



R.M.K. COLLEGE OF ENGINEERING AND TECHNOLOGY

[An Autonomous Institution]

R.S.M Nagar, Kavaraipettai, Gummidipoondi Taluk, Thiruvallur District, Tamil Nadu- 601 206
Affiliated to Anna University, Chennai / Approved by AICTE, New Delhi/ Accredited by NAAC with A+ Grade
An ISO 9001:2015 Certified Institution / All the Eligible UG Programs are accredited by NBA, New Delhi.



B.E. / B.TECH- ARTIFICIAL INTELLIGENCE AND DATA SCIENCE REGULATIONS – 2022 CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The B.Tech. Artificial Intelligence & Data Science Graduates of R.M.K. College and Engineering Technology will:

- PEO 1 : Work effectively in inter-disciplinary field with the knowledge of Artificial Intelligence and Data Science to develop appropriate solutions to the real-world problems.
- PEO 2: Excel in professional career and pursue higher education in the field of Artificial Intelligence and Data Science.
- PEO 3: Apply their knowledge to the technological revolution through life-long learning.
- PEO 4: Excel as socially committed engineers or entrepreneurs with high ethical and moral values.

PROGRAM OUTCOMES (POs)

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

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and

need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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

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

1. Apply fundamental concepts of Artificial Intelligence and Data Science to solve technical problems.
2. Utilize Artificial Intelligence and Data Science tools to provide innovative business solutions.
3. Implement the domain knowledge to achieve successful career as an employee, entrepreneur and an engineering professional.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES(PEOs) WITH PROGRAMME OUTCOMES(POs)

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
I	3	3	3	3	2	2	2	1	1	1	1	1
II	3	3	3	3	2	1	1	1	3	3	1	3
III	2	2	2	2	2	3	2	3	3	1	1	1
IV	3	3	3	3	2	2	2	3	3	3	2	1
I	3	3	3	3	2	2	2	1	1	1	1	1

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

PROGRAMME SPECIFIC OBJECTIVES	PROGRAMME OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
I	3	3	3	3	3	3	2	1	1	1	1	2
II	3	3	3	3	3	3	2	1	1	1	1	2
III	2	2	2	2	3	2	2	2	3	2	3	3

YEAR II	SEMESTER III	Universal Human Values II						✓	✓	✓	✓	✓	✓	✓	
		Discrete Mathematics	✓	✓	✓	✓									
		Tamils and Technology							✓	✓	✓	✓	✓	✓	✓
		Computer Organization and Architecture	✓	✓	✓	✓					✓	✓	✓		✓
		Design and Analysis of Algorithms	✓	✓	✓	✓	✓				✓	✓	✓		✓
		Artificial Intelligence	✓	✓	✓						✓	✓	✓		✓
		Data Science using Python	✓	✓	✓	✓	✓				✓	✓	✓		✓
		Product Development Lab-3	✓	✓	✓	✓	✓				✓	✓	✓		✓
		Aptitude and Coding Skills I	✓	✓								✓	✓		
		Internship and Seminar	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Value Education (Non Credit)													
	SEMESTER IV	Probability and Statistics	✓	✓	✓	✓									
		Operating Systems	✓	✓	✓	✓	✓				✓	✓	✓		✓
		Distributed and Cloud Computing	✓	✓	✓		✓				✓	✓	✓		✓
		Machine Learning	✓	✓	✓		✓				✓	✓	✓		✓
		Web Application Development	✓	✓	✓		✓				✓	✓	✓		✓
		Professional Elective I													
		Product Development Lab-4													
		Aptitude and Coding Skills II	✓	✓								✓	✓		
		Mini Project and Design Thinking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Yoga/Personality Development (Non Credit)													
YEAR III	SEMESTER V	Open Elective I													
		Professional Elective II													
		Professional Elective III													
		Computer Networks	✓	✓	✓		✓				✓	✓	✓		✓

AI AND CLOUD COMPUTING	Cloud Foundations	✓	✓	✓		✓			✓	✓	✓		✓
	Cloud Architecting	✓	✓	✓		✓			✓	✓	✓		✓
	Virtualization	✓	✓	✓		✓			✓	✓	✓		✓
	Data Engineering in Cloud	✓	✓	✓		✓			✓	✓	✓		✓
	DevOps	✓	✓	✓		✓			✓	✓	✓		✓
	Cloud Security Foundations	✓	✓	✓		✓			✓	✓	✓		✓
	Software Defined Networks	✓	✓	✓		✓			✓	✓	✓		✓
	Storage Technologies	✓	✓	✓		✓			✓	✓	✓		✓
	Machine Learning for NLP in Cloud	✓	✓	✓		✓			✓	✓	✓		✓
	Cloud Services Management	✓	✓	✓		✓			✓	✓	✓		✓
	Capstone Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
INTELLIGENT HEALTHCARE	AI and ML for Healthcare	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓
	Health Care Analytics	✓	✓	✓					✓	✓	✓		✓
	Health Informatics	✓	✓	✓					✓	✓	✓		✓
	Bio-informatics	✓	✓	✓					✓	✓	✓		✓
	Clinical Data Science	✓	✓	✓					✓	✓	✓		✓
	Machine Intelligence for Medical Image Analysis	✓	✓	✓					✓	✓	✓		✓
	Smart and Interactive Healthcare Technologies	✓	✓	✓					✓	✓	✓		✓
	Deep Learning in Genomics and Biomedicine	✓	✓	✓					✓	✓	✓		✓
	Computer Vision in Healthcare Applications	✓	✓	✓		✓			✓	✓	✓		✓
	Capstone Project	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CYBER SECURITY	Cryptography and Cyber Security	✓	✓	✓		✓			✓	✓	✓		✓
	Ethical Hacking	✓	✓	✓		✓			✓	✓	✓		✓
	Social Network Security	✓	✓	✓		✓			✓	✓	✓		✓



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I - VIII SEMESTER CURRICULUM

SEMESTER –I								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA101	Matrices and Calculus	BSC	5	3	0	2	4
2	22CH101	Engineering Chemistry	BSC	5	3	0	2	4
3	22CS101	Problem Solving using C++	ESC	5	3	0	2	4
4	22CS102	Software Development Practices	ESC	5	3	0	2	4
5	22EC101	Digital Principles and System Design	ESC	5	3	0	2	4
LABORATORY COURSES WITH THEORY COMPONENT								
6	22GE202	Computer aided Engineering Graphics	ESC	3	1	0	2	2
LABORATORY COURSES								
7	22GE111	Product Development Lab-1	EEC	2	0	0	2	1
MANDATORY COURSES								
8		Induction Program (Non Credit)	MC	3Weeks				
TOTAL				30	16	0	14	23

SEMESTER –II								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES WITH LABORATORY COMPONENT								
1	22MA201	Transforms and Numerical Methods	BSC	5	3	0	2	4
2	22CS201	Data Structures	ESC	5	3	0	2	4
3	22PH201	Physics for Computer Science and Information Technology	BSC	5	3	0	2	4
4	22HS101	Professional Communication	HSMC	4	2	0	2	3
5	22CS202	Java Programming	ESC	5	3	0	2	4
6	22CS203	Database Management System	PCC	5	3	0	2	4
LABORATORY COURSES								
7	22GE211	Product Development Lab - 2	EEC	2	0	0	2	1
MANDATORY COURSES								
8	22CH104	Environmental Sciences and Sustainability (Non Credit)	MC	2	2	0	0	0
AUDIT COURSES								
9		Yoga for Stress Management	AC	1	1	0	0	0
THEORY COURSES								
10	22GE201	Heritage of Tamils	HSMC	1	1	0	0	1
TOTAL				35	21	0	14	25

SEMESTER – III								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.	22GE302	Universal Human Values II	HSMC	3	3	0	0	3
2.	22MA301	Discrete Mathematics	BSC	4	3	1	0	4
3.	22GE301	Tamils and Technology	HSMC	1	1	0	0	1
4.	22CS302	Computer Organization and Architecture	ESC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
5.	22CS303	Design and Analysis of Algorithms	PCC	4	2	0	2	3
6.	22AI301	Artificial Intelligence	PCC	5	3	0	2	4
7.	22AI302	Data Science using Python	PCC	4	2	0	2	3
LABORATORY COURSES								
8.	22CS313	Product Development Lab 3	EEC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
9.	22CS311	Aptitude and Coding Skills I	EEC	2	0	0	2	1
10.	22AI312	Internship and Seminar	EEC	2	0	0	2	1
AUDIT COURSES								
11.		Value Education (Non Credit)	AC	1	1	0	0	0
TOTAL				31	18	1	12	24

*2 weeks for one credit. Internship during 2 Semester Summer Vacation

SEMESTER – IV								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES WITH LABORATORY COMPONENT								
1.	22MA401	Probability and Statistics	BSC	5	3	0	2	4
2.	22CS304	Operating Systems	PCC	4	2	0	2	3
3.	22CS401	Distributed and Cloud Computing	PCC	4	2	0	2	3
4.	22AI401	Machine Learning	PCC	5	3	0	2	4
5.	22CS402	Web Application Development	PCC	5	3	0	2	4
6.		Professional Elective I	PEC	4	2	0	2	3
LABORATORY COURSES								
7.	22CS413	Product Development Lab-4	PCC	2	0	0	2	1
EMPLOYABILITY ENHANCEMENT COURSES								
8.	22CS411	Aptitude and Coding Skills II	EEC	2	0	0	2	1
9.	22CS412	Mini Project and Design Thinking	EEC	2	0	0	2	1
AUDIT COURSES								
10.		Yoga/Personality Development (Non Credit)	AC	1	1	0	0	0
TOTAL				34	16	0	18	24

SEMESTER – V								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1		Open Elective I	OEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
2		Professional Elective II	PEC	4	2	0	2	3
3		Professional Elective III	PEC	4	2	0	2	3
4	22CS501	Computer Networks	PCC	5	3	0	2	4
5	22AI501	Reinforcement Learning	PCC	4	2	0	2	3
6	22AI502	Data Exploration, Feature Engineering and Visualization	PCC	4	2	0	2	3
EMPLOYABILITY ENHANCEMENT COURSES								
8	22CS511	Advanced Aptitude and Coding Skills I	EEC	2	0	0	2	1
9	22AI512	Internship and Seminar	EEC	2	0	0	2	1
MANDATORY COURSES								
10		Indian Constitution (Non Credit)	MC	1	1	0	0	0
TOTAL				29	15	0	14	21

*2 weeks for one credit. Internship during 4 Semester Summer Vacation

SEMESTER – VI								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1.		Professional Ethics	HSMC	2	2	0	0	2
2.		Open Elective II	OEC	3	3	0	0	3
THEORY COURSES WITH LABORATORY COMPONENT								
3.		Professional Elective IV	PEC	4	2	0	2	3
4.		Professional Elective V	PEC	4	2	0	2	3
5.	22AI602	Automation Theory and Compiler Design	PCC	4	2	0	2	3
6.	22CS602	Object Oriented Software Engineering	PCC	5	3	0	2	4
7.	22AI601	Big Data Analytics	PCC	4	2	0	2	3
EMPLOYABILITY ENHANCEMENT COURSES								
8.	22CS611	Advanced Aptitude and Coding Skills II	EEC	2	0	0	2	1
TOTAL				31	19	0	10	22

SEMESTER – VII								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY COURSES								
1	22AI701	Innovation, Entrepreneurship and Artificial Intelligence	PCC	2	2	0	0	2
2		Open Elective III	OEC	3	3	0	0	3
3		Open Elective IV	OEC	3	3	0	0	3
LAB INTEGRATED THEORY COURSES								
4		Professional Elective VI	PEC	4	2	0	2	3
5	22AI702	Natural Language Processing	PCC	5	3	0	2	4
6	22AI703	Deep Learning	PCC	4	2	0	2	3
LAB COURSE								
7	22AI704	MLOps	PCC	2	0	0	2	1
MANDATORY COURSES								
8		Essence of Indian Knowledge Tradition (Non Credit)	MC	1	1	0	0	0
TOTAL				24	16	0	8	19

SEMESTER – VIII								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
EMPLOYABILITY ENHANCEMENT COURSES								
1	22AI811	Project Work	EEC	16	0	0	16	8
TOTAL				16	0	0	16	8

CREDIT SUMMARY

S. No.	Subject Area	Credits Per Semester								Credit Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1	HSMC	-	4	4	-	-	2	-	-	10	6.06%
2	BSC	8	8	4	4	-	-	-	-	24	14.55%
3	ESC	14	8	3	-	-	-	-	-	25	15.15%
4	PCC	-	4	10	14	10	10	10	-	57	34.33%
5	PEC	-	-	-	3	6	6	3	-	18	10.91%
8	OEC	-	-	-	-	3	3	6	-	12	7.27%
7	EEC	1	1	3	3	2	1	-	8	19	11.52%
8	MC			✓	✓	✓		✓			
	Total	23	25	24	24	20	21	19	8	164+2	

HSMC – Humanities and Social Sciences including Management courses; **BSC** – Basic Science Courses; **ESC** – Engineering Science Courses including workshop, drawing, basics of electrical/mechanical/computer etc.; **PCC** – Professional Core Courses; **PEC** – Professional Elective Courses relevant to chosen specialization/branch; **OEC** – Open Subjects–Electives from other technical and/or emerging subjects **EEC** – Project Work, Seminar and Internship in Industry or elsewhere

ELECTIVE VERTICALS:

ADVANCED ANALYTICS								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22AI901	Business Intelligence and Analytics *	PEC	4	2	0	2	3
2.	22AI902	Social Network Analytics	PEC	4	2	0	2	3
3.	22AI903	Text and Speech Analytics	PEC	4	2	0	2	3
4.	22AI904	Edge Stream Analytics	PEC	4	2	0	2	3
5.	22AI905	Ethics in Data Science	PEC	3	3	0	0	3
6.	22AI906	Web Information Search and Analytics	PEC	4	2	0	2	3
7.	22AI907	Image and Video Analytics*	PEC	4	2	0	2	3
8.	22AI908	Geometric and Topological Data Analysis*	PEC	4	2	0	2	3
9.	22AI909	Mining Large Data Sets*	PEC	4	2	0	2	3
10.	22AI910	Cognitive Science and Analytics*	PEC	4	2	0	2	3
11.	22AI812	Capstone Project*	PEC	12	0	0	12	6

*for Honours Degree

COMPUTATIONAL INTELLIGENCE								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22AI911	Soft Computing*	PEC	4	2	0	2	3
2.	22AI912	Optimization Methods in Machine Learning	PEC	4	2	0	2	3
3.	22AI913	Computational Neuroscience	PEC	4	2	0	2	3
4.	22AI914	Graph Theory and Neural Networks	PEC	4	2	0	2	3

5.	22AI915	Ethics in AI	PEC	3	3	0	0	3
6.	22AI916	Computer Vision	PEC	4	2	0	2	3
7.	22AI917	Applied AI*	PEC	4	2	0	2	3
8.	22AI918	Recommender Systems*	PEC	4	2	0	2	3
9.	22AI919	Knowledge Engineering *	PEC	4	2	0	2	3
10.	22AI920	Deep Generative Models*	PEC	4	2	0	2	3
11.	22AI812	Capstone Project*	PEC	12	0	0	12	6

*for Honours Degree

AI and CLOUD COMPUTING								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22CS907	Cloud Foundations*	PEC	4	2	0	2	3
2.	22CS908	Cloud Architecting	PEC	4	2	0	2	3
3.	22CS909	Virtualization	PEC	4	2	0	2	3
4.	22AI921	Data Engineering in Cloud	PEC	4	2	0	2	3
5.	22CS910	DevOps	PEC	4	2	0	2	3
6.	22CS912	Cloud Security Foundations	PEC	4	2	0	2	3
7.	22CS927	Software Defined Networks*	PEC	4	2	0	2	3
8.	22CS928	Storage Technologies*	PEC	4	2	0	2	3
9.	22AI922	Machine Learning for NLP in Cloud*	PEC	4	2	0	2	3
10.	22CS930	Cloud Services Management*	PEC	4	2	0	2	3
11.	22AI812	Capstone Project*	PEC	12	0	0	12	6

*for Honours Degree

INTELLIGENT HEALTHCARE								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22AI923	AI and ML for Healthcare*	PEC	4	2	0	2	3
2.	22AI924	Health Care Analytics	PEC	4	2	0	2	3
3.	22AI925	Health Informatics	PEC	4	2	0	2	3
4.	22AI926	Bio-informatics	PEC	4	2	0	2	3
5.	22AI927	Clinical Data Science	PEC	4	2	0	2	3
6.	22AI928	Machine Intelligence for Medical Image Analysis	PEC	4	2	0	2	3
7.	22AI929	Smart and Interactive Healthcare Technologies*	PEC	4	2	0	2	3
8.	22AI930	Deep Learning in Genomics and Biomedicine*	PEC	4	2	0	2	3
9.	22AI931	Computer Vision in Healthcare Applications*	PEC	4	2	0	2	3
10.	22AI932	Intelligent Embedded Systems*	PEC	4	2	0	2	3
11.	22AI812	Capstone Project*	PEC	12	0	0	12	6

*for Honours Degree

CYBER SECURITY								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22CS701	Cryptography and Cyber Security*	PEC	4	2	0	2	3
2.	22CS901	Ethical Hacking	PEC	4	2	0	2	3
3.	22CS902	Social Network Security	PEC	4	2	0	2	3
4.	22CS904	Web Security	PEC	4	2	0	2	3
5.	22CS905	Digital and Mobile Forensics	PEC	4	2	0	2	3
6.	22CS906	Vulnerability Analysis and Penetration Testing	PEC	4	2	0	2	3
7.	22CS936	Advanced Network Security*	PEC	4	2	0	2	3
8.	22CS924	Network Design and Programming*	PEC	4	2	0	2	3
9.	22CS925	Fault Tolerant Computing *	PEC	4	2	0	2	3
10.	22CS923	Engineering Secured Software Systems*	PEC	4	2	0	2	3
11.	22AI812	Capstone Project*	PEC	12	0	0	12	6

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EMERGING TECHNOLOGIES								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22AI933	GPU Computing	PEC	4	2	0	2	3
2.	22CS921	Industrial IoT	PEC	4	2	0	2	3
3.	22AI934	AI in Block Chain	PEC	4	2	0	2	3
4.	22AI935	Digital Marketing	PEC	4	2	0	2	3
5.	22AI937	Augmented and Virtual Reality	PEC	4	2	0	2	3
6.	22CS922	Quantum Computing	PEC	4	2	0	2	3
7.	22AI936	Intelligent Robots	PEC	4	2	0	2	3
8.	22CS930	Game Development	PEC	4	2	0	2	3
9.	22CS931	3D Printing and Design	PEC	4	2	0	2	3
10.	22CS932	Serverless Computing	PEC	4	2	0	2	3
11.	22AI812	Capstone Project	PEC	4	2	0	2	3

OPEN ELECTIVE – OFFERED TO OTHER DEPARTMENTS								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	22AI925	Health Informatics	OEC	4	2	0	2	3
2	22AI934	AI in Block Chain	OEC	4	2	0	2	3
3	22AI933	GPU Computing	OEC	4	2	0	2	3
4	22AI936	Intelligent Robots	OEC	4	2	0	2	3

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WITH SPECIALIZATION IN
ADVANCED ANALYTICS / COMPUTATIONAL INTELLIGENCE / AI and CLOUD
COMPUTING / INTELLIGENT HEALTHCARE / CYBER SECURITY**

Additional 18 credits to be completed from the courses offered in the specific Professional Elective Verticals

**R2022 CURRICULUM OF
B.TECH. (HONOURS) IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**
Additional 18 credits to be completed from the courses offered in any Professional Elective Verticals

**R2022
MINOR DEGREE CURRICULUM OFFERED BY
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
(for other B.E. / B.Tech. Programmes)**

MINOR DEGREE IN ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SI. No	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
1.	22MA401	Probability and Statistics	5	3	0	2	4
2.	22AI302	Data Science using Python	4	2	0	2	3
3.	22AI301	Artificial Intelligence	5	3	0	2	4
4.	22AI401	Machine Learning	5	3	0	2	4
5.	22AI502	Data Exploration, Feature Engineering and Visualization	4	2	0	2	3
6.	22AI812	Capstone Project	12	0	0	6	6

**MINOR DEGREE IN
ADVANCED ANALYTICS / COMPUTATIONAL INTELLIGENCE / AI and CLOUD
COMPUTING / INTELLIGENT HEALTHCARE**
Additional 18 credits to be completed from the courses offered in the specific Professional Elective Verticals

**R2022
B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE WITH MINOR DEGREE**

SI. No	NAME OF THE MINOR DEGREE	OFFERRING DEPARTMENT
1.	Internet of Things	Electronics and Communication Engineering

SEMESTER – I

22MA101	MATRICES & CALCULUS (Common to All Branches)	L	T	P	C	
		3	0	2	4	
OBJECTIVES:						
The Course will enable learners to:						
<ul style="list-style-type: none"> • Explain the concepts of matrix algebra techniques needed for practical applications. • Determine the curvature of the curves. • Illustrate the simple applications of multivariable calculus and vector calculus. • Elaborate the concept and application of multiple integrals. 						
UNIT I	MATRICES					15
Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Statement and applications of Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.						
Theory : 9						
Experiments using SCILAB:						
<ol style="list-style-type: none"> 1. Introduction to SCILAB through matrices and general syntax. 2. Finding the Eigenvalues and Eigenvectors. 3. Plotting the graph of a quadratic form. 						
Laboratory: 6						
UNIT II	SINGLE VARIABLE CALCULUS					15
Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature–Evolutes.						
Theory: 9						
Experiments using SCILAB:						
<ol style="list-style-type: none"> 1. Evaluating the radius of curvature. 2. Finding the coordinates of the center of curvature. 3. Tracing of Curves. 						
Laboratory: 6						
UNIT III	MULTIVARIABLE CALCULUS					15
Partial derivatives (excluding Euler’s theorem) – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor’s series for functions of two variables – Maxima and minima of functions of two variables.						
Theory: 9						
Experiments using SCILAB:						
<ol style="list-style-type: none"> 1. Evaluating the maxima of functions of several variables. 2. Evaluating the minima of functions of several variables. 3. Evaluation of Jacobians. 						
Laboratory: 6						
UNIT IV	MULTIPLE INTEGRALS					15
Double integrals – Change of order of integration – Area enclosed by plane curves – Triple integrals – Volume of solids.						
Theory: 9						
Experiments using SCILAB:						

<ol style="list-style-type: none"> Evaluating area under a curve. Evaluating area using double integral.. Evaluation of volume by integrals. 		Laboratory: 6
UNIT V	VECTOR CALCULUS	15
<p>Gradient, divergence and curl (excluding vector identities) – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration – Green’s theorem in a plane and Gauss divergence theorem (Statement only) – Simple applications involving cubes and rectangular parallelopipeds.</p>		Theory: 9
<p>Experiments using SCILAB:</p> <ol style="list-style-type: none"> Evaluating gradient. Evaluating directional derivative. Evaluating divergent and curl. 		Laboratory: 6
TOTAL: 75 PERIODS		
<p>OUTCOMES:</p> <p>At the end of this course, the students will be able to:</p> <p>CO1: Use the matrix algebra methods to diagonalize the matrix.</p> <p>CO2: Determine the evolute of the curve.</p> <p>CO3: Apply differential calculus ideas on the function of several variables.</p> <p>CO4: Evaluate the area and volume by applying the concept of multiple integration.</p> <p>CO5: Utilize the concept of vector calculus in evaluating integrals.</p>		
<p>TEXT BOOKS:</p> <ol style="list-style-type: none"> Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley and Sons, 10th Edition, New Delhi, 2016. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014. 		
<p>REFERENCES:</p> <ol style="list-style-type: none"> M. K. Venkataraman, “Engineering Mathematics”, Volume I, 4th Edition, The National Publication Company, Chennai, 2003. SivaramakrishnaDass, C. Vijayakumari, “Engineering Mathematics”, Pearson Education India, 4th Edition 2019. H. K. Dass, and Er. Rajnish Verma, “Higher Engineering Mathematics”, S. Chand Private Limited, 3rd Edition 2014. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008. S.S. Sastry, “Engineering Mathematics”, Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014. 		
<p>LIST OF EQUIPMENTS:</p> <ol style="list-style-type: none"> SCILAB- Open source 		

22CH101	ENGINEERING CHEMISTRY (Common to All Branches)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> To understand the water quality criteria and interpret its applications in water purification. To gain insights into the basic concepts of electrochemistry and implement its applications in chemical sensors. To acquire knowledge on the fundamental principle of energy storage devices and relate it to electric vehicles. To identify the different types of smart materials and explore their applications in Engineering and Technology. To assimilate the preparation, properties and applications of nanomaterials in various fields. 					
UNIT I	WATER TECHNOLOGY				15
<p>Sources of water –Impurities - Drinking water quality parameters –Hardness and its types, problems - Municipal water treatment and disinfection (chlorination- break-point chlorination,UV, Ozonation). Boiler troubles- Scales and sludges, Boiler feed water: Requirements - Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment –Ion exchange demineralization - Principle, process and fouling. Desalination of brackish water: Reverse osmosis –principle-types of membranes, process and fouling.</p> <p style="text-align: right;">(Theory-9)</p> <p>Determination of total, temporary and permanent hardness of water by EDTA method. Determination of chloride content of water sample by argentometric method. Determination of alkalinity in water sample</p> <p style="text-align: right;">(Laboratory-6)</p>					
UNIT II	ELECTROCHEMISTRY AND SENSORS				15
<p>Introduction- Conductance- factors affecting conductance – Electrodes– origin of electrode potential – single electrode potential, standard electrode potential – measurement of single electrode potential –over voltage - reference electrodes (standard hydrogen electrode, calomel electrode)-ion selective electrode- glass electrode - Nernst equation (derivation),numerical problems, Electrochemical series and its applications.</p> <p>Chemical sensors – Principle of chemical sensors – Breath analyzer– Gas sensors – CO₂ sensors- Sensor for health care – Glucose sensor.</p> <p style="text-align: right;">(Theory-9)</p> <p>Determination of the amount of NaOH using a conductivity meter. Determination of the amount of acids in a mixture using a conductivity meter. Determination of the amount of given hydrochloric acid using a pH meter.</p> <p style="text-align: right;">(Laboratory-6)</p>					
UNIT III	ENERGY STORAGE DEVICES AND ENERGY SOURCES				15
<p>Batteries –Primary alkaline battery - Secondary battery - Pb-acid battery, Fuel cell - H₂ – O₂ fuel cell.</p> <p>Batteries used in E- vehicle: Ni-metal hydride battery, Li-ion Battery, Li-air Battery</p> <p>Nuclear Energy – Nuclear fission, fusion, differences, characteristics – nuclear chain reactions – light water nuclear reactor – breeder reactor.</p> <p style="text-align: right;">(Theory-9)</p> <p>Determination of single electrode potential of the given electrode.</p>					

Estimation of the iron content of the given solution using a potentiometer.
 Determination of electrochemical cell potential (using different electrodes/ different concentrations of electrolytes)
 (Laboratory-6)

UNIT IV	SMART MATERIALS FOR ENGINEERING APPLICATIONS	15
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Polymers – Definition – Classification – smart polymeric materials - Preparation, properties and applications of Piezoelectric polymer - Polyvinylidene fluoride (PVDF), Electroactive polymer- Polyaniline (PANI) and Biodegradable polymer - Polylactic acid (PLA).
 Polymer composites: Definition, Classification – FRP's – Kevlar.
 Shape Memory Alloys: Introduction, Shape memory effect – Functional properties of SMAs – Types of SMA - Nitinol (Ni-Ti) alloys - applications.
 Chromogenic materials: Introduction – Types - applications.
 (Theory-9)

Determination of the molecular weight of polymer using Ostwald viscometer.
 Application of polymeric fibers in 3D printing.
 (Laboratory-6)

UNIT V	NANO CHEMISTRY	15
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Introduction – synthesis – top-down process (laser ablation, chemical vapor deposition), bottom-up process (precipitation, electrochemical deposition) – properties of nanomaterials – types – nanotubes - carbon nanotubes, applications of CNT - nanocomposites – General applications of nanomaterials in electronics, information technology, medical and healthcare, energy, environmental remediation, construction and transportation industries.
 (Theory-9)

Determination of concentration of BaSO₄ nanoparticles by conductometric titrations.
 Preparation of ZnO nanocrystal by precipitation method.
 (Laboratory-6)

TOTAL: 75 PERIODS

OUTCOMES:

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

- CO1:** Interpret the water quality parameters and explain the various water treatment methods.
CO2: Construct the electro chemical cells and sensors.
CO3: Compare different energy storage devices and predict their relevance in electric vehicles.
CO4: Classify different types of smart materials, their properties and applications in Engineering and Technology.
CO5: Integrate the concepts of nano chemistry and enumerate its applications in various fields.

TEXT BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company Pvt. Ltd., New Delhi, 2022.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2012.

REFERENCES:

1. S.S. Dara and S.S. Umare, "A Textbook of Engineering Chemistry", 12th Edition, S.Chand & Company, New Delhi, 2013.
2. V.R. Gowarikar, Polymer Science, 2nd edition, New Age International Publishers, 2021.
3. J. C. Kuriacose and J. Rajaram, "Chemistry in Engineering and Technology", Volume - 1 & Volume - 2, Tata McGraw-Hill Education Pvt. Ltd., 2010.
4. Geoffrey A. Ozin, Andre C. Arsenault and Ludovico Cademartiri, "Nanochemistry: A Chemical Approach to Nanomaterials", 2nd Edition, RSC publishers, 2015.

5. PrasannaChandrasekhar, “Conductingpolymers, fundamentalsandapplications–Including Carbon Nanotubes and Graphene”, Second Edition, Springer Science & Business Media, New York, 2019.
6. J. Mendham, R. C. Denney, J. D. Barnes, M. J. K. Thomas and B. Sivasankar, “Vogel’s Quantitative Chemical Analysis”, 6th edition, Pearson Education Pvt. Ltd., 2019.

LIST OF EQUIPMENTS:

1. Conductivity meter – 20 Nos.
2. pH meter - 19 Nos.
3. Potentiometer - 20 Nos.

22CS101	PROBLEM SOLVING USING C++ (Common to All Branches)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> • To learn problem solving and programming fundamentals. • To gain knowledge on pointers and functions. • To apply the principles of object orientated programming. • To understand operator overloading, inheritance and polymorphism. • To use the functionalities of I/O operations, files build C++ programs using exceptions. 					
UNIT I	PROBLEM SOLVING AND PROGRAMMING FUNDAMENTALS				15
<p>Computational thinking for Problem solving – Algorithmic thinking for Problem solving - Building Blocks - Problem Solving and Decomposition - Dealing with Error – Evaluation.</p> <p>Overview of C – Data types – Identifiers – Variables – Storage Class Specifiers – Constants – Operators - Expressions – Statements – Arrays and Strings – Single-Dimensional – Two-Dimensional Arrays – Arrays of Strings – Multidimensional Arrays.</p> <p>List of Exercises:</p> <ol style="list-style-type: none"> 1. Write C/C++ programs for the following: <ol style="list-style-type: none"> a. Find the sum of individual digits of a positive integer. b. Compute the GCD of two numbers. c. Find the roots of a number (Newton’s method) 2. Write C/C++ programs using arrays: <ol style="list-style-type: none"> a. Find the maximum of an array of numbers. b. Remove duplicates from an array of numbers. c. Print the numbers in an array after removing even numbers. 3. Write C/C++ programs using strings: <ol style="list-style-type: none"> a. Checking for palindrome. b. Count the occurrences of each character in a given word. 					
UNIT II	POINTERS AND FUNCTIONS				15
<p>Pointers -Variables – Operators – Expressions – Pointers and Arrays – Functions - Scope Rules – Function Arguments – return Statement – Recursion – Structures – Unions – Enumerations.</p> <p>List of Exercises:</p> <ol style="list-style-type: none"> 1. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members: EID, Ename, Designation, DOB, DOJ, Basicpay Note that DOB and DOJ should be implemented using structure within structure. 2. Compute internal marks of students for five different subjects using structures and functions. 					
UNIT III	CLASSES AND OBJECTS				15
<p>Concepts of Object Oriented Programming – Benefits of OOP – Simple C++ program - Classes and Objects - Member functions - Nesting of member functions - Private member functions - Memory Allocation for Objects - Static Data Members - Static Member functions - Array of Objects - Objects as function arguments - Returning objects - friend functions – Const Member</p>					

functions - Constructors – Destructors.

List of Exercises:

1. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.
2. Program to illustrate default constructor, parameterized constructor and copy constructors.

UNIT IV	OPERATOR OVERLOADING, INHERITANCE AND POLYMORPHISM	15
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Operator Overloading - Overloading Using Friend functions – Inheritance – Types of inheritance – Virtual Base Class - Abstract Class – Constructors in Derived Classes - member class: nesting of classes.

Pointer to objects – this pointer- Pointer to derived Class - Virtual functions – Pure Virtual Functions – Polymorphism.

List of Exercises:

1. Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.
2. Write a Program to Demonstrate Friend Function and Friend Class.
3. Program to demonstrate inline functions.
4. Program for Overriding of member functions.
5. Write C++ programs that illustrate how the following forms of inheritance are supported:
a) Single inheritance b) Multiple inheritance c) Multi level inheritance d) Hierarchical inheritance.

UNIT V	I/O, FILES AND EXCEPTIONS	15
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C++ Streams – Unformatted I/O - Formatted Console I/O – Opening and Closing File – File modes - File pointers and their manipulations – Templates – Class Templates – Function Templates - Exception handling.

List of Exercises:

1. Program to demonstrate pure virtual function implementation.
2. Count the number of account holders whose balance is less than the minimum balance using sequential access file.
3. Write a Program to Demonstrate the Catching of all Exceptions.
4. Mini project.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

- CO1:** Solve problems using basic constructs in C.
- CO2:** Implement C programs using pointers and functions.
- CO3:** Apply object-oriented concepts and solve real world problems.
- CO4:** Develop C++ programs using operator overloading and polymorphism.
- CO5:** Implement C++ programs using Files and exceptions.

TEXT BOOKS:

1. Herbert Schildt, “The Complete Reference C++”, 4th edition, MH, 2015. (Unit 1 & 2)
2. E Balagurusamy, “Object Oriented Programming with C++”, 4th Edition, Tata McGraw-Hill Education, 2008. (Unit 3, 4 & 5)

REFERENCES:

1. Karl Beecher, “Computational Thinking: A beginner's guide to problem-solving and programming”, BCS Learning & Development Ltd, 2017. (Unit 1)
2. Nell Dale, Chip Weems, “Programming and Problem Solving with C++”, 5th Edition, Jones and Barklett Publishers, 2010.

3. John Hubbard, "Schaum's Outline of Programming with C++", MH, 2016.
4. Yashavant P. Kanetkar, "Let us C++", BPB Publications, 2020
5. ISRD Group, "Introduction to Object-oriented Programming and C++", Tata McGraw-Hill Publishing Company Ltd., 2007.
6. D. S. Malik, "C++ Programming: From Problem Analysis to Program Design", Third Edition, Thomson Course Technology, 2007.
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01297200240671948837_shared/overview

LIST OF EQUIPMENTS:

1. Standalone desktops with C/C++ compiler (or) Server with C/C++ compiler.

22CS102	SOFTWARE DEVELOPMENT PRACTICES (Common to All Branches)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> • To discuss the essence of agile development methods. • To set up and create a GitHub repository. • To create interactive websites using HTML • To design interactive websites using CSS. • To develop dynamic web page using Java script. 					
UNIT I	AGILE SOFTWARE DEVELOPMENT AND Git and GitHub				15
<p>Software Engineering Practices – Waterfall Model - Agility – Agile Process – Extreme Programming - Agile Process Models – Adaptive Software Development – Scrum – Dynamic Systems Development Method – Crystal – Feature Driven Development – Lean Software Development – Agile Modeling – Agile Unified Process – Tool set for Agile Process.</p> <p>Introduction to Git –Setting up a Git Repository - Recording Changes to the Repository - Viewing the Commit History - Undoing Things - Working with Remotes -Tagging - Git Aliases - Git Branching - Branches in a Nutshell - Basic Branching and Merging - Branch Management - Branching Workflows - Remote Branches - Rebasing.</p> <p>Introduction to GitHub – Set up and Configuration - Contribution to Projects, Maintaining a Project – Scripting GitHub.</p>					
List of Exercises:					
<ol style="list-style-type: none"> 1. Form a Team, Decide on a project: <ol style="list-style-type: none"> a) Create a repository in GitHub for the team. b) Choose and follow a Git workflow <ul style="list-style-type: none"> ▪ Each team member can create a StudentName.txt file with contents about themselves and the team project ▪ Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository. ▪ Team members can now create a Pull request to merge the branch to master branch or main development branch. ▪ The Pull request can have two reviewers, one peer team member and one faculty. Reviewers can give at least one comment for Pull Request updating. ▪ Once pull request is reviewed and merged, the master or main development branch will have files created by all team members. 2. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews. 3. Form a Team, Decide on a project: <ol style="list-style-type: none"> c) Create a repository in GitHub for the team. d) Choose and follow a Git workflow <ul style="list-style-type: none"> ▪ Each team member can create a StudentName.txt file with contents about themselves and the team project ▪ Each team member can create a branch, commit the file with a proper commit message and push the branch to remote GitHub repository. ▪ Team members can now create a Pull request to merge the branch to master branch or main development branch. 					

	<ul style="list-style-type: none"> ▪ The Pull request can have two reviewers, one peer team member and one faculty. Reviewers can give at least one comment for Pull Request updation. ▪ Once pull request is reviewed and merged, the master or main development branch will have files created by all team members. <p>4. Create a web page with at least three links to different web pages. Each of the web pages is to be designed by a team member. Follow Git workflow, pull request and peer reviews.</p>	
UNIT II	HTML	15
<p>Introduction – Web Basics – Multitier Application Architecture – Cline-Side Scripting versus Server-side Scripting – HTML5 – Headings – Linking – Images – Special Characters and Horizontal Rules – Lists – Tables – Forms – Internal Linking – meta Elements – Form input Types – input and datalist Elements – Page-Structure Elements.</p> <p>List of Exercises:</p> <p>1. Create web pages using the following:</p> <ul style="list-style-type: none"> • Tables and Lists • Image map • Forms and Form elements • Frames 		
UNIT III	CSS	15
<p>Inline Styles – Embedded Style Sheets – Conflicting Styles – Linking External Style Sheets – Positioning Elements – Backgrounds – Element Dimensions – Box Model and Text Flow – Media Types and Media Queries – Drop-Down Menus – Text Shadows – Rounded Corners – Colour – Box Shadows – Linear Gradients – Radial Gradients – Multiple Background Images – Image Borders – Animations – Transitions and Transformations – Flexible Box Layout Module – Multicolumn Layout.</p> <p>List of Exercises:</p> <p>1. Apply Cascading style sheets for the web pages created.</p>		
UNIT IV	JAVASCRIPT BASICS	15
<p>Introduction to Scripting – Obtaining user input – Memory Concepts – Arithmetic – Decision Making: Equality and Relational Operators – JavaScript Control Statements – Functions – Program Modules – Programmer-defined functions – Scope rules – functions – Recursion – Arrays – Declaring and Allocating Arrays – References and Reference Parameters – Passing Arrays to Functions – Multidimensional arrays.</p> <p>List of Exercises:</p> <p>1. Form Validation (Date, Email, User name, Password and Number validation) using JavaScript.</p>		
UNIT V	JAVASCRIPT OBJECTS	15
<p>Objects – Math, String, and Date, Boolean and Number, document Object – Using JSON to Represent objects – DOM: Objects and Collections – Event Handling.</p> <p>List of Exercises:</p> <p>1. Implement Event Handling in the web pages.</p>		

Mini Projects-Develop any one of the following web applications (not limited to one) using above technologies.

- a. Online assessment system
- b. Ticket reservation system
- c. Online shopping
- d. Student management system
- e. Student result management system
- f. Library management
- g. Hospital management
- h. Attendance management system
- i. Examination automation system
- j. Web based chat application

TOTAL: 75 PERIODS

OUTCOMES:

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

- CO1:** Apply agile development methods in software development practices.
CO2: Set up and create a GitHub repository.
CO3: Develop static and dynamic webpages using HTML.
CO4: Design interactive personal or professional webpages using CSS.
CO5: Develop web pages using Java script with event-handling mechanism.

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering: A Practitioner’s Approach”, McGraw Hill International Edition, Ninth Edition, 2020.
2. Scott Chacon, Ben Straub, “Pro GIT”, Apress Publisher, 3rd Edition, 2014.
3. Deitel and Deitel and Nieto, “Internet and World Wide Web - How to Program”, Pearson, 5th Edition, 2018.

REFERENCES:

1. Roman Pichler, “Agile Product Management with Scrum Creating Products that Customers Love”, Pearson Education, 1 st Edition, 2010.
2. Jeffrey C and Jackson, “Web Technologies A Computer Science Perspective”, Pearson Education, 2011.
3. Stephen Wynkoop and John Burke, “Running a Perfect Website”, QUE, 2nd Edition, 1999.
4. Chris Bates, “Web Programming – Building Intranet Applications”, 3rd Edition, Wiley Publications, 2009.
5. Gopalan N.P. and Akilandeswari J., “Web Technology”, Second Edition, Prentice Hall of India, 2014.
6. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013382690411003904735_shared/overview
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944214274703362099_shared/overview

LIST OF EQUIPMENTS:

Systems with either Netbeans or Eclipse
Java/JSP/ISP Webserver/Apache
Tomcat / MySQL / Dreamweaver or
Equivalent/ Eclipse, WAMP/XAMP

22EC101	DIGITAL PRINCIPLES AND SYSTEMS DESIGN (Common to All Branches)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> • To acquire the knowledge in Digital fundamentals and its simplification methods. • To familiarize the design of various combinational digital circuits using logic gates. • To realize various sequential circuits using flip flops. • To interpret various clocked sequential circuits. • To elucidate various semiconductor memories and related technology. • To build various logic functions using Programmable Logic Devices. 					
UNIT I	BOOLEAN ALGEBRA AND LOGIC GATES				9
Review of number systems-representation-conversions, Review of Boolean algebra- theorems, sum of product and product of sum simplification, canonical forms, min term and max term, Simplification of Boolean expressions-Karnaugh map, Implementation of Boolean expressions using logic gates and universal gates.					
List of Experiments:					
1. Implementation of Boolean expression using logic gates.					
UNIT II	COMBINATIONAL LOGIC CIRCUITS				9
Design of combinational circuits - Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/De-mux, Parity Generator/Checker					
List of Experiments:					
1. Design of adders					
2. Design of subtractors.					
3. Design of binary adder using IC7483					
4. Design of Multiplexers & Demultiplexers.					
5. Design of Encoders and Decoders.					
6. Implementation of a boolean function using a multiplexer.					
UNIT III	SEQUENTIAL CIRCUITS				9
Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Asynchronous and Synchronous Counters Design - Shift registers, Universal Shift Register					
List of Experiments:					
1. Design and implementation of 3 bit ripple counters.					
2. Design and implementation of 3 bit synchronous counter					
3. Design and implementation of shift registers					
UNIT IV	SYNCHRONOUS SEQUENTIAL CIRCUITS DESIGN				9
Design of clocked sequential circuits - Moore/Mealy models, state minimization, state assignment, circuit implementation					
UNIT V	MEMORY AND PROGRAMMABLE LOGIC DEVICES				9
Basic memory structure ROM: PROM – EPROM – EEPROM – RAM – Static and dynamic RAM – Programmable Logic Devices: Programmable Logic Array (PLA) – Programmable Array Logic (PAL) – Implementation of combinational logic circuits using PLA, PAL.					

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Implement digital circuits using simplified Boolean functions.

CO2: Realize Combinational circuits for a given function using logic gates.

CO3: Demonstrate the operation of various counters and shift registers using Flip Flops.

CO4: Analyze Synchronous Sequential circuits.

CO5: Summarize the various types of memory devices.

CO6: Design the Combinational circuits using Programmable Logic Devices.

CO7: Perform practical exercises as an individual and / or team member to manage the task in time.

CO8: Express the experimental results with effective presentation and report.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, Digital Design, With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6th Edition, Pearson, 2018.

2. S.Salivahanan and S.Arivazhagan,Digital Circuits and Design, 5th Edition, Oxford University Press, 2018.

REFERENCES:

1. A.Anandkumar, Fundamental of digital circuits, 4th Edition, PHI Publication,2016.

2. WilliamKleitz, Digital Electronics-A Practical approach to VHDL, Prentice Hall International Inc, 2012.

3.CharlesH.Roth, Jr. andLarry L. Kinney, Fundamentals of Logic Design, 7th Edition, Thomson Learning, 2014.

4.Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson Education Inc, 2017.

5.John.M Yarbrough, Digital Logic: Applications and Design, 1st Edition, Cengage India, 2006.

NPTEL LINK: <https://nptel.ac.in/courses/108/105/108105132/>

LIST OF EQUIPMENTS:

22GE101	COMPUTER AIDED ENGINEERING GRAPHICS (Common to All Branches)	L	T	P	C
		1	0	2	2
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> To help students understand universal technical drawing standards. To provide training on drafting software to draw part models. To demonstrate the concepts of orthographic and isometric projections. To use drawing skills for communicating concepts, ideas for engineering product design. Use pictorial views to visualize and draw the isometric view of the objects. 					
UNIT I	INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CONIC SECTIONS				9
<p>Introduction to Engineering Drawing - Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Conic curves - Ellipse, Parabola and Hyperbola by Eccentricity method.</p> <p style="text-align: right;">(Theory - 3)</p> <p>Drawing of a title block with necessary text, projection symbol and lettering using drafting software.</p> <p>Drafting of Conic curves - Ellipse, Parabola and Hyperbola</p> <p style="text-align: right;">(Laboratory - 6)</p>					
UNIT II	ORTHOGRAPHIC PROJECTION				9
<p>Visualization concepts and Orthographic Projection - Layout of views – Orthographic Projection- Conversion of pictorial diagram into orthographic views.</p> <p style="text-align: right;">(Theory - 3)</p> <p>Drawing orthographic view of simple solids like Prism, Pyramids, Cylinder, Cone, etc, and dimensioning.</p> <p>Drawing of orthographic views from the given pictorial diagram.</p> <p style="text-align: right;">(Laboratory -6)</p>					
UNIT III	PROJECTION OF PLANES				9
<p>Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method.</p> <p style="text-align: right;">(Theory - 3)</p> <p>Drawing of plane Surface inclined to HP.</p> <p>Drawing of plane Surface inclined to VP.</p> <p style="text-align: right;">(Laboratory -6)</p>					
UNIT IV	PROJECTION OF SOLIDS				9
<p>Projection of simple solids like Prisms, Pyramids, Cylinder and Cone when the axis is inclined to HP by rotating object method.</p> <p style="text-align: right;">(Theory - 3)</p> <p>Drawing of simple solids like prism and pyramids when the axis is inclined to HP.</p> <p>Drawing of simple solids like cylinder and cone when the axis is inclined to HP.</p> <p style="text-align: right;">(Laboratory -6)</p>					
UNIT V	ISOMETRIC DRAWING				9

Principles of isometric view – Isometric view of simple solids – Prism, Pyramid, Cylinder and Cone.

(Theory - 3)

Drawing isometric projection of simple solids.

Modeling of 2D to 3D objects using drafting software.

(Laboratory -6)

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Explain the various engineering standards required for drafting and explore knowledge in conic sections.

CO2: Draw the orthographic views of 3D primitive objects.

CO3: Describe the projection of plane surfaces by the rotating plane method.

CO4: Apply the projection concepts and drafting tools to draw projections of solids. **CO5:** Sketch the pictorial views of the objects using CAD tools.

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 15th Edition, 2019.

REFERENCES:

1. Bhatt N.D. “Engineering Drawing”, Charotar Publishing House, 53rd edition, 2019.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition, 2019.
3. Engineering Drawing Practice for Schools and Colleges BIS SP46:2003 (R2008), Published by Bureau of Indian Standards (BIS), 2008.
4. Parthasarathy. N.S and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2019.
5. Gopalakrishna. K.R., Engineering Drawing Vol. 1 & 2, Subhas Publications, 27th Edition, 2017.

22GE111	PRODUCT DEVELOPMENT LAB - 1 (Common to All Branches)	L	T	P	C
		0	0	2	1
<p>The students may be grouped into 3 to 4 and work under a project supervisor. The device/system/component/prototype Idea to be developed by the students and a final presentation to be done by the students about the idea generated at the end of the semester.</p> <p>OBJECTIVES:</p> <p>The Course will enable learners to:</p> <ul style="list-style-type: none"> • Understand the functionalities and limitation of various machine/equipment • Demonstrate various operations that can be performed to machines • Summarize the basic principles of machines to convert their ideas into products 					
<p>I 1. Study of Manufacturing Processes (Carpentry, Plumbing, Machines and Welding). 2. Study of fundamental operations of 3D Printer and Scanner with Software. 3. Study of Smart Machining (CNC and Laser cutting) and Engraving Techniques.</p> <p>II 1. Study of Fundamental of Circuit Design. 2. Study of PCB Milling Machine. 3. Study of Soldering and Desoldering.</p> <p>III 1. Study of Computer Peripheral Devices (Processing Information Devices)</p> <p>IV 1. Present the Product Idea Presentation - Phase – I.</p>					
TOTAL: 30 PERIODS					
<p>Note: The students can select the prototype to be made of their choice after learning the above exercises.</p>					

OUTCOMES:

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

CO1: Understand the concept of manufacturing processes.

CO2: Describe the working of the machine element.

CO3: Discuss the various applications of engineering materials

CO4: Summarize the basics of core engineering concepts.

CO5: Describe the process for converting ideas into products

LIST OF EQUIPMENTS:

1. CNC Router – 1 No.
2. 3D Printer – 1 No.
3. 3D Scanner – 1 No.
4. Laser cutting Machine – 1 No.
5. Centre lathe – 2 Nos.
6. Arc welding transformer with cables and holders – 2 Nos.
7. Plumbing tools – 2 Nos.
8. Carpentry tools – 2 Nos.
9. Multimeter – 10 Nos.
10. Drilling Machine – 1 No.
11. Solder Stations 5 Sets
12. Desoldering Machine – 1 No.
13. PCB Milling Machine – 1 No.
14. Variable Power Supply – 1 No.
15. Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc. – 10 Sets
16. Personal Desktop Computers – 30 Nos.

SEMESTER – II

22MA201	TRANSFORMS AND NUMERICAL METHODS (Common to CSE / ADS)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> • Introduce the concepts of Laplace transforms and Z-transforms. • Illustrate the application of transforms in solving differential and difference equations. • Explain the Numerical methods for handling algebraic and transcendental equations. • Introduce the numerical techniques for interpolation, differentiation and integration. 					
UNIT I	LAPLACE TRANSFORMS				15
Laplace transforms – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions – Derivatives and integrals of transforms – Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform – Convolution theorem (Statement only). Theory: 9					
Experiments using SCILAB:					
<ol style="list-style-type: none"> 1. Finding Laplace transform of a function. 2. Finding inverse Laplace Transforms. 3. Determine the input for given output function of Laplace Transform. 					

		Laboratory: 6
UNIT II	Z – TRANSFORMS	15
Z-transforms – Elementary properties – Inverse Z-transforms – partial fractions method – residues method – Convolution theorem.		Theory: 9
Experiments using SCILAB:		
<ol style="list-style-type: none"> 1. Finding Z –transform of a sequence. 2. Finding convolution of two sequences. 3. Plotting the input and output function of Z transform. 		Laboratory: 6
UNIT III	SOLUTION OF DIFFERENTIAL AND DIFFERENCE EQUATIONS	15
Solution of linear ordinary differential equation of second order with constant coefficients and first order simultaneous equations with constant coefficients using Laplace transform. Formation of difference equations – Solution of first and second order difference equations with constant coefficients using Z-transform.		Theory: 9
Experiments using SCILAB:		
<ol style="list-style-type: none"> 1. Solving second order Ordinary Differential Equation. 2. Finding the Laplace transform and its inverse of a function numerically. 3. Finding the Z-transform numerically 		Laboratory: 6
UNIT IV	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	15
Solution of algebraic and transcendental equations by Newton Raphson method - Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Gauss Seidel Iterative method– Eigenvalues of a matrix by Power method.		Theory: 9
Experiments using SCILAB:		
<ol style="list-style-type: none"> 1. Finding the real roots of algebraic and transcendental equations using Newton Raphson method. 2. Finding the largest Eigenvalue by power method. 3. Solving system of linear equations using Gauss Seidel Method. 		Laboratory: 6
UNIT V	NUMERICAL DIFFERENTIATION AND INTEGRATION	15
Finite differences – Forward and Backward differences – Interpolation – Newton’s forward and backward interpolation formulae - Lagrange’s interpolation for unequal intervals - Numerical Differentiation - Newton’s and Lagrange’s formulae - Numerical integration using Trapezoidal and Simpson’s 1/3 rules – Evaluation of double integrals by Trapezoidal and Simpson’s 1/3 rules.		Theory: 9
Experiments using SCILAB:		
<ol style="list-style-type: none"> 1. Finding approximately the missing value using Lagrange interpolation. 2. Evaluating line integrals by trapezoidal rule. 3. Evaluating line integrals by Simpson’s rule. 		Laboratory: 6
TOTAL: 75 PERIODS		

OUTCOMES:

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

CO1: Determine Laplace transform and inverse transform of simple functions.

CO2: Determine Z- transform and inverse transform of simple functions.

CO3: Solve ordinary differential equations using Laplace transform and difference equations using Z-Transform.

CO4: Compute the solutions of algebraic, transcendental and the system of equations.

CO5: Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

TEXT BOOKS:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7th Edition, 2009.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES:

1. Erwin. Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Jain R.K. and Iyengar S. R. K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics", Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.
4. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
5. Sastry S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

LIST OF EQUIPMENTS:

1. SCILAB - Open source

22CS201	DATA STRUCTURES (Common to CSE / IT / ADS)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> • To understand the concepts of List ADT. • To learn linear data structures – stacks and queues ADTs. • To understand and apply Tree data structures. • To understand and apply Graph structures. • To analyze sorting, searching and hashing algorithms. 					
UNIT I	LINEAR DATA STRUCTURES – LIST				15
Algorithm analysis - running time calculations - Abstract Data Types (ADTs) – List ADT – array- based implementation – linked list implementation – singly linked lists - circularly linked lists - doubly-linked lists – applications of lists – Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).					
List of Exercises:					
<ul style="list-style-type: none"> • Array implementation of List ADTs. • Linked list implementation of List ADTs. 					
UNIT II	LINEAR DATA STRUCTURES – STACKS, QUEUES				15
Stack ADT – Stack Model - Implementations: Array and Linked list - Applications - Balancing symbols - Evaluating arithmetic expressions - Conversion of Infix to postfix expression - Queue ADT – Queue Model - Implementations: Array and Linked list - applications of queues					

- Priority Queues – Binary Heap – Applications of Priority Queues.		
List of Exercises:		
<ul style="list-style-type: none"> • Array implementation of Stack and Queue ADTs. • Linked list implementation of Stack and Queue ADTs. • Applications of List – Polynomial manipulations • Applications of Stack – Infix to postfix conversion and expression evaluation. 		
UNIT III	NON LINEAR DATA STRUCTURES – TREES	15
Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT– AVL Tree.		
List of Exercises:		
<ul style="list-style-type: none"> • Implementation of Binary Trees and operations of Binary Trees. • Implementation of Binary Search Trees. • Implementation of Heaps using Priority Queues. 		
UNIT IV	NON LINEAR DATA STRUCTURES - GRAPHS	15
Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Applications of graphs – BiConnectivity – Euler circuits.		
List of Exercises:		
<ul style="list-style-type: none"> • Graph representation and Traversal algorithms. 		
UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	15
Searching- Linear Search - Binary Search - Sorting - Bubble sort - Selection sort - Insertion sort – Hashing - Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		
List of Exercises:		
<ul style="list-style-type: none"> • Implement searching and sorting algorithms. 		
TOTAL: 75 PERIODS		
OUTCOMES:		
Upon completion of the course, the students will be able to:		
CO1: Implement abstract data types for list.		
CO2: Solve real world problems using appropriate linear data structures.		
CO3: Apply appropriate tree data structures in problem solving.		
CO4: Implement appropriate Graph representations and solve real-world applications.		
CO5: Implement various searching and sorting algorithms.		
TEXT BOOKS:		
1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, 4th Edition, Pearson Education, 2014.		
2. Sartaj Sahni, “Data Structures, Algorithms and Applications in C++”, Silicon paper publications, 2004.		
REFERENCES:		
1. Rajesh K. Shukla, “Data Structures using C and C++”, Wiley India Publications, 2009.		
2. Narasimha Karumanchi, “Data Structure and Algorithmic Thinking with Python: Data Structure and Algorithmic Puzzles”, CareerMonk Publications, 2020.		
3. Jean-Paul Tremblay and Paul Sorenson, “An Introduction to Data Structures with Application”, McGraw-Hill, 2017.		
4. Mark Allen Weiss, “Data Structures and Algorithm Analysis in Java”, Third Edition, Pearson Education, 2012.		

5. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, Second Edition, University Press, 2008.
6. Ellis Horowitz, Sartaj Sahni, Dinesh P Mehta, “Fundamentals of Data Structures in C++”, Second Edition, Silicon Press, 2007.
7. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01350157816505139210584/overview
LIST OF EQUIPMENTS:
Systems with Linux/Ubuntu Operating System with gnu C++ compiler

22PH201	PHYSICS FOR COMPUTER SCIENCE AND INFORMATION TECHNOLOGY (Common to All Branches)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> Learn the fundamental concepts of Physics and apply this knowledge to scientific, engineering and technological problems. Make the students enrich basic knowledge in electronics and quantum concepts and apply the same in computing fields. 					
UNIT I	LASER AND FIBRE OPTICS				15
Population of energy levels – Einstein’s A and B coefficients derivation - Resonant cavity - Optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction- Engineering applications of lasers in data storage (qualitative). Fibre optics: Principle and propagation of light through optical fibre - V-number - Types of optical fibres (Material, refractive index and mode) - Losses in optical fibre - Fibre optic communication - Fibre optic sensors (pressure and displacement). <div style="text-align: right;">(Theory -9)</div>					
List of Experiments:					
1. Determination of divergence of laser beam 2. Determination of acceptance angle and numerical aperture of an optical fibre <div style="text-align: right;">(Laboratory -6)</div>					
UNIT II	ELECTRON THEORIES OF MATERIALS				15

Classical free electron theory - Expressions for electrical conductivity and thermal conductivity - Wiedemann-Franz law - Success and failures of CFT- Effect of temperature on Fermi function- Density of energy states and average energy of electron at 0 K - Energy bands in solids.

(Theory -9)

List of Experiments

1. Determination of thermal conductivity of a bad conductor by Lee's disc method
2. Measurement of the internal resistance using potentiometer

(Laboratory -6)

UNIT III	SEMICONDUCTOR PHYSICS	15
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Intrinsic Semiconductors – E-kdiagram-Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors- Band gap determination-Extrinsic semiconductors - Carrier concentration in n-type and p-type semiconductors -Electrical conductivity of intrinsic and extrinsic semiconductors -Variation of Fermi level with temperature and impurity concentration - Hall effect and its applications.

(Theory -9)

List of Experiments

1. Bandgap determination of intrinsic semiconductor.
2. Determination of wavelength of semiconductor laser

(Laboratory -6)

UNIT IV	INTRODUCTION TO NANO DEVICES AND QUANTUM COMPUTING	15
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Introduction to nanomaterial -Electron density in a bulk material - Size dependence of Fermi energy - Quantum confinement - Quantum structures - Density of states in quantum well, quantum wire and quantum dot structures - Band gap of nanomaterial.
Quantum computing: Quantum states - classical bits - quantum bits or qubits - CNOT gate - multiple qubits - Bloch sphere - quantum gates - advantages of quantum computing over classical computing.

(Theory - 9)

List of Experiments

1. Synthesis of nanoparticles by sol-gel method
2. Determination of particle size using laser source

(Laboratory - 6)

UNIT V	MAGNETIC AND SUPERCONDUCTING MATERIALS	15
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Introduction- Bohr magneton -magnetic dipole moment - origin of magnetic moments - types of magnetic materials-Ferromagnetism: Domain Theory - antiferromagnetism - ferrimagnetism - magnetic principle in computer data storage - Magnetic hard disc (GMR sensor) - Introduction to spintronics.
Superconducting materials – properties, types of superconductors, applications – SQUID and MAGLEV trains - *superconducting qubits in quantum computing*.

(Theory -9)

List of Experiments

1. Determination of hysteresis loss using B-H loop
2. Determination of magnetic susceptibility of a paramagnetic liquid using Quincke's apparatus

(Laboratory -6)

TOTAL: 75 PERIODS

OUTCOMES:

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

- CO1:** Discuss the basic principles of working of laser and their applications in fibre optic communication
- CO2:** Summarize the classical and quantum electron theories and energy band structures
- CO3:** Describe the conductivity in intrinsic and extrinsic semiconductors and importance of Hall effect measurements
- CO4:** Associate the properties of nanoscale materials and their applications in quantum computing
- CO5:** Interpret the properties of magnetic and superconducting materials and their applications in computer data storage

TEXT BOOKS:

1. **S.O. Kasap**, Principles of Electronic Materials and Devices, McGraw-Hill Education (Indian Edition) 2020.
2. **Jaspri Singh**, Semiconductor Devices: Basic Principles, Wiley (Indian Edition) 2007.
3. **Parag K Lala**, Quantum Computing: A Beginner's Introduction, McGraw-Hill Education (Indian Edition) 2020.

REFERENCES:

1. **R.P. Feynman**, The Feynman Lectures on Physics - Vol. II, The New Millennium Edition, 2012.
2. **M.A. Wahab**, Solid State Physics, 3rd Edition, Narosa Publishing House Pvt. Ltd., 2015.
3. **B.Rogers, J. Adams and S.Pennathur**, Nanotechnology: Understanding Small System, CRC Press, 2014.
4. **C.P. Williams**, Explorations in Quantum Computing, Springer-Verlag London, 2011.
5. **Wilson J.D. and Hernandez C.A.**, Physics Laboratory Experiments, Houghton Mifflin Company, New York 2005.
6. **Department of Physics**, Physics laboratory manual, R.M.K. Group of Institutions, 2021.

LIST OF EQUIPMENTS:

1.	Semiconductor Laser	6 Nos.
2.	Determination of optical fibre parameters	6 Nos.
3.	Lee's disc apparatus	6 Nos.
4.	Potentiometer	6 Nos.
5.	Bandgap determination set up	6 Nos.
6.	Sol-gel synthesis	2 Nos.
7.	B-H loop set-up	5 Nos.
8.	Quincke's apparatus	2 Nos.

22HS101	PROFESSIONAL COMMUNICATION (Common to All Branches)	L	T	P	C
		2	0	2	3
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> • Strengthen basic reading and writing skills. • Comprehend listening contexts competently. • Inculcate reading habit and develop effective reading skills. • Improve active and passive vocabulary. • Acquire speech clarity with right pronunciation. • Develop vocabulary of a general kind and enhance grammatical accuracy. • Imbibe Content and Language Integrated Learning (CLIL). 					
UNIT I	FORMAL AND INFORMAL COMMUNICATION				12
<p>Listening: Short Texts, Short Formal and Informal Conversations Speaking: Self Introduction, Exchanging Personal Information Reading: Practice in Skimming, Scanning and Predicting, Reading Comprehension Writing: Free Writing, Hints Development Grammar: Parts of Speech, Prepositions. Vocabulary: Compound Nouns, Technical Words.</p> <p style="text-align: right;">(Theory 6)</p> <ol style="list-style-type: none"> 1. Familiarization of Vowel Sounds-Monophthongs, Diphthongs and Consonant Sounds 2. Listening to Formal Conversations in British and American Accents 3. Guided Writing 					

		(Laboratory 6)
UNIT II	GRAMMAR AND LANGUAGE DEVELOPMENT	12
<p>Listening: Telephonic Conversations. Speaking: Sharing information of a personal kind - Greetings – Taking leave. Reading: Short comprehension passages - Pre-reading and Post-reading (multiple choice questions shortquestions / open and close ended questions) Writing: Instructions, Recommendations, Checklists Grammar: Tenses, Framing ‘Wh’ & ‘Yes’ or ‘No’ questions Vocabulary: Numerical Adjectives, Collocations</p> <p style="text-align: right;">(Theory 6)</p> <p>1. Communication Etiquettes 2. Self -Introduction using SWOT Analysis</p> <p style="text-align: right;">(Laboratory 6)</p>		
UNIT III	BASIC TECHNICAL WRITING AND STUDY SKILLS	12
<p>Listening: Listening to longer texts and filling up the tables Speaking: Asking about routine actions and expressing opinions Reading: Short texts (Cloze Test) Writing: Formal letters, E-mail writing, Interpretation of Charts and Graphs Grammar: Cause and Effect expressions, Conditional Clauses Vocabulary: Often misspelled and confusing words</p> <p style="text-align: right;">(Theory 6)</p> <p>Mechanics of Reading Skills News Reading–Cloze Tests</p> <p style="text-align: right;">(Laboratory 6)</p>		
UNIT IV	GROUP DISCUSSION AND JOB APPLICATIONS	12
<p>Listening: Listening to recorded dialogues of conversations and completing exercises based on them Speaking: Discussion on Social issues. Reading: Reading text from magazines Writing: Purpose Expressions, Letter of Application, Minutes of Meeting. Grammar: Modal Verbs, Subject-Verb agreement Vocabulary : Sequence Words</p> <p style="text-align: right;">(Theory 6)</p> <p>1. Group Presentation, Group Discussion: Do’s and Don’ts of GroupDiscussion 2. Discussions on failure and success in interviews of famous personalities Spotting Errors</p> <p style="text-align: right;">(Laboratory 6)</p>		
UNIT V	ART OF REPORTING	12
<p>Listening: Listening to TED talks Speaking: Debate & Presentations Reading: Biographies Writing: Definitions (Single line & Extended), Report Writing (Industrial visit, Accident and Feasibilityreports) Grammar: Reported speech Vocabulary : Verbal Analogies</p> <p style="text-align: right;">(Theory 6)</p> <p>1. Writing based on listening to academic lectures and discussions 2. Leadership skills, Negotiation skills 3. Mechanics of Report Writing</p> <p style="text-align: right;">(Laboratory 6)</p>		
LIST OF PROJECTS		

<ol style="list-style-type: none"> 1. Create a podcast on a topic that will be interesting to college students 2. Read and Review (Movie/Book/Technical Article) 3. Presentation on Social Issues 4. Submit a report on “Global English: A study”
TOTAL: 60 PERIODS
<p>OUTCOMES:</p> <p>Upon completion of the course, the students will be able to:</p> <p>CO1: Comprehend conversations and short talks delivered in English</p> <p>CO2: Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques</p> <p>CO3: Read articles of a general kind in magazines and newspapers efficiently</p> <p>CO4: Write short general essays, personal letters and E-mails in English</p> <p>CO5: Develop vocabulary of a general kind by enriching reading skills</p>
<p>TEXT BOOKS:</p> <ol style="list-style-type: none"> 1. Kumar, Suresh E, & Sreehari, P. <i>Communicative English</i>. Orient Black Swan, 2007. 2. Richards, Jack C. <i>Interchange Students’ Book-2</i> New Delhi: CUP,2015.
<p>REFERENCES:</p> <ol style="list-style-type: none"> 1. Bailey, Stephen. <i>Academic Writing: A practical guide for students</i>. New York: Rutledge,2011. 2. Dhanavel, S P. <i>English and Soft Skills, Volume Two</i>, Orient Black Swan. 3. Elbow, Peter. <i>Writing Without Teachers</i>. London: Oxford University Press, 1973. 4. Larsen, Kristine. <i>Stephen Hawking: A Biography</i>, Greenwood: Publishing Group, 2005. 5. Redston, Chris & Gillies Cunningham. <i>Face2Face (Pre- intermediate Students’ Book & Workbook)</i> Cambridge University Press, New Delhi: 2005. 6. Lewis, Norman. <i>Word Power Made Easy</i>, Latest Edition: Penguin Random House India: 2015

WEB REFERENCES:

1. Basics of Business Communication
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012688768083632128308_shared/overview
 2. communicating to Succeed
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012686653619175424640_shared/overview
 3. Business English
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683227498151936279_shared/overview
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013267708367904768573/overview (lab support)
 4. Business Writing
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01268947760100966433_shared/overview
 5. Email Etiquettes
https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01329462386556108817682_shared/overview
 6. Email Writing Skills
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268954363013529666_shared/overview
 7. Time Management
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012985921210736640721_shared/overview
 8. Understanding Body Language
https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01297973765144576024689_shared/overview
9. ONLINE RESOURCES:
<https://infyspringboard.onwingspan.com/web/en/page/home>

22CS202	JAVA PROGRAMMING (Common to CSE / ADS)	L	T	P	C
		3	0	2	4

OBJECTIVES:**The Course will enable learners to:**

- To explain object oriented programming concepts and fundamentals of Java
- To apply the principles of packages, interfaces and exceptions
- To develop a Java application with I/O streams, threads and generic programming
- To build applications using strings and collections.
- To apply the JDBC concepts

UNIT I JAVA FUNDAMENTALS**15**

An Overview of Java - Data Types, Variables, and Arrays – Operators - Control Statements – Class Fundamentals – Declaring objects – Methods – Constructors – this keyword – Overloading methods - Overloading constructors - Access Control – Static – Final

List of Exercises:

1. Develop a Java application to generate Electricity bill. You must use one super class called EB Bill and must have two sub classes namely Domestic Bill and Commercial Bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff

If the type of the EB connection is domestic, calculate the amount to be paid as follows: First 100 units - Rs. 1 per unit

101-200 units - Rs. 2.50 per unit 201 -500 units - Rs. 4 per unit

> 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

First 100 units - Rs. 2 per unit

101-200 units - Rs. 4.50 per unit 201 -500 units - Rs. 6 per unit

> 501 units - Rs. 7 per unit

2. Arrays Manipulations: (Use Methods for implementing these in a Class)

a. Find kth smallest element in an unsorted array

b. Find the sub array with given sum

c. Matrix manipulations – Addition, Subtraction, Multiplication

d. Remove duplicate elements in an Array

e. Accept an integer value N and print the Nth digit in the integer sequence 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and so on till infinity.

Example: The 11th digit in the sequence 12345678910111213.... is 0.

UNIT II INHERITANCE, INTERFACES AND EXCEPTION HANDLING**15**

Inheritance: Inheritance basics, Using super, Method Overriding, Using Abstract Classes, Using final with Inheritance - Package and Interfaces: Packages, Packages and member access, Importing Packages, Interfaces, Static Methods in an Interface – Exception Handling: Exception-Handling Fundamentals, Exception Types, Uncaught Exceptions, Using try and catch, Multiple catch Clauses, Nested try Statements, throw, throws, finally, Java's Built-in Exceptions.

List of Exercises:

1. Develop a Java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa), time converter (hours to minutes, seconds and vice versa) using packages.

2. Develop a Java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.

3. Design a Java interface for ADT Stack. Implement this interface using array and built-in classes. Provide necessary exception handling in both the implementations.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains the methods print Area () that prints the area of the given shape and Numberofsides() that prints the number of sides of the given shape.
5. Write a Java program to apply built-in and user defined exceptions.

UNIT III	MULTITHREADING, I/O AND GENERIC PROGRAMMING	15
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Multithreaded Programming: Creating a Thread, Thread Priorities, Synchronization, Interthread Communication – I/O: I/O Basics, Reading Console Input, Writing Console Output, Reading and Writing Files – Generics: Introduction, Generic class, Bounded Types, Generic Methods, Generic Interfaces, Generic Restrictions.

List of Exercises:

1. Write a Java program to read and copy the content of one file to other by handling all file related exceptions.

UNIT IV	STRING HANDLING AND COLLECTIONS	15
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Lambda Expressions - String Handling – Collections: The Collection Interfaces, The Collection Classes – Iterator – Map - Regular Expression Processing.

List of Exercises:

1. String Manipulation:
 - a. Reversing a set of words and count the frequency of each letter in the string.
 - b. Pattern Recognition - Find the number of patterns of form 1[0]1 where [0] represents any number of zeroes (minimum requirement is one 0) there should not be any other character except 0 in the [0] sequence in a given binary string.
 - c. Remove all the occurrences of string S2 in string S1 and print the remaining.
 - d. Find the longest repeating sequence in a string
 - e. Print the number of unique string values that can be formed by rearranging the letters in the string S.
2. Write a Java program that correctly implements producer consumer problem using the concept of inter thread communication.
3. Collections:
 - a. Write a program to perform string operations using ArrayList. Write functions for the following
 - i. Append - add at end
 - ii. Insert – add at particular index
 - iii. Search
 - iv. List all string starts with given letter
 - b. Find the frequency of words in a given text.

UNIT V	JDBC CONNECTIVITY	15
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JDBC – DataSource, Configurations, Connection, Connection Pools, Driver Types, ResultSet, Prepared Statement, Named Parameter, Embedded SQL (Insert, Update, Delete, Join, union etc), ResultSet Navigation, Connection Close and Clean up.

List of Exercises:

- Mini Project (using JDBC)

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Understand the object oriented programming concepts and fundamentals of Java.

CO2: Develop Java programs with the packages, interfaces and exceptions.

CO3: Build Java applications with I/O streams, threads and generics programming.

CO4: Apply strings and collections in developing applications.

CO5: Implement the concepts of JDBC.

TEXT BOOKS:

1. Herbert Schildt, "Java: The Complete Reference", 11th Edition, McGraw Hill Education, 2019.

REFERENCES:

1. Cay S. Horstmann, Gary Cornell, "Core Java Volume – I Fundamentals", 11th Edition, Prentice Hall, 2019.
2. Paul Deitel, Harvey Deitel, Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
3. Steven Holzner, Java 2 Black book, Dream tech press, 2011.
4. Timothy Budd, Understanding Object-oriented programming with Java, Third Edition, Pearson Education, 2008.
5. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview

LIST OF EQUIPMENTS:

1. Java and Eclipse / NetBeans IDE or Equivalent

22CS203	DATABASE MANAGEMENT SYSTEM (Common to CSE / ADS)	L	T	P	C
		3	0	2	4

OBJECTIVES:**The Course will enable learners to:**

- To understand the basic concepts of Data modeling and Database Systems.
- To understand SQL and effective relational database design concepts.
- To learn relational algebra, calculus and normalization.
- To know the fundamental concepts of transaction processing, concurrency control techniques, recovery procedure and data storage techniques.
- To understand query processing, efficient data querying and advanced databases.

UNIT I | DATABASE CONCEPTS**15**

Concept of Database and Overview of DBMS - Characteristics of databases - Data Models, Schemas and Instances - Three-Schema Architecture - Database Languages and Interfaces - Introductions to data models types - ER Model- ER Diagrams - Enhanced ER Model - reducing ER to table Applications: ER model of University Database Application – Relational Database Design by ER- and EER-to-Relational Mapping.

List of Exercises:

1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements

UNIT II | STRUCTURED QUERY LANGUAGE**15**

SQL Data Definition and Data Types – Constraints – Queries – INSERT, UPDATE, and DELETE in SQL - Views - Integrity Procedures, Functions, Cursor and Triggers - Embedded SQL - Dynamic SQL.

List of Exercises:

1. Database Querying – Simple queries, Nested queries, Sub queries and Joins
2. Views, Sequences, Synonyms
3. Database Programming: Implicit and Explicit Cursors

UNIT III | RELATIONAL ALGEBRA, CALCULUS AND NORMALIZATION**15**

Relational Algebra – Operations - Domain Relational Calculus- Tuple Relational Calculus - Fundamental operations.

Relational Database Design - Functional Dependency – Normalization (1NF, 2NF 3NF and BCNF) – Multivalued Dependency and 4NF – Joint Dependencies and 5NF - De-normalization.

List of Exercises:

1. Procedures and Functions
2. Triggers

UNIT IV | TRANSACTIONS, CONCURRENCY CONTROL AND DATA STORAGE**15**

Transaction Concepts – ACID Properties – Schedules based on Recoverability, Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Transaction Recovery – Concepts – Deferred Update – Immediate Update.

Organization of Records in Files – Unordered, Ordered – Hashing Techniques – RAID – Ordered Indexes – Multilevel Indexes - B+ tree Index Files – B tree Index Files.

List of Exercises:

1. Exception Handling
2. Database Design using ER modeling, normalization and Implementation for any application
3. Database Connectivity with Front End Tools

UNIT V | QUERY OPTIMIZATION AND ADVANCED DATABASES**15**

Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics.

Distributed Database Concepts – Design – Concurrency Control and Recovery – NOSQL Systems – Document-Based NOSQL Systems and MongoDB.

List of Exercises:

1. Case Study using real life database applications anyone from the following list

- a) Inventory Management for a EMart Grocery Shop
- b) Society Financial Management
- c) Cop Friendly App – Eseva
- d) Property Management – eMall
- e) Star Small and Medium Banking and Finance

- Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.
- Apply Normalization rules in designing the tables in scope.
- Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.
- Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.
- Ability to showcase ACID Properties with sample queries with appropriate settings

TOTAL: 75 PERIODS

OUTCOMES:

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

CO1: Map ER model to Relational model to perform database design effectively.

CO2: Implement SQL and effective relational database design concepts.

CO3: Apply relational algebra, calculus and normalization techniques in database design.

CO4: Understand the concepts of transaction processing, concurrency control, recovery procedure and data storage techniques.

CO5: Apply query optimization techniques and understand advanced databases.

TEXT BOOKS:

- 1. Elmasri R. and S. Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition, 2016.
- 2. Abraham Silberschatz, Henry F.Korth, “Database System Concepts”, Tata McGraw Hill , 7th Edition, 2021.

REFERENCES:

- 1. Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education, 2013.Raghu Ramakrishnan, Gehrke “Database Management Systems”, MCGraw Hill, 3rd Edition 2014.
- 2. Plunkett T., B. Macdonald, “Oracle Big Data Hand Book” , McGraw Hill, First Edition, 2013
- 3. Gupta G K , “Database Management Systems” , Tata McGraw Hill Education Private Limited, New Delhi, 2011.
- 4. C. J. Date, A.Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2015.
- 5. Maqsood Alam, Aalok Muley, Chaitanya Kadaru, Ashok Joshi, Oracle NoSQL Database: Real-Time Big Data Management for the Enterprise, McGraw Hill Professional, 2013.

6. Thomas Connolly, Carolyn Begg, “Database Systems: A Practical Approach to Design, Implementation and Management”, Pearson, 6th Edition, 2015.
7. Database Management System Part – 1 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview
8. Database Management System Part – 2 https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0127673005629194241_shared/overview
9. Online Resources: https://infyspringboard.onwingspan.com/web/en/page/home
LIST OF EQUIPMENTS:
1. MySql and Eclipse / NetBeans IDE or Equivalent

22GE211	PRODUCT DEVELOPMENT LAB - 2 (Common to All Branches)	L	T	P	C
		0	0	2	1
The students may be grouped into a batch of strength 3 or 4 to work under a project supervisor.					

The student batches should study the device/system/component and will do literature review to develop prototype idea. Further at the end of the semester they will make a final presentation to exhibit the conceptual design skills and the process to develop a product.

OBJECTIVES:

The Course will enable learners to:

- Use the innovative design methodology to articulate the product concepts.
- Summarize the requisite Engineering Principles for transforming concepts into products.
- Conduct basic tests to extract the qualitative and quantitative performance factors.

List of Exercise/Experiments

1. Study of Basic Engineering Design Concepts.
2. Conduct a literature survey on the implementation of the design concepts.
3. Prepare the design concepts for an identified literature gap.
4. Present the Product Idea Presentation – Phase II.

TOTAL: 30 PERIODS

OUTCOMES:

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

CO1: Understand the working and capacity of various engineering systems.

CO2: Infer the outcomes in the product development process.

CO3: Perform basic engineering and material characterization tests.

CO4: Demonstrate the ability to provide conceptual design strategies for a product.

CO5: Implement the Science, Engineering, Technology and Mathematics (STEM) for product design.

LIST OF EQUIPMENTS:

22CH104	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY (Common to All Branches)	L	T	P	C
		2	0	0	MC

OBJECTIVES:**The Course will enable learners to:**

- To gain knowledge of the environment and various natural resources.
- To identify the Scientific and Technological solutions to pollution issues and waste management.
- To understand the significance of the conservation of biodiversity.
- To recognize the needs and benefits of sustainability and its management.
- To comprehend the effects of human population on the environment.

UNIT I	NATURAL RESOURCES	7
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Definition, scope and importance of environment – need for public awareness. Introduction to natural resources - Types - Forest resources: Use and over-exploitation, deforestation and its impacts, Food resources: effects of modern agriculture, organic farming, Renewable energy sources - Solar, Wind, Geothermal, Tidal, OTE and Biomass.

Field activity -Tree plantation

UNIT II	POLLUTION AND WASTE MANAGEMENT	7
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Pollution - Definition –causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Nuclear hazards - nuclear accidents and holocaust -Role of an individual in prevention of pollution –Case studies.

Waste management- Municipal solid wastes, e- waste, plastic waste.

Field study – Solid waste management of the institution

UNIT III	BIODIVERSITY AND ITS CONSERVATION	6
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Biodiversity: types – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species, extinct, rare, vulnerable species of India – conservation of biodiversity: In-situ and ex-situ method.

Field study – Biodiversity of the institution

UNIT IV	SUSTAINABILITY AND MANAGEMENT	5
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Sustainability-concept, needs and challenges-Circular economy -Sustainable Development Goals- Concept of Carbon footprint, Environmental Impact Assessment, Clean Development Mechanism, solutions.

Field study – Carbon footprint of the institution

UNIT V	HUMAN POPULATION	5
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Introduction - Population growth, variation among nations, population explosion, Environment and human health – endemic/epidemic/pandemic– Role of information technology in environment and human health.

Case Study – Pandemics of 21st century**TOTAL: 30 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to:**

CO1: Investigate and use conservational practices to protect natural resources.

CO2: Identify the causes of pollutants and illustrate suitable methods for pollution abatement.

CO3: Adapt the values of biodiversity and its conservation methods.

CO4: Recognize suitable sustainable development practices and apply it in day-to-day life.

CO5: Assess the impacts of human population and suggest suitable solutions.

TEXT BOOKS:

1. Anubha Kaushik and C.P. Kaushik, “Perspectives in environmental studies”, New Age International Publishers, 2nd edition, 2021.

2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2017.
3. Gilbert M.Masters, Introduction to Environmental Engineering and Science, 3 rd edition, Pearson Education, 2014.
4. Erach Bharuch, Textbook of Environmental Studies for Undergraduate Courses, Third Edition, Universities Press(I) Pvt. Ltd., Hyderabad, 2021.
REFERENCES:
1. William P.Cunningham & Mary Ann Cunningham Environmental Science: A Global Concern, McGraw Hill, 14 th edition, 2017.
2. Rajagopalan, R, Environmental Studies-From Crisis to Cure, Oxford University Press, 2015.
3. G. Tyler Miller and Scott E. Spoolman, —Environmental Science, Cengage Learning India Pvt, Ltd., Delhi, 2014.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2012.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning, 2015.
6. Environment Impact Assessment Guidelines, Notification of Government of India, 2006 and subsequent amendments, 2022

	(Common to All Branches)	1	0	0	1
OBJECTIVES:					
The course is designed to					
<ul style="list-style-type: none"> • Recognize Tamil literature and its significance in Tamil culture. • Introduce the Tamils' rich artistic and cultural legacy. • Familiarize the different types of folk and martial arts that are unique to Tamil Nadu. • Acquaint the concept of Thinaï in Tamil literature and culture. • Comprehend the significance of Tamil in developing Indian culture. 					
UNIT I	LANGUAGE AND LITERATURE	3			
Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature 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 Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.					
UNIT II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3			
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making -- Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.					
UNIT III	FOLK AND MARTIAL ARTS	3			
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.					
UNIT IV	THINAI CONCEPT OF TAMILS	3			
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 of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.					
UNIT V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3			
Contribution of Tamils to Indian Freedom Struggle – The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement – Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.					
TOTAL: 15 PERIODS					
OUTCOMES:					
Upon completion of the course, the students will be able to:					
CO1: State the role of Tamil literature in shaping Tamil Cultural roots.					
CO2: Express the cultural and religious significance of Tamil art and sculptures.					
CO3: Identify and describe the techniques of folk and martial arts.					
CO4: Classify the role of Thinaï concept in Tamil culture and literature.					
CO5: Compare the idea of cultural and intellectual contributions of Tamils.					
TEXT-CUM-REFERENCE BOOKS:					
தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: 3. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).					
4. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).					
5. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)					

6. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
7. Social Life of Tamils (Dr.K.K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
8. Social Life of the Tamils - The Classical Period (Dr.S .Singaravelu) (Published by: International Institute of Tamil Studies.
9. Historical Heritage of the Tamils (Dr. S. V. Subaramanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
10. The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
11. 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)
12. Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author)
13. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
14. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL) – Reference Book

SEMESTER III

22GE302	UNIVERSAL HUMAN VALUES II: UNDERSTANDING HARMONY (Common to III Semester CSE, , ADS and IV Semester ECE Branches)	L	T	P	C
		3	2	0	4
OBJECTIVES: The objective of the course is fourfold: <ul style="list-style-type: none"> • Development of a holistic perspective based on self-exploration about Themselves(humanbeing), family, society and nature/existence. • Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence • Strengthening of self-reflection. • Development of commitment and courage to act. 					
UNIT I	Course Introduction - Need, Basic guidelines, Content and Process for Value Education				6+6
<p>. Purpose and motivation for the course, recapitulation from Universal Human Values-I- Self-Exploration–Its content and process-Natural Acceptance and Experiential Validation-as the process for self-exploration - Continuous Happiness and Prosperity-A look at basic Human Aspirations.</p> <p>Right understanding, Relationship and Physical Facility-The basic requirements for fulfillment of aspirations of every human being with correct priority-Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario.</p> <p>Methods to fulfill the human aspirations: Understanding and living in harmony at various levels.</p> <p>Practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking</p>					
UNIT II	Understanding Harmony in the Human Being– Harmony in Myself!				6+6
<p>Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’ -the needs of Self and Body: happiness and physical facility.</p> <p>Recognizing the body as an instrument of ‘I’- its characteristics and activities -Appreciating the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail- Programs to ensure Sanyam and Health.</p> <p>Practice sessions to discuss the role others have played in making material goods available to everyone – Identifying those from one’s own life. Practice sessions to differentiate between prosperity and accumulation. Discussions on health and dealing with diseases</p>					
UNIT III	Understanding harmony in the family and society- Harmony in human-human relationship				6+6
<p>Understanding values in human beings and human relationships; meaning of Justice -nine universal values in relationships- program for their fulfillment to ensure mutual happiness-Trust and Respect as the foundational values of relationships.</p> <p>Comprehending the meaning of Trust and Respect - difference between intention and competence</p>					

- difference between respect and differentiation - the other salient values in relationships. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, Fearlessness (trust) and co-existence as comprehensive Human Goals - visualizing a universal harmonious order in society-Undivided society, Universal order-from family to world family.

Practice sessions to reflect on relationships in family, hostel and institutes extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discussions with scenarios. Eliciting examples from student's lives

UNIT IV	Understanding Harmony in the Nature and Existence-Whole existence as coexistence	6+6
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Understanding the harmony in nature, its inter-connectedness - mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature.
Recognizing Existence as Co-existence of mutually interacting units in all- pervasive space - holistic perception of harmony at all levels of existence.

Practice sessions to discuss human being as cause of imbalance in nature- pollution, depletion of resources and role of technology etc.

UNIT V	Implications of the above Holistic Understanding of Harmony on Professional Ethics	6+6
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Natural acceptance of human values - definitiveness of Ethical Human Conduct - basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.

Competence in professional ethics: Ability to utilize the professional competence for augmenting universal human order - Ability to identify the scope and characteristics of people friendly and eco-friendly production systems - Ability to identify and develop appropriate technologies and management patterns for above production systems - case studies of typical holistic technologies, management models and production systems.

Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations

Sum up.

Practice sessions / exercises: Case studies to discuss the conduct as an engineer or scientist etc.

TOTAL: 75 PERIODS

OUTCOMES:**Upon completion of the course, the students :**

.CO1: Would become more aware of themselves, and their surroundings (family, society, nature).

CO2: Would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.

CO3: Would have better critical ability.

CO4: Would become sensitive to their commitment towards what they have understood (human values, human relationship, and human society).

CO5: Would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

TEXTBOOKS:

1. R R Gaur, R Sangal, G P Bagaria, *Human Values and Professional Ethics*, Excel Books, New Delhi, Second Edition 2019.

REFERENCES:

1. Nagaraj A, Jeevan Vidya: Ek Parichaya Jeevan Vidya Prakashan, Amarkantak, 1999.

2. E.F Schumacher, *Small is Beautiful*, Vintage classics, London, 1993

3. A. N. Tripathi, Human Values, New Age Intl. Publishers, New Delhi, Third Edition 2020.

4. Maulana Abdul Kalam Azad, India Wins Freedom, Oriental blackswan private limited, Hyderabad, 2020.

5. Mahatma Gandhi, *Hind Swaraj or Indian Home Rule*, Maheswari Publications, Delhi 2020

6. Romain Rolland, *The life of Vivekananda and the universal gospel*, Publication house of Ramakrishna Math, Kolkata, Thirty second edition 2018.

7. Romain Rolland, *Mahatma Gandhi: The man who become one with the universal being*, Srishti Publishers & Distributors, New Delhi, Sixth Edition 2013.

8. Dennis P Heaton, *The story of stuff*. (2010): 553-556.

9. Mohandas Karamchand Gandhi, *The story of my experiments with truth: An auto biography*, Om Books International, 2018.

10. Cecile Andrews, *Slow is beautiful: new visions of community, leisure, and joie de vivre*, Newsociety publishers, 2006

11. Joseph Cornelius Kumarappa, *The economy of permanence. CP*, All India Village Industries Assn., 1946.

22MA301	DISCRETE MATHEMATICS (Common to CSE, IT, AD) (Theory Course)			L	T	P	C
				3	2	0	4
OBJECTIVES: The course is designed to: <ul style="list-style-type: none"> • Describe the arguments using connectives and rules of inference. • Introduce the basic concept of counting and generating functions. • Define the graphs and it's models. • Understand the concept of group theory, lattices and Boolean algebra. 							
UNIT I	LOGIC AND PROOFS						15
Propositional logic - Propositional equivalences - Predicates and quantifiers - Nested quantifiers - Rules of inference - Introduction to proofs - Proof methods and strategy.							
UNIT II	COMBINATORICS						15
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 and its applications.							
UNIT III	GRAPHS						15
Graphs and graph models - Graph terminology and special types of graphs - Matrix representation of graphs and graph isomorphism - Connectivity - Euler and Hamilton paths.							
UNIT IV	ALGEBRAIC STRUCTURES						15
Algebraic systems - Semi groups and monoids - Groups - Subgroups - Homomorphism's - Normal subgroup and cosets - Lagrange's theorem - Definitions and examples of Rings and Fields.							
UNIT V	LATTICES AND BOOLEAN ALGEBRA						15
Partial ordering - Posets - Lattices as posets - Properties of lattices - Lattices as algebraic systems - Sub lattices - Direct product and homomorphism - Some special lattices - Boolean algebra.							
TOTAL: 75 PERIODS							
OUTCOMES: Upon completion of the course, the students will be able to: CO1: Validate the arguments using connectives and rule of inference. CO2: Solve linear recurrence relations. CO3: Determine Euler's path and Hamilton paths. CO4: Identify algebraic structures of groups, rings, and fields. CO5: Interpret lattices as algebraic structures.							
TEXTBOOKS:							
1. Rosen, K.H., "Discrete Mathematics and its Applications", 8th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2021.							
2. Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30th Reprint, 2017.							
REFERENCES:							
1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 5th Edition, Pearson Education Asia, Delhi, 2014.							

2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3rd Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

22CS302	COMPUTER ORGANIZATION AND ARCHITECTURE (Common to CSE and ADS)	L	T	P	C
		3	0	0	3
OBJECTIVES: The Course will enable learners to:					
<ul style="list-style-type: none"> • Describe the basic principles and operations of digital computers. • Design arithmetic and logic unit for various fixed and floating point operations • Construct pipeline architectures for RISC processors. • Explain various memory systems & I/O interfacing • Discuss parallel processor and multi-processor architectures 					
UNIT I	COMPUTER FUNDAMENTALS	9			
Computer Types - Functional Units — Basic Operational Concepts — Number Representation and Arithmetic Operations - Performance Measurement — Instruction Set Architecture - Memory Locations and Addresses - Instructions and Instruction Sequencing - Addressing Modes.					
UNIT II	COMPUTER ARITHMETIC	9			
Addition and Subtraction of Signed Numbers - Design of Fast Adders - Multiplication of Unsigned Numbers - Multiplication of Signed Numbers - Fast Multiplication - Integer Division - Floating-Point Numbers and Operations.					
UNIT III	BASIC PROCESSING UNIT AND PIPELINING	9			
Basic Processing Unit: Concepts - Instruction Execution - Hardware Components - Instruction Fetch and Execution Steps -Control Signals - Hardwired Control. Pipelining: Basic Concept - Pipeline Organization- Pipelining Issues - Data Dependencies - Memory Delays - Branch Delays - Resource Limitations - Performance Evaluation -Superscalar Operation.					
UNIT IV	I/O AND MEMORY	9			
Input/Output Organization: Bus Structure - Bus Operation - Arbitration - The Memory System: Basic Concepts - Semiconductor RAM Memories - Read-only Memories - Direct Memory Access - Memory Hierarchy - Cache Memories - Performance Considerations - Virtual Memory - Memory Management Requirements - Secondary Storage.					
UNIT V	PARALLEL PROCESSING AND MULTICORE COMPUTERS	9			
Parallel Processing: Use of Multiple Processors - Symmetric Multiprocessors - Multithreading and Chip Multiprocessors - Clusters - Nonuniform Memory Access Computers Vector Computation - Multicore Organization.					
TOTAL: 45 PERIODS					
OUTCOMES: Upon completion of the course, the students will be able to:					
CO1: Explain the basic principles and operations of digital computers.					
CO2: Design Arithmetic and Logic Unit to perform fixed and floating-point operations					
CO3: Develop pipeline architectures for RISC Processors.					
CO4: Summarize Various Memory systems & I/O interfacing.					
CO5: Recognize Parallel Processor and Multi Processor Architectures					
TEXT BOOKS:					
1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer organization, Tata McGraw Hill, Sixth edition, 2012.					
2. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.					

REFERENCES:

1. John P. Hayes, Computer Architecture and Organization, Third Edition, TataMcGraw Hill, 2012.

2. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface, 6th edition, Morgan Kaufmann, 2021.

3. John L. Hennessy and David A. Patterson, Computer Architecture – A Quantitate Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

22CS303	DESIGN AND ANALYSIS OF ALGORITHMS (Common to CSE and ADS)	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to: <ul style="list-style-type: none"> • Critically analyse the efficiency of alternative algorithmic solutions for the same problem • Illustrate brute force and divide and conquer design techniques. • Explain dynamic programming for solving various problems. • Apply greedy technique and iterative improvement technique to solve optimization problems • Examine the limitations of algorithmic power and handling it in different problems. 					
UNIT I	INTRODUCTION				6+6
Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving –Fundamentals of the Analysis of Algorithmic Efficiency – Asymptotic Notations and their properties. Analysis Framework – Mathematical analysis for Recursive and Non-recursive algorithms List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Perform the recursive algorithm analysis. 2. Perform the non-recursive algorithm analysis. 					
UNIT II	BRUTE FORCE AND DIVIDE AND CONQUER				6+6
Brute Force - String Matching - Exhaustive Search - Knapsack Problem - Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort - Multiplication of Large Integers – Closest-Pair and Convex Hull Problems - Transform and Conquer Method: Heap Sort List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Write a program to search an element using binary search 2. Write a program to sort the elements using merge sort and find time complexity. 3. Write a program to sort the elements using quick sort and find time complexity. 4. Write a program to sort the elements using heap sort 					
UNIT III	DYNAMIC PROGRAMMING				6+6
Dynamic programming – Principle of optimality – Floyd’s algorithm – Multi stage graph - Optimal Binary Search Trees - Longest common subsequence - Matrix-chain multiplication – Travelling Salesperson Problem – Knapsack Problem and Memory functions. List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Solve Floyd’s algorithm 2. Write a program to find optimal binary search tree for a given list of keys. 3. Solve the multi-stage graph to find shortest path using backward and forward approach 4. Write a program to find the longest common subsequence 					
UNIT IV	GREEDY TECHNIQUE AND ITERATIVE IMPROVEMENT				6+6
Greedy Technique – Prim’s algorithm and Kruskal’s Algorithm – Huffman Trees. The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs - The Stable marriage Problem List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Write a program to find minimum spanning tree using Prim’s algorithm 2. Implement Kruskal’s algorithm to find minimum spanning tree 3. Write a program to solve maximum flow problem 					
UNIT V	BACKTRACKING AND BRANCH AND BOUND				6+6

P, NP NP- Complete and NP Hard Problems. Backtracking – N-Queen problem - Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem - Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem

List of Exercise/Experiments:

1. Write a program to implement sum of subset problem.
2. Write a program to solve N-Queen problem
3. Solve the assignment problem using branch and bound technique
4. Solve knapsack problem using branch and bound technique

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Solve mathematically the efficiency of recursive and non-recursive algorithms

CO2: Design and Analyse the efficiency of divide and conquer and transform and conquer algorithmic techniques

CO3: Implement and analyse the problems using dynamic programming

CO4: Solve the problems using and greedy technique and iterative improvement technique for optimization

CO5: Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound technique.

TEXT BOOKS:

Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.

Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.

REFERENCES:

Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.

S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.

<http://nptel.ac.in/>

LIST OF EQUIPMENTS:

Standalone PC with C/C++/Java

22AI301	ARTIFICIAL INTELLIGENCE (Lab Integrated)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
<ul style="list-style-type: none"> • To understand the various Intelligent agents and search strategies in AI. • To learn about different problem-solving strategies using heuristic function. • To learn about knowledge-based agents and first order logics. • To understand knowledge representation and planning. • To know about the expert system. 					
UNIT I	ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS				9+6
Introduction to AI – Foundations of Artificial Intelligence - Intelligent Agents – Agents and Environments - Concept of rationality – Nature of environments – Structure of agents - Problem solving agents – Example Problems - Search Algorithms – Uninformed Search Strategies.					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implement basic search strategies – 8-Puzzle, 8 - Queens problem. 2. Implement Breadth First Search & Depth first Search Algorithm 3. Implement Water Jug problem. 4. Solve Tic-Tac-Toe problem. 					
UNIT II	PROBLEM SOLVING				9+6
Heuristic search strategies – heuristic functions- Game Playing – Mini-max Algorithm - Optimal decisions in games – Alpha-beta search –Monte-Carlo search for Games - Constraint satisfaction problems – Constraint propagation – Backtracking search for CSP – Local search for CSP – Structure of CSP					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implement A* and memory bounded A* algorithms. 2. Implement Minimax algorithm & Alpha-Beta pruning for game playing. 3. Constraint Satisfaction Problem 4. Mini Project – Chess. Sudoku. 					
UNIT III	LOGICAL AGENTS				9+6
Knowledge-based agents – Logic - Propositional logic – Propositional theorem proving – Propositional model checking – Agents based on propositional logic					
First-Order Logic – Syntax and semantics – Using First-Order Logic - Knowledge representation and engineering – Inferences in first-order logic – Propositional Vs First-Order Inference - Unification and First-Order Inference - Forward chaining – Backward chaining – Resolution.					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implement Unification algorithm for the given logic. 2. Implement forward chaining and backward chaining using Python. 					
UNIT IV	KNOWLEDGE REPRESENTATION AND PLANNING				9+6
Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information					
Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – non-deterministic domains – Time, schedule, and resources – Analysis					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implementation of object detection. 2. Implement classical planning algorithms. 					
UNIT V	LEARNING AND EXPERT SYSTEMS				9+6
Forms of Learning – Developing Machine Learning systems – Statistical Learning - Deep Learning: Simple feed-forward network - Neural Networks – Reinforcement Learning: Learning from rewards – Passive and active Reinforcement learning.					
Expert Systems: Functions – Main structure – if-then rules for representing knowledge –					

developing the shell – Dealing with uncertainty

Lab Programs:

1. Develop an Expert system.
2. Mini-Project – Develop Machine Learning based classification Models.

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Illustrate the structure of agents and to implement various Intelligent agents.

CO2: Apply search strategies in problem solving and game playing using heuristic function.

CO3: Implement logical agents and first-order logic problems.

CO4: Apply problem-solving strategies with knowledge representation mechanism for solving hard problems.

CO5: Demonstrate the basics of expert systems and to develop models using machine learning techniques.

TEXT BOOKS:

1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.
4. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.
2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020
3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003
4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.
5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, 1st Edition by Patterson, Pearson, India, 2015.
6. NPTEL Courses:
 - a. An Introduction to Artificial Intelligence - https://onlinecourses.nptel.ac.in/noc23_cs05/preview
 - b. Artificial Intelligence: Knowledge Representation And Reasoning - https://onlinecourses.nptel.ac.in/noc23_cs09/preview

22AI302	DATA SCIENCE USING PYTHON (Lab Integrated)	L	T	P	C	
		2	0	2	3	
OBJECTIVES:						
<p>The Course will enable learners to:</p> <ul style="list-style-type: none"> • To learn the fundamentals of Data Science. • To experiment and implement python libraries for data science Learn the tools and packages in Python for Data Science. • To apply and implement basic classification algorithms • To apply clustering and outlier detection approaches. • To present and interpret data using visualization libraries in Python 						
UNIT I	INTRODUCTION					6+6
<p>Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.</p> <p>List of Exercise/Experiments:</p> <ol style="list-style-type: none"> 1. Download, install and explore the features of R/Python for data analytics <ul style="list-style-type: none"> • Installing Anaconda • Basic Operations in Jupiter Notebook • Basic Data Handling 						
UNIT II	PYTHON LIBRARIES FOR DATA SCIENCE					6+6
<p>Introduction to Numpy - Multidimensional Ndarrays – Indexing – Properties – Constants – Data Visualization: Ndarray Creation – Matplotlib - Introduction to Pandas – Series – Dataframes – Visualizing the Data in Dataframes - Pandas Objects – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – Joins-Pivot Tables - String operations – Working with time series – High performance Pandas.</p> <p>List of Exercise/Experiments:</p> <ol style="list-style-type: none"> 1. Working with Numpy arrays - Creation of numpy array using the tuple, Determine the size, shape and dimension of the array, Manipulation with array Attributes, Creation of Sub array, Perform the reshaping of the array along the row vector and column vector, Create Two arrays and perform the concatenation among the arrays. 2. Working with Pandas data frames - Series, DataFrame , and Index, Implement the Data Selection Operations, Data indexing operations like: loc, iloc, and ix, operations of handling the missing data like None, Nan, Manipulate on the operation of Null Vaues (is null(), not null(), dropna(), fillna()). 3. Perform the Statistics operation for the data (the sum, product, median, minimum and maximum, quantiles, arg min, arg max etc.). 4. Use any data set compute the mean ,standard deviation, Percentile. 						
UNIT III	CLASSIFICATION					6+6
<p>Basic Concepts – Decision Tree Induction – Bayes Classification Methods – Rule-Based Classification – Model Evaluation and Selection.</p> <p>Bayesian Belief Networks – Classification by Backpropagation – Support Vector Machines – Associative Classification – K-Nearest-Neighbor Classifiers – Fuzzy Set Approaches - Multiclass Classification - Semi-Supervised Classification.</p> <p>List of Exercise/Experiments:</p>						

	<ol style="list-style-type: none"> 1. Apply Decision Tree algorithms on any data set. 2. Apply SVM on any data set 3. Implement K-Nearest-Neighbor Classifiers 	
UNIT IV	CLUSTERING AND OUTLIER DETECTION	6+6
Cluster Analysis – Partitioning Methods – Evaluation of Clusters – Probabilistic Model-Based Clustering – Outliers and Outlier Analysis – Outlier Detection Methods – Statistical Approaches – Clustering and Classification-Based Approaches. List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Apply K-means algorithms for any data set. 2. Perform Outlier Analysis on any data set. 		
UNIT V	DATA VISUALIZATION	6+6
Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn. List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Basic plots using Matplotlib. 2. Implementation of Scatter Plot. 3. Construction of Histogram, bar plot, Subplots, Line Plots. 4. Implement the three dimensional potting. 5. Visualize a dataset with Seaborn. 		
TOTAL:30+30 = 60 PERIODS		
OUTCOMES:		
At the end of this course, the students will be able to:		
CO1: Explain the fundamentals of data science		
CO2: Experiment python libraries for data science		
CO3: Apply and implement basic classification algorithms		
CO4: Implement clustering and outlier detection approaches		
CO5: Present and interpret data using visualization tools in Python		
TEXT BOOKS:		
1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit 1)		
2. Ashwin Pajankar, Aditya Joshi, Hands-on Machine Learning with Python: Implement Neural Network Solutions with Scikit-learn and PyTorch, Apress, 2022.		
3. Jake VanderPlas, “Python Data Science Handbook – Essential tools for working with data”, O’Reilly, 2017.		
REFERENCES:		
1. Roger D. Peng, R Programming for Data Science, Lulu.com, 2016		
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012.		
3. Samir Madhavan, Mastering Python for Data Science, Packt Publishing, 2015		
4. Laura Igual, Santi Seguí, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", 1st Edition, Springer, 2017		
5. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50 Essential Concepts", 3rd Edition, O'Reilly, 2017		
6. Hector Guerrero, “Excel Data Analysis: Modelling and Simulation”, Springer International Publishing, 2nd Edition, 2019		
7. NPTEL Courses:		
a. Data Science for Engineers - https://onlinecourses.nptel.ac.in/noc23_cs17/preview		
b. Python for Data Science - https://onlinecourses.nptel.ac.in/noc23_cs21/preview		

22GE301	TAMILS AND TECHNOLOGY (Common to All Branches)	L	T	P	C
		1	0	0	1
OBJECTIVES:					
The course is designed to					
<ul style="list-style-type: none"> • Recognize the historical significance of weaving and pottery technologies in ancient Tamil civilization. • Highlight the concepts of design and construction technology during the Sangam age. • Provide an overview of manufacturing technology and its role in Tamil society. • Illustrate the agricultural and irrigation techniques employed in ancient Tamil society. • Promote scientific Tamil and Tamil computing. 					
UNIT I	WEAVING AND CERAMIC TECHNOLOGY				3
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.					
UNIT II	DESIGN AND CONSTRUCTION TECHNOLOGY				3
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.					
UNIT III	MANUFACTURING TECHNOLOGY				3
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 beads - Archeological evidences - Gem stone types described in Silappathikaram.					
UNIT IV	AGRICULTURE AND IRRIGATION TECHNOLOGY				3
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoempu 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.					
UNIT V	SCIENTIFIC TAMIL & TAMIL COMPUTING				3
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.					
TOTAL: 15 PERIODS					

OUTCOMES:

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

CO1: Identify the role of weaving and ceramic technology in ancient Tamil Culture.

CO2: Assess the design and construction technology ideas in the current Tamil society.

CO3: Identify the different types of manufacturing technology used in Tamil society and their significance.

CO4: Classify agricultural and irrigation technologies in ancient Tamil society and its current relevance.

CO5: Discuss the fundamentals of scientific Tamil and Tamil computing.

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).

2. கணினித் தமிழ் - முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).

3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை - ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

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.Subaramanian, 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 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 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

22CS311	APTITUDE AND CODING SKILLS – I (Common to All Branches)	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<p>The Course will enable learners to:</p> <ul style="list-style-type: none"> ● Develop vocabulary for effective communication and reading skills. ● Build the logical reasoning and quantitative skills. ● Develop error correction and debugging skills in programming. 					
List of Exercises:					
<p>1. English – Phase I Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering</p>					
<p>2. Logical Reasoning – Phase I Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency</p>					
<p>3. Quantitative Ability - Phase I Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability</p>					
<p>4. Automata Fix – Phase I Logical, Compilation and Code reuse</p>					
TOTAL: 30 PERIODS					
OUTCOMES:					
Upon completion of the course, the students will be able to:					
CO1: Develop vocabulary for effective communication and reading skills.					
CO2: Build the logical reasoning and quantitative skills.					
CO3: Develop error correction and debugging skills in programming.					

22CS313	PRODUCT DEVELOPMENT LAB – 3 (Design and Analysis Phase) (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- To provide an adequate understanding of project/product concepts and creative design process.
- Create a methodology to develop solutions to complex systems.

The students can form a team of 3 or 4 to work on the approved topic by the faculty in-charge. All approved product/process topics should have the following stages as listed under activities. The faculty in-charge conducts a periodic review to endorse the work process and during the review, the faculty shall provide suggestions/ideas to improvise the project towards completion. An interim report (consisting of literature, photographs, proof of the work done, etc..) for all listed activities should be submitted by the team during periodic review for evaluation. A final project report is required at the end of the semester for evaluation.

LIST OF ACTIVITIES:

1. Develop the design stage for a product from the concept.
 - Researching it in-depth.
 - Ideating possible solutions.
 - Selecting a promising solution.
 - Make a mock-up model
 - Comprehend the design features of the mock-up model.
2. Evaluate the pros-cons of the mock-up (& with the existing product).
3. Generate the Design for Manufacturing and Assembly (DFMA) process route for the product with necessary interdisciplinary collaborations.

TOTAL: 30 PERIODS

OUTCOMES:

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

- CO1 Enhance their skills in design concepts, rules and procedures.
 CO2 Develop their cognitive strategy to think, organize, learn and behave.
 CO3 Demonstrate the ability to provide conceptual design strategies for a product.
 CO4 Describe the procedure for designing a Mock-up model.
 CO5 Recognize and apply appropriate interdisciplinary and integrative strategies for solving complex problems

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No	Equipment Name	Quantity
1	CNC Router	1 No
2	3D Printer	1 No
3	3D Scanner	1 No
4	Laser cutting Machine	1 No

5	Centre lathe	2 Nos
6	Arc welding transformer with cables and holders	2 Nos
7	Plumbing tools	2 Sets
8	Carpentry tools	2 Sets
9	Multimeter	10 Nos
10	Drilling Machine	1 No
11	Solder Stations	5 Sets
12	Desoldering Machine	1 No
13	PCB Milling Machine	1 No
14	Variable Power Supply	1 No
15	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	10 Sets
16	Personal Desktop Computers	30 Nos
17	3D Modelling software – Creo/ AutoCAD/ etc.,	30 Licence

SEMESTER IV

22MA401	PROBABILITY AND STATISTICS (Common to CSE and ADS) (Theory Course with Laboratory Component)	L	T	P	C
		3	0	2	4
OBJECTIVES: The course is designed to: <ul style="list-style-type: none"> ● Provide the necessary basic concepts of random variables and to introduce some standard distributions. ● Test the hypothesis for small and large samples. ● Introduce the concepts of Analysis of Variances. ● Understand the concept of statistical quality control. 					
UNIT I	ONE-DIMENSIONAL RANDOM VARIABLES	15			
Basic probability definitions- Independent events- Conditional probability (revisit) - Random variable - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.					
List of Exercise/Experiments using R Programming: <ol style="list-style-type: none"> 1. Finding conditional probability. 2. Finding mean, variance and standard deviation. 					
UNIT II	TWO-DIMENSIONAL RANDOM VARIABLES	15			
Joint distributions - Marginal and conditional distributions - Covariance - Correlation and linear regression - Transformation of random variables.					
List of Exercise/Experiments using R Programming: <ol style="list-style-type: none"> 1. Finding marginal density functions for discrete random variables. 2. Calculating correlation and regression. 					
UNIT III	TESTING OF HYPOTHESIS	15			
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 F distributions for mean and variance - Chi-square test- Contingency table (test for independent) - Goodness of fit.					
List of Exercise/Experiments using R Programming: <ol style="list-style-type: none"> 1. Testing of hypothesis for given data using Z - test. 2. Testing of hypothesis for given data using t - test. 					
UNIT IV	DESIGN OF EXPERIMENTS	15			
One way and Two-way classifications - Completely randomized design - Randomized blockdesign - Latin square design.					
List of Exercise/Experiments R Programming: <ol style="list-style-type: none"> 1. Perform one-way ANOVA test for the given data. 2. Perform two-way ANOVA test for the given data. 					
UNIT V	STATISTICAL QUALITY CONTROL	15			
Control charts for measurements (\bar{X} and R charts) - Control charts for attributes (p, c and npcharts) - Tolerance limits.					
List of Exercise/Experiments using R Programming:					

1. Interpret the results for \bar{X} -Chart for variable data.
2. Interpret the results for R-Chart for variable data.

TOTAL:75 PERIODS

OUTCOMES:

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

- CO1: Calculate the statistical measures of standard distributions.
- CO2: Compute the correlation & regression for two dimensional random variables.
- CO3: Apply the concept of testing the hypothesis.
- CO4: Implement the concept of analysis of variance for various experimental designs.
- CO5: Demonstrate the control charts for variables and attributes.

TEXTBOOKS:

1. R.A. Johnson, I. Miller and J. Freund, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. J.S. Milton and J.C. Arnold, "Introduction to Probability and Statistics", Tata McGrawHill, 4th Edition, 2017.

REFERENCES:

1. J.L. Devore, "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 9th Edition, 2016.
2. S.M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 6th Edition, Elsevier, 2020.
3. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
4. R.E. Walpole, R.H. Myers, S.L. Myers and K. Ye, "Probability and Statistics for Engineers and Scientists". Pearson Education, Asia, 9th Edition, 2012.

22CS304	OPERATING SYSTEM (Common to CSE and ADS)	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to: <ul style="list-style-type: none"> • Explain the basic concepts of operating systems and process. • Discuss threads and analyse various CPU scheduling algorithms. • Describe the concept of process synchronization and deadlocks. • Analyse various memory management schemes. • Describe I/O management and file systems. 					
UNIT I	INTRODUCTION TO OPERATING SYSTEMS AND PROCESSES				6+6
Introduction: Computer system organization - architecture – Resource management - Protection and Security – Virtualization - Operating System Structures: Services - User and Operating-System Interface - System Calls - System Services - Design and Implementation - Building and Booting an Operating System – Processes: Process Concept - Process Scheduling - Operations on Processes – Inter process Communication - IPC in Shared-Memory Systems - IPC in Message-Passing Systems List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Basic Unix file system commands such as ls, cd, mkdir, rmdir, cp, rm, mv, more, lpr, man, grep, sed, etc.. 2. Programs using Shell Programming. 3. Implementation of Unix System Calls. 4. Implementation of IPC using message queue <ol style="list-style-type: none"> a. Get the input data (integer value) from a process called sender b. Use Message Queue to transfer this data from sender to receiver process c. The receiver does the prime number checking on the received data d. Communicate the verified/status result from receiver to sender process, this status should be displayed in the Sender process. Note: Simultaneously execute two or more processes. Don't do it as a single process					
UNIT II	THREADS AND CPU SCHEDULING				6+6
Threads & Concurrency: Overview - Multicore Programming - Multithreading Models - Thread Libraries - Implicit Threading - Threading Issues - CPU Scheduling: Basic Concepts – Scheduling Criteria - Scheduling Algorithms - Thread Scheduling - Multi-Processor Scheduling - Real-Time CPU Scheduling List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Write a program to implement the following actions using pthreads <ol style="list-style-type: none"> a. Create a thread in a program and called Parent thread, this parent thread creates another thread (Child thread) to print out the numbers from 1 to 20. The Parent thread waits till the child thread finishes b. Create a thread in the main program, this program passes the 'count' as arguments to that thread function and this created thread function has to print your name 'count' times. 2. Write C programs to implement the various CPU Scheduling Algorithms. 					
UNIT III	PROCESS SYNCHRONISATION AND DEADLOCKS				6+6
Process Synchronization: The critical-section problem – Peterson's Solution, Synchronization hardware, Mutex locks, Semaphores, monitors - Classic problems of synchronization: Bounded Buffer Problem - Reader's & Writer Problem, Dining Philosopher Problem. Deadlock: System model - Deadlock characterization, Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection - Recovery from deadlock.					

List of Exercise/Experiments:

1. Process Synchronization using Semaphores. A shared data has to be accessed by two categories of processes namely A and B. Satisfy the following constraints to access the data without any data loss.

- a. When a process A1 is accessing the database another process of the same category is permitted.
- b. When a process B1 is accessing the database neither process A1 nor another 74 process B2 is permitted.
- c. When a process A1 is accessing the database process B1 should not be allowed to access the database. Write appropriate code for both A and B satisfying all the above constraints using semaphores.

Note: The time-stamp for accessing is approximately 10 sec.

2. Bankers Algorithm for Deadlock Avoidance

UNIT IV	MEMORY MANAGEMENT	6+6
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Memory Management: Contiguous Memory Allocation - Paging - Structure of the Page Table – Swapping - Virtual Memory: Demand Paging – Copy-on write – Page Replacement – Allocation of frames – Thrashing – Memory Compression

List of Exercise/Experiments:

1. Analysis and Simulation of Memory Allocation and Management Techniques
 - i. First Fit ii. Best Fit iii. Worst Fit
2. Implementation of Page Replacement Techniques
 - i. FIFO ii. LRU iii. Optimal page replacement

UNIT V	STORAGE MANAGEMENT	6+6
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Mass Storage Structure: Overview of Mass Storage Structure- HDD scheduling – Swap Space Management, I/O systems: I/O Hardware, Application I/O interface, Kernel I/O Subsystem, File System Interface: File Concept – Access Methods – Directory Structure – Protection, File-System Implementation: File-System Structure- File-System Operations - Directory Implementation - Allocation Methods - Free-Space Management, - Case Study-Linux

List of Exercise/Experiments:

1. Simulation of File Allocation Techniques
 - i. Sequential ii. Linked list iii. indexed
2. Implementation of File Organization Strategies
 - i. Single level directory ii. Two level directory iii. Hierarchical level directory

TOTAL: 60 PERIODS

OUTCOMES:

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

- CO1:** Implement the basic concepts of operating systems and process.
- CO2:** Analyse various CPU scheduling algorithms and thread mechanism.
- CO3:** Implement the concepts of process synchronization and deadlocks.
- CO4:** Design various memory management schemes to given situation.
- CO5:** Implement various I/O and file management techniques.

TEXTBOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts” II, 10th Edition, John Wiley and Sons Inc., 2018.
2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi.

REFERENCES:

1. William Stallings, "Operating Systems: Internals and Design Principles", 7th Edition, Prentice Hall, 2018.

2. Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.

LIST OF EQUIPMENTS:

Standalone desktops with C/C++/Java/Equivalent compiler.

22CS401	DISTRIBUTED AND CLOUD COMPUTING	L	T	P	C
		2	0	2	3
OBJECTIVES: <ul style="list-style-type: none"> ✓ To articulate the concepts and models underlying distributed computing ✓ To maintain consistency and perform efficient coordination in distributed systems through the use of logical clocks, global states, and snapshot recording algorithms. ✓ To learn different distributed mutual exclusion algorithms. ✓ To develop the ability to understand the cloud infrastructure and virtualization that help in the development of cloud. ✓ To explain the high-level automation and orchestration systems that manage the virtualized infrastructure. 					
UNIT I	INTRODUCTION	6 + 6			
Definition - Relation to computer system components - Message-passing systems versus shared memory systems - Primitives for distributed communication - Synchronous versus asynchronous executions. A model of distributed computations: A distributed program - A model of distributed executions - Models of communication networks - Global state of a distributed system.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Develop a distributed program that uses Java's messaging API (JMS) to communicate between nodes. Explore the different messaging paradigms (pub/sub, point-to-point) and evaluate their performance and scalability. 2. Develop a model of a distributed program using Java's concurrency and synchronization primitives. 					
UNIT II	LOGICAL TIME, GLOBAL STATE, AND SNAPSHOT ALGORITHMS	6 + 6			
Logical time – Scalar Time – Vector Time - Efficient implementations of vector clocks – Virtual Time. Global state and snapshot recording algorithms: System model - Snapshot algorithms for FIFO channels and non-FIFO channels.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Develop a program in Java that implements vector clocks to synchronize the order of events between nodes in a distributed system. 2. Implement a snapshot algorithm for recording the global state of the distributed system using vector clocks, for both FIFO and non-FIFO channels. Test the algorithm by recording snapshots at various points in the system's execution and analyzing the resulting global state. 					
UNIT III	DISTRIBUTED MUTUAL EXCLUSION ALGORITHMS	6 + 6			
Introduction - Lamport's algorithm - Ricart–Agrawala algorithm - Quorum-based mutual exclusion algorithms - Maekawa's algorithm - Suzuki–Kasami's broadcast algorithm.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Implement Lamport's algorithm for mutual exclusion in a distributed system using Java's RMI API. 					

	<ol style="list-style-type: none"> 2. Develop a program in Java that implements Maekawa's algorithm for mutual exclusion in a distributed system. 3. Implement Suzuki-Kasami's broadcast algorithm in Java to achieve reliable message delivery in a distributed system. 	
UNIT IV	CLOUD INFRASTRUCTURE AND VIRTUALIZATION	6 + 6
Data Center Infrastructure and Equipment – Virtual Machines – Containers – Virtual Networks – Virtual Storage.		
List of Exercise/Experiments:		
<ol style="list-style-type: none"> 1. Set up a virtualized data center using a hypervisor like VMware or VirtualBox and create multiple virtual machines (VMs) on it. Configure the VMs with different operating systems, resources, and network configurations, and test their connectivity and performance. 2. Deploy a containerized application on a virtual machine using Docker or Kubernetes. 		
UNIT V	AUTOMATION AND ORCHESTRATION	6 + 6
Automation - Orchestration: Automated Replication and Parallelism - The MapReduce Paradigm: The MapReduce Programming Paradigm – Splitting Input – Parallelism and Data size – Data access and Data Transmission – Apache Hadoop – Parts of Hadoop – HDFS Components – Block Replication and Fault Tolerance – HDFS and MapReduce - Microservices.		
List of Exercise/Experiments:		
<ol style="list-style-type: none"> 1. Set up and configure a single-node Hadoop cluster. 2. Run the word count program in Hadoop. 3. Deploy a microservices architecture using a container orchestration tool like Kubernetes or Docker Swarm. 		
TOTAL: 60 PERIODS		
OUTCOMES:		
Upon completion of the course, the students will be able to:		
CO1: Articulate the main concepts and models underlying distributed computing.		
CO2: Learn how to maintain consistency and perform efficient coordination in distributed systems through the use of logical clocks, global states, and snapshot recording algorithms.		
CO3: Learn different distributed mutual exclusion algorithms		
CO4: Develop the ability to understand the cloud infrastructure and virtualization that help in the development of cloud.		
CO5: Explain the high-level automation and orchestration systems that manage the virtualized infrastructure.		
TEXT BOOKS:		
<ol style="list-style-type: none"> 1. Ajay D. Kshemkalyani, Mukesh Singhal, “Distributed Computing: Principles, Algorithms, and Systems”, Cambridge University Press, 2011. (Unit 1, 2, 3) 2. Douglass E. Comer, “The Cloud Computing Book: The future of computing explained”, CRC Press, 2021. (Unit 4, 5) 		
REFERENCES:		
<ol style="list-style-type: none"> 1. Arshdeep Bahga, Vijay Madisetti, “Cloud Computing: A Hands-on Approach”, Universities Press Private Limited, 2014. 		

2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2017.
3. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
4. Hagit Attiya, Jennifer Welch, “Distributed Computing: Fundamentals, Simulations and Advanced Topics”, John Wiley & Sons, Inc., 2004.

LIST OF EQUIPMENTS:

Java, VMWare/VirtualBox, Hadoop, AWS/GCP/Azure/Any cloud platform, Eclipse/Equivalent IDE.

22AI401	MACHINE LEARNING (Lab Integrated)	L	T	P	C
		3	0	2	4
OBJECTIVES:					
<ul style="list-style-type: none"> • To discuss the basics of Machine Learning and model evaluation. • To study dimensionality reduction techniques. • To understand the various classification algorithms. • To elaborate on unsupervised learning techniques. • To discuss the basics of neural networks and various types of learning. 					
UNIT I	INTRODUCTION				9+6
Machine Learning – Types – Applications – Preparing to Model – Activities – Data – Exploring structure of Data – Data Quality and Remediation – Data Pre-processing – Modelling and Evaluation: Selecting a Model -Training a Model – Model representation and Interpretability – Evaluating Performance of a Model – Improving Performance.					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implementation of Candidate Elimination algorithm 2. Implementation of ML model evaluation techniques (R-Squared/Adjusted R-Squared/Mean Absolute Error/Mean Squared Error) 3. Implementation of ML model evaluation techniques (Confusion Matrix/F1 Score/AUC-ROC Curve) 					
UNIT II	FEATURE ENGINEERING AND DIMENSIONALITY REDUCTION				9+6
Feature Engineering – Feature Transformation – Feature Subset Selection - Principle Component Analysis – Feature Embedding – Factor Analysis – Singular value decomposition and Matrix Factorization – Multidimensional scaling – Linear Discriminant Analysis – Canonical Correlation Analysis – Isomap – Locally linear Embedding – Laplacian Eigenmaps.					
Lab Programs:					
<ol style="list-style-type: none"> 1. Write python code to identify feature co-relations (PCA) 2. Interpret Canonical Covariates with Heatmap 3. Feature Engineering is the way of extracting features from data and transforming them into formats that are suitable for Machine Learning algorithms. Implement python code for Feature Selection/ Feature Transformation/ Feature Extraction. 4. Mini Project – Feature Subset Selection 					
UNIT III	SUPERVISED LEARNING				9+6
Linear Regression -Relation between two variables – Steps – Evaluation – Logistic Regression – Decision Tree – Algorithms – Construction – Classification using Decision Tree – Issues – Rule-based Classification – Pruning the Rule Set – Support Vector Machines – Linear SVM – Optimal Hyperplane – Radial Basis Functions – Naïve Bayes Classifier – Bayesian Belief Networks.					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select the appropriate data set for your experiment and draw graphs. 2. Implement and demonstrate the working of the decision tree-based ID3 algorithm 3. Build a Simple Support Vector Machines using a data set 					
UNIT IV	UNSUPERVISED LEARNING				9+6
Clustering – Types – Applications - Partitioning Methods – K-means Algorithm – K-Medoids – Hierarchical methods – Density based methods DBSCAN – Finding patterns using Association Rules – Hidden Markov Model.					
Lab Programs:					
<ol style="list-style-type: none"> 1. Implement a k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions 2. Implement market basket analysis using association rules 					

3. Mini Project using Clustering analysis.

UNIT V	NEURAL NETWORKS AND TYPES OF LEARNING	9+6
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Biological Neuron – Artificial Neuron – Types of Activation function – Implementations of ANN – Architectures of Neural Networks – Learning Process in ANN – Back propagation – Deep Learning – Representation Learning – Active Learning – Instance based Learning – Association Rule Learning – Ensemble Learning Algorithm – Regularization Algorithm- Reinforcement Learning – Elements- Model-based- Temporal Difference Learning.

Lab Programs:

1. Build an ANN by implementing the Single-layer Perceptron. Test it using appropriate data sets.
2. Implement Multi-layer Perceptron and test the same using appropriate data sets.
3. Build a RBF Network to calculate the fitness function with five neurons.
4. Mini Project – Face recognition,

TOTAL: 45+30 = 75 PERIODS

OUTCOMES:

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

CO1: Explain the basics of Machine Learning and model evaluation.

CO2: Study dimensionality reduction techniques.

CO3: Understand and implement various classification algorithms.

CO4: Understand and implement various unsupervised learning techniques.

CO5: Build Neural Networks and understand the different types of learning.

TEXT BOOKS:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, “Machine Learning”, Pearson, 2019. (Unit 1 – chap 1,2,3/ Unit 2 – Chap 4 / Unit 4 – 9 / Unit 5 – Chap 10, 11)
2. Ethem Alpaydin, “Introduction to Machine Learning, Adaptive Computation and Machine Learning Series”, Third Edition, MIT Press, 2014. (Unit 2 – Chap 6 / Unit 4 – chap 8.2.3/ Unit 5 – Chap 18)

REFERENCES:

1. Anuradha Srinivasaraghavan, Vincy Joseph, “Machine Learning”, First Edition, Wiley, 2019. (Unit 3 – Chap 7,8,9,10,11 / Unit 4 – 13, 11.4, 11.5,12)
2. Peter Harrington, “Machine Learning in Action”, Manning Publications, 2012.
3. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition,
4. Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013.
6. Christoph Molnar, “Interpretable Machine Learning - A Guide for Making Black Box Models Explainable”, Creative Commons License, 2020.
7. NPTEL Courses:
 - a. Introduction to Machine Learning - https://onlinecourses.nptel.ac.in/noc23_cs18/preview

22CS402	WEB APPLICATION DEVELOPMENT (Lab Integrated)			L	T	P	C
				3	0	2	4
OBJECTIVES:							
The Course will enable learners to:							
<ul style="list-style-type: none"> • Simplify website development using Spring boot as server-side technologies. • Build single page applications using REACT as a reusable UI component technology as client-side technology. • Assemble REACT as a front end technology and Node js as a server side technology to develop enterprise applications • Develop a scalable and responsive web application • Develop an industry ready application web enterprise feature 							
UNIT I	SPRING BOOT AND STRUTS						9+6
Spring Boot: Introducing Spring Boot, getting started with springboot, Common springboot taskManaging configuration, creating custom properties, executing code on Springboot application startup, Database access with Spring data, Securing spring boot application.							
List of Exercise/Experiments:							
<ol style="list-style-type: none"> 1. Use Spring Boot to build a Web Application 2. Create REST Service for an Education Site. 							
UNIT II	JAVA REACT						9+6
React: Introduction to React, Pure React- The Virtual DOM, React Elements, React with JSX, Props, State, and the Component Tree, Enhancing Components - Flux.							
List of Exercise/Experiments:							
<ol style="list-style-type: none"> 1. Build Search filter in React 2. Display a list in React 3. Create Simple Login form in React 							
UNIT III	NODE JS						9+6
Node JS: Introduction to Node JS, Setting up Node.js, Node.js Modules- Finding and loading CommonJS and JSON modules using require, Hybrid CommonJS/Node.js/ES6 module scenarios, npm - the Node.js package management system.							
List of Exercise/Experiments:							
<ol style="list-style-type: none"> 1. Write a node.js program for making external http calls 2. Write a program in node.js to parse the given url. 							
UNIT IV	WEB FRAMEWORK (ANGULAR) – I						9+6
Introduction- Angular First App, Angular UI with Bootstrap CSS Authentication, Authentication Service, Unsubscribe, Logout and Route Guard Cleanup, Customer Service, Http Service, Token Interceptor, Multi Provider, Compile-time Configuration, Runtime Configuration, Error Handling.							
List of Exercise/Experiments:							
<ol style="list-style-type: none"> 1. Create a Dropdown using Angular UI bootstrap 2. Modify existing components and generating new components using Angular. 							
UNIT V	WEB FRAMEWORK (ANGULAR)-II						9+6
Dependency injection in Angular, Reactive programming in Angular, Laying out pages with Flex Layout, Implementing component communications, Change detection and component lifecycle.							
List of Exercise/Experiments:							
Launching your app with Angular root module							
TOTAL: 45+30 = 75 PERIODS							

OUTCOMES:

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

CO1: Write Web API/RESTful API application programming interface to communicate with Spring boot as a server-side technology.

CO2: Build single page applications using REACT as a reusable UI component technology as client-side technology

CO3: Build applications using Node Js as server-side technologies

CO4: Able to develop a web application using latest Angular Framework

CO5: Apply various Angular features including directives, components, and services.

TEXT BOOKS:

1. Somnath Musib, Spring Boot in Practice, Manning publication, June 2022 (<https://www.manning.com/books/spring-boot-in-practice>)
2. Alex Banks, Eve Porcello, "Learning React", May 2017, O'Reilly Media, Inc. ISBN: 9781491954621 (<https://www.oreilly.com/library/view/learningreact/9781491954614/>)
3. David Herron, "Node.js Web Development - Fourth Edition", 2018, Packt Publishing, ISBN: 9781788626859
4. Sukesh Marla, "A Journey to Angular Development Paperback", BPB Publications. (https://in.bpbonline.com/products/a-journey-to-angulardevelopment?_pos=1&_sid=0a0a0e9fb&_ss=r)
5. Yakov Fain Anton Moiseev, "Angular Development with TypeScript", 2nd Edition. (<https://www.manning.com/books/angular-development-with-typescript-secondedition>).

REFERENCES:

1. Sue Spielman, The Struts Framework 1: A Practical guide for Java Programmers, 1st Edition. Elsevier 2002.
2. https://onlinecourses.nptel.ac.in/noc23_cs46/preview LIST OF EQUIPMENTS: VSCode, Angular JS, React JS, Node JS, Ruby, Django

22CS411	APTITUDE AND CODING SKILLS – II (Common to All Branches)	L	T	P	C
		0	0	2	1
OBJECTIVES:					
The Course will enable learners to:					
<ul style="list-style-type: none"> ● Develop advanced vocabulary for effective communication and reading skills. ● Build an enhanced level of logical reasoning and quantitative skills. ● To develop error correction and debugging skills in programming. ● To apply data structures and algorithms in problem solving. 					
List of Exercises:					
1. English – Phase II					
Vocabulary: Synonyms, Antonyms, Grammar: Subject-Verb Agreement, Tenses and Articles, Prepositions and Conjunctions, Speech and Voices, Comprehension: Inferential and Literal Comprehension, Contextual Vocabulary, Comprehension ordering					
2. Logical Reasoning – Phase II					
Deductive Reasoning: Coding deductive logic, Directional sense, Blood relations, Objective Reasoning, Selection decision tables, Puzzles, Inductive reasoning: Coding pattern and Number series pattern recognition, Analogy and Classification pattern recognition, Abductive Reasoning: Logical word sequence, Data sufficiency					
3. Quantitative Ability - Phase II					
Basic Mathematics: Divisibility, HCF and LCM, Numbers, decimal fractions and power, Applied Mathematics: Profit and Loss, Simple and Compound Interest, Time, Speed and Distance, Engineering Mathematics: Logarithms, Permutation and Combinations, Probability					
4. Automata Fix – Phase II					
Logical, Compilation and Code reuse					
5. Automata - Phase II					
Data Structure Concepts: Array and Matrices, Linked list, String processing and manipulation, Stack/Queue, Sorting and Searching					
Advanced Design and Analysis Techniques: Greedy Algorithms, Minimum Spanning Trees, String Matching, Divide and Conquer, Computational Geometry					
TOTAL: 30 PERIODS					
OUTCOMES:					
Upon completion of the course, the students will be able to:					
CO1: Develop advanced vocabulary for effective communication and reading skills.					
CO2: Build an enhanced level of logical reasoning and quantitative skills.					
CO3: Develop error correction and debugging skills in programming.					
CO4: Apply data structures and algorithms in problem solving.					

22CS412	MINI PROJECT AND DESIGN THINKING LAB	L	T	P	C
		0	0	2	1
OBJECTIVES:					
<p>The Course will enable learners to:</p> <ul style="list-style-type: none"> • Introducing students to design thinking that enhances innovation activities in terms of value creation and sustainability in problem solving. • Strengthen students' individual and collaborative capabilities to identify problems/needs, develop sound hypotheses, collect, and analyze appropriate data, develop prototypes to collect meaningful feedback in a real-world environment. 					
LIST OF EXERCISES:					
UNIT 1					
Introduction: Design thinking overview- Design Process – Principles of Design Thinking –Problems Best suited for Design Thinking - Visualization tool – Case Study: Problem Identification (6)					
UNIT 2					
Empathize – Information Gathering – Analysis – Story Telling tool- Innovation- Ideation Finding and Evaluating Ideas Mind Mapping Tool Case Study: Analysing the Identified Problem. (6)					
UNIT 3					
Designing Prototypes – Tasks in Prototyping –Understanding Different Prototypes- Developing different prototypes -Demonstration –Prototyping Tools Case Study: Prototyping the solution. (6)					
UNIT 4					
Testing and Evaluation – Testing Prototypes – Evaluation – Improving solution – Strategic Opportunities – Case Study: Evaluating the solution. (6)					
UNIT 5					
Applications: HealthCare and Science – Education- Transportation - Finance – Technology. (6)					
TOTAL: 30 PERIODS					
OUTCOMES:					
Upon completion of the course, the students will be able to:					
CO1: Understand the design thinking process and able to visualize the problem.					
CO2: Analyse the problem using innovation tools					
CO3: Design a prototype for an identified problem solution					
CO4: Testing and evaluate strategies in improving the solution					
CO5: Apply the innovation ideas to real-world applications.					

22CS413	PRODUCT DEVELOPMENT LAB - 4 (Prototype Phase) (Common to All Branches)	L	T	P	C
		0	0	2	1

OBJECTIVES:

The Course will enable learners to:

- Analyze the real-time problems in product development from an engineering perspective.
- Implement the DFMA process route to make and assemble the product.
- Test and qualify the product or a system with acquired knowledge.
- Identify the business opportunities for the developed product or process.

The student batch of PDD Lab 3 shall continue their product/ process design work under the guidance of the faculty incharge. All batches should cover the following stages of prototyping work as listed under activities. The faculty incharge shall conduct periodic reviews to endorse the work progress and during the review, the faculty shall provide suggestions/ideas to improvise the project towards completion. An interim report (consisting of BoM, Stages of Prototyping, photographs, proof of work done, etc..) for all listed activities should be submitted by the team during periodic review for evaluation. A final project report is required at the end of the semester and the evaluation is based on an oral presentation in front of the examiner panel constituted by the Head of the Department.

LIST OF ACTIVITIES:

1. Develop Engineering BoM for the approved industrial Mock-up from Phase III. Transform the Engineering BoM to develop a Prototype.
2. Devise / Plan an economically efficient manufacturing process to make the Prototype and testing.
3. Deliberation of the Product / Process outcome – Phase IV. Preparation and submission of a project report.

TOTAL: 30 PERIODS

OUTCOMES:

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

- CO1 Identify the real-time problems through literature.
 CO 2 Develop feasible solutions for the problems.
 CO 3 Evaluate the methods to develop solutions to the problem.
 CO 4 Analyze the business opportunities for a new product.
 CO 5 Prepare a detailed report for the experimental dissemination.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.No	Equipment Name	Quantity
1	CNC Router	1 No
2	3D Printer	1 No
3	3D Scanner	1 No

4	Laser cutting Machine	1 No
5	Centre lathe	2 Nos
6	Arc welding transformer with cables and holders	2 Nos
7	Plumbing tools	2 Sets
8	Carpentry tools	2 Sets
9	Multimeter	10 Nos
10	Drilling Machine	1 No
11	Solder Stations	5 Sets
12	Desoldering Machine	1 No
13	PCB Milling Machine	1 No
14	Variable Power Supply	1 No
15	Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc.	10 Sets
16	Personal Desktop Computers	30 Nos
17	Numerical Simulation Tools	30 Licence
18	Test bench: Mech: Digital Micrometre/ Vernier/ Bore gauge/ etc EEE : (Based on the electrical components) ECE : (Based on the electronic components)	5 Nos

SEMESTER V

22AI502	Data Exploration, Feature Engineering and Visualization (Lab Integrated)	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to: <ul style="list-style-type: none"> • To outline an overview of exploratory data analysis and phases involved in data analytics • To understand the basics of feature engineering on different types of data. • To experiment the data visualization • To describe the methods of time series analysis • To explain the basics of tree and hierarchical representation of big data 					
UNIT I	EXPLORATORY DATA ANALYSIS				6+6
EDA fundamentals – Understanding data science – Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA. Visual Aids For EDA- Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques -Descriptive Statistics-types of kurtosis, quartiles, Grouping Datasets-data aggregation, group wise transformation.					
List of Exercise/Experiments <ol style="list-style-type: none"> 1. Install the following Data Mining and data Analysis tool: Weka, KNIME, Tableau Public. 2. Perform exploratory data analysis (EDA) on with datasets like email data set. Export all your emails as a dataset, import them inside a pandas data frame, visualize them and get different insights from the data. 					
UNIT II	FEATURE ENGINEERING				6+6
Text Data – Visual Data – Feature-based Time-Series Analysis – Data Streams – Feature Selection and Evaluation.					
List of Exercise/Experiments <ol style="list-style-type: none"> 1. Implement document embeddings for fake news identification. 2. Implement feature based representations of time series 3. Implement feature selection algorithm for data streams 					
UNIT III	VISUALIZING DATA				6+6
The Seven Stages of Visualizing Data, Processing-load and displaying data – functions, sketching and scripting, Mapping-Location, Data, two sided data ranges, smooth interpolation of values over time - Visualization of numeric data and non numeric data.					
List of Exercise/Experiments <ol style="list-style-type: none"> 1. Perform text mining on a set of documents and visualize the most important words in a visualization such as word cloud. 2. Perform Data Analysis and representation on a Map using various Map data sets with Mouse Rollover effect, user interaction, etc.. 3. Build cartographic visualization for multiple datasets involving various countries of the world; states and districts in India etc. 					
UNIT IV	TIME SERIES ANALYSIS				6+6
Overview of time series analysis-showing data as an area, drawing tabs, handling mouse input, Connections and Correlations – Preprocessing-introducing regular expression, sophisticated sorting, Scatterplot Maps-deployment issues.					
List of Exercise/Experiments					

<ol style="list-style-type: none"> 1. Perform Time Series Analysis with datasets like Open Power System Data. 2. Build a time-series model on a given dataset and evaluate its accuracy. 		
UNIT V	TREES, HIERARCHIES, AND RECURSION	6+6
<p>Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Use a case study on a data set and apply the various visualization techniques and present an analysis report. 2. Mini-Project:- Create a Dashboard for a dataset with a visualization tool. 		
TOTAL: 30+30 = 60 PERIODS		
OUTCOMES:		
Upon completion of the course, the students will be able to:		
CO1: Explain the overview of exploratory data analysis and phases involved in data analytics.		
CO2: Understand the basics of feature engineering on different types of data.		
CO3: Apply the visualization techniques in data.		
CO4: Describe the methods of time series analysis.		
CO5: Represent the data in tree and hierarchical formats.		
TEXT BOOKS:		
13. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt Publishing , First Edition, March 2020.		
14. Guozhu Dong, Huan Liu, "Feature Engineering for Machine Learning and Data Analytics", First Publication, CRC Press, First edition, 2018.		
15. Ben Fry, “Visualizing Data”, O’reilly Publications, First Edition, 2007.		
REFERENCES:		
1. Danyel Fisher & Miriah Meyer, “Making Data Visual: A Practical Guide To Using Visualization For Insight”, O’reilly publications, 2018.		
2. Claus O. Wilke, ”Fundamentals of Data Visualization”, O’reilly publications, 2019.		
3. EMC Education Services, “Data Science and Big data analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley Publishers, 2015.		
4. Tamara Munzner, “Visualization Analysis and Design”, A K Peters/CRC Press; 1st edition, 2014.		
5. Matthew O. Ward, Georges Grinstein, Daniel Keim, “Interactive Data Visualization: Foundations, Techniques, and Applications”, 2nd Edition, CRC press, 2015.		
LIST OF EQUIPMENTS:		
1. Systems with Python/R, Tableau Public / PowerBI		

**PROFESSIONAL ELECTIVE
VERTICAL I – ADVANCED ANALYTICS**

22AI901	Business Intelligence and Analytics (Lab Integrated)	L	T	P	C
		2	0	2	3
OBJECTIVES:					
<p>The Course will enable learners to:</p> <ul style="list-style-type: none"> • To understand the business intelligence (BI) methodology and concepts. • To learn about descriptive, inferential statistics and data warehousing operations. • To analyze wide range of applications of data mining. • To analyze the various prescriptive analytics methods. • To develop and deploy Business Analytic Models. 					
UNIT I	OVERVIEW OF BUSINESS INTELLIGENCE				6+6
<p>Evolution of Computerized Decision Support to Analytics- A Framework for Business Intelligence - Analytics Overview - Analytics Examples- Introduction to Big Data Analytics- Overview of the Analytics Ecosystem.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Perform Customer Segmentation, Classification using customer data of a certain organization. Analyze the data from the standpoint of paying capacity and purchasing pattern similarities among the company's clients. 2. Build a data model by taking an available data for a certain company and create a series of analysis and visualizations on various metrics related to the products of that company. 					
UNIT II	DESCRIPTIVE ANALYTICS				6+6
<p>The Nature of Data- Data Preprocessing- Statistical Modeling for Business Analytics- Regression Modeling for Inferential Statistics- Business Reporting- Data Visualization- Types of charts and graphs- Visual Analytics- Information Dashboards- Business Intelligence and Data Warehousing- Data Warehousing Process - Data Warehousing architecture - Data Integration and the Extraction, Transformation, and Load (ETL) Processes- Data Warehouse Development.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Consider Groceries dataset for Market Basket Analysis and investigate customer's historical transactions. Focus on descriptive analytics of customer's purchase behavior, revealing interesting combinations of products that are frequently bought together, and creating valuable suggestions for the company. 2. Given Life Expectancy (WHO) dataset that provides information on both life expectancy and GDP per capita by year for different countries and regions, Explore and visualize the data using appropriate plots, and develop meaningful insights. 					
UNIT III	PREDICTIVE ANALYTICS				6+6
<p>Data Mining Concepts – Data Mining Process – Data Mining Methods - Text Analytics and Text Mining – NLP – Applications – Process – Sentiment Analysis – Web Mining – Search Engines – Web Analytics – Social Analytics.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Perform Customer Review Sentiment Analysis with text data extracted from customer reviews of a certain company and explore it using specialized statistical and linguistic tools to identify positive, negative, and neutral experiences and their strength and subjectivity. 2. Using Microsoft Stock Data/Amazon Stock Data or INTEL Stock Data, Explore the company's 					

historical stock performance and find insights about the future.		
UNIT IV	PRESCRIPTIVE ANALYTICS	6+6
<p>Model-based Decision Making – Structure of Mathematical Models for Decision Support – Certainty, Uncertainty and Risk – Decision Modelling – Multiple Goals, Sensitivity Analysis, WhatIf Analysis and Goal Seeking – Decision Analysis – Introduction to Simulation – Location-based Analytics for Organizations – Impacts of Analytics in Organization. Case study: prepare a detailed report on applications of analytics in different industries.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Perform Retail Price Optimization using dataset of price data for a retail company containing information such as product names, historical prices, product categories and characteristics, volume of sales, and time and geographic notations. Calculate the optimal selling prices for the products to create efficient, data-driven recommendations for the company. 2. Perform Credit Card Fraud Detection using online transactions dataset and analyze it for suspicious operations using statistical methods. 		
UNIT V	BUSINESS ANALYTICS MODEL	6+6
<p>Overview of Business Analytics Model – Deployment of BA Model – Business Analytics at the Strategy Level – Link between Strategy and Deployment – Strategy and BA – Priority – Development and Deployment- Case Study: Specification of Requirements, Technical support - Establishing Business Processes – New Business Processes – Optimizing Existing Business Processes.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Consider Sales Product Dataset and analyze sales data from various aspects. Extract key performance indicators (KPIs) that will enable you to make data-driven decisions and improve company’s business. 2. Perform Customer Churn Prediction and analyze a company’s data to identify customers who are likely to churn based on a variety of factors, such as the number of calls to customer service and the total charge for calls. 		
TOTAL:30+30 = 60PERIODS		
<p>OUTCOMES:</p> <p>Upon completion of the course, the students will be able to:</p> <p>CO1: Understand the business intelligence (BI) methodology and concepts.</p> <p>CO2: Learn about descriptive, inferential statistics and data warehousing operations.</p> <p>CO3: Analyze wide range of applications of data mining.</p> <p>CO4: Analyze the various prescriptive analytics methods.</p> <p>CO5: Develop and deploy Business Analytic Models.</p>		
TEXT BOOKS:		
<ol style="list-style-type: none"> 1. Ramesh Sharda, Dursun Delen, Efraim Turban, “Business Intelligence, Analytics, and Data Science: A Managerial Perspective”, Pearson, 4th Edition, 2018. 2. Jesper Thorlund & Gert H.N. Laursen, “Business Analytics for Managers: Taking Business Intelligence beyond Reporting, Wiley, 2010. 		
REFERENCES:		
<ol style="list-style-type: none"> 1. Shmueli, Patel, and Bruce: Wiley, Data Mining for Business Intelligence, Concepts, Techniques and Applications, Wiley, 2010 2. R.N.Prasad and Seema Acharya, “Fundamentals of Business Analytics”, 2nd Edition, Wiley, 2016. 		
LIST OF EQUIPMENTS:		
<ol style="list-style-type: none"> 1. Jupyter Notebook / Tableau / Power BI 		

22AI902	SOCIAL NETWORK ANALYSIS (Lab Integrated)				L	T	P	C	
					2	0	2	3	
OBJECTIVES:									
<ul style="list-style-type: none"> ● To outline the components of the social network. ● To explain the modeling and visualization of the social network. ● To classify descriptive and inferential methods. ● To discuss about the evolution of the social network. ● To illustrate the applications in real time systems. 									
UNIT I	INTRODUCTION							6+6	
<p>Basics of Social Network Analysis: Introduction- The Social network and Representation -Types of Networks-Network parts and Level of Analysis-Networks as Social Structure and Institution- Theoretical Assumptions-Causality in Social Network Studies- A Brief History of Social Network Analysis-Mathematical Foundations: Graphs-Paths and components-Adjacency matrices-Ways and modes-Matrix products-Sources of network data-Types of nodes and types of ties- Data Collection: Network questions- Question formats-Interviewee burden-Data collection and reliability-Archival data collection-Data from electronic sources.</p> <p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Program for performing matrix operations by importing the dataset 2. Use a graph to Represent social relation in a social media network. 3. Program for Thinning, Transposing, multiplying and Symmetrizing the networks 									
UNIT II	MODELING AND VISUALIZATION							6+6	
<p>Data Management: Data import-Cleaning network data- Data transformation-Normalization-Cognitive social structure data-Matching attributes and networks-Converting attributes to matrices-Data export,- Multivariate Techniques Used in Network Analysis: Multidimensional scaling-Correspondence analysis-Hierarchical clustering,- Visualization: Layout-Embedding node attributes-Node filtering-Ego networks-Embedding tie characteristics-Visualizing network change-Exporting visualizations-Closing comments.</p> <p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Import the data and perform the following operations <ol style="list-style-type: none"> a. Creating list of nodes b. Merging/Joining Numeric IDs into the Edgelist c. Tidying up edgelists and list of nodes d. Adding attributes e. Creating adjacency matrix 									
UNIT III	DESCRIPTIVE AND INFERENTIAL METHODS							6+6	
<p>Descriptive Methods in Social Network Analysis: Graph and Matrix-Social Network Representation – Density – Centrality, Centralization and Prestige- Cliques – Multidimensional Scaling(MDS) and Dendrogram – Structural Equivalence -Two mode Networks and Bipartite Matrix-Inferential Methods in Social Network Analysis: Permutation and QAP (Quadratic Assignment Procedure) Correlation-P* or Exponential Random Graph Model(ERGM)</p> <p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Using statnet, igraph, sna_tools to perform statistical analysis, simulation and vizualization of network data 2. Create igraph object for 2-mode network 									
UNIT IV	EVOLUTION							6+6	
<p>Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social</p>									

Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

List of Experiments:

1. Work with Interactive visualization with visNetwork and networkD3
2. Work with geographical coordinates of places using Multidimensional Scaling

UNIT V	APPLICATIONS	6+6
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A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

List of Experiments:

1. Work with Twitter Networks
2. Perform network analysis using Centrality, Clustering & Transitivity

TOTAL: 30+30 = 60 PERIODS

OUTCOMES:

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

- CO1: Define the internal components and terminology of the social network.
- CO2: Explain fundamental exploratory multivariate techniques and visualizing network data.
- CO3: Discuss most common descriptive and inferential statistical tools available.
- CO4: Discuss about the evolution of the social network.
- CO5: Illustrate the real time applications of social network analysis.

TEXT BOOKS:

1. Song Yang , Franziska B. Keller, “Social Network Analysis Methods and Examples”, SAGE Publications Inc. 2017.
2. Stephen P Borgatti, Martin G. Everett, Jeffrey C. Johnson, “Analyzing Social Networks”, Second Edition, 2017.

REFERENCES:

1. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014 .
2. Przemyslaw Kazienko, Nitesh Chawla, “Applications of Social Media and Social Network Analysis”, Springer,2015.
3. Ajith Abraham, Aboul Ella Hassanien, Vaclav Snasel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012.
4. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011.
5. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2012.

**PROFESSIONAL ELECTIVE
VERTICAL II – COMPUTATIONAL INTELLIGENCE**

22AI911	SOFT COMPUTING (Lab Integrated)	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to:					
<ul style="list-style-type: none"> • To learn the basic concepts of Soft Computing. • To understand artificial neural networks. • To explain fuzzy systems. • To explain Genetic Algorithms. • To discuss the various Hybrid algorithms and various Swarm Intelligence algorithms. 					
UNIT I	INTRODUCTION	6+6			
Neural Networks - Application Scope of Neural Networks - Fuzzy Logic - Genetic Algorithm - Hybrid Systems - Soft Computing - Artificial Neural Network - Evolution of Neural Networks - Basic Models of ANN – Weights – Bias – Threshold – Learning Rate – Momentum Factor – Vigilance Parameter- McCulloch–Pitts Neuron - Linear Separability - Hebb Network.					
List of Exercise/Experiments					
<ol style="list-style-type: none"> 1. Write a program to implement Hebb’s rule. 2. Implement McCulloch-Pitts model using Simple Neural Network. 					
UNIT II	ARTIFICIAL NEURAL NETWORKS	6+6			
Perceptron Networks - Adaptive Linear Neuron - Multiple Adaptive Linear Neurons - Back-Propagation Network - Radial Basis Function Network - Pattern Association – Auto associative and Hetero associative Memory Networks - Bidirectional Associative Memory (BAM) - Hopfield Networks - Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps.					
List of Exercise/Experiments					
<ol style="list-style-type: none"> 1. Implement Kohonen self-Organizing feature maps 2. Write a program for solving linearly separable problem using Perceptron Model 					
UNIT III	FUZZY SYSTEMS	6+6			
Fuzzy Logic - Classical Sets (Crisp Sets) - Fuzzy Sets – Fuzzy Relation - Features of the Membership Functions - Fuzzification - Methods of Membership Value Assignments - Defuzzification - Lambda-Cuts for Fuzzy Sets (Alpha-Cuts) - Lambda-Cuts for Fuzzy Relations - Defuzzification Methods – Fuzzy Reasoning – Fuzzy Inference Systems.					
List of Exercise/Experiments					
<ol style="list-style-type: none"> 1. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations. 2. Implementation of fuzzy relations (Max-Min Composition) 					
UNIT IV	GENETIC ALGORITHMS	6+6			
Biological Background - Traditional Optimization and Search Techniques- Genetic Algorithm and Search Space- - Simple GA - General Genetic Algorithm - Operators - Stopping Condition - Constraints - Problem Solving - The Schema Theorem- Classification - Holland Classifier Systems- Genetic Programming - Advantages and Limitations- Applications.					
List of Exercise/Experiments					

<ol style="list-style-type: none"> 1. Implement travelling salesperson problem (tsp) using genetic algorithms. 2. Implement two classes city and fitness using genetic algorithm. 		
UNIT V	HYBRID SOFT COMPUTING AND SWARM INTELLIGENCE ALGORITHMS	6+6
Neuro-Fuzzy Hybrid Systems - Genetic Neuro-Hybrid Systems - Genetic Fuzzy Hybrid and Fuzzy Genetic Hybrid Systems - Simplified Fuzzy ARTMAP – Swarm Intelligence Algorithms - Ant Colony Optimization – Artificial Bee Colony – Particle Swarm Optimization – Firefly Algorithm.		
List of Exercise/Experiments <ol style="list-style-type: none"> 1. To design and implement fuzzy logic for a washing machine system. 2. Case study on hybrid system. To study the designing of Neuro-Fuzzy Systems 		
Mini Project: <ol style="list-style-type: none"> 1. Apply Swarm Intelligence Algorithms for any one of the following applications: <ol style="list-style-type: none"> a. Disease diagnosis b. Image Processing c. Business Intelligence d. Cyber Security etc. 2. Case study on Hybrid Systems. 3. To study the designing of Neuro Fuzzy systems. 4. To design and implement fuzzy logic for a washing machine system. 		
TOTAL: 30+30 = 60 PERIODS		
OUTCOMES: Upon completion of the course, the students will be able to: CO1: Understand the basic concepts of Soft Computing CO2: Artificial neural networks and its applications. CO3: Fuzzy logic and its applications. CO4: Solving problems using Genetic algorithms. CO5: Applications of Soft computing to solve problems in varieties of application domains.		
TEXT BOOKS: <ol style="list-style-type: none"> 1. S. N. Sivanandam , S. N. Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2019. 2. Adam Slovik, "Swarm Intelligence Algorithms: Modification and Applications", Taylor & Francis, First Edition, 2020. 		
REFERENCES: <ol style="list-style-type: none"> 1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002. 2. Kwang H. Lee, First course on Fuzzy Theory and Applicationsl, Springer, 2005. 3. N.P. Padhy, S. P. Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015. 4. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017. 5. NPTEL Courses: <ol style="list-style-type: none"> a. Introduction To Soft Computing - https://onlinecourses.nptel.ac.in/noc23_cs40/preview 		

22AI912	OPTIMIZATION METHODS IN MACHINE LEARNING (Lab Integrated)	L	T	P	C	
		3	0	0	3	
OBJECTIVES:						
<ul style="list-style-type: none"> To understand the basics of different Submodular functions and Associated Polyhedra. To discuss Submodularity and its Applications. To analyze the various methods of Non-Smooth Convex Optimizations. To analyze the various Separable Optimization Problems. To discuss the various Submodular minimization methods and optimizations. 						
UNIT I	INTRODUCTION					6+6
<p>Introduction – Definition – Submodularity – Associated Polyhedra – Polymatroids – Lovasz Extension – Definition – Greedy Algorithm – Links between submodularity and convexity.</p> <p>Properties of Associated Polyhedra: Support functions – Facial Structure – Positive and Symmetric submodular Polyhedra</p> <p>List of Lab Experiments:</p> <ol style="list-style-type: none"> Implement various Matrix Operations. Solve polyhedral optimization problems using simplex method. Implement Minimum Cost Path Greedy algorithm. 						
UNIT II	SUBMODULARITY					6+6
<p>Convex and Concave closures of set functions – Structured Sparsity – Convex Relaxation of Combinatorial Penalty – l_q relaxations of submodular penalties – Shaping level sets – Examples and Applications of Submodularity – Cardinality based functions – Cut functions – Set Covers – Flows – Entropies – Spectral functions of submatrices – Best Subset Selection – Matroids.</p> <p>List of Lab Experiments:</p> <ol style="list-style-type: none"> Implement Applications of Submodularity in Machine Learning. <ul style="list-style-type: none"> Algorithmic game theory. P-time solvable problems 						
UNIT III	NON-SMOOTH CONVEX OPTIMIZATION					6+6
<p>Projected Subgradient descent – Ellipsoid Method – Kelly’s Method – Analytic Centre Cutting planes – Mirror descent/conditional gradient – Bundle and Simplicial Methods – Proximal Methods – Simplex algorithm for Linear Programming – Active Set Method for Quadratic Programming – Active Set Algorithms for Least-squares Problems.</p> <p>List of Lab Experiments:</p> <ol style="list-style-type: none"> Implementation ellipsoid method for minimizing convex functions. Implementation of set algorithms for least-squares problems. 						
UNIT IV	SEPARABLE OPTIMIZATION PROBLEMS					6+6
<p>Analysis: Optimality conditions for base polyhedral – Equivalence with submodular function Minimization – Quadratic Optimization Problems – Separable problems on other polyhedra.</p> <p>Algorithms: Divide-and Conquer algorithm for proximal problems – Iterative algorithms – Exact minimization-Approximate minimization.</p> <p>List of Lab Experiments:</p> <ol style="list-style-type: none"> Solve Quadratic Optimization Problems. Implementation Divide-and Conquer algorithm for proximal problems. 						
UNIT V	SUBMODULAR MINIMIZATION AND OPTIMIZATION					6+6
<p>Minimizers of Submodular Functions – Combinatorial Algorithms – Minimizing Symmetric posimodular functions – Ellipsoid method – Simplex method for Submodular function minimization – Analytic centre cutting planes -Minimum norm point algorithm – Approximate minimization through convex optimization – Special Structure. Maximization with cardinality constraints – Submodular function minimization.</p>						

List of Lab Experiments:

1. Implementation Simplex method for solving Submodular functions.
2. Implementation of Minimum norm point algorithm for solving Submodular functions.

TOTAL: 30+30 = 60 PERIODS

OUTCOMES:

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

CO1: Understand the basics of different Submodular functions and Associated Ployhedra.

CO2: Discuss Submodularity and its Applications.

CO3: Analyze the various methods of Non-Smooth Convex Optimizations.

CO4: Analyze the various Separable Optimization Problems.

CO5: Discuss the various Submodular minimization methods and optimizations.

TEXT BOOKS:

1. Francis Bach, "Learning with Submodular Functions: A Convex Optimization Perspective", Foundations and Trends in Machine Learning, Now Publishers Inc., 2013.

REFERENCES:

1. A. Beck, "First-Order Methods in Optimization", MOS-SIAM Series on Optimization, 2017.
2. S. Bubeck, "Convex Optimization: Algorithms and Complexity, Foundations and Trends in Optimization", 2015.
3. Stephen Boyd, Lieven Vandenberghe, Convex Optimization, Cambridge University Press, Seventh Edition, 2009.
4. Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, Optimization for Machine Learning, The MIT Press, 2012.

**PROFESSIONAL ELECTIVE
VERTICAL III – AI AND CLOUD COMPUTING**

22CS907	CLOUD FOUNDATIONS	L	T	P	C
		2	0	2	3
OBJECTIVES: <ul style="list-style-type: none"> ✓ To describe the different ways a user can interact with Cloud. ✓ To discover the different compute options in Cloud and implement a variety of structured and unstructured storage models. ✓ To confer the different application managed service options in the cloud and outline how security in the cloud is administered in Cloud. ✓ To demonstrate how to build secure networks in the cloud and identify cloud automation and management tools. ✓ To determine a variety of managed big data services in the cloud. 					
UNIT I	INTRODUCTION TO CLOUD	6+6			
Cloud Computing - Cloud Versus Traditional Architecture - IaaS, PaaS, and SaaS - Cloud Architecture - The GCP Console - Understanding projects - Billing in GCP - Install and configure Cloud SDK - Use Cloud Shell - APIs - Cloud Console Mobile App.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Install and configure cloud SDK. 2. Connect to computing resources hosted on Cloud via Cloud Shell. 					
UNIT II	COMPUTE AND STORAGE	6+6			
Compute options in the cloud - Exploring IaaS with Compute Engine - Configuring elastic apps with autoscaling - Exploring PaaS - Event driven programs - Containerizing and orchestrating apps - Storage options in the cloud - Structured and unstructured storage in the cloud - Unstructured storage using Cloud Storage - SQL managed services - NoSQL managed services.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Create virtual machine instances of various machine types using the Cloud Console and the command line. Connect an NGINX web server to your virtual machine. 2. Create a small App Engine application that displays a short message. 3. Create, deploy, and test a cloud function using the Cloud Shell command line. 4. Deploy a containerized application. 5. Create a storage bucket, upload objects to it, create folders and subfolders in it, and make objects publicly accessible using the Cloud command line. 					
UNIT III	APIs AND SECURITY IN THE CLOUD	6+6			
The purpose of APIs – API Services - Managed message services - Introduction to security in the cloud - The shared security model - Encryption options - Authentication					

and authorization with Cloud IAM - Identify Best Practices for Authorization using Cloud IAM.

List of Exercise/Experiments:

1. Deploy a sample API with any of the API service.
2. Publish messages with managed message service using the Python client library.
3. Create two users. Assign a role to a second user and remove assigned roles associated with Cloud IAM. Explore how granting and revoking permissions works from Cloud Project Owner and Viewer roles.

UNIT IV	NETWORKING, AUTOMATION AND MANGAEMENT TOOLS	6+6
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Introduction to networking in the cloud - Defining a Virtual Private Cloud - Public and private IP address basics - Cloud network architecture - Routes and firewall rules in the cloud - Multiple VPC networks - Building hybrid clouds using VPNs - Different options for load balancing - Introduction to Infrastructure as Code - Terraform - Monitoring and management tools.

List of Exercise/Experiments:

1. Create several VPC networks and VM instances and test connectivity across networks.
2. Create two nginx web servers and control external HTTP access to the web servers using tagged firewall rules.
3. Configure a HTTP Load Balancer with global backends. Stress test the Load Balancer and denylist the stress test IP.
4. Create two managed instance groups in the same region. Then, configure and test an Internal Load Balancer with the instances groups as the backends.
5. Monitor a Compute Engine virtual machine (VM) instance with Cloud Monitoring by creating uptime check, alerting policy, dashboard and chart.

UNIT V	BIG DATA AND MACHINE LEARNING SERVICES	6+6
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Introduction to big data managed services in the cloud - Leverage big data operations - Build Extract, Transform, and Load pipelines - Enterprise Data Warehouse Services - Introduction to machine learning in the cloud - Building bespoke machine learning models with AI Platform - Pre-trained machine learning APIs.

List of Exercise/Experiments:

1. Create a cluster, run a simple Apache Spark job in the cluster, then modify the number of workers in the cluster.
2. Create a streaming pipeline using one of the cloud service.
3. Set up your Python development environment, get the relevant SDK for Python, and run an example pipeline using the Cloud Console.
4. Use cloud-based data preparation tool to manipulate a dataset. Import datasets, correct mismatched data, transform data, and join data.

5. Utilize a cloud-based data processing and analysis tool for data exploration and use a machine learning platform to train and deploy a custom TensorFlow Regressor model for predicting customer lifetime value.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Describe the different ways a user can interact with Cloud.

CO2: Discover the different compute options in Cloud and implement a variety of structured and unstructured storage models.

CO3: Discuss the different application managed service options in the cloud and outline how security in the cloud is administered in Cloud.

CO4: Demonstrate how to build secure networks in the cloud and identify cloud automation and management tools.

CO5: Discover a variety of managed big data services in the cloud.

REFERENCES:

1. <https://cloud.google.com/docs>
2. <https://www.cloudskillsboost.google/paths/36>
3. <https://nptel.ac.in/courses/106105223>
4. Anthony J. Sequeira, "AWS Certified Cloud Practitioner (CLF-C01) Cert Guide", First Edition, Pearson Education, 2020.
5. [AWS Documentation \(amazon.com\)](https://aws.amazon.com/documentation/)
6. [AWS Skill Builder](https://aws.amazon.com/skillbuilder/)
7. AWS Academy Cloud Foundations Course - https://www.awsacademy.com/vforcesite/LMS_Login

LIST OF EQUIPMENTS:

GCP / CloudSkillBoost Platform/AWS Console /AWS Academy Learner Lab.

22CS908	CLOUD ARCHITECTING	L	T	P	C
		2	0	2	3
OBJECTIVES:					
The Course will enable learners:					
<ul style="list-style-type: none"> To make architectural decisions based on AWS architectural principles and best practices. To describe the features and benefits of Amazon EC2 instances, and compare and contrast managed and unmanaged database services. To create a secure and scalable AWS network environment with VPC, and configure IAM for improved security and efficiency. To use AWS services to make infrastructure scalable, reliable, and highly available. To use AWS managed services to enable greater flexibility and resiliency in an infrastructure. 					
UNIT I	INTRODUCING CLOUD ARCHITECTING AND STORAGE LAYER				6+6
<p>Cloud architecting - The AWS Well-Architected Framework - AWS global infrastructure - Amazon S3 - Amazon S3 Versioning - Storing data in Amazon S3 - Moving data to and from Amazon S3 - Amazon S3 Transfer Acceleration - Choosing Regions for your architecture.</p> <p>List of Exercise/Experiments:</p> <ol style="list-style-type: none"> Creating a Static Website for the Café. Configure an S3 bucket to automatically encrypt all uploaded objects. Set up a cross-region replication configuration for an S3 bucket. 					
UNIT II	COMPUTE LAYER AND DATABASE LAYER				6+6
<p>Adding compute with Amazon EC2 - Choosing an Amazon Machine Image (AMI) to launch an Amazon EC2 instance - Selecting an Amazon EC2 instance type - Using user data to configure an EC2 instance - Adding storage to an Amazon EC2 instance - Amazon EC2 pricing options - Amazon EC2 considerations - Database layer considerations - Amazon Relational Database Service (Amazon RDS) - Amazon DynamoDB - Database security controls - Migrating data into AWS databases.</p> <p>List of Exercise/Experiments:</p> <ol style="list-style-type: none"> Creating a Dynamic Website for the Café. Creating an Amazon RDS database. Migrating a Database to Amazon RDS. Create a web application that stores data in a managed database using EC2 instances and Amazon RDS. 					
UNIT III	CREATING AND CONNECTING NETWORKS				6+6
<p>Creating an AWS networking environment - Connecting your AWS networking environment to the internet - Securing your AWS networking environment - Connecting your remote network with AWS Site-to-Site VPN - Connecting your remote network with AWS Direct Connect - Connecting virtual private clouds (VPCs) in AWS with VPC peering - Scaling your VPC network with AWS Transit Gateway - AWS Transit Gateway -</p>					

Connecting your VPC to supported AWS services. Securing User and Application Access: Account users and AWS Identity and Access Management (IAM) - Organizing users - Federating users - Multiple accounts.

List of Exercise/Experiments:

1. Creating a Virtual Private Cloud.
2. Creating a VPC Networking Environment for the Café.
3. Creating a VPC Peering Connection.
4. Configure a VPC with subnets, an internet gateway, route tables, and a security group, and connect an on-premises network to the VPC.

UNIT IV	RESILIENT CLOUD ARCHITECTURE	6+6
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Scaling your compute resources - Scaling your databases - Designing an environment that's highly available – Monitoring - Reasons to automate - Automating your infrastructure - Automating deployments - AWS Elastic Beanstalk - Overview of caching - Edge caching - Caching web sessions - Caching databases.

List of Exercise/Experiments:

1. Controlling Account Access by Using IAM.
2. Creating Scaling Policies for Amazon EC2 Auto Scaling.
3. Creating a Highly Available Web Application.
4. Creating a Scalable and Highly Available Environment for the Café.
5. Streaming Dynamic Content Using Amazon CloudFront.

UNIT V	BUILDING DECOUPLED ARCHITECTURES, MICROSERVICES AND SERVERLESS ARCHITECTURE	6+6
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Decoupling your architecture - Decoupling with Amazon Simple Queue Service (Amazon SQS) - Decoupling with Amazon Simple Notification Service (Amazon SNS) - Sending messages between cloud applications and on-premises with Amazon MQ. Introducing microservices - Building microservice applications with AWS container services - Introducing serverless architectures - Building serverless architectures with AWS Lambda - Extending serverless architectures with Amazon API Gateway - Orchestrating microservices with AWS Step Functions - Disaster planning strategies - Disaster recover patterns.

List of Exercise/Experiments:

1. Breaking a Monolithic Node.js Application into Microservices.
2. Implementing a Serverless Architecture on AWS.
3. Implementing a Serverless Architecture for the Café.
4. Creating an AWS Lambda Function and explore using AWS Lambda with Amazon S3.

TOTAL: 60 PERIODS

OUTCOMES:

Upon Completion of this course, the students will be able to:

- CO1:** Make architectural decisions based on AWS architectural principles and best practices
- CO2:** Describe the features and benefits of Amazon EC2 instances, and compare and contrast managed and unmanaged database services.
- CO3:** Create a secure and scalable AWS network environment with VPC, and configure IAM for improved security and efficiency.

CO4: Use AWS services to make infrastructure scalable, reliable, and highly available

CO5: Use AWS managed services to enable greater flexibility and resiliency in an infrastructure

REFERENCES:

1. AWS Certified Solutions Architect Official Study Guide by Joe Baron, Hisham Baz, Tim Bixler
2. Architecting the Cloud by Michael Kavis.
3. [AWS Documentation \(amazon.com\)](https://aws.amazon.com/documentation/)
4. [AWS Skill Builder](https://aws.amazon.com/skillbuilder/)
5. AWS Academy Cloud Architecting Course - https://www.awsacademy.com/vforcesite/LMS_Login

LIST OF EQUIPMENTS:

AWS Console Account/AWS Academy Learner Lab.

**PROFESSIONAL ELECTIVE
VERTICAL IV – INTELLIGENT HEALTHCARE**

22AI923	AI AND ML FOR HEALTHCARE (Lab Integrated)			L	T	P	C	
				2	0	2	3	
OBJECTIVES:								
<ul style="list-style-type: none"> • To gain a deep insight into the key concepts of AI and Big data for healthcare. • To familiarize the principles of drug discovery and molecular modeling • To learn the various techniques of machine intelligence for Cancer prediction. • To explore the recent trends in medical imaging. • To understand the Remote patient monitoring and AI assisted surgery techniques 								
UNIT I	CURRENT HEALTHCARE, BIG DATA, AND MACHINE LEARNING						6+6	
<p>Current healthcare practice- Value-based treatments and healthcare services- Increasing data volumes in healthcare – Analytics of healthcare data – The new age of healthcare- Precision medicine- Artificial intelligence and medical visualization- Intelligent personal health records- Robotics and artificial intelligence-powered devices- Ambient assisted living- Success factors for artificial intelligence in healthcare</p> <p>List of Lab Exercises:</p> <ol style="list-style-type: none"> 1. Perform Diagnostic Analytics for a medical data set 2. Perform Prescriptive Analytics for a medical data set 								
UNIT II	DRUG DISCOVERY AND MOLECULAR MODELING						6+6	
<p>Introduction - The scope of artificial intelligence in drug discovery- Types of machine learning in artificial intelligence- Molecular modeling and databases in AI for drug molecules- ML methods in molecular modeling- Drug characterization- Drug design for neuroreceptors using ANN techniques- Use of deep learning in drug design</p> <p>List of Lab Exercises:</p> <ol style="list-style-type: none"> 1. Perform drug discovery Analytics using pharmaceutical data set 2. Perform Molecular Modeling Analytics using Molecular Modeling DataBase 								
UNIT III	CANCER DIAGNOSTICS AND TREATMENT DECISIONS						6+6	
<p>Background- AI, ML, and deep learning in cancer- Determine cancer susceptibility- Enhanced cancer diagnosis and staging- Predict cancer treatment response- Predict cancer recurrence and survival- Personalized cancer pharmacotherapy</p> <p>List of Lab Exercises:</p> <ol style="list-style-type: none"> 1. Perform Cancer Detection Analytics using a medical data set. 2. Perform Cancer Treatment Decision Analytics using a medical data set. 								
UNIT IV	ARTIFICIAL INTELLIGENCE FOR MEDICAL IMAGING						6+6	
<p>Introduction – AI in radiology/medical imaging – overcoming the hurdles - X-rays and AI in medical imaging - Ultrasound and AI in medical imaging- Application of AI in medical imaging - The development of AI in medical devices - Limitations of AI in medical devices - The future frontiers of AI in medical devices</p> <p>List of Lab Exercises:</p> <ol style="list-style-type: none"> 1. Perform Xray Image Analysis using a medical data set. 2. Perform Ultrasound Analysis using a medical data set. 								
UNIT V	REMOTE PATIENT MONITORING USING AI						6+6	
<p>Introduction - Deploying patient monitoring - The role of AI in remote patient monitoring - Diabetes prediction and monitoring using AI - Cardiac monitoring using AI - Neural applications and remote patient monitoring - Artificial intelligence assisted surgery- Preoperative – Intraoperative - Postoperative</p> <p>List of Lab Exercises:</p>								

1. Develop a IOT based Remote Patient Monitoring system Project

TOTAL: 30+30=60 PERIODS

OUTCOMES:

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

CO1: Understand the key concepts of AI and Big data for healthcare.

CO2: Describe the principles of drug discovery and molecular modeling.

CO3: Implement various techniques of machine intelligence for Cancer prediction.

CO4: Identify the recent trends in medical imaging.

CO5: Understand the Remote patient monitoring system.

TEXT BOOKS:

1. Artificial Intelligence in Healthcare. Adam Bohr, Kaveh Memarzadeh, Academic Press is an imprint of Elsevier, 2020.

REFERENCES:

1. Arjun Panesar ,Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes, APress, 2019.
2. Biomedical Image Analysis, Rangaraj M. Rangayyan, 2004.
3. Ranjay Krishna, "Computer Vision: Foundations and Applications", Stanford University, December 2017.
4. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer 2011
5. S.N. Sivanandam, S.N. Deepa, Principles of Soft Computing, 3rd Edition, Wiley, 2018.

22AI924	Healthcare Analytics (Lab Integrated)			L	T	P	C
				2	0	2	3
OBJECTIVES:							
<p>The Course will enable learners to:</p> <ul style="list-style-type: none"> To understand the health data formats, health care policy and standards To learn the significance and need of machine learning for healthcare. To learn to measure healthcare quality To learn to build healthcare predictive models To learn to apply healthcare analytics for critical care applications 							
UNIT I	HEALTHCARE FOUNDATIONS						6+6
<p>Introduction to Healthcare Analytics – Foundation, History and Examples - Healthcare Industry Basics – Healthcare Financing-Healthcare Policy – Patient data – Standardised Clinical Codesets</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> Analyze electronic health record (EHR) data: Use data from an EHR system to analyze patterns in patient health outcomes. Identify factors that are associated with good or poor health outcomes Use a dataset that has patient information, including age, gender, body mass index (BMI), blood pressure, and cholesterol level. Identify different patient groups based on these features. 							
UNIT II	MACHINE LEARNING FOUNDATIONS						6+6
<p>Model framework for medical decision making - Tree Like reasoning, Probabilistic reasoning and Bayes Theorem- Criterion tables and Weighted sum approach- Pattern association and neural network - Machine Learning Pipeline – Exploring and visualizing data – Feature Selection – Training model parameter – Evaluating model performance</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> Use data from a public health agency to assess the health of a population. Identify trends in health outcomes such as disease incidence and mortality rates. Use statistical analyses and visualizations to identify factors that are associated with good or poor health outcomes. Develop algorithms with feature selection that can accurately classify skin lesions as either benign or malignant melanoma. The goal is to improve early detection and treatment of skin cancer. 							
UNIT III	HEALTHCARE QUALITY						6+6
<p>Measuring Healthcare Quality – healthcare measures – HVBP program – HRR program – HAC program – ESRD quality incentive program – SNFVBP – HHVBP – MIPS</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> Analyze patient data to identify trends in readmission rates. Using a tool like Tableau or Power BI, create visualizations that show how readmission rates vary by demographic group, medical condition, and other factors. Use machine learning algorithms to build a predictive model for disease outbreak considering environmental factors such as weather patterns and population density. 							
UNIT IV	HEALTHCARE PREDICTIVE MODELS						6+6
<p>Predictive analytics in healthcare – modeling task – obtaining dataset – importing dataset – data splitting – demographic, triage, financial variables – vital signs – codes – medication information – final preprocessing steps – building the models – using the models to predict – improving the models</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> Extract disease labels from clinical reports Develop algorithms that can accurately diagnose thoracic diseases from chest X-rays. 							
UNIT V	CASE STUDIES						6+6

Congestive heart failure – Breast cancer prediction – Readmission prediction – Healthcare and emerging technologies

List of Exercise/Experiments

1. ECG analysis using heartpy library
2. Develop algorithms that could accurately classify ECG signals into different heartbeat categories.

TOTAL:30+30 = 60 PERIODS

OUTCOMES:

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

- CO1: Understand the health data formats, health care policy and standards
CO2: Explain the significance and need of machine learning for healthcare.
CO3: Learn to measure healthcare quality
CO4: Build healthcare predictive models
CO5: Apply healthcare analytics for critical care applications

TEXTBOOKS:

1. Vikas Kumar, “Health Care Analytics Made Simple”, Packt Publishing, 2018.
2. Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.

REFERENCES:

1. Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
2. Hui Jang, Eva K.Lee, “HealthCare Analysis : From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
3. Kulkarni ,Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.

LIST OF EQUIPMENTS:

1. Jupyter Notebook
2. Tensorflow, Pytorch

**PROFESSIONAL ELECTIVE
VERTICAL V – CYBER SECURITY**

22CS701	Cryptography and Cyber Security (Lab Integrated)	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to: <ul style="list-style-type: none"> • To understand the fundamentals of network security and security architecture. • To learn and implement the different symmetric key cryptographic algorithms. • To implement the various asymmetric key cryptographic algorithms and techniques. • To know the importance of message authentication and integrity. • To learn the various security practices and system security mechanisms. 					
UNIT I	INTRODUCTION	6+6			
Security trends - Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Perform encryption, decryption using the following substitution techniques <ol style="list-style-type: none"> (i) Ceaser cipher, (ii) playfair cipher iii) Hill Cipher iv) Vigenere cipher 2. Perform encryption and decryption using following transposition techniques <ol style="list-style-type: none"> (i) Rail fence ii) row & Column Transformation 					
UNIT II	SYMMETRIC KEY CRYPTOGRAPHY	6+6			
MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures – Modular arithmetic-Euclid’s algorithm- Congruence and matrices. SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Apply DES algorithm for practical applications. 2. Apply AES algorithm for practical applications. 					
UNIT III	PUBLIC KEY CRYPTOGRAPHY	6+6			
MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler’s totient function - Chinese Remainder Theorem – Exponentiation and Algorithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Implement RSA Algorithm using HTML and JavaScript. 2. Implement the Diffie-Hellman Key Exchange algorithm for a given problem. 					
UNIT IV	AUTHENTICATION	6+6			
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS-Entity Authentication: Biometrics, Passwords, Challenge Response protocols-Authentication applications -X.509					
List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Calculate the message digest of a text using the SHA-1 algorithm. 2. Implement the SIGNATURE SCHEME - Digital Signature Standard. 					

UNIT V	SECURITY PRACTICE AND SYSTEM SECURITY	6+6
Electronic Mail security – PGP– IP security – Web Security – SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.		
List of Exercise/Experiments:		
<ol style="list-style-type: none"> 1. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other software 2. Automated Attack and Penetration Tools: Exploring N-Stalker, a Vulnerability Assessment Tool 3. Defeating Malware: i) Building Trojans ii) Rootkit Hunter 		
TOTAL: 60 PERIODS		
OUTCOMES:		
Upon completion of the course, the students will be able to:		
CO1: Understand the fundamentals of network security and security architecture.		
CO2: Implement the different symmetric key cryptographic algorithms.		
CO3: Implement the various asymmetric key cryptographic algorithms and techniques.		
CO4: Understand message authentication and integrity.		
CO5: Learn the various security practices and system security mechanisms.		
TEXT BOOKS:		
<ol style="list-style-type: none"> 1. William Stallings, Cryptography and Network Security: Principles and Practice, Pearson education 8th Edition, 2020. 		
REFERENCES:		
<ol style="list-style-type: none"> 1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt. Ltd 1st Edition,2011 2. Behrouz A.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007. 3. Wade Trappe, Lawrence C. Washington: Introduction to Cryptography with Coding Theory, 3rd Edition, 2020. 		
LIST OF EQUIPMENTS:		
<ol style="list-style-type: none"> 1. Java / Python 		

22CS901	ETHICAL HACKING	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to: <ul style="list-style-type: none"> Understand Information Security, Cyber threats, attacks, web security. Know about different modes of hacking tools and phases of penetration tests and Methodologies. Gain the knowledge of the use and availability of tools to support an ethical hack. Gain the knowledge of interpreting the results of a controlled attack. 					
UNIT I	FUNDAMENTALS OF ETHICAL HACKING	6+6			
Overview of Cyber threats – Data and Network Security Attacks – Threats: MAC spoofing – Access control Network protocol and services–Hacking terms - Ethical Hacking overview –Modes of Ethical Hacking – Ethics and Legality.					
Indicative List of Exercise/Experiments: <ol style="list-style-type: none"> Setup a honey pot and monitor the honey pot on network Write a script or code to demonstrate SQL injection attacks Write a code to demonstrate DoS attacks 					
UNIT II	HACKING METHODOLOGY RECONNAISSANCE	6+6			
Foot printing: Reconnaissance - Footprinting theory – Penetration test – Phases of Penetration test - Methods of Footprinting – Network Information gathering process – Terminologies of Foot printing –Footprinting through search engine directives – Whois tool –NetCraft – Extract Information from DNS - Foot printing from Email servers – Shodan – Dig – MetaGooFil – Social Engineering.					
Indicative List of Exercise/Experiments: <ol style="list-style-type: none"> Performing footprinting using Google Hacking, website information, information about an archived website, to extract contents of a website, to trace any received email, to fetch DNS information. Create a social networking website login page using phishing techniques 					
UNIT III	SCANNING AND ENUMERATION	6+6			
Scanning: Concept of Nmap - - Port scanning with Nmap – Subnet - Scanning IPs with Nmap Pings and Ping sweeps – Port - Three way handshake – NmapSyn scanning – Nmap TCP Scan – Nmap UDP Scan - Bypass of IPS and IDS – Nmap Script Engine Enumeration: Service Fingerprinting – Vulnerability Scanners – Basic Banner Grabbing – Common Network services – SMTP – DNS – RPCBIND Enumeration – SMB – NetBIOS					
Indicative List of Exercise/Experiments: <ol style="list-style-type: none"> Implement Passive scanning, active scanning, session hijacking, cookies extraction using Burp suit tool Use port scanning. network scanning tools,IDS tool, sniffing tool and generate reports. 					
UNIT IV	SYSTEM AND NETWORK VULNERABILITY	6+6			
Metasploit – Penetration testing with framework Metasploit – Scan services to identify vulnerabilities – Scan FTP services – Scan HTTP services – Exploitation – Post exploitation techniques – Meterpreter – Rootkit – Backdoor					

– Password hashes – Privilege Escalation - Scanning vulnerable services with Nessus

Indicative List of Exercise/Experiments:

1. Penetration Testing using Metasploit and metasploitable
2. Creating a simple keylogger in python
3. Creating a virus
4. Creating a trojan.
5. Install rootkits and study variety of options

UNIT V	SOFTWARE VULNERABILITY (OWASP 10)	6+6
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Fundamentals of OWASP Zed Attack Proxy (ZAP) – Web app vulnerability scan - Code Injection Attacks – Broken Authentication – Sensitive Data Exposure – XML External Entities – Broken Access Control – Security misconfiguration – Website pen testing - Cross Site Scripting (XSS) – Insecure Deserialization – Using Components with known vulnerabilities – Insufficient logging and monitoring.

Indicative List of Exercise/Experiments:

1. Install jcrypt tool (or any other equivalent) and demonstrate Asymmetric, Symmetric Crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security And Management
2. Hacking a website by Remote File Inclusion
3. Disguise as Google Bot to view hidden content of a website
4. To use Kaspersky for Lifetime without Patch

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Understand the basics of information security, threats and its attacks

CO2: Understand the fundamentals of ethical hacking with the hacking methodologies

CO3: Analyze the phases of the penetration test with the methods

CO4: Understand the vulnerabilities and use the frameworks to identify vulnerabilities by service scan

CO5: Understand the web security issues with the fundamentals of OWASP

TEXTBOOKS:

1. McClure, S., Scambray, J. and Kurtz, G., 2012. Hacking Exposed Network Security Secrets and Solutions. New York: McGraw-Hill.
2. Engebretson, P., 2013. The Basics Of Hacking And Penetration Testing. Amsterdam: Syngress, an imprint of Elsevier.

REFERENCES:

1. Zaid Sabih, Learn Ethical Hacking from Scratch, 2018, PACKT publishing, ISBN: 978-1-78862-205-9
2. Harsh Bothra, Hacking be a hacker with ethics, Khanna Publishing, 2016, ISBN: 978-03-86173-05-8

LIST OF SOFTWARE:

1. **Metasploit Framework (MSF)**
2. **WireShar**
3. **Nmap**
4. **John the Ripper**
5. **Burp suite or OWASP ZAP**
6. **Kali Linux**

**PROFESSIONAL ELECTIVE
VERTICAL VI – EMERGING TECHNOLOGIES**

22AI933	GPU COMPUTING (Lab Integrated)		L	T	P	C
			2	0	2	3
OBJECTIVES:						
<p>The Course will enable learners to:</p> <ul style="list-style-type: none"> • To understand the basics of GPU Architectures and CUDA Programming. • To learn synchronization using CUDA. • To discuss memories and its impact on performance. • To understand the various parallel algorithms on GPU. • To learn the basics of OPENCL. 						
UNIT I	GPU ARCHITECTURES AND CUDA PROGRAMMING					6+6
<p>Heterogeneous Parallel Computing – Architecture of a modern GPU – Parallel Programming languages and models – GPU Computing – Introduction to Data Parallelism and CUDA C: Data Parallelism – CUDA Program Structure – A vector additional Kernel – Device Global Memory and Data Transfer – Kernel functions and Threading.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Write and execute simple CUDA C programs. 2. Write and execute CUDA C program to add two arrays. 						
UNIT II	MULTI-DIMENSIONAL DATA & SYNCHRONIZATION					6+6
<p>CUDA Thread Organization - Mapping Threads to Multi-Dimensional Data – Synchronization and Transparent Scalability – Assigning resources to Blocks – Querying Device Properties – Thread Scheduling and Latency Tolerance.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Implement Matrix-Matrix Multiplication using threads. 2. Optimize Matrix transpose using CUDA. 						
UNIT III	CUDA MEMORIES & PERFORMANCE					6+6
<p>CUDA Memories – Memory Access Efficiency – CUDA Device Memory Types – Reducing global Memory Traffic – Performance Considerations - Warps and Thread Execution – Global Memory Bandwidth – Dynamic Partitioning of Execution Resources – Instruction Mix and Thread Granularity.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Implement Tiled Matrix-Matrix Multiplication. 2. Write a matrix multiplication kernel function that increases thread granularity. 						
UNIT IV	ALGORITHMS ON GPU					6+6
<p>Parallel Patterns: Convolution – Prefix Sum – Sparse Matrix – Vector Multiplication.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Implement 1D Parallel Convolution Algorithm 2. Implement Parallel scan algorithm to generate the sum of N values. 						
UNIT V	OPENCL BASICS					6+6
<p>Introduction – OpenCL Platform Model – Execution Model – Programming model – Memory Model – OpenCL Runtime.</p> <p>List of Exercise/Experiments</p> <ol style="list-style-type: none"> 1. Vector Addition Using an OpenCL C++ Wrapper. 2. Implement Image rotation using OpenCL. <p>Mini Project:</p> <ul style="list-style-type: none"> • Apply CUDA and OpenGL to accelerate the performance of various image processing operations. 						

TOTAL: 30+30 = 60 PERIODS

OUTCOMES:

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

- CO1: Understand the basics of GPU Architectures and implement simple CUDA Programs.
- CO2: Learn synchronization using CUDA.
- CO3: Explain CUDA memories and its impact on performance.
- CO4: Apply various parallel algorithms on GPU.
- CO5: Apply OpenCL to solve programs and improve performance.

TEXT BOOKS:

1. David Kirk and Wen-mei Hwu, Programming Massively Parallel Processors – A hands-on Approach, Morgan Kaufmann, Second Edition, 2013.
2. Benedict Gaster, Lee Howes, David R. Kaeli, “Heterogeneous Computing with OpenCL”, Third Edition, Morgan Kaufman, 2012.

REFERENCES:

1. David Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous Computing with OpenCL 2.0”, Third Edition, Morgan Kaufman, 2015.
2. John L. Hennessy and David A. Patterson, “Computer Architecture - A Quantitative Approach”, Sixth Edition, Morgan Kaufman, 2017.
3. NPTEL Courses:
 - a. GPU Architectures And Programming -
https://onlinecourses.nptel.ac.in/noc23_cs61/preview

LIST OF EQUIPMENTS:

1. Systems with CUDA Toolkit, OpenCL

22CS931	INDUSTRIAL IoT	L	T	P	C
		2	0	2	3
OBJECTIVES: The Course will enable learners to: <ul style="list-style-type: none"> • Introduce how IoT has become a game changer in the new economy where the customers are looking for integrated value. • Get insights over architecture and protocols of IIoT • Know the various sensors and interfacing used in IIoT. • Bring the IoT perspective in thinking and building solutions. 					
UNIT I	INTRODUCTION				6+6
Introduction to IOT, What is IIOT? IOT Vs. IIOT, History of IIOT, Components of IIOT - Sensors, Interface, Networks, People Process, Hype cycle, IOT Market, Trends, future Real life examples, Key terms – IOT Platform, Interfaces, API, clouds, Data Management Analytics, Mining Manipulation, Thinking about Prototyping – Costs versus ease of prototyping, prototyping and Production, open source versus Closed Source, Role of IIOT in Manufacturing Processes, Use of IIOT in plant maintenance practices, Sustainability through Business excellence tools Challenges, Benefits in implementing IIOT List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation. 2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1sec after every 2seconds. 					
UNIT II	ARCHITECTURE AND PROTOCOLS				6+6
Overview of IOT components; Various Architectures of IOT and IIOT, Advantages &disadvantages, Industrial Internet - Reference Architecture; IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IOT; Need for protocols, Wi-Fi, Zigbee, Bacnet, IIOT protocols –COAP, MQTT, 6LoWPAN, LWM2M, AMPQ List of Exercise/Experiments: <ol style="list-style-type: none"> 1. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection. 2. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. 3. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth. 4. Write a program on Arduino/Raspberry Pi to upload and retrieve temperature and humidity data to ThingSpeak cloud. 					
UNIT III	SENSORS AND INTERFACING				6+6
Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial,Parallel, Ethernet, BACNet , Current, M2M, Prototyping online Components – Getting Started with an API, Writing a New API, Real Time Reactions. List of Exercise/Experiments: <ol style="list-style-type: none"> 1. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested. 2. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested. 					
UNIT IV	CLOUD, SECURITY AND GOVERNANCE				6+6
IIOT cloud platforms: Overview of cots cloud platforms, predix, thingworks, azure., Data analytics, cloud services, Business models: Saas, Paas, Iaas; Introduction to web security, Conventional web					

technology and relationship with IIOT, Vulnerabilities of IoT, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity; Management aspects of cyber security.

List of Exercise/Experiments:

1. To install MySQL database on Raspberry Pi and perform basic SQL queries.
2. Write a program on Arduino/Raspberry Pi to publish and subscribe temperature data to MQTT broker.

UNIT V | IOT ANALYTICS AND APPLICATIONS

6+6

IOT Analytics : Role of Analytics in IOT, Data visualization Techniques, Statistical Methods; IOT Applications : Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Plant Automation, Real life examples of IIOT in Manufacturing Sector.

List of Exercise/Experiments:

1. Mini Project – Home Automation, Vehicle Tracking, Agriculture Applications, Healthcare applications

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1: Describe IOT, IIOT

CO2: Understand various IoT Layers and their relative importance

CO3: Interpret the requirements of IIOT sensors and understand the role of actuators.

CO4: Study various IoT platforms and Security

CO5: Design various applications using IIoT in manufacturing sector and realize the importance of Data Analytics in IoT

TEXT BOOKS:

1. Daniel Minoli, Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, 1st Edition, Wiley Publications, 2013
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles, Architecting the Internet of Things, Springer-Verlag Berlin Heidelberg 2011 Industry 4.0: The Industrial Internet of Things

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, CISCO Press, 2017.
3. Sudip Misra, Anandarup Mukherjee, Arjit Roy, “Introduction to IoT”, Cambridge University Press, 2021.
4. HakimaChaouchi, The Internet of Things Connecting Objects to the Web Willy Publications.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley Publications
6. https://onlinecourses.nptel.ac.in/noc20_cs69/preview

LIST OF EQUIPMENTS:

1. Arduino Uno With USB Cable
2. Bread Board (GL-840)
3. LED (3 Color Each-5)
4. Resistor (10 Ω ,10K Ω)
5. Hookup Wire
6. RGB LED
7. Push Button
8. IR-Sensor
9. Buzzer
10. Piezo Sensor
11. Potentiometer (10K Ω)
12. Temperature Sensor
13. Bluetooth Module
14. 7 Segment Display
15. DC Toy Motor
16. Ultrasonic Sensor
17. WiFi Module
18. System With Internet Connection