
3. Sales forecasting in retail or manufacturing area.
4. Image-based product categorization in image analytics
5. Video surveillance for security in video analytics.
6. Chatbot feedback and Query analysis in text analytics.
7. Employee attrition analysis in HR analytics.
8. Social media digital marketing analytics.
9. Customer lifetime value prediction for the E-commerce applications.

Course Code	SOCIAL NETWORK SECURITY	L	T	P	E	C
23CS55E/ 23IT55E / 23AI55E		3	0	0	0	3

COURSEOUTCOMES

Upon the successful completion of the course, the student will be able to

CO1: Recognize security challenges and vulnerabilities in social networking platforms. (CDL1)

CO2: Apply AI/ML techniques for behavioral analysis and user profiling in social network security. (CDL2)

CO3: Detect and prevent cyber threats using AI/ML approaches, including phishing attacks and malware detection.(CDL2)

CO4: Develop strategies for securing cloud-based and IoT-integrated social networks. (CDL2)

CO5: Design access control mechanisms and ensure compliance with privacy regulations. (CDL2)

CO1: Recognize security challenges and vulnerabilities in social networking platforms. (CDL1) **L:9**

Introduction to Social networks. Types of Social media, Social media platforms, Social media monitoring, Hashtag, Viral content, Social media marketing, Social media privacy, Challenges, opportunities and pitfalls in online social network, Security issues related to social media.

CO2: Apply AI/ML techniques for behavioral analysis and user profiling in social network security.(CDL2) **L:8**

AI/ML for behavioral analysis in social networks – User behavior profiling – Anomaly detection – Fraud detection techniques – Hands-on: K-Means clustering for user behavior, Naive Bayes for email spam detection.

CO3: Detect and prevent cyber threats using AI/ML approaches, including phishing attacks and malware detection. (CDL2) **L:10**

Cyber threat detection using AI/ML – Phishing attack detection with Logistic Regression and Random Forest – Malware classification using SVM – URL threat detection using CNN & NLP – Intrusion detection using Deep Learning (LSTM, Autoencoders).

CO4: Develop strategies for securing cloud-based and IoT-integrated social networks. (CDL2) **L:10**

Cloud security challenges in social platforms–IoTsecurity:Securing device ecosystems and dataflow–Integration of cloud and IoT security:End-to-endprotection strategies Hands-on Applications: Secure Cloud File Storage with AES Encryption - Simulating IoT Attacks and Detection Using Wire shark

CO5: Design access control mechanisms and ensure compliance with privacy regulations.(CDL2) **L:8**

Role-Based and Attribute-Based Access Control in social networks – Fine-grained access policies –Privacy-Enhancing Technologies: Data anonymization – pseudonymization - encryption to safeguard user data – Legal Frameworks and Compliance: GDPR - CCPA – DPDP

TEXTBOOKS

1. WilliamStallings,NetworkSecurityEssentials:ApplicationsandStandards, 6th Edition, Pearson, 2020.
2. B.A.Forouzan,CryptographyandNetworkSecurity,3rd Edition,Tata McGraw-Hill, 2016.

REFERENCES

1. Soma Halder & Sinan Ozdemir, Hands-On Machine Learning for Cybersecurity, Packt Publishing, 2018.
2. Mark Stamp, Information Security: Principles and Practice, 3rd Edition, Wiley, 2021.
3. Vishal Chopra, Phishing and Countermeasures: Understanding the Threats and Defending Against Attacks, Springer, 2022.
4. Nina Godbole & Sunit Belapure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2011.
5. ChuanlongXie,HaibinZhu,MachineLearningandSecurity,O'Reilly,2018.
6. PaulBradley,SocialEngineering:TheArtofHumanHacking,Wiley,2011.

L:45;TOTAL:45PERIODS

Course Code	CYBER SECURITY AND ETHICAL HACKING	L	T	P	E	C
23CS56E/ 23IT56E/ 23AD56E		2	0	2	0	3

COURSEOUTCOMES

Upon the successful completion of the course, the students will be able to

Theory Component

CO1: Outline the fundamentals of cyber security, including threats, terminologies, and legal frameworks. (CDL1)

CO2: Identify system and network vulnerabilities using ethical hacking methodologies. (CDL1)

CO3: Apply security measures to mitigate cyber threats such as MITM attacks, session hijacking, and remote exploitation. (CDL2)

CO4: Apply exploitation techniques and mitigation strategies for web, wireless, and mobile platform attacks. (CDL2)

Practical Component

CO5: Implement fundamental cyber security practices using industry-standard tools like Kali Linux, Wireshark, and Ettercap. (PDL1)

CO6: Conduct ethical hacking tasks using reconnaissance and exploitation frameworks such as Nmap, Metasploit, and Burp Suite. (PDL1)

CO1: Outline the fundamentals of cyber security, including threats,terminologies, and legal frameworks.

Introduction to Cyber Security: Evolution, importance, and impact of cyber securityin modern systems - Threats & Vulnerabilities: Definition, types of cyber threats - Cyber Security Terminologies: Key concepts including CIA triad - Cybercrime & LegalFrameworks: Classification of cybercrimes, types of cybercriminals, globalperspectives on cyber security laws - Cyber Laws & IT Act: Overview of cyber laws,Indian IT Act, cybercrime punishments. **L:6 P:3**

CO5: Implement fundamental cyber security practices using industry-standardtools like Kali Linux, Wireshark, and Ettercap.

Setting up Kali Linux, Password Cracking: Crackstation, hash identificationtechniques, Google Dorking: Using Google Hacking Database (GHDB) forreconnaissance

CO2: Identify system and network vulnerabilities using ethical hackingmethodologies.

Introduction to Ethical Hacking: Concepts, objectives, and methodologies inpenetration testing - Footprinting& Reconnaissance: Gathering intelligence, hackercategories, social engineering techniques - Scanning & Enumeration: Port scanning,network scanning, vulnerability assessment methods - Exploitation Techniques:Banner grabbing, OS fingerprinting, scanning methodologies (Nmap, Ping Sweep). **L:6 P: 9**

CO6: Conduct ethical hacking tasks using reconnaissance and exploitationframeworks such as Nmap, Metasploit, and Burp Suite.

Reconnaissance Tools: Amass for OS fingerprinting, NESSUS for vulnerabilityassessment, Exploitation Tools: Metasploit framework for vulnerability exploitation.

CO3: Apply security measures to mitigate cyber threats such as MITM attacks,session hijacking, and remote exploitation. **L:6 P:6**

Network Security Measures: Network sniffing (promiscuous vs. non-promiscuousmodes), intrusion detection methods - MITM Attacks & Countermeasures: ARPspoofing, MAC flooding, SSL stripping, DNS poisoning, protective measures -

Session
Hijacking & DoS Attacks: TCP session hijacking, denial-of-service attack types, mitigation strategies - Remote Exploitation: SMTP and SQL vulnerabilities, securing servers against common exploits.

CO5: Implement fundamental cyber security practices using industry-standardtools like Kali Linux, Wireshark, and Ettercap.

Network Analysis: Wireshark for packet inspection, Ettercap for MITM attacks.

CO4: Apply exploitation techniques and mitigation strategies for web, wireless,and mobile platform attacks.

Web Security: Web server and web application hacking (SQL injection, parametertampering, broken authentication) - Wireless Security Threats: Wi-Fi encryption,WPA/WEP cracking, rogue access point detection - Mobile Platform Exploitation:Mobile malware, app vulnerabilities, Android and iOS security models – MitigationStrategies: Intrusion prevention, secure software development practices, encryptionmethods. **L:6 P:6**

CO6: Conduct ethical hacking tasks using reconnaissance and exploitationframeworks such as Nmap, Metasploit, and Burp Suite.

Web Application Security: Nuclei scanner for automated security assessments, Burp Suite for web application penetration testing.

TEXT BOOKS

1. Dr. Erdal Ozkaya, "Cybersecurity: The Beginner’s Guide", Packt Publishing, 2020.
2. Dafydd Stuttard& Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", John Wiley & Sons, 2nd Edition, 2020.
3. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No Starch Press, 2024.

REFERENCE BOOKS

1. David Kennedy, Jim O’Gorman, Devon Kearns, Mati Aharoni, "Metasploit: The Penetration Tester’s Guide", No Starch Press, 2023.
2. Allen Harper, Shon Harris, "Gray Hat Hacking: The Ethical Hacker’s Handbook", 6th Edition, McGraw Hill, 2022.
3. Yuri Diogenes & Erdal Ozkaya, "Cybersecurity – Attack and Defense Strategies", 3rd Edition, Packt Publishing, 2022.
4. Donovan, Martin, “Hacking: Learn the Basics of Ethical Hacking and Penetration Testing”, 2019.
5. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2020.

WEB REFERENCES

- https://owasp.org/
- https://www.kali.org/docs/
- https://attack.mitre.org/
- https://www.sans.org/security-resources/
- https://www.eccouncil.org/train-certify/certified-ethical-hacker-ceh/

L:30; P:30; TOTAL: 60PERIODS

Course Code	DIGITAL FORENSICS	L	T	P	E	C
23CS59E/ 23IT59E/ 23AD59E		3	0	0	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the students will be able to

CO1: identify digital forensics concepts and apply forensic procedures to manage digital evidence. (CDL1)
CO2: analyze cybercrime laws and apply forensic readiness and legal methods to handle digital evidence. (CDL1)
CO3: apply forensic methods to analyze digital, mobile, and embedded evidence. (CDL2)
CO4: apply internet and memory forensic techniques for evidence acquisition and analysis in investigations. (CDL2)
CO5: apply legal and forensic practices to tackle digital investigation challenges. (CDL1)

CO1: identify digital forensics concepts and apply forensic procedures tomanage digital evidence. (CDL1)

History of Forensic Science – Digital Forensics – Digital Evidence – The DigitalForensics Process: Identification Phase – Collection Phase – ExaminationPhase – Analysis Phase – Presentation Phase. **L:9**

CO2: analyze cybercrime laws and apply forensic readiness and legalmethods to handle digital evidence. (CDL1)

Introduction to Cybercrime Law – International Legal Framework of CybercrimeLaw – Digital Crime – Substantive Criminal Law – Investigation Methods forCollecting Digital Evidence – International Cooperation in Order to Collect DigitalEvidence – Digital Forensic Readiness – Law Enforcement vs. Enterprise DigitalForensic Readiness – Frameworks, Standards, and Methodologies – CERT–InGuidelines for Handling and Reporting Cyber Incidents. **L:9**

CO3: apply forensic methods to analyze digital, mobile, and embeddedevidence. (CDL2)

Introduction to Computer Forensics - Evidence Collection – Examination –Analysis – Mobile and Embedded Forensics: Collection Phase – ExaminationPhase – Reverse Engineering and Analysis of Applications – Data RecoveryTechniques and Tools. **L:9**

CO4: apply internet and memory forensic techniques for evidenceacquisition and analysis in investigations. (CDL2)

Internet Forensics: Layers of Network Abstraction – The Internet – TracingInformation on the Internet – Collection Phase: Local Acquisition – NetworkAcquisition – Remote Acquisition – Memory Forensics: Memory Management –Volatility – Memory Analysis in Criminal Investigations – Malware **L:9**

Analysis.

CO5: apply legal and forensic practices to tackle digital investigationchallenges. (CDL1)

Legal Challenges in Digital Forensic Investigations: Constitutional issues indigital investigations, Federal Rules of Evidence – The Future of Cybercrime,Terror, and Policy: Introduction – Considering the future of cybercrime – Socialmovements, technology, and social change – Challenges in Digital Forensics:Computational Forensics – Automation and Standardization – Reinforcement ofCERT-In Policies in Future Cybercrime Contexts. **L:9**

TEXTBOOKS:

1. Andre Arnes, Digital Forensic, John Wiley & Sons Ltd, 2019.
2. Thomas J. Holt, Adam M. Bossler, and Kathryn C. Seigfried-Spellar, Cybercrime and Digital Forensics an Introduction, 2nd Edition, Routledge, 2023.

REFERENCES:

1. Joakim Kavrestad, Fundamentals of Digital Forensics: Theory, Methods and Real-Life Applications, Springer, 2020.
2. Keshav Kaushik, Rohit Tanwar, Susheela Dahiya, Komal Kumar Bhatia, Yulei Wu, "Unleashing the Art of Digital Forensics, 1st Edition CRC Press, 2023.
3. Ahmed A. Abd El-Latif, Lo'aiTawalbeh, Manoranjan Mohanty, Brij B. Gupta , Konstantinos E. Psannis, Digital Forensics and Cyber Crime Investigation: Recent Advances and Future Directions , 1st Edition, CRC Press, 2024

L: 45; TOTAL: 45 PERIODS

CourseCode		**L**	**T**	**P**	**E**	**C**
23CS01N	**PYTHONPROGRAMMING**	**2**	**0**	**2**	**0**	**3**

COURSEOUTCOMES

Uponthe successfulcompletionofthe course,thestudentwillbeable to

TheoryComponent:

CO1: execute the basic programming constructs in Python environment.(CDL1)
CO2: apply conditional and looping constructs for simple problem solving. (CDL1)
CO3: demonstratethe representationofcompounddatausinglist.(CDL2)
CO4:developsimplepackagesusinghierarchicaldatastructures.(CDL2)
CO5: applypythonlibrarieslike NumPy, pandas,matplotlibtosolveapplications.(CDL2)

PracticalComponent:

CO6:demonstrateprogramsforsimplealgorithmsusingsequential,controlstructuresand modularapproach.(PDL1)
CO7:developapplicationwith hierarchicaldatastructures using packages.

CO1: executethebasicprogrammingconstructsin Pythonenvironment. **L:5**

Pythoninterpreterandinteractivemode-valuesanddatatypes:Variables – expressions- **P:5**

statements–operators-precedenceofoperators–InputandOutput – comments - Errors:Syntax Errors-Runtimeerrors –LogicalErrors.

CO6:demonstrate programsforsimple algorithmsusing sequential,controlstructuresandmodular approach.

Solvethesimpleproblemsusingbasicprogrammingconstructinpython.

CO2: applyconditionalandloopingconstructsforsimpleproblemsolving. **L:5**

Conditionals:Booleanvaluesandoperators-conditional(if) – alternative(if-else)–chained conditional(if-elif-else)-Iteration:state –while–for–break –continue-pass-Fruitfulfunctions: Functionargumentanditstypes-returnvalues–parameters-localandglobalscope–function composition–recursion-DocumentingFunction. **P:5**

CO6:
demonstrateprogramsforsimplealgorithmsusingsequential,controlstructuresandmodular approach.

Solveproblemwithconditional,loopingconstructswithfunctions.

CO3: demonstratetherepresentationofcompounddatausinglist. **L:7**

Classes and Inheritance - Object Oriented Programming - Class Instances - Class Methods. Strings:stringslices - immutability - stringfunctionsandmethods–stringmodule-Lists:listoperations -listslices-listmethods - listloop - mutability -aliasing - cloninglists - listParameters-Listsasarrays. **P:7**

CO7:developapplicationwithhierarchicaldatastructuresusingpackages.

Implement problemsusingstringand list concepts.

CO4:developsimplepackages usinghierarchicaldatastructures **L:6**

Tuples:tupleassignment-tupleasreturnvalue-Dictionaries:operationsandmethods–advanced listprocessing-listcomprehension-Filesandexception:textfiles-readingandwritingfiles- formatoperator-commandlinearguments-errorsand exceptions-handlingexceptions–modules –packages-Namespace. **P:6**

CO7:developapplicationwithhierarchicaldatastructuresusingpackages.

Solveproblemsusingtuples,dictionaries–Implementproblemusing filesand modules.

CO5:applypythonlibrarieslikeNumPy,pandas, matplotlib tosolveapplications. **L:7**

NumPyBasics:ArraysandVectorizedComputation–Pandas:DataLoading,storageandFile Formats –DataCleaningandPreparation–DataWrangling:Join,CombineandReshape–Plotting andVisualization–DataaggregationandGroupoperations. **P:7**

CO7: developapplicationwithhierarchicaldatastructuresusingpackages.

DevelopsimpleapplicationsusingNumPyandPandaspackages fordataexploration.

TEXTBOOKS:

1. MartinC.Brown,"TheCompleteReferencePYTHON",McGrawHillPublications,4th Edition,2018.
2. WesMcKinney,"PythonforDataAnalysis:DataWranglingwithPandas,NumPy&Jupyter",O'Reillypublications,3rd Edition,2022.

REFERENCEBOOKS:

1. JohnV.Guttag,"IntroductiontoComputationandProgrammingUsingPython:WithApplication toUnderstandingData",Prentice-Hall International publishers,3rdEdition,2021.
2. MeenuKohli, "BasicCorePythonProgramming", BPBPublications, 1stEdition, 2021

WebReferences:

1.SWAYAM/NPTELCourse–JoyofComputingusingPython

SoftwareRequirements:

- Python3.x
- GoogleColaboratory/Jupyter/Anacondanavigator

L: 30; P: 30; TOTAL: 60 PERIODS

Course Code	FOUNDATIONS OF OBJECT ORIENTED	L	T	P	E	C
23CS02N	PROGRAMMING	2	0	2	0	3

COURSE OUTCOMES

Upon the successful completion of the course, the student will be able to

Theory Component

CO1: explore the constructs of object oriented program(CDL1)
CO2: apply constructor and overloading mechanisms to simple application (CDL1)
CO3: employee code reusability through inheritance and polymorphism (CDL1)
CO4: develop real-world applications by using files, streams, and exceptions (CDL2)
CO5: construct well-defined, efficient data handling strategies using templates and STL (CDL1)

Practical Component

CO6: implement the basic object oriented principles such as class, objects, and constructors (PDL1)
CO7: establish code reusability through inheritance and polymorphism (PDL1)
CO8: solve problems using templates, STL, files and exception handling (PDL1)

CO1: explore the constructs of object oriented program **L:6, P:6**

Introduction to OOPs - Applications of OOP - Structure of C++ - Program - C++ Basics: Keywords – Constants - Data Types - Dynamic Initialization of Variables – Reference Variables - Operators in C++ - C++ Class Overview: Class Definition Objects – Class Members - Access Control – Scope Resolution operator – Inline Function - Friend Functions - static class members.

CO2: apply constructor and overloading mechanisms to simple programs **L:6,**
CO6: implement the basic object oriented principles such as class, objects, and constructors **P:6**

Constructors: Parameterized Constructors - Multiple Constructors in a Class – Constructors with Default Arguments - Dynamic initialization of Objects - Copy Constructors – Dynamic Constructors - Destructors - Function Overloading - Operator overloading - Rules for Operator overloading - overloading of binary and unary operators.

CO3: employe code reusability through inheritance and polymorphism **L:6,**
CO7: establish code reusability through inheritance and polymorphism **P:6**

Introduction to inheritance - Defining Derived Classes - Single Inheritance – Multiple Inheritance - Multi-Level Inheritance - Hierarchical Inheritance - Hybrid Inheritance -

Virtual Base Classes - Abstract Classes - Constructors in Derived Classes – Introduction to pointers - Pointers to Objects - Virtual Functions - Pure Virtual Functions – Virtual Destructors.

CO4: develop real-world applications by using files, streams, and exceptions **L:6, P:6**

Files in C++: File handling in C++ - File I/O - Formatted and Unformatted I/O - Basics of Exception Handling, Types of exceptions - Exception Handing Mechanism - Throwing and Catching Mechanism.

CO5:construct well-defined, efficient data handling strategies using templates and STL **L:6, P:6**

CO8: solve problems using templates, STL, files and exception handling

Class Templates - Class Templates with Multiple Parameters - Function Templates, Function Templates with Multiple Parameters –Member Function Templates - STL.

TEXT BOOKS

1. Herbert Schildt, "C++: The Complete Reference", 5th Edition, Tata McGraw – Hill Publishers, 2014.
2. Paul Deitel, Harvey Deitel, "C++ How to Program", 8th Edition, Prentice Hall Publisher, 2016.
3. Trivedi, Bhushan "Programming with ANSI C++", 2nd Edition, Oxford University Press - NASW Press, 2013.

REFERENCE BOOKS

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, 2nd Edition, Reprint 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Pearson Education, 4th Edition, 2012.
3. Bjarne Stroustrup, "The C++ Programming language", Pearson Education, 4th Edition, 2013.

L: 30; P:30; TOTAL: 60 PERIODS

Course Code	LINEAR ALGEBRA, MATHEMATICAL LOGIC AND SET THEORY	L	T	P	E	C
23SH01E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: analyze concepts of vector spaces. (CDL 1)

CO2: measure the similarity between different datasets using Inner product spaces. (CDL 1)

CO3: decompose the matrix for computational convenience. (CDL 1)

CO4: illustrate the validity of the arguments. (CDL 1)

CO5**:** analyze the concepts of Sets, Relations and Functions. (CDL 1)

CO1: analyze concepts of vector spaces

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions. **L:6 T:3**

CO2: measure the similarity between different datasets using Inner product spaces

Linear transformation - Null spaces and ranges – Rank Nullity theorem - Matrix representation of a linear transformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process**.** **L:6 T:3**

CO3: decompose the matrix for computational convenience

Generalized eigenvector - QR decomposition- generalized inverse - Singular value decomposition and applications – Pseudo Inverse . **L:6 T:3**

CO4: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Predicate Calculus and Quantifiers - Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO5: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Partial Ordering Relation - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions. **L:6 T:3**

TEXT BOOKS

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 8th Edition, 2021.
2. Bernard Kolman and David Hill, "Elementary Linear Algebra with Application" Pearson India, 9th Edition, 2019.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

REFERENCE BOOKS

1. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi,2017.
2. Friedberg, A.H., I nsel,A.J.and Spence, L., Elementary Linear Algebra, a matrix approach, 2nd Edition pearson Publication.
3. Raju.K.George and Abhijith Ajayakumar, A course in Linear Algebra, Springer, 2024.
4. Seymour Lipschutz Marc Lipson., "Linear Algebra" Schaum's Out lines series, 6th Edition, McGraw – Hill Education, 2018.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	LINEAR STRUCTURES AND	L	T	P	E	C
23SH02E	TRANSFORMATIONS	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: solve the linear system of equations. (CDL 1)

CO2: determine the dimension of vector spaces. (CDL 1)

CO3: find the orthonormal vectors using Inner product spaces. (CDL 1)

CO4: illustrate Jordan canonical form on a finite dimensional vector space. (CDL 1)

CO5:decompose the matrix using Generalized Eigen vectors for computation.(CDL 1)

CO 1: solve the linear system of equations **L:6, T:3**

General system of linear equations – Matrices– Echelon form of matrix- Solving linear systems- Consistency of a system of linear equations -LU factorization.

CO2: determine the dimension of vector spaces **L:6, T:3**

Vector spaces – Subspaces – Linear combinations – linear span - Linear independence and linear dependence – Bases and dimensions.

CO3: find the orthonormal vectors using Inner product spaces

Linear transformation - Null spaces and ranges – Rank Nullity Theorem - Matrix representation of a lineartransformations - Inner product space - Norms - Orthonormal Vectors - Gram Schmidt orthogonalisation process. **L:6, T:3**

CO4: illustrate Jordan canonical form on a finite dimensional vector space

Generalized eigenvector- Chains- Canonical basis the minimum polynomial- - Algebraic and Geometric multiplicity of Eigen Values - Similar matrices-Modal matrix-Jordan canonical form. **L:6, T:3**

CO5: decompose the matrix using Generalized Eigen vectors for computation **L:6 T:3**

Eigen-values using QR transformations – Generalized Inverse Eigen vectors – Canonical forms – Singular value decomposition and applications – Pseudo inverse

TEXT BOOKS

1. Bernard Kolman and David Hill, "Elementary Linear Algebra with Application" Pearson India, 9th Edition 2019.
2. Seymour Lipschutz Marc Lipson., "Linear Algebra" Schaum's Out lines series, Six edition, McGraw – Hill Education, 2018.

REFERENCE BOOKS

1. Friedberg, A.H., I nsel,A.J.and Spence, L., Elementary Linear Algebra, A Matrix Approach, 2nd Edition, Pearson 2019.
2. Jim Defranza. Daniel Gagiardi "Introduction to Linear Algebra with Applications" Waveland PrLnk, 2015.
3. Eggar.Goodaire"Linear Algebra Pure & Applied", World Sceintific, New Delhi, first edition, 2015.
4. Raju.K.George and Abhijith Ajayakumar, A course in Linear Algebra, Springer, 2024.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH03E	**NUMBER THEORY**	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: acquire the concepts of theory of numbers. (CDL 1)

CO2: apply the fundamental propositions to interpret solutions of congruence. (CDL 1)

CO3: find the primitive roots for the congruence. (CDL 1)

CO4: analyze the inter-relation between arithmetical functions. (CDL 1)

CO5: determine quadratic residues of congruence. (CDL 1)

CO1 : acquire the concepts of theory of numbers

Introduction – Divisibility- Greatest common divisor - Prime numbers - The fundamental theorem of arithmetic - The series of reciprocals of the primes - The Euclidean algorithm(without Proof) - The greatest common divisor of more than two numbers. **L:6 T:3**

CO2 : apply the fundamental propositions to interpret solutions of congruence

Congruence - Linear congruence - Euler-Fermat theorem - Polynomial congruence modulo p – Wilson's Theorem **L:6, T:3**

CO3: analyze the inter-relation between arithmetical functions.

The Mobius function μ(n) – The Euler Totient function φ(n)– A relation connecting φ and μ – A product formula for φ(n) – properties of φ(n) –Multiplicative functions– completely multiplicative function. **L:6, T:3**

CO4: determine quadratic residues of congruence

Quadratic Residues – Legendre's symbol and its properties – Evaluation of (-1|p) and (2|p) – Gauss lemma – The Quadratic Reciprocity law – Applications – The Jacobi symbol. **L:6, T:3**

CO5: implement the concepts of congruence in cryptography

Chinese remainder theorem - Applications of Chinese remainder theorem - Cryptography and its application – RSA algorithm and Rabin Cryptosystem. **L:6, T:3**

TEXT BOOKS

1. Tom M.Apostol, "Introduction to Analytic Number Theory", Springer International Edition, Narosa Publishing House, New Delhi, 2013.
2. G.A.Jones&J.M.Jones, "Elementary Number Theory", Springer publications, 2012.

REFERENCE BOOKS

1. David M.Burton, "Elementary Number Theory", McGraw Hill, 7th Edition,2023
2. Joseph H.Silverman, "A Friendly Introduction to Number Theory", Pearson Education, 4th Edition, 2019.
3. Titu Andreesu, Gabriel Dospinescu, Oleg MushKarov, Number Theory: concepts and problems, Springer Science & Business Media, 2017.
4. S B Malik , "Basic Number Theory", S Chand publications, 2nd Edition, 2018

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH04E	NUMERICAL ANALYSIS	2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: solve algebraic and transcendental equations using numerical methods. (CDL 1)

CO2: interpolate and approximate the polynomial of data. (CDL 1)

CO3: perform numerical differentiation and integration. (CDL 1)

CO4: find numerical solution of ordinary differential equation. (CDL 1)

CO5: classify and find numerical solution of partial differential equations. (CDL 1)

CO 1: solve algebraic and transcendental equations using numerical methods

Solutions of Algebraic linear equations Newton - Raphson Method, Fixed Point Iteration method - Solutions of algebraic simultaneous linear equations - Gauss Elimination –Gauss Seidel Methods. **L:6 T:3**

CO 2: interpolate and approximate the polynomial of data

Curve Fitting – Method of Least Squares – Fitting a Straight Line – Fitting a Second Degree Parabola - Finite differences - Newton's Forward & Backward Difference Formulae - Central Differences - Stirling's Formula - Lagrange's Formula. **L:6 T:3**

CO 3: perform numerical differentiation and integration

Derivatives using forward and backward difference Formulae - Trapezoidal rule - Simpson's rules - Double integration using Trapezoidal and Simpson's rules. **L:6 T:3**

CO 4: find numerical solution of ordinary differential equation

Taylor's Series Method - Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods - Milne's Method - Finite difference for solving ordinary differential equation. **L:6 T:3**

CO 5: classify and find numerical solution of partial differential equations

Classification of Partial Differential Equations of second order - Finite difference solution of one dimensional heat equation by explicit and implicit methods (Crank Nichelson and Bender Schmidth methods) - One dimensional wave equation and two dimensional Laplace and Poisson equations. **L:6 T:3**

TEXT BOOKS

1. Grewal, B.S., "Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB", 11th Edition, Khanna Publishers, New Delhi, 2014.
2. M.K.Jain, S.R.K.Iyengar, R.K.Jain "Numerical Methods for scientific and Engineering Computation", 6th Edition, New age International Publishers, 2019.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, J. Wiley and Sons, 2023.

REFERENCE BOOKS

1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 8th Edition, Tata McGrawHill, New Delhi, 2021.
2. Saumyen Guha, Rajesh Srivastava "Numerical Methods: For Engineering and Science", Oxford University Press, New Delhi, 1st Edition with third impression, 2015.
3. K.Sankara Rao , "Numerical Methods For Scientists And Engineers", 5th Edition, New age International Publisher, 2018

4. Dr Chaitanya Kumar, Dr Harinderjit Kaur Chawla, Dr Indarpal Singh "A Textbook on Numerical Methods and Analysis" Sultan Chand and SonsPublisher, 2024

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH05E	**OPTIMIZATION TECHNIQUES**	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: find optimum solution of linear programming problem. (CDL 1)

CO2: determine the optimum schedule for assignment and transportation problems. (CDL 1)

CO3: acquire decision making in Pure and Mixed Strategies. (CDL 1)

CO4: analyze the network for optimal schedule. (CDL 1)

CO5:compute optimum solution of non-linear programming. (CDL 1)

CO1: find optimum solution of linear programming problem

Linear Programming Problem – Mathematical Formulation of Linear Programming Problems (LPP) – Graphical Solution Method - Canonical and Standard Forms of LPP - Simplex Method - Linear Programming using Artificial Variables - Two Phase Method. **L:6 T:3**

CO2:acquire decision making in Pure and Mixed Strategies

Basic Terms in Game Theory - Two-Person Zero-Sum Games - Maximin-Minimax Principal - Games without Saddle Points - Mixed Strategies-Pure and Mixed Strategies with Saddle Point- Mixed Strategy Problems by Arithmetic Method- Graphic Solution of 2 × n and m × 2 Games. **L:6 T:3**

CO3: analyze the network for optimal schedule

Development of Network Analysis - Network Analysis and Rules of Network Construction - Critical Path Method (CPM) - Programme Evaluation and Review Technique (PERT). **L:6 T:3**

CO4: compute optimum solution of non – linear programming

Formulating a Non-Linear Programming Problem – Constrained Optimization with equality Constraints- Graphical Solution – Kuhn- Tucker Conditions with Non negative constraints- Quadratic Programming – Wolfe's modified Simplex method. **L:6 T:3**

CO5: solve non-linear constrained optimization

Optimization using Gradient Descent – Constrained optimization - Lagrange Multipliers - Convex optimization - Non linear Constrained Optimization. **L:6 T:3**

TEXT BOOKS

1. KantiSwarup, Gupta P.K and Man Mohan, Operations Research: Introduction to management Science, Sultan Chand &Sons, 20th Revised Edition, 2022.
2. Hamdy A Taha, Operations Research - An Introduction, 10th Edition, Pearson Education, 2019.

REFERENCE BOOKS

1. Sharma JK., Operations Research, Trinity, New Delhi, 6th Edition, 2017.

2. Sundaresan.V, Ganapathy Subramanian. K.S. and Ganesan.K, Resource Management Techniques, A.R. Publications, 11th Edition, 2017.
3. Gupta P K, Mohan Man, Problems in Operations Research, Sultan Chand & Sons, 2014
4. V K Kapoor, Operations Research , Concept problems & solutions, Sultan Chand & Sons, 2017

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH06E	**PRINCIPLES OF DISCRETE MATHEMATICS**	**2**	**1**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:
CO1: illustrate the validity of the arguments. (CDL 1)
CO2: analyze the concepts of Sets, Relations and Functions. (CDL 1)
CO3: perform the principles of counting and solve recurrence relations. (CDL 1)
CO4: interpret the basic concepts of graphs. (CDL 1)
CO5: compute minimum Spanning Trees and shortest route for the graph. (CDL 1)

CO1: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6 T:3**

CO2: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions. **L:6 T:3**

CO3: perform the principles of counting and solve recurrence relations.

Mathematical induction - Strong induction and well ordering -The basics of counting – The pigeonhole principle - Recurrence relations – Solving linear recurrence relations – Generating functions - Inclusion and exclusion principle. **L:6 T:3**

CO4:interpret the basic concepts of graphs

Graphs and their properties - Special types of graphs – Matrix representation of graphs and graph isomorphism- Euler and Hamiltonian graphs. **L:6 T:3**

CO5: compute minimum Spanning Trees and shortest route for the graph

Trees – Some properties of Trees – Pendant vertices in a Tree – Distance and centers in a Tree – Rooted and Binary Trees - Spanning Trees- minimum spanning tree–Prim's algorithm. **L:6 T:3**

TEXT BOOKS

1. Kenneth H.Rosen, Discrete Mathematics and its Applications (with Combinatory and Graph Theory), Special Indian Edition, Tata McGraw-Hill Publishing CompanyLimited, New Delhi, 8th Edition, 2021.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, first Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2020.
3. Narsingh Deo, Graph Theory with Applications to Engineering and ComputerScience, 1st Edition, Dover Publications Inc., 2016.

REFERENCE BOOKS

1. Ralph .P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, 5th Edition, Pearson Education Asia, Delhi, 2019.
2. Bondy, J.A., Murty.U.S.R., Graph Theory with applications, North Holland publication, 2008.
3. K.Balakrishnan, Schaum's Outline of Graph Theory, Tata Mc Graw-Hill Pub, 2020.
4. Richard J.J, Introduction to Graph Theory, 1stEdition, Parker Pub.Company, 2017.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	RANDOM PROCESSES AND QUEUEING THEORY	L	T	P	E	C
23SH07E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

CO1: interpret the basic characteristic features of Random processes. (CDL 1)
CO2: encapsulate the time averages of uncertain events. (CDL 1)
CO3: evaluate spectral densities of functions. (CDL 1)
CO4: analyze the characteristics of Markovian queues. (CDL 1)
CO5**:**apply the concepts of queuing theory in networks.(CDL 1)

CO1: interpret the basic characteristic features of Random processes **L:6, T:3**

Classification - Stationary process - Markov process - Markov chains - Transition probabilities.

CO2 : encapsulate the time averages of uncertain events **L:6, T:3**

Counting Process - Ergodic process - Poisson Process - Renewal Processes - Gaussian process.

CO3 :evaluate spectral densities of functions **L:6, T:3**

Auto correlation - Cross correlation – Power spectral density–Cross spectral density-Properties–Wiener – Khintchine theorem (without proof).

CO4 : analyze the characteristics of Markovian queues **L:6, T:3**

Markovian models – Birth and Death Queuing models- Steady state results: Single and multiple server queuing models- queues with finite waiting rooms- Finite source models- Little's Formula.

CO5: apply the concepts of queuing theory in networks **L:6, T:3**

M/G/1 queue- Pollaczek- Khintchine formula, series queues- open and closed networks.

TEXT BOOKS

1. Oliver C. Ibe, "Fundamentals of Applied Probability and Random processes", Academic Press, 2nd Edition, 2014.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes, Tata McGraw-Hill Education, 3rdEdition, 2017.
3. John F Shortle, James M Thompson, Donald Gross and Carl M Harris, "Fundamentals of Queueing Theory", Wiley and Sons Publication Limited, 5thEdition, 2018.

REFERENCE BOOKS

1. Miller.S.L and Childers, S.L, Probability and Random Processes with applications to Signal Processing and Communications, Elsevier Inc., 2nd Edition, 2012.
2. Peyton. Z. Peebles Jr., Probability Random Variables and Random Signal Principles, 4th Edition, Tata McGraw-Hill Publishers, New Delhi, 2017.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	STATISTICAL TECHNIQUES AND NUMERICAL METHODS	L	T	P	E	C
23SH08E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:
CO1: calculate the various measures of dispersion. (CDL 1)
CO2: apply the principles of hypothesis testing in small and large samples. (CDL 1)
CO3: analyze the variances in design of experiments. (CDL 1)
CO4: find solution of linear equations and to perform differentiation and integration numerically. (CDL 1)
CO5: compute numerical solution of differential equations. (CDL 1)

CO1: calculate the various measures of dispersion

Central tendencies - Mean, median, mode - Measures of Dispersion –Mean deviation, and Quartile deviation–Moments– Skewness –Kurtosis - Correlation and Regression. **L:6, T:3**

CO2: apply the principles of hypothesis testing in small and large samples

Sampling distributions - Statistical hypothesis - Large sample testsbased on Normal distribution for single mean and difference of means -Tests based on t, and F distributions - Chi-square -Contingency table for independent of attributes – Goodness of fit. **L:6, T:3**

CO3: analyze the variances in design of experiments

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design – 2^2 factorial design. **L:6, T:3**

CO4: find solution of linear equations and to perform differentiation and integrationnumerically

Solution of algebraic and transcendental linear equations - Newton - Raphson Method- Solution of simultaneous equations – Gauss Elimination method – Gauss Seidel method – Interpolation – Lagrange's Method - Numerical Differentiation – Newton's forward difference and backward difference formula – Numerical integration - Single integration using Trapezoidal and Simpson's 1/3 rd and 3/8 th rules. **L:6, T:3**

CO5: compute numerical solution of differential equations

Taylor's Series Method – Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods – Milne's Method - Solution of one dimensional heat equation by explicit and implicit methods(Crank Nichelson and Bender Schmidth methods) - Two dimensional Laplace and Poisson equations. **L:6, T:3**

TEXT BOOKS

1. Richard A. Johnson, "Miller and Freund's Probability and Statistics for Engineers", 9thEdition, Pearson Education Private Ltd., 2018.
2. Grewal, B.S., "Numerical Methods in Engineering & Science: With Programs in C, C++ &MATLAB", 11thEdition, Khanna Publishers, New Delhi, 2014.

REFERENCE BOOKS

1. Dharmaraja Selvamuthu, Dipayan Das, Introduction to Statistical Methods, Design of Experiments and Statistical Quality Control, Springer Verleg Singapore Pvt. Ltd., 2018.
2. S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons, Delhi, 2014.
3. M.K.Jain.S.R.K.Iyengar,R.K.Jain "Numerical Methods for scientific and Engineering Computation", 6th Edition, New age International Publishers, 2019.
4. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 8th Edition, Tata McGraw - Hill, New Delhi, 2021.

L : 30; T :15; TOTAL : 45 PERIODS

Course Code	TRANSFORMS, MATHEMATICAL LOGIC AND SET THEORY	L	T	P	E	C
23SH09E		2	1	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course, the students will be able to:

Theory Components:

CO1: apply Laplace transform to solve ordinary differential equations. (CDL 1)
CO2: compute the Fourier transforms of various functions. (CDL 1)
CO3: solve difference equations using Z-Transform. (CDL 1)
CO4: illustrate the validity of the arguments. (CDL 1)
CO5**:**analyze the concepts of Sets, Relations and Functions. (CDL 1)

CO 1 : apply Laplace transform to solve ordinary differential equations

Definition of Laplace transform and its inverse – Transforms of elementary functions – Properties – Transforms of periodic functions – Initial and final value theorems – Convolution theorem.- solutions of linear ordinary differential equations with constant coefficients. **L:6, T:3**

CO2 : compute the Fourier transforms of various functions

Fourier Integral theorem (without proof)–Fourier transform pair–Fourier Sine and Cosine transforms–Properties–Transforms of simple functions–Convolution theorem –Parseval's theorem. **L:6, T:3**

CO3 : solve difference equations using Z-Transform

Z– transform –Elementary properties – Inverse Z–transform – Convolution theorem- Initial and final value theorem – Formation of difference equations –Solutions of difference equations using Z–transform. **L:6, T:3**

CO4: illustrate the validity of the arguments.

Propositional Logic – Equivalences and Implications – Normal forms – Rules of inference – Proof methods and Strategies - Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. **L:6, T:3**

CO5: analyze the concepts of Sets, Relations and Functions

Basic Definitions - Set operations – Laws of set theory – Relations – Properties of relations - Equivalence Relation - Matrices of relations - Closure of relations – Functions – Bijective functions - Inverse and Compositions of functions **L:6, T:3**

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publications, Delhi, 2021.
2. Kenneth H.Rosen, Discrete Mathematics and its Applications, Tata McGraw-Hill Publishing

Company Limited, New Delhi, 8th Edition, 2021.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 10thEdition, Wiley India, 2017.

REFERENCE BOOKS

1. Ramana B.V, "Higher Engineering Mathematics", Tata Mc-Graw Hill Education, New Delhi, 2017.
2. Trembly J.P and Manohar.R. Discrete Mathematical Structures with Applications to Computer Science, 1st Edition, Tata McGraw-Hill Pub. Company Limited, New Delhi, 2017.
3. J K Goyal, K.P.Gupta, Laplace and Fourier Transforms, Pragati Prakashan, 2016

L : 30; T :15; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH10E	**FUNDAMENTALS OF LASER TECHNOLOGY**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:
CO1: explain the fundamentals of lasers (CDL1)
CO2: demonstrate the laser surface modification process (CDL1)
CO3: describe the laser machining processes (CDL1)
CO4: identify the laser measurement and testing process (CDL1)
CO5: organizethe advanced applications and safety measures of laser (CDL1)

CO1: explain the fundamentals of lasers

Characteristics of laser -laser principle- population inversion-line broadening mechanisms-Q switching - threshold condition for laser-three-level and four-level systems-conditions for continuous wave (CW) and pulsed laser action- pumping schemes-classification of lasers:Er:YAG - carbon dioxide lasers - argon laser - X-Ray lasers - fiber lasers - Raman lasers. **L:9**

CO2: demonstrate the laser surface modification process

Laser surface heat treatment: process parameters - advantages and disadvantages of laser surface treatment; laser surface melting - laser direct metal deposition: processing parameters - methods for applying the coating material- laser alloying and cladding - advantages and disadvantages -laser physical vapor deposition - laser shock peening: analysis - advantages and disadvantages **L:9**

CO3: describe the laser machining processes

Laser welding parameters: beam power, spot diameter and traverse speed; welding efficiency; mechanism of laser welding: conduction mode welding, keyhole welding; laser cutting – process characteristics-fusion cutting, sublimation cutting, photochemical ablation;laser drilling –single pulse drilling-percussion drilling, trepanning applications - laser marking - dot matrix marking, engraving, image micro machining -lasers for marking - application **L:9**

CO4: identify the laser measurement and testing process

Laser for measurement - distance -length-velocity-acceleration-current-voltage-atmospheric effect-laser application in spatial frequency filtering.
Holography: basic principle - methods - Holographic interferometry and applications-holography for non – destructive testing – holographic components **L:9**

CO5: organizethe advanced applications and safety measures of laser

Laser advanced application in defence-laser weapons- industry for material handling: ASRS and AGV- medicine -laser activated therapy - photodynamic therapy, laser angioplasty, lasers in surgery - photocoagulation, photodisruption and photoablation - laser scanning confocal microscopy - Laser safety - danger - safety limits for eye and skin - class four safety arrangements - electric hazards- chemical hazards - fume hazards - explosion hazards - safety guidelines **L:9**

TEXTBOOKS:

1. William M. Steen, "Laser Material Processing", Springer Verlag, 2010
2. K.Thyagarajan, AjoyK.Ghatak, "Lasers, Theory and Applications", Springer,2nd Edition, 2011.
3. Chunlei Guo, Subhash Chandra SinghHandbook of Laser Technology and Applications Lasers Applications: Materials Processing and Spectroscopy, 2nd Edition, (Vol.3), 2021

REFERENCES:

1. Uday Shanker Dixit, Shrikrishna N. Joshi, J. Paulo Davim, "Application of Lasers in Manufacturing" Springer Singapore, 1stEdition, 2019
2. Stephan Wieneke and Christoph Gerhard, "Lasers in Medical Diagnosis and Therapy Basics, applications and future prospects" IOP Publishing Ltd, 2018
3. AK Katiyar, CK Pandey and Manisha Bajpai, "Fundamentals of Laser Systems and Applications", Wiley, 2017.

L : 45; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH11E	**NANOMATERIALS FOR ENGINEERS**	3	0	0	0	3

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:
CO1: explain the fundamentals of nanomaterials (CDL1)
CO2: interpret the different properties of nanomaterials (CDL1)
CO3: demonstrate the synthesis of nanomaterials (CDL1)
CO4: illustrate the characterization of nanomaterials (CDL1)
CO5: organize the applications of nanomaterials(CDL1)

CO1: explain the fundamentals of nanomaterials

Introduction to nanomaterials - size effect - specific surface area - surface to volume ratio - quantum confinement effects - morphology - density - melting point - wettability - classification based on the dimension - nanoparticles - nanowires - nanoclusters - nanotubes - quantum wells - metal based nanomaterials - nanocomposites - carbon nanotubes - nanosized metals - alloys - semiconductors - ceramics **L:9**

CO2: interpret the different properties of nanomaterials

Mechanical behavior- comparison of bulk and nano materials - elastic and plastic deformation - tensile strength - superplasticity -hardness - nano hardness -influence of porosity - grain size – thermodynamics of nanoparticles- heat capacity – phase transformation of nanoparticles- electrical and optical properties: electrical conductivity in nano tubes, nano rods and nanocomposites - photoconductivity of nanorods - electroluminiscesnce in nanoparticles- magnetic properties: magnetic hysteresis - superparamagnetism **L:9**

CO3: demonstrate the synthesis of nanomaterials

Bottom-up and top-down approach - inert gas condensation - plasma arc technique - ion sputtering - ball milling - molecular beam epitaxy - chemical vapour deposition - method - electrodeposition - ultrasonication - microemulsions method - solvothermal synthesis - microwave assisted synthesis. **L:9**

CO4: illustrate the characterization of nanomaterials

X-ray diffraction - energy dispersive spectrum - atomic force microscopy - high resolution transmission electron microscopy - Raman spectroscopy - x-ray photoelectron spectroscopy - electrochemcial characterization measurements - cyclic voltammetry - linear sweep voltametry - Brunauer-Emmett-Teller - surface area analysis - nanoindentation - determination of nano hardness. **L:9**

CO5: organize the applications of nanomaterials

Functional graphene - carbon nanotube - polymer composite applications in defence and aerospace - nanomaterials for solar cells - nanoscale catalysts for energy and automobile industries - rechargeable batteries based on nanomaterials - nanomaterials for electrodes and wearable electronics - nano based coating and paints - nanosensors -gas sensors - bio sensors - nano electro mechanical systems **L:9**

TEXTBOOKS:

1. Charles P Poole, Frank J Ownes, Introduction to Nanoscience and Nanotechnology, An Indian Adaption, Wiley, 2020
2. Hornyak, G.Louis, Tibbals, H.F., Dutta, Joydeep, Fundamentals of Nanotechnology, CRC Press, 1st Edition, 2018
3. Dieter Vollath, Nanomaterials an introduction to synthesis, properties and applications, Wiley, 2nd Edition, 2013

REFERENCES:

1. Narendra Kumar, Sunita Kumbhat, Essentials in Nanoscience and Nanotechnology, Wiley, 1st Edition, 2016
2. G. Cao,Ying Wang, Nanostructures and nanomaterials: Synthesis, properties and applications, Imperial College Press, 2nd Edition, 2011
3. B.S. Murty , P. Shankar , Baldev Raj , B B Rath , James Murday, Textbook of Nanoscience and Nanotechnology, Springer, 1st Edition, 2013

L : 45; TOTAL : 45 PERIODS

Course Code		**L**	**T**	**P**	**E**	**C**
23SH12E	**PHOTONICS**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successfully completing the course , the students will be able to:

CO1: explain the basics of photonics (CDL1)
CO2: demonstrate the properties of photonic crystal (CDL1)
CO3: outline the basics of bio photonics (CDL1)
CO4: interpret the quantum confinement in photonic materials(CDL1)
CO5: organize the applications of photonic materials (CDL1)

CO1:explain the basics of photonics

Wave phenomena – interference, diffraction-photon properties - energy, flux, statistics- **L:9**

Interaction of photons with atoms-optical amplification-three and four level system -EDFA-semiconductor light sources-detectors-light manipulation - birefringence - Faraday's rotation - interaction of light with RF and acoustic waves - Raman-Nath diffraction experiment .

CO2: demonstrate the properties of photonic crystal

Electromagnetic theory of light-electromagnetic properties of material- polarization of light; Reflection and refraction- Fresnel equations; absorption, dispersion, and scattering of electromagnetic waves -Bragg grating; 1D photonic crystals -photonic band structure-real and reciprocal lattices; 2D and 3D photonic crystals-emerging applications of photonic crystals - 1D Bragg grating - periodic dielectric wave guide - 2D photonic crystal slab and fibre. **L:9**

CO3:outline the basics of bio photonics

Fundamentals of light and matter-basics of light-matter interactions in molecules, cells and tissues -lasers for biophotonics -bioimaging: principles and applications-transmission microscopy, Kohler illumination-optical biosensors-light activated therapy: photo thermal and photo dynamic therapy- tissue engineering with light- optical tweezers, scissors and traps - bio nanophotonics applications - bio chip - DNA micro-arrays - gene chip - lab on chip. **L:9**

CO4:interpret the quantum confinement in photonic materials

Quantum confined materials: quantum wells, quantum wires, quantum dots, quantum rings, manifestations of quantum confinement, optical properties, quantum confined stark effect, dielectric confinement effect. **L:9**

Nanoplasmonics: optical response of metals, plasmons, optical properties of metal nanoparticles, size dependent absorption and scattering, coupled nanoparticles - metal-dielectric core-shell nanoparticles - local electromagnetic fields in metal nanoparticles.

CO5: organize the applications of photonic materials

Excitation energy transfer – device operation: nanophotonic AND gate - nanophotonic OR gate – interconnection with photonic devices - metamaterials concept; super lens, hyperbolic metamaterials and application in high-resolution imaging: hyper lens - tunable photonic metamaterials based devices - electro-optical metamaterials - phase-change metamaterials - metamaterials in solar energy harvesting - perfect absorbers and thermal emitter **L:9**

TEXTBOOKS:

1. Bahaa E. A. Saleh, Malvin Carl Teich, Fundamentals of Photonics, 3rdEdition, Wiley,2019.
2. Brian Culshaw, Introducing Photonics, Cambridge University Press, 2020.
3. Gerd Keiser, Biophotonics: Concepts to Applications, second edition, Springer Nature Singapore Pvt. Ltd 2022.

REFERENCES:

1. Joseph W. Haus, Fundamentals and Applications of Nanophotonics, Woodhead Publishing, 2016.
2. W.Cai and V. Shalaev, Optical Metamaterials: Fundamentals and Applications, 2ndEdition, Springer, 2024.
3. P PYupapin, K Srinuanjan, S Kamoldilok, Devices, Circuits and Systems: Nanophotonics, Pan Stanford Publishing, 2013.
4. Paulo Ribeiro, Maria Raposo, "Optics, Photonics and Laser Technology", Springer International publishing, 1stEdition, 2018

L : 45; TOTAL : 45 PERIODS

Course Code		L	T	P	E	C
23SH13E	**BIOLOGY FOR COMPUTING**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: describe the structure, interaction and applications of biomolecules

CO2: interpret the structure and functions of the gene and protein using the bioinformatics data

CO3: simulate the behavior of simple biological models using computational softwares

CO4: identify and design molecules for new drug development by computational methods

CO1: describe the structure, interaction and applications of biomolecules **L:9**

Biomolecules-I :

Introduction – monomeric units and polymeric structures of carbohydrates, proteins, nucleic acids and lipids. Enzymes: enzymatic action via Lock and key – Enzyme therapy - immune response monitoring – molecular modification – encapsulation. Agarose gel electrophoresis: SDS, PAGE and 2D – Molecular interactions: covalent and non-covalent interactions, antigen – antibody interactions. Methods to measure the interactions: UV-visible and single crystal X-ray diffraction.

Biomolecules -II **L:9**

Chromosome structure and function – chromosome abnormalities – chromosome dynamics – nuclear architecture. DNA transcription, replication and segregation. DNA finger printing. Pedigree analysis. Identifying human disease genes (functional cloning versus positional cloning; mutation screening). Human genome project: introduction – steps – salient features. Hap map project – salient features.

CO2: interpret the structure and functions of the gene and protein using the bioinformatics data **L:9**

Bioinformatics: introduction – biological databases – types. DNA databases – EMBL, gene bank, DDBJ. Protein databases: Swiss Prot/TrEMBL, PIR. Sequence motif databases - Pfam, PROSITE, Protein structure databases, protein data Bank – SCOP, CATH, and KEGG. Sequence analysis – methods of sequencing: sangar method, maxama - gilbert method and edman degradation method, NGS methods of sequencing.Basic local alignment search tool (BLAST) – types – determining the identity of an organism from its r DNA gene nucleotide sequence. Softwares for handling the databases –ChemDiff.

CO3: simulate the behavior of simple biological models using computational softwares **L:9**

Quantum mechanics: influence of physics on theoretical chemistry. Semi empirical methods – slater determinants – Hartree – Fock equation. Semi empirical models - Ab-initio calculations: Thermodynamic functions – koopmans's theorem – isodesmic reactions, Density functional theory for larger molecules. Introduction to Gaussian and ADF : Geometry optimization, frequency calculation, location of transition state, intrinsic reaction co-ordinates, molecular orbitals and population analysis, natural bond orbital analysis, calculation of equilibrium constants and rate constants. Introduction to GROMACS: GROMACS input files, simulations of liquid water, water methanol mixtures, S-peptide and free energy of salvation. Introduction to SCILAB- Scilab programming: Curve fitting, integral transforms and introduction to molecular dynamics. Execution of programs for liquid argon.

CO4: identify and design molecules for new drug development by computational methods **L:9**

Drug design: General approach to discovery of new drugs – lead modification – calculation of the various drug likeness rules like Lipinski's rule, MDDR - like rule, Veber rule, Ghose filter, BBB rule, CMC-50 like rule and Quantitative estimate of drug-likeness (QED) using

DruLiTo and Swiss ADMEsoftware. Pharmacokinetic properties of drug using Osiris and Molinspiration software. Structure-based drug designing approaches - target identification and validation - physiochemical principles of drug action – drug stereo chemistry – drug action - 3D database – computer aided drug design. Identification of the suitable target using Pharmmapper - Molecular docking programs using Autovinasoftwares and visualization tools - Preparation of protein and ligand using ADT and pymol-generation of paper publication-quality images and data analysis-protein-protein docking-Protein DNA docking

TEXT BOOKS

1. Shawn T. O'Neil, A Primer for Computational Biology, Oregon State Campus, Corvallis, USA, 2019.
2. Frank Jensen, Introduction to Computational Chemistry, 3rdEdition, Wiley publishing LLC. USA, 2016
3. Philly Charles, Genes, Genomes, Genetics and Chromosomes, Nottinghamshire, England, 2020.

REFERENCE BOOKS

1. Ariel Fernández Stigliano, Biomolecular Interfaces: Interactions, Functions and Drug Design, 1stEdition, Springer International Publishing AG, London, 2016.
2. S.C. Rastogi, P.Rastogi, N.Mendiratta, Bioinformatics: Methods and Applications - Genomics, Proteomics and Drug Discovery, 5th Edition, PHI Learning Pvt. Ltd., Delhi, 2022.
3. Robert A. Copeland, Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis, 3rdEdition, Wiley-Blackwell, New York, 2023.

L: 45; TOTAL: 45 PERIODS

Course Code		L	T	P	E	C
23SH14E	**BIOLOGICAL SYSTEMS FOR ENGINEERS**	**3**	**0**	**0**	**0**	**3**

COURSE OUTCOMES:

Upon successful completion of the course the students will be able to

CO1: understanding of bio design principles to create novel devices and structures and cell biology

CO2: explain the structure and stability of biomolecules

CO3: describe the principle, components and applications of various instruments for medical diagnosis

CO4: interpret the major bio-energetic pathways

CO5: explain the properties characterization and application of various biomaterials

CO1: understand the basic principles of biology to create novel devices **L:9**

Cell - prokaryotic and eukaryotic cells - plant cell and animal cell - structural and function of Mitochondria - Chloroplast - Lysosomes - Golgi bodies - Nucleus. Cell cycle: mitosis and meiosis. Bioinspired devices: GPS, aircrafts, swim suits, bullet train, super hydrophobic and self-cleaning surfaces.

CO2: explain the structure and stability of biomolecules **L:9**

Introduction - monomeric units and polymeric structures of carbohydrates, proteins, nucleic acids and lipids. Molecular interactions: covalent and non-covalent interactions – methods of quantification and determination: UV – visible, CD, and SPR.

Enzymes - classification - specific activity - enzyme activity - chemical nature of enzymes. Protein and non-protein nature of enzymes. Metalloenzymes and metal activated enzymes. Industrial applications of enzymes: biosensors and bio bleaching.

CO3: describe the principle and applications of various instruments for medical diagnosis **L:9**

Basic concepts of instrumentation: static and dynamic characteristics, design criteria, instrumentation, amplifiers. Biopotential electrodes: fundamentals - body surface electrodes - microelectrodes - Principle, components and applications of microscope: light and electron microscope. Electrocardiograph, glucometer, CT, magnetic resonance imaging, ultrasonic imaging. Artificial Intelligence for disease diagnosis.

CO4: interpret the major bio-energetic pathways

Thermodynamics in biological systems - exothermic and endothermic versus endergonic and exergonic reactions - concept of K_{eq} and its relation to standard free energy - spontaneity - ATP as an energy currency. Glucose synthesis from CO_2 + H_2O (photosynthesis) – decomposition of glucose (Glycolysis and Krebs cycle). Energy yielding and energy consuming reactions. Concept of energy charge. Regulation of glycogenesis - measurement of blood glucose level. **L:9**

CO5: explain the properties, characterization, and applications of various biomaterials **L:9**

Biomaterials: introduction - types: alloys, polymers. Composites - properties: biocompatibility, elasticity, immune compatibility, resorbability, cytotoxicity, hemocompatibility and biodegradability. Physicochemical characterization: XRD and SEM. Applications: tissue engineering, heart valves, dental and orthopaedic implants.

TEXT BOOKS

1. Y.Nelson, L.David, Lehninger, "Principles of Biochemistry", International Edition, New York, 7th Edition, 2017.
2. Nagata, Kazuhiro, Real-Time Analysis of Biological Interactions, Springer, Japan, 3rd Edition, 2015.
3. I. Bertini, H.B Gray, Bioinorganic Chemistry, University Science Book, California, 4thEdition, 2014.

REFERENCE BOOKS:

1. P.N.Bartlett, Bioelectrochemistry: Fundamentals, Experimental Techniques and Applications, 2nd Edition, John Wiley & Sons, New Delhi, 2014.
2. Ratner and Hoffmann, Biomaterial Science: An Introduction to Materials in Medicine, 2ndEdition, Elsevier Academic Press, London, 2015.
3. Lesile Cromwell, "Bio-medical instrumentation and measurement", Prentice Hall of India, New Delhi, 2nd Edition, Reprint, 2017.

L: 45; TOTAL: 45 PERIODS

Course Code	POLYMER SCIENCE AND TECHNOLOGY	L	T	P	E	C
23SH15E		3	0	0	0	3

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: acquire knowledge on structure - property relationship of polymers

CO2: identify the suitable polymerization techniques for the large scale synthesis of polymers

CO3: explain the basic principles of various polymer processing techniques and their applications

CO4: interpret the chemical, thermal, electrical, and mechanical properties of the polymers

CO5: familiar with plastics waste disposal, value addition, associated environmental issues and legislation

CO1: acquire knowledge on structure - property relationship of polymers **L: 9**

Basic concepts of polymerization - polydispersity - conformation and configuration of macromolecules - stereo isomerism and tacticity in polymers - geometrical isomerism. Structure - property relationship -molecular force and chemical bonding in polymers - effect of polymerization on PDI. General rules for polymer solubility - crystallinity and orientation in polymers. Polymer chain flexibility: concept - factors deciding polymer flexibility - amorphous and crystalline polymers - crystallinity in polymers - factors affecting crystallinity - properties affected by crystallinity of polymers. Glass transition temperature and crystalline melting points. Factors affecting glass transition temperature.

CO2: identify the suitable polymerization techniques for the large scale synthesis of polymers **L:9**

Basic aspects of polymer synthesis - bulk, solution and suspension polymerization (styrene and MMA) - emulsion polymerization (vinyl acetate, styrene) - preparation of phenolic and epoxy resins. Modern techniques in polymerization: metathesis polymerization - controlled polymerization methods, viz., nitroxide mediated polymerization (NMD), atom transfer radical polymerization (ATRP), group transfer polymerization (GTP), and reversible addition fragmentation termination (RAFT).

CO3: explain the basic principles of various polymer processing techniques and their applications **L:9**

Plastics technology: raw materials - additives for compounding (fillers, plasticizers and softeners, lubricants, promoters, anti-aging additives, flame retarders, colorants, blowing agents, UV stabilizers,) - requirements and functions of additives. Pre-compounding operations: mixing, drum blenders, ribbon blenders, mixing rolls, internal mixers, mixing extruders, blenders for making organosol and plastisol, granulators, pelletizers.

Advanced fabrication techniques: RTM, RIM, filament winding, BMC/SMC. Post-forming and finishing, machining, welding and design of polymers products. Selections of polymers, additives, mold design. Analysis of defects in moulded products. Processing of reinforced thermoplastics and thermosets: manual processing methods and semi-automatic processing methods. Rubber processing: internal mixer and open mill.

CO4: interpret the chemical, thermal, electrical, and mechanical properties of polymers **L:9**

Physical testing: density, mechanical behaviour, MFI, and water/solvent adsorption. Chemical testing: ignition - pyrolysis - solvent extraction - elemental analysis. Thermal analysis: vicat softening point - dynamic mechanical thermal analysis. Morphological analysis: atomic force microscopy and chemical force microscopy. Spectroscopic analysis:

IR peaks assigned for rubber. Study of hydrogenation, halogention, evidence for cyclization and formation of ionomers. Analysis of carbon filled rubber - Case studies.

CO5: familiar with plastics waste disposal, value addition, associated environmental issues and legislation **L-9**

Polymer waste: sources, collection, segregation, and identification by simple techniques. Life cycle assessment, risk factor analysis. Plastics waste management techniques: chemical recycling, thermal conversion technologies, microbial, microwave, and ultrasonic. Use of plastics waste for value addition. Plastics waste management rule - environmental issues.

TEXT BOOKS

1. Premamoy Ghosh, Polymer Science and Technology: Plastics, Rubber, Blends and Composites, 3rd Edition, McGraw Hill Education, 2017.
2. Richard A Petherick, Polymer Science and Technology for Engineers and Scientists, Whittles Publishing, 2010.
3. Michael L. Berins, SPI Plastics Engineering Handbook of the Society of the Plastics Industry, Inc. 1st Edition, Springer New York, 2012
4. Vishu Shah, Handbook of Plastics Testing Technology,2nd Revised Edition, Wiley–Blackwell, 1998**.**

REFERENCES

1. Gowarikar V R, Polymer science, 5th Edition, New Age International Private Limited, 2023
2. Fred W. Billmeyer, Textbook of Polymer Science, 3rd Edition, John Wiley & Sons, 2007
3. Nayak S.K, Text Book on Fundamentals of Plastics Testing, Springer (I) Private Limited, 2020
4. J S Anand, Recycling & Plastics Waste Management, Central Institute of Plastics Engineering and Technology, 1997.
5. Korschwitz J, Polymer Characterization and Analysis, John Wiley and Sons, 1990.

L: 45; TOTAL: 45 PERIODS

Course Code	SENSORS FOR ENGINEERING APPLICATIONS	L	T	P	E	C
23SH16E		3	0	0	0	3

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Gain knowledge on basic concepts of sensors and Transducer.

CO2: know about the thermal and motion sensors for various applications.

CO3: enumerate the principles and applications of optical and magnetic sensors and transducers used in various field.

CO4: explain the construction, working principle and applications of electrochemical and electric sensors.

CO5: Design the sensors for environmental monitoring

CO1: Gain knowledge on basic concepts of sensors and Transducer. **L: 9**

Introduction – Historical development of sensors – Human body as a sensor system – sensors and transducers. Principle and classification of sensor. Sensor characteristics – sensor properties – various transducers – piezoelectric effect – pyroelectric effect – seebeck effect and peltier effect. Advantages and limitations of Sensors.

CO2: know about the thermal and motion sensors for various applications. **L:9**

Thermal sensors: introduction – types - primary sensor: gas thermometer and He low temperature thermometer. Secondary sensor: Resistance thermometer and NQR thermometer. Temperature sensing technologies: IC sensor, resistive temperature detectors, thermocouples and thermistor.

Motion sensors: Introduction and principle. Types: Infra red and microwave. Specialized motion sensor: proximity and ranging sensor. Motion Sensors in everyday life: The role of motion sensors in home security.

CO3: enumerate the principles and applications of optical and magnetic sensors and transducers used in various field **L:9**

Magnetic sensors: Introduction – principle and applications: magnetic field sensors and magneto-resistive Sensors, hall effect sensors.

Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor, CCD, CMOS sensors. Pulse oximeter, portable pulse oximeter, wearable pulse oximeter; wearable capnometer for monitoring of expired.

CO4: explain the construction, working principle and applications of electrochemical and electric sensors **L-9**

Electrochemical sensors: Introduction - fundamental concepts – chemiresistors.

Conductometric sensor: amperometric sensor - potentiometric sensors - impendence sensors

Electric sensors: Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. Real time applications: Glucose Monitoring

Devices, GlucoWatch G2 Biographer, GlucoTrackTM; Pulse oximeter, Portable Pulse Oximeter, wearable pulse oximeter.

CO5: Design the sensors for environmental monitoring **L-9**

Environmental Sensor: Introduction - environmental quantities**:** time, moisture acidity/alkalinity, wind-chill, radioactive count rate. Surveying and security. Sensors for environmental monitoring. Smoke and fire detector. Pressure sensor in emission testing, pollution devices, and wind management systems.

TEXT BOOKS

1. Jacob Fraden, Handbook of Modern Sensors: Physics, Design and Applications, 5th edition, Springer Nature, New Delhi, 2016
2. D. Patranabis, Sensors and Transducers, 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.
3. John Veteline, Aravind Raghu, Introduction to sensors, CRC press, New Delhi,2011.
4. S Nihtianov, A. Luque Smart Sensors and MEMS, 2nd Edition, Woodhead Publishing Limited, New Delhi,2018.
5. Edward Sazonov and Michael R. Neuman, Wearable Sensors - Fundamentals, Implementation and Applications, Elsevier publishing company, Amsterdam, Netherland,2014.

REFERENCE BOOKS

1. Shantanu Bhattacharya,A K Agarwal, NripenChanda, Ashok Pandey and Ashis Kumar Sen Environmental, Chemical and Medical Sensors, Springer Verlag, Singapore,2018 .

2. Krzysztof Iniewski, Optical, Acoustic, Magnetic, and Mechanical Sensor Technologies, 1st Edition, CRC Press, New Delhi, 2017.

L: 45; TOTAL: 45 PERIODS