



# R.M.K. ENGINEERING COLLEGE

(An Autonomous Institution)

R.S.M Nagar, Kavaraipettai, Gummidipoondi Taluk, Thiruvallur District,  
Tamil Nadu- 601206

Affiliated to Anna University, Chennai / Approved by AICTE, New Delhi/Accredited by NAAC with A+ Grade  
An ISO 21001:2018 Certified Institution / All the Eligible UG Programs are accredited by NBA, New Delhi



## B.E. COMPUTER SCIENCE AND DESIGN REGULATIONS-2022 CHOICE BASED CREDIT SYSTEM

### PROGRAMME EDUCATIONAL OBJECTIVES(PEOs)

The Computer Science and Design Graduates of R.M.K. Engineering College will:

**PEO 1.** Apply the ideologies of Computer Science, System Design, Mathematics, Science and Basic Engineering to solve real world problems.

**PEO 2.** Act as a member of multi-disciplinary teams and implement efficient system design technology solutions in global standards.

**PEO 3.** Shine in the field of software design industry or in higher studies with the essence of Computer Science and Design.

**PEO 4.** Have ethics, leadership and social responsibility with an appropriate insight of the varying public needs.

### 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 modelling 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:**

- Apply knowledge acquired from the basic system design and core software areas of Computer Science and Design for solving real world problems.
- Apply recent technologies and robust analytical skills to produce quality software in scientific and business applications.
- Excel in emerging computer languages and design methodologies for innovative career paths as an entrepreneur and pursue higher studies.

## **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.

PROGRAM EDUCATIONAL OBJECTIVES	PROGRAM OUTCOMES											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 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	3	3	3	3	2	2	2	3	3	3	2	1
IV	2	2	2	2	2	3	2	3	3	1	1	1

### MAPPING OF PROGRAM EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMME SPECIFIC OUTCOMES

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

PROGRAM EDUCATIONAL OBJECTIVES	PROGRAM SPECIFIC OUTCOMES		
	PSO1	PSO2	PSO3
I	3	3	3
II	2	3	2
III	3	3	3
IV	1	1	1

Contribution

1: Reasonable

2: Significant

3: Strong











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## B.E. COMPUTER SCIENCE AND DESIGN

REGULATIONS-2022

CHOICE BASED CREDIT SYSTEM

I-VIII SEMESTER CURRICULUM

SEMESTER –I								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
<b>THEORY COURSES WITH LABORATORY COMPONENT</b>								
1.	22GE101	Heritage of Tamils	HSMC	1	1	0	0	1
2.	22MA101	Matrices and Calculus	BSC	5	3	0	2	4
3.	22CH101	Engineering Chemistry	BSC	5	3	0	2	4
4.	22CS101	Problem Solving using C++	ESC	5	3	0	2	4
5.	22CS102	Software Development Practices	ESC	5	3	0	2	4
6.	22EC101	Digital Principles and System Design	ESC	5	3	0	2	4
<b>LABORATORY COURSES WITH THEORY COMPONENT</b>								
7.	22ME202	Computer aided Engineering Graphics	ESC	3	1	0	2	2
<b>LABORATORY COURSES</b>								
8.	22ME111	Product Development Lab-1	EEC	2	0	0	2	1
<b>MANDATORY COURSES</b>								
9.		Induction Program (Non Credit)	MC	3 Weeks				
<b>TOTAL</b>				<b>31</b>	<b>17</b>	<b>0</b>	<b>14</b>	<b>24</b>

SEMESTER –II								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C

<b>THEORY COURSES</b>								
1.	22GE201	Tamils and Technology	HSMC	1	1	0	0	1
<b>THEORY COURSES WITH LABORATORY COMPONENT</b>								
2	22MA201	Transforms and Numerical Methods	BSC	5	3	0	2	4
3	22CS201	Data Structures	ESC	5	3	0	2	4
4	22PH201	Physics for Computer Science and Information Technology	BSC	5	3	0	2	4
5	22HS101	Professional Communication	HSMC	4	2	0	2	3
6	22CS202	Java Programming	ESC	5	3	0	2	4
7	22IT202	Database Management System	PCC	5	3	0	2	4
<b>LABORATORY COURSES</b>								
8	22ME211	Product Development Lab – 2	EEC	2	0	0	2	1
<b>MANDATORY COURSES</b>								
9	22CH104	Environmental Sciences and Sustainability (Non Credit)	MC	2	2	0	0	0
<b>AUDIT COURSES</b>								
10	22AC201	Yoga for Stress Management	AC	1	1	0	0	0
<b>TOTAL</b>				<b>35</b>	<b>21</b>	<b>0</b>	<b>14</b>	<b>25</b>

<b>SEMESTER –III</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY COURSES</b>								
1.	22MA301	Discrete Mathematics	BSC	4	3	1	0	4
2.	22GE301	Universal Human Values 2: Understanding Harmony	HSMC	4	2	0	2	3
3.	22CS302	Computer Organization and Architecture	ESC	3	3	0	0	3
<b>THEORY COURSES WITH LABORATORY COMPONENT</b>								

4.	22CS305	Advanced Java Programming	PCC	5	3	0	2	4
5.	22CS304	Operating Systems	PCC	4	2	0	2	3
6.	22CD301	Design Thinking	PCC	4	2	0	2	3
<b>LABORATORY COURSES</b>								
7.	22ME311	Product Development Lab – 3	EEC	2	0	0	2	1
<b>EMPLOYABILITY ENHANCEMENT COURSES</b>								
8.	22CS311	Aptitude and Coding Skills I	EEC	2	0	0	2	1
9.	22CS312	Internship and Seminar*	EEC	2	0	0	2	1
<b>AUDIT COURSES</b>								
10.		Value Education (Non Credit)	AC	1	1	0	0	0
<b>TOTAL</b>				<b>31</b>	<b>16</b>	<b>1</b>	<b>14</b>	<b>23</b>

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

<b>SEMESTER –IV</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY COURSES</b>								
1	22MA401	Probability and Statistics	BSC	5	3	0	2	4
2	22IT407	Web Development Frameworks	PCC	5	3	0	2	4
3	22CS306	Design and analysis of algorithms	PCC	5	3	0	2	4
4	22CD401	Human Computer Interaction	PCC	4	2	0	2	3
5	22CD402	Design Programming	PCC	5	3	0	2	4
6		Professional Elective I	PEC	5	3	0	2	4
<b>LABORATORY COURSES</b>								
7	22ME411	Product Development Lab - 4	EEC	2	0	0	2	1
<b>EMPLOYABILITY ENHANCEMENT COURSES</b>								

8	22CS411	Aptitude and Coding Skills II	EEC	2	0	0	2	1
<b>AUDIT COURSES</b>								
9	22AC401	Yoga/ Personality Development (Non Credit)	AC	1	1	0	0	0
<b>TOTAL</b>				<b>34</b>	<b>18</b>	<b>0</b>	<b>16</b>	<b>25</b>

<b>SEMESTER –V</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>THEORY COURSES</b>								
1		Open Elective I	OEC	3	3	0	0	3
<b>THEORY COURSES WITH LABORATORY COMPONENT</b>								
2		Professional Elective II	PEC	4	2	0	2	3
3		Professional Elective III	PEC	4	2	0	2	3
4	22CD501	Computer Graphics and Multimedia	PCC	4	2	0	2	3
5	22CD502	Product Centric Agile Development	PCC	4	2	0	2	3
6	22CS501	Computer Networks	PCC	5	3	0	2	4
<b>EMPLOYABILITY ENHANCEMENT COURSES</b>								
7	22CS511	Advanced Aptitude and Coding Skills I	EEC	2	0	0	2	1
8	22CS512	Internship*	EEC	2	0	0	2	1
<b>AUDIT COURSES</b>								
9		Indian Constitution (Non Credit)	MC	3	3	0	0	0
<b>TOTAL</b>				<b>31</b>	<b>17</b>	<b>0</b>	<b>14</b>	<b>21</b>

\*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
<b>THEORY COURSES</b>								
1	22CS603	Professional Ethics	HSMC	3	3	0	0	3
2		Open Elective II	OEC	3	3	0	0	3
<b>THEORY COURSES WITH LABORATORY COMPONENT</b>								
3.	22CS602	Object Oriented Software Engineering	PCC	4	2	0	2	3
4.	22CD601	Principles of UI/UX Design	PCC	4	2	0	2	3
5.		Professional Elective IV	PEC	4	2	0	2	3
6.		Professional Elective V	PEC	4	2	0	2	3
<b>EMPLOYABILITY ENHANCEMENT COURSES</b>								
7	22CS611	Advanced Aptitude and Coding Skills II	EEC	2	0	0	2	1
<b>TOTAL</b>				<b>24</b>	<b>14</b>	<b>0</b>	<b>10</b>	<b>19</b>

SEMESTER –VII								
Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
<b>THEORY COURSES</b>								
1		Open Elective III	OEC	3	3	0	0	3
2		Open Elective IV	OEC	3	3	0	0	3
3	22AI602	Automation Theory and Compiler Design	PCC	3	3	0	0	3
<b>THEORY COURSES WITH LABORATORY COMPONENT</b>								
4	22CD701	Mobile Application Development	PCC	4	2	0	2	3
5		Professional Elective VI	PEC	4	2	0	2	3
<b>EMPLOYABILITY ENHANCEMENT COURSES</b>								

6	22CS711	Professional Readiness for Innovation, Employability and Entrepreneurship	EEC	6	0	0	6	3
<b>MANDATORY COURSES</b>								
7		Essence of Indian Knowledge Tradition (Non Credit)	MC	1	1	0	0	0
<b>TOTAL</b>				<b>24</b>	<b>14</b>	<b>0</b>	<b>10</b>	<b>18</b>

<b>SEMESTER –VIII</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>EMPLOYABILITY ENHANCEMENT COURSES</b>								
1.	22CD801	Project Work	EEC	16	0	0	16	8
<b>TOTAL</b>				<b>16</b>	<b>0</b>	<b>0</b>	<b>16</b>	<b>8</b>

### SUMMARY OF CREDIT DISTRIBUTION

S. No.	Subject Area	Credits Per Semester								Credit Total	Percentage
		I	II	III	IV	V	VI	VII	VIII		
1.	<b>HSMC</b>	1	4	3			3			11	<b>6.75%</b>
2.	<b>BSC</b>	8	8	4	4					24	<b>14.7%</b>
3.	<b>ESC</b>	14	8	3						25	<b>15.34%</b>
4.	<b>PCC</b>		4	10	15	10	6	6		51	<b>31.29%</b>
5.	<b>PEC</b>				4	6	6	3		19	<b>11.66%</b>
6.	<b>OEC</b>					3	3	6		12	<b>7.36%</b>
7.	<b>EEC</b>	1	1	3	2	2	1	3	8	21	<b>12.8%</b>
8.	<b>MC</b>										
<b>Total</b>		<b>24</b>	<b>25</b>	<b>23</b>	<b>25</b>	<b>21</b>	<b>19</b>	<b>18</b>	<b>8</b>	<b>163</b>	

**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

### PROFESSIONAL ELECTIVE VERTICALS

<b>CREATIVE MEDIA DESIGN</b>	<b>VIRTUAL AND AUGMENTED REALITY</b>	<b>CYBER SECURITY</b>	<b>CLOUD COMPUTING</b>	<b>ARTIFICIAL INTELLIGENCE</b>
Digital Audio and Video Design	Augmented and Virtual Reality	Ethical Hacking	Cloud Foundations	Artificial Intelligence
3D Modelling and Design	Game Design	Social Network Security	Cloud Architecting	Data Science using Python
Multimedia Security	GPU Computing	Enterprise Cyber Security	Virtualization	Soft Computing
Interactive Visual Data Analysis for Designer	Information Design and Visualization	Cloud and Data Security	DevOps	Computer Vision
Design Process and Perspectives	Internet of Things	Digital and Mobile Forensics	Data Engineering in Cloud	Deep Learning
C# and .Net Programming	Metaverse	Vulnerability Analysis and Penetration Testing	Cloud Security Foundations	Reinforcement and Ensemble Learning
Streaming Media tools and Technologies*	3D Printing and Design*	Engineering Secure Software Systems	Cloud Services Management	Text and Speech Analytics
Film making*	Digital Marketing*	Network Design and Programming*	Storage Technologies*	Generative AI Fundamentals*
Robotics Process Automation*	Mobile VR and AI in Moduley *	Fault Tolerant Computing*	Machine Learning for NLP in Cloud*	Data Exploration, Feature Engineering and Visualization*
Capstone Project*	Capstone Project*	Block Chain Technology*	Software Defined Networks*	Machine Learning*
		Capstone Project*	Capstone Project*	Capstone Project*

\*Minimum of 2 advanced courses with Capstone Project for Honours Degree

**R2022 CURRICULUM OF  
B.TECH. (HONOURS) IN COMPUTER SCIENCE AND DESIGN  
WITH SPECIALIZATION IN  
CREATIVE MEDIA DESIGN / MEDIA PROCESSING / VIRTUAL AND  
AUGMENTED REALITY / CYBER SECURITY / CLOUD COMPUTING /  
ARTIFICIAL INTELIGENCE**

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

<b>CREATIVE MEDIA DESIGN</b>								
<b>Sl. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>Category</b>	<b>Contact Periods</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1.	22CD901	Digital Audio and Video Design	PEC	3	3	0	0	3
2.	22CD902	3D Modelling and Design	PEC	3	3	0	0	3
3.	22CD903	Multimedia Security	PEC	3	3	0	0	3
4.	22CD904	Interactive Visual Data Analysis for Designer	PEC	3	3	0	0	3
5.	22CD905	Design Process and Perspectives	PEC	3	3	0	0	3
6.	22CD934	C# and .Net Programming	PEC	4	2	0	2	3
7.	22CD906	Streaming Media tools and Technologies*	PEC	3	3	0	0	3
8.	22CD907	Film making*	PEC	4	2	0	2	3
9.	22CD908	Robotics Process Automation*	PEC	3	3	0	0	3
10.	22CD812	Capstone Project*	EEC	12	0	0	12	6

\*Minimum of 2 advanced courses with Capstone Project for Honours Degree

<b>VIRTUAL AND AUGMENTED REALITY</b>								
1.	22CD918	Augmented and Virtual Reality	PEC	4	2	0	2	3
2.	22CD919	Game Design	PEC	4	2	0	2	3
3.	22AI922	GPU Computing	PEC	3	3	0	0	3
4.	22CD924	Information Design and Visualization	PEC	3	3	0	0	3
5.	22CD921	Internet of Things	PEC	3	3	0	0	3
6.	22CD922	Metaverse	PEC	4	2	0	2	3

7.	22CD923	3D Printing and Design*	PEC	3	3	0	0	3
8.	22CD920	Digital Marketing*	PEC	3	3	0	0	3
9.	22CD925	Mobile VR and AI in Moduley*	PEC	3	3	0	0	3
10.	22CD812	Capstone Project*	EEC	12	0	0	12	6

\*Minimum of 2 advanced courses with Capstone Project for Honours Degree

<b>CYBER SECURITY</b>								
1.	22CS901	Ethical Hacking	PEC	4	2	0	2	3
2.	22CS902	Social Network Security	PEC	4	2	0	2	3
3.	22CS930	Enterprise Cyber Security	PEC	3	3	0	0	3
4.	22CS904	Cloud and Data Security	PEC	3	3	0	0	3
5.	22CS905	Digital and Mobile Forensics	PEC	3	3	0	0	3
6.	22CS906	Vulnerability Analysis and Penetration Testing	PEC	3	3	0	0	3
7.	22CS927	Engineering Secure Software Systems	PEC	3	3	0	0	3
8.	22CS928	Network Design and Programming*	PEC	3	3	0	0	3
9.	22CS929	Fault Tolerant Computing*	PEC	3	3	0	0	3
10.	22CS903	Block Chain Technology*	PEC	3	3	0	0	3
11.	22IT910	Rest Application Development Using Spring Boot and JPA	PEC	4	2	0	2	3
12.	22CS812	Capstone Project*	EEC	12	0	0	12	6

\*Minimum of 2 advanced courses with Capstone Project for Honours Degree

<b>CLOUD COMPUTING</b>								
1.	22CS907	Cloud Foundations	PEC	4	2	0	2	3
2.	22CS908	Cloud Architecting	PEC	4	2	0	2	3
3.	22CS909	Virtualization	PEC	3	3	0	0	3
4.	22CS910	DevOps	PEC	3	3	0	0	3
5.	22CS911	Data Engineering in Cloud	PEC	3	3	0	0	3
6.	22CS912	Cloud Security Foundations	PEC	3	3	0	0	3
7.	22CS934	Cloud Services Management	PEC	3	3	0	0	3
8.	22CS932	Storage Technologies*	PEC	3	3	0	0	3
9.	22CS933	Machine Learning for NLP in Cloud*	PEC	3	3	0	0	3
10.	22CS931	Software Defined	PEC	3	3	0	0	3

		Networks*						
11.	22CS812	Capstone Project*	EEC	12	0	0	12	6

\*Minimum of 2 advanced courses with Capstone Project for Honours Degree

ARTIFICIAL INTELLIGENCE								
1.	22AI301	Artificial Intelligence	PEC	5	3	0	2	4
2.	22AI302	Data Science using Python	PEC	4	2	0	2	3
3.	22AI921	Soft Computing	PEC	3	3	0	0	3
4.	22CD929	Computer Vision	PEC	3	3	0	0	3
5.	22CD928	Deep Learning	PEC	3	3	0	0	3
6.	22CS937	Reinforcement and Ensemble Learning	PEC	3	3	0	0	3
7.	22AI903	Text and Speech Analytics	PEC	3	3	0	0	3
8.	22CS920	Generative AI Fundamentals*	PEC	3	3	0	0	3
9.	22CD926	Data Exploration, Feature Engineering and Visualization*	PEC	3	3	0	0	3
10.	22CD927	Machine Learning*	PEC	3	3	0	0	3
11.	22CS812	Capstone Project*	EEC	12	0	0	12	6

\*Minimum of 2 advanced courses with Capstone Project for Honours Degree

## R2022

### B. E. (HONOURS) IN COMPUTER SCIENCE AND DESIGN

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

## R2022 (2022-23)

### MINOR DEGREE CURRICULUM OFFERED BY DEPARTMENT OF COMPUTER SCIENCE AND DESIGN (FOR OTHER B.E. / B.TECH PROGRAMMES)

### MINOR DEGREE IN VIRTUAL AND AUGMENTED REALITY

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1	22CD930	Computer Graphics and Multimedia	PCC	3	3	0	0	3
2	22CD931	Augmented and Virtual Reality	PEC	3	3	0	0	3
3	22CD932	Game Design	PEC	3	3	0	0	3
4	22CD933	Digital Marketing	PEC	3	3	0	0	3

5	22CD934	Capstone Project	EEC	12	0	0	12	6
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**MINOR DEGREE IN  
CREATIVE MEDIA DESIGN / MEDIA PROCESSING / VIRTUAL AND  
AUGMENTED REALITY / CYBER SECURITY / CLOUD COMPUTING /  
ARTIFICIAL INTELLIGENCE**

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

**R2022**

**B.E. COMPUTER SCIENCE AND DESIGN WITH MINOR DEGREE**

Sl.No	Name of the Minor Degree	Offering Department
1	Internet of Things	Electronics and Communication Engineering
2	VLSI Technology	Electronics and Communication Engineering
3	Robotics and Automation	Mechanical Engineering
4	Electric Vehicle Technology	Electrical and Electronics Engineering
5	Embedded System	Electrical and Electronics Engineering
6	Entrepreneurship and Innovation	Information Technology

**OPEN ELECTIVE OFFERED BY CSD TO OTHER DEPARTMENTS**

Sl. No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
1.	22CD001	Computer Graphics and Multimedia	OE	3	3	0	0	3
2.	22CD002	Principles of UI/UX Design	OE	3	3	0	0	3
3.	22CD003	Multimedia Security	OE	3	3	0	0	3
4.	22CD004	Digital Marketing	OE	3	3	0	0	3

**SEMESTER – I**

22GE101	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

**OBJECTIVES:**

The course is designed to

- 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 thinai in Tamil literature and culture.
- Comprehend the significance of Tamil in developing Indian culture.

<b>UNIT I</b>	<b>LANGUAGE AND LITERATURE</b>	<b>3</b>
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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.

<b>UNIT II</b>	<b>HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE</b>	<b>3</b>
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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.

<b>UNIT III</b>	<b>FOLK AND MARTIAL ARTS</b>	<b>3</b>
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Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

<b>UNIT IV</b>	<b>THINAI CONCEPT OF TAMILS</b>	<b>3</b>
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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.

<b>UNIT V</b>	<b>CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE</b>	<b>3</b>
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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**

**COURSE OUTCOMES:**

On successful completion of this course, the students will be able to

- State the role of Tamil literature in shaping Tamil Cultural roots.
- Express the cultural and religious significance of Tamil art and sculptures.
- Identify and describe the techniques of folk and martial arts.
- Classify the role of Thinai concept in Tamil culture and literature.
- Compare the idea of cultural and intellectual contributions of Tamils.

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.	பொருறை – 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.Subatamanian, Dr.K.D.Thirunavukkarasu ) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City 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

22MA101	MATRICES & CALCULUS (Common to All Branches)	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Explain the concepts of matrix algebra techniques needed for practical applications.</li> <li>• Determine the curvature of the curves.</li> <li>• Illustrate the simple applications of multivariable calculus and vector calculus.</li> <li>• Elaborate the concept and application of multiple integrals.</li> </ul>					
<b>UNIT I</b>	<b>MATRICES</b>				<b>15</b>
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					
Exercises using SCILAB:					

<ol style="list-style-type: none"> <li>1. Introduction to SCILAB through matrices and general syntax.</li> <li>2. Finding the Eigenvalues and Eigenvectors.</li> <li>3. Plotting the graph of a quadratic form.</li> </ol>		Laboratory: 6
<b>UNIT II</b>	<b>SINGLE VARIABLE CALCULUS</b>	<b>15</b>
Curvature in Cartesian and Polar Co-ordinates – Centre and radius of curvature – Circle of curvature–Evolutes.		Theory: 9
Exercises using SCILAB:		
<ol style="list-style-type: none"> <li>1. Evaluating the radius of curvature.</li> <li>2. Finding the coordinates of the center of curvature.</li> <li>3. Tracing of Curves.</li> </ol>		Laboratory: 6
<b>UNIT III</b>	<b>MULTIVARIABLE CALCULUS</b>	<b>15</b>
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
Exercises using SCILAB:		
<ol style="list-style-type: none"> <li>1. Evaluating the maxima of functions of several variables.</li> <li>2. Evaluating the minima of functions of several variables.</li> <li>3. Evaluation of Jacobians.</li> </ol>		Laboratory: 6
<b>UNIT IV</b>	<b>MULTIPLE INTEGRALS</b>	<b>15</b>
Double integrals – Change of order of integration – Area enclosed by plane curves – Triple integrals – Volume of solids.		Theory: 9
Exercises using SCILAB:		
<ol style="list-style-type: none"> <li>1. Evaluating area under a curve.</li> <li>2. Evaluating area using double integral..</li> <li>3. Evaluation of volume by integrals.</li> </ol>		Laboratory: 6
<b>UNIT V</b>	<b>VECTOR CALCULUS</b>	<b>15</b>
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 parallelepipeds.		Theory: 9
Exercises using SCILAB:		
<ol style="list-style-type: none"> <li>1. Evaluating gradient.</li> <li>2. Evaluating directional derivative.</li> <li>3. Evaluating divergent and curl.</li> </ol>		Laboratory: 6

**TOTAL: 75 PERIODS**

**OUTCOMES:**

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

**CO1:** Use the matrix algebra methods to diagonalize the matrix.

**CO2:** Determine the evolute of the curve.

**CO3:** Apply differential calculus ideas on the function of several variables.

**CO4:** Evaluate the area and volume by applying the concept of multiple integration.

**CO5:** Utilize the concept of vector calculus in evaluating integrals.

**TEXT BOOKS:**

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

**REFERENCES:**

1. M. K. Venkataraman, "Engineering Mathematics", Volume I, 4th Edition, The National Publication Company, Chennai, 2003.
2. SivaramakrishnaDass, C. Vijayakumari, "Engineering Mathematics", Pearson Education India, 4th Edition 2019.
3. H. K. Dass, and Er. Rajnish Verma, "Higher Engineering Mathematics", S. Chand Private Limited, 3rd Edition 2014.
4. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 6th Edition, New Delhi, 2008.
5. S.S. Sastry, "Engineering Mathematics", Vol. I & II, PHI Learning Private Limited, 4th Edition, New Delhi, 2014.

**SOFTWARE REQUIREMENTS:**

1. SCILAB- Open source

22CH101	ENGINEERING CHEMISTRY (Common to All Branches)	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"><li>• To understand the water quality criteria and interpret its applications in water purification.</li><li>• To gain insights into the basic concepts of electrochemistry and implement its applications in chemical sensors.</li><li>• To acquire knowledge on the fundamental principle of energy storage devices and relate it to electric vehicles.</li><li>• To identify the different types of smart materials and explore their applications in Engineering and Technology.</li><li>• To assimilate the preparation, properties and applications of nanomaterials in various fields.</li></ul>					
<b>UNIT I</b>	<b>WATER TECHNOLOGY</b>	<b>15</b>			
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.

(Theory-9)

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

(Laboratory-6)

<b>UNIT II</b>	<b>ELECTROCHEMISTRY AND SENSORS</b>	<b>15</b>
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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.

Chemical sensors – Principle of chemical sensors – Breath analyzer– Gas sensors – CO<sub>2</sub> sensors-Sensor for health care – Glucose sensor.

(Theory-9)

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.

(Laboratory-6)

<b>UNIT III</b>	<b>ENERGY STORAGE DEVICES AND ENERGY SOURCES</b>	<b>15</b>
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Batteries – Primary alkaline battery - Secondary battery - Pb-acid battery, Fuel cell - H<sub>2</sub> – O<sub>2</sub> fuel cell.

Batteries used in E- vehicle: Ni-metal hydride battery, Li-ion Battery, Li-air Battery

Nuclear Energy – Nuclear fission, fusion, differences, characteristics – nuclear chain reactions – light water nuclear reactor – breeder reactor.

(Theory-9)

Determination of single electrode potential of the given electrode.

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)

<b>UNIT IV</b>	<b>SMART MATERIALS FOR ENGINEERING APPLICATIONS</b>	<b>15</b>
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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. <p style="text-align: right;">(Theory-9)</p> Determination of the molecular weight of polymer using Ostwald viscometer. Application of polymeric fibers in 3D printing. <p style="text-align: right;">(Laboratory-6)</p>	
<b>UNIT V</b>	<b>NANO CHEMISTRY</b> <span style="float: right;"><b>15</b></span>
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. <p style="text-align: right;">(Theory-9)</p> Determination of concentration of BaSO <sub>4</sub> nanoparticles by conductometric titrations. Preparation of ZnO nanocrystal by precipitation method. <p style="text-align: right;">(Laboratory-6)</p>	
<b>TOTAL: 75 PERIODS</b>	
<b>OUTCOMES:</b> <b>At the end of this course, the students will be able to:</b> <b>CO1:</b> Interpret the water quality parameters and explain the various water treatment methods. <b>CO2:</b> Construct the electro chemical cells and sensors. <b>CO3:</b> Compare different energy storage devices and predict their relevance in electric vehicles. <b>CO4:</b> Classify different types of smart materials, their properties and applications in Engineering and Technology. <b>CO5:</b> Integrate the concepts of nano chemistry and enumerate its applications in various fields.	
<b>TEXT BOOKS:</b> 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.	
<b>REFERENCES:</b> 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. Prasanna Chandrasekhar, “Conducting polymers, fundamentals and applications – 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.

<b>22CS101</b>	<b>PROBLEM SOLVING USING C++</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	<b>(Common to All Branches)</b>	<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Learn problem solving and programming fundamentals.</li> <li>• Gain knowledge on pointers and functions.</li> <li>• Apply the principles of object orientated programming.</li> <li>• Understand operator overloading, inheritance and polymorphism.</li> <li>• Use the functionalities of I/O operations, files build C++ programs using exceptions.</li> </ul>					
<b>UNIT I</b>	<b>PROBLEM SOLVING AND PROGRAMMING FUNDAMENTALS</b>				<b>15</b>
<p>Computational thinking for Problem solving – Algorithmic thinking for Problem solving - Building Blocks - Problem Solving and Decomposition - Dealing with Error – Evaluation. 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><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Write C/C++ programs for the following:             <ol style="list-style-type: none"> <li>a. Find the sum of individual digits of a positive integer.</li> <li>b. Compute the GCD of two numbers.</li> <li>c. Find the roots of a number (Newton's method)</li> </ol> </li> <li>2. Write C/C++ programs using arrays:             <ol style="list-style-type: none"> <li>a. Find the maximum of an array of numbers.</li> <li>b. Remove duplicates from an array of numbers.</li> <li>c. Print the numbers in an array after removing even numbers.</li> </ol> </li> <li>3. Write C/C++ programs using strings:             <ol style="list-style-type: none"> <li>a. Checking for palindrome.</li> <li>b. Count the occurrences of each character in a given word.</li> </ol> </li> </ol>					
<b>UNIT II</b>	<b>POINTERS AND FUNCTIONS</b>				<b>15</b>
<p>Pointers -Variables – Operators – Expressions – Pointers and Arrays – Functions - Scope Rules – Function Arguments – return Statement – Recursion – Structures – Unions – Enumerations.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Generate salary slip of employees using structures and pointers. Create a structure Employee with the following members:</li> </ol>					

<p>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.</p>		
<b>UNIT III</b>	<b>CLASSES AND OBJECTS</b>	<b>15</b>
<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 functions - Constructors – Destructors.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Write a program Illustrating Class Declarations, Definition, and Accessing Class Members.</li> <li>2. Program to illustrate default constructor, parameterized constructor and copy constructors.</li> </ol>		
<b>UNIT IV</b>	<b>OPERATOR OVERLOADING, INHERITANCE AND POLYMORPHISM</b>	<b>15</b>
<p>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.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Write a Program to Demonstrate the i) Operator Overloading. ii) Function Overloading.</li> <li>2. Write a Program to Demonstrate Friend Function and Friend Class.</li> <li>3. Program to demonstrate inline functions.</li> <li>4. Program for Overriding of member functions.</li> <li>5. Write C++ programs that illustrate how the following forms of inheritance are supported: <ol style="list-style-type: none"> <li>a) Single inheritance b)Multiple inheritance c)Multi level inheritance d)Hierarchical inheritance.</li> </ol> </li> </ol>		
<b>UNIT V</b>	<b>I/O, FILES AND EXCEPTIONS</b>	<b>15</b>
<p>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.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Program to demonstrate pure virtual function implementation.</li> <li>2. Count the number of account holders whose balance is less than the minimum balance using sequential access file.</li> <li>3. Write a Program to Demonstrate the Catching of all Exceptions.</li> <li>4. Mini project.</li> </ol>		
<b>TOTAL: 45+30 = 75 PERIODS</b>		
<p><b>OUTCOMES:</b>  <b>At the end of this course, the students will be able to:</b>  <b>CO1:</b> Solve problems using basic constructs in C.</p>		

**CO2:** Implement applications using procedures, modularity.  
**CO3:** Apply object-oriented concepts and solve real world problems.  
**CO4:** Develop C++ programs using code reusability.  
**CO5:** Implement generic programs.  
**CO6:** Develop simple projects using object orientation

**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++", 5<sup>th</sup> 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](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01297200240671948837_shared/overview)

**SOFTWARE REQUIREMENTS:**

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

<b>22CS102</b>	<b>SOFTWARE DEVELOPMENT PRACTICES (Common to All Branches)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- Discuss the essence of agile development methods.
- Set up and create a GitHub repository.
- Create interactive websites using HTML
- Design interactive websites using CSS.
- Develop dynamic web page using Java script.

<b>UNIT I</b>	<b>AGILE SOFTWARE DEVELOPMENT AND Git and GitHub</b>	<b>15</b>
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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.

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.

Introduction to GitHub – Set up and Configuration - Contribution to Projects, Maintaining a Project – Scripting GitHub.

**List of Exercises:**

1. Form a Team, Decide on a project:
  - a) Create a repository in GitHub for the team.
  - b) Choose and follow a Git workflow
    - 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:
  - c) Create a repository in GitHub for the team.
  - d) Choose and follow a Git workflow
    - 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 updation.
    - Once pull request is reviewed and merged, the master or main development branch will have files created by all team members.
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.

<b>UNIT II</b>	<b>HTML</b>	<b>15</b>
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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.

**List of Exercises:**

1. Create web pages using the following:
  - Tables and Lists
  - Image map
  - Forms and Form elements
  - Frames

<b>UNIT III</b>	<b>CSS</b>	<b>15</b>
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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.

**List of Exercises:**

1. Apply Cascading style sheets for the web pages created.

<b>UNIT IV</b>	<b>JAVASCRIPT BASICS</b>	<b>15</b>
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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.

**List of Exercises:**

1. Form Validation (Date, Email, User name, Password and Number validation) using JavaScript.

<b>UNIT V</b>	<b>JAVASCRIPT OBJECTS</b>	<b>15</b>
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Objects – Math, String, and Date, Boolean and Number, document Object – Using JSON to Represent objects – DOM: Objects and Collections – Event Handling.

**List of Exercises:**

1. Implement Event Handling in the web pages.

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.
- CO6:** Build applications using scripting languages

**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, 1st 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](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](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0130944214274703362099_shared/overview)

**SOFTWARE REQUIREMENTS:**

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

22EC101	DIGITAL PRINCIPLES AND SYSTEM DESIGN (Common to All Branches)	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Acquire the knowledge in Digital fundamentals and its simplification methods.</li> <li>• Familiarize the design of various combinational digital circuits using logic gates.</li> <li>• Realize various sequential circuits using flip flops.</li> <li>• Interpret various clocked sequential circuits.</li> <li>• Elucidate various semiconductor memories and related technology.</li> <li>• Build various logic functions using Programmable Logic Devices.</li> </ul>					
<b>UNIT I</b>	<b>BOOLEAN ALGEBRA AND LOGIC GATES</b>	<b>9+6</b>			
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.					
<b>List of Exercises:</b>					
1. Implementation of Boolean expression using logic gates.					
<b>UNIT II</b>	<b>COMBINATIONAL LOGIC CIRCUITS</b>	<b>9+6</b>			
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					
<b>List of Exercises:</b>					
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.

<b>UNIT III</b>	<b>SEQUENTIAL CIRCUITS</b>	<b>9+6</b>
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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 Exercises:**

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

<b>UNIT IV</b>	<b>SYNCHRONOUS SEQUENTIAL CIRCUITS DESIGN</b>	<b>9+6</b>
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Design of clocked sequential circuits - Moore/Mealy models, state minimization, state assignment, circuit implementation

<b>UNIT V</b>	<b>MEMORY AND PROGRAMMABLE LOGIC DEVICES</b>	<b>9+6</b>
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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 : 45+30 =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. William Kleitz, Digital Electronics-A Practical approach to VHDL, Prentice Hall International Inc, 2012.
3. Charles H. Roth, Jr. and Larry 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/>

22ME202	COMPUTER AIDED ENGINEERING GRAPHICS (Common to All Branches)	L	T	P	C
		1	0	2	2
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand universal technical drawing standards.</li> <li>• Provide training on drafting software to draw part models.</li> <li>• Demonstrate the concepts of orthographic and isometric projections.</li> <li>• Use drawing skills for communicating concepts, ideas for engineering product design.</li> <li>• Use pictorial views to visualize and draw the isometric view of the objects.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO CONVENTIONS IN ENGINEERING DRAWING AND CONIC SECTIONS</b>				<b>9</b>
<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>					
<b>UNIT II</b>	<b>ORTHOGRAPHIC PROJECTION</b>				<b>9</b>
<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>					
<b>UNIT III</b>	<b>PROJECTION OF PLANES</b>				<b>9</b>
<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>					
<b>UNIT IV</b>	<b>PROJECTION OF SOLIDS</b>				<b>9</b>
<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>					

<b>UNIT V</b>	<b>ISOMETRIC DRAWING</b>	<b>9</b>
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)		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Explain the various engineering standards required for drafting and explore knowledge in conic sections.		
<b>CO2:</b> Draw the orthographic views of 3D primitive objects.		
<b>CO3:</b> Describe the projection of plane surfaces by the rotating plane method.		
<b>CO4:</b> Apply the projection concepts and drafting tools to draw projections of solids.		
<b>CO5:</b> Sketch the pictorial views of the objects using CAD tools.		
<b>TEXT BOOKS:</b>		
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.		
<b>REFERENCES:</b>		
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.		

<b>22ME111</b>	<b>PRODUCT DEVELOPMENT LAB – 1</b> <b>(Common to All Branches)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
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.					
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand the functionalities and limitation of various machine/equipment</li> <li>• Demonstrate various operations that can be performed to machines</li> <li>• Summarize the basic principles of machines to convert their ideas into products</li> </ul>					
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.
II 1. Study of Fundamental of Circuit Design.
2. Study of PCB Milling Machine.
3. Study of Soldering and Desoldering.
III 1. Study of Computer Peripheral Devices (Processing Information Devices)
IV 1. Present the Product Idea Presentation - Phase – I.
<b>TOTAL: 30 PERIODS</b>
<b>Note:</b> The students can select the prototype to be made of their choice after learning the above exercises.
<b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b> <b>CO1:</b> Understand the concept of manufacturing processes. <b>CO2:</b> Describe the working of the machine element. <b>CO3:</b> Discuss the various applications of engineering materials <b>CO4:</b> Summarize the basics of core engineering concepts. <b>CO5:</b> Describe the process for converting ideas into products
<b>LIST OF EQUIPMENTS:</b>
1. 3D Scanner – 1 No. 2. Laser cutting Machine – 1 No. 3. Centre lathe – 2 Nos. 4. Arc welding transformer with cables and holders – 2 Nos. 5. Plumbing tools – 2 Nos. 6. Carpentry tools – 2 Nos. 7. Multimeter – 10 Nos. 8. Drilling Machine – 1 No. 9. Solder Stations 5 Sets 10. Desoldering Machine – 1 No. 11. PCB Milling Machine – 1 No. 12. Variable Power Supply – 1 No. 13. Electronic Components like Resistors, Transistors, Diode, Inductor, Capacitor, etc. – 10 Sets 14. Personal Desktop Computers – 30 Nos.

### SEMESTER – II

<b>22GE201</b>	<b>TAMILS AND TECHNOLOGY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		1	0	0	1
<b>OBJECTIVES:</b>					
The course is designed to <ul style="list-style-type: none"> <li>• Recognize the historical significance of weaving and pottery technologies in ancient Tamil civilization.</li> </ul>					

<ul style="list-style-type: none"> <li>• Highlight the concepts of design and construction technology during the Sangam age.</li> <li>• Provide an overview of manufacturing technology and its role in Tamil society.</li> <li>• Illustrate the agricultural and irrigation techniques employed in ancient Tamil society.</li> <li>• Promote scientific Tamil and Tamil computing.</li> </ul>	
<b>UNIT I WEAVING AND CERAMIC TECHNOLOGY</b> Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.	<b>3</b>
<b>UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY</b> 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.	<b>3</b>
<b>UNIT III MANUFACTURING TECHNOLOGY</b> 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.	<b>3</b>
<b>UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY</b> Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu 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.	<b>3</b>
<b>UNIT V SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</b> 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.	<b>3</b>
<b>TOTAL: 15 PERIODS</b>	
<b>COURSE OUTCOMES:</b>	
On successful completion of this course, the students will be able to <ul style="list-style-type: none"> <li>• Identify the role of weaving and ceramic technology in ancient Tamil Culture.</li> <li>• Assess the design and construction technology ideas in the current Tamil society.</li> <li>• Identify the different types of manufacturing technology used in Tamil society and their significance.</li> </ul>	

- Classify agricultural and irrigation technologies in ancient Tamil society and its current relevance.
- 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.	பொருதை – 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.Subatamanian, Dr.K.D.Thirunavukkarasu ) (Published by: International Institute of Tamil Studies).
8.	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies.)
9.	Keeladi - 'Sangam City 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

22MA201	TRANSFORMS AND NUMERICAL METHODS (Common to CSE / IT / ADS / CSD)	L	T	P	C
		3	0	2	4

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

- 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.

<b>UNIT I</b>	<b>LAPLACE TRANSFORMS</b>	<b>15</b>
<p>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). <span style="float: right;">Theory: 9</span></p> <p>Exercices using SCILAB:</p> <ol style="list-style-type: none"> <li>1. Finding Laplace transform of a function.</li> <li>2. Finding inverse Laplace Transforms.</li> <li>3. Determine the input for given output function of Laplace Transform. <span style="float: right;">Laboratory: 6</span></li> </ol>		
<b>UNIT II</b>	<b>Z – TRANSFORMS</b>	<b>15</b>
<p>Z-transforms – Elementary properties – Inverse Z-transforms – partial fractions method – residues method – Convolution theorem. <span style="float: right;">Theory: 9</span></p> <p>Exercices using SCILAB:</p> <ol style="list-style-type: none"> <li>1. Finding Z –transform of a sequence.</li> <li>2. Finding convolution of two sequences.</li> <li>3. Plotting the input and output function of Z transform. <span style="float: right;">Laboratory: 6</span></li> </ol>		
<b>UNIT III</b>	<b>SOLUTION OF DIFFERENTIAL AND DIFFERENCE EQUATIONS</b>	<b>15</b>
<p>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. <span style="float: right;">Theory: 9</span></p> <p>Exercices using SCILAB:</p> <ol style="list-style-type: none"> <li>1. Solving second order Ordinary Differential Equation.</li> <li>2. Finding the Laplace transform and its inverse of a function numerically.</li> <li>3. Finding the Z-transform numerically <span style="float: right;">Laboratory: 6</span></li> </ol>		
<b>UNIT IV</b>	<b>SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS</b>	<b>15</b>
<p>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. <span style="float: right;">Theory: 9</span></p> <p>Exercices using SCILAB:</p>		

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

<b>UNIT V</b>	<b>NUMERICAL DIFFERENTIATION AND INTEGRATION</b>	<b>15</b>
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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

Exercices using SCILAB:

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, 7<sup>th</sup> Edition, 2009.
2. Grewal, B.S., and Grewal, J.S., “Numerical Methods in Engineering and Science”, Khanna Publishers, 10<sup>th</sup> Edition, New Delhi, 2015.

**REFERENCES:**

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

**SOFTWARE REQUIREMENTS:**

1. SCILAB - Open source

22CS201	DATA STRUCTURES (Common to CSE / IT / ADS / CSD)	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>Understand the concepts of List ADT.</li> <li>Learn linear data structures – stacks and queues ADTs.</li> <li>Understand and apply Tree data structures.</li> <li>Understand and apply Graph structures.</li> <li>Analyze sorting, searching and hashing algorithms.</li> </ul>					
<b>UNIT I</b>	<b>LINEAR DATA STRUCTURES – LIST</b>				<b>15</b>
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). <b>List of Exercises:</b> <ul style="list-style-type: none"> <li>Array implementation of List ADTs.</li> <li>Linked list implementation of List ADTs.</li> </ul>					
<b>UNIT II</b>	<b>LINEAR DATA STRUCTURES – STACKS, QUEUES</b>				<b>15</b>
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. <b>List of Exercises:</b> <ul style="list-style-type: none"> <li>Array implementation of Stack and Queue ADTs.</li> <li>Linked list implementation of Stack and Queue ADTs.</li> <li>Applications of List – Polynomial manipulations</li> <li>Applications of Stack – Infix to postfix conversion and expression evaluation.</li> </ul>					
<b>UNIT III</b>	<b>NON LINEAR DATA STRUCTURES – TREES</b>				<b>15</b>
Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT– AVL Tree. <b>List of Exercises:</b> <ul style="list-style-type: none"> <li>Implementation of Binary Trees and operations of Binary Trees.</li> <li>Implementation of Binary Search Trees.</li> <li>Implementation of Heaps using Priority Queues.</li> </ul>					
<b>UNIT IV</b>	<b>NON LINEAR DATA STRUCTURES – GRAPHS</b>				<b>15</b>
Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Applications of graphs – BiConnectivity – Euler circuits. <b>List of Exercises:</b> <ul style="list-style-type: none"> <li>Graph representation and Traversal algorithms.</li> </ul>					
<b>UNIT V</b>	<b>SEARCHING, SORTING AND HASHING TECHNIQUES</b>				<b>15</b>

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:**

- 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 linear and non-linear data structures.

**CO2:** Apply sorting and searching to solve simple problems.

**CO3:** Identify and use appropriate data structures in problem solving.

**CO4:** Implement advanced data structures to solve complex problems.

**CO5:** Analyze and evaluate the time and space complexity of various algorithms associated with different data structures.

**CO6:** Apply different data structures in practical programming scenarios and applications.

**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](https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01350157816505139210584/overview)

**SOFTWARE REQUIREMENTS:**

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:**

- Learn the fundamental concepts of Physics and apply this knowledge to scientific, engineering and technological problems.
- 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).

(Theory -9)

**List of Exercises:**

1. Determination of divergence of laser beam
2. Determination of acceptance angle and numerical aperture of an optical fibre.

(Laboratory -6)

**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 Exercises:**

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**

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 Exercises:**

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**

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 Exercises:**

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**

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 Exercises:**

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. **Jasprit 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, 3<sup>rd</sup> 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.

<b>22HS101</b>	<b>PROFESSIONAL COMMUNICATION (Common to All Branches)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- 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).

<b>UNIT I</b>	<b>FORMAL AND INFORMAL COMMUNICATION</b>	<b>12</b>
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**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.

(Theory 6)

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)

<b>UNIT II</b>	<b>GRAMMAR AND LANGUAGE DEVELOPMENT</b>	<b>12</b>
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**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

(Theory 6)

1. Communication Etiquettes
2. Self -Introduction using SWOT Analysis

(Laboratory 6)

<b>UNIT III</b>	<b>BASIC TECHNICAL WRITING AND STUDY SKILLS</b>	<b>12</b>
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**Listening:** Listening to longer texts and filling up the tables  
**Speaking:** Asking about routine actions and expressing opinions  
**Reading:** Short texts (Cloze Test)

<b>Writing:</b> Formal letters, E-mail writing, Interpretation of Charts and Graphs <b>Grammar:</b> Cause and Effect expressions, Conditional Clauses <b>Vocabulary:</b> Often misspelled and confusing words	(Theory 6)
Mechanics of Reading Skills News Reading–Cloze Tests	(Laboratory 6)

<b>UNIT IV</b>	<b>GROUP DISCUSSION AND JOB APPLICATIONS</b>	<b>12</b>
<p><b>Listening:</b> Listening to recorded dialogues of conversations and completing exercises based on them  <b>Speaking:</b> Discussion on Social issues.  <b>Reading:</b> Reading text from magazines  <b>Writing:</b> Purpose Expressions, Letter of Application, Minutes of Meeting.  <b>Grammar:</b> Modal Verbs, Subject-Verb agreement  <b>Vocabulary :</b> Sequence Words</p> <p>(Theory 6)</p> <ol style="list-style-type: none"> <li>Group Presentation, Group Discussion: Do's and Don'ts of Group Discussion</li> <li>Discussions on failure and success in interviews of famous personalities Spotting Errors</li> </ol> <p>(Laboratory 6)</p>		

<b>UNIT V</b>	<b>ART OF REPORTING</b>	<b>12</b>
<p><b>Listening:</b> Listening to TED talks  <b>Speaking:</b> Debate &amp; Presentations  <b>Reading:</b> Biographies  <b>Writing:</b> Definitions (Single line &amp; Extended), Report Writing (Industrial visit, Accident and Feasibility reports)  <b>Grammar:</b> Reported speech  <b>Vocabulary :</b> Verbal Analogies</p> <p>(Theory 6)</p> <ol style="list-style-type: none"> <li>Writing based on listening to academic lectures and discussions</li> <li>Leadership skills, Negotiation skills</li> <li>Mechanics of Report Writing</li> </ol> <p>(Laboratory 6)</p> <p><b>LIST OF PROJECTS</b></p> <ol style="list-style-type: none"> <li>Create a podcast on a topic that will be interesting to college students</li> <li>Read and Review (Movie/Book/Technical Article)</li> <li>Presentation on Social Issues</li> </ol> <p>Submit a report on “Global English: A study”</p>		

**TOTAL: 60 PERIODS**

<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Comprehend conversations and short talks delivered in English  <b>CO2:</b> Participate efficiently in informal conversations and develop an awareness of the self and apply well-defined techniques  <b>CO3:</b> Read articles of a general kind in magazines and newspapers efficiently  <b>CO4:</b> Write short general essays, personal letters and E-mails in English  <b>CO5:</b> Develop vocabulary of a general kind by enriching reading skills</p>
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<b>TEXT BOOKS:</b>
<ol style="list-style-type: none"> <li>1. <b>Kumar, Suresh E, &amp; Sreehari, P.</b> <i>Communicative English</i>. Orient Black Swan, 2007</li> <li>2. <b>Richards, Jack C.</b> <i>Interchange Students' Book-2</i> New Delhi: CUP,2015.</li> </ol>
<b>REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. <b>Bailey, Stephen.</b> <i>Academic Writing: A practical guide for students</i>. New York: Rutledge,2011.</li> <li>2. <b>Dhanavel, S P.</b> <i>English and Soft Skills, Volume Two</i>, Orient Black Swan.</li> <li>3. <b>Elbow, Peter.</b> <i>Writing Without Teachers</i>. London: Oxford University Press, 1973.</li> <li>4. <b>Larsen, Kristine.</b> <i>Stephen Hawking: A Biography</i>, Greenwood: Publishing Group, 2005.</li> <li>5. <b>Redston, Chris &amp; Gillies Cunningham.</b> <i>Face2Face (Pre- intermediate Students' Book &amp; Workbook)</i> Cambridge University Press, New Delhi: 2005.</li> <li>6. <b>Lewis, Norman.</b> <i>Word Power Made Easy</i>, Latest Edition: Penguin Random House India: 2015</li> </ol>
<b>WEB REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. Basics of Business Communication <a href="https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012688768083632128308_shared/overview">https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012688768083632128308_shared/overview</a></li> <li>2. Communicating to Succeed <a href="https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012686653619175424640_shared/overview">https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012686653619175424640_shared/overview</a></li> <li>3. Business English <a href="https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683227498151936279_shared/overview">https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012683227498151936279_shared/overview</a> <a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013267708367904768573/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013267708367904768573</a> / overview (lab support)</li> <li>4. Business Writing <a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126894776_0100966433_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0126894776_0100966433_shared/overview</a></li> <li>5. Email Etiquettes <a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013294623865_56108817682_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013294623865_56108817682_shared/overview</a></li> <li>6. Email Writing Skills <a href="https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268954363013529666_shared/overview">https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01268954363013529666_shared/overview</a></li> <li>7. Time Management <a href="https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012985921210736640721_shared/overview">https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_012985921210736640721_shared/overview</a></li> <li>8. Understanding Body Language <a href="https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_0129797376514_4576024689_shared/overview">https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_0129797376514_4576024689_shared/overview</a></li> <li>9. ONLINE RESOURCES: <a href="https://infyspringboard.onwingspan.com/web/en/page/home">https://infyspringboard.onwingspan.com/web/en/page/home</a></li> </ol>

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

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

- Explain object-oriented programming concepts and fundamentals of Java
- Apply the principles of packages, interfaces and exceptions
- Develop a Java application with I/O streams, threads and generic programming
- Build applications using strings and collections.
- 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.

<b>UNIT III</b>	<b>MULTITHREADING, I/O AND GENERIC PROGRAMMING</b>	<b>15</b>
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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.

<b>UNIT IV</b>	<b>STRING HANDLING AND COLLECTIONS</b>	<b>15</b>
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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.	
<b>UNIT V</b>	<b>JDBC CONNECTIVITY</b>
<b>15</b>	
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.	
<b>List of Exercises:</b>	
<ul style="list-style-type: none"> <li>• Mini Project (using JDBC)</li> </ul>	
<b>TOTAL: 75 PERIODS</b>	
<b>OUTCOMES:</b>	
<b>Upon completion of the course, the students will be able to:</b>	
<b>CO1:</b> Apply object oriented programming concepts to develop reusable and modular code.	
<b>CO2:</b> Explain the basic syntax and structure of Java programs.	
<b>CO3:</b> Build Java programs using basic constructs.in Java.	
<b>CO4:</b> Apply strings, collections and generic programming in developing applications.	
<b>CO5:</b> Develop client server applications using database connectivity.	
<b>CO6:</b> Design projects using object orientation to real life problems.	
<b>TEXT BOOKS:</b>	
1. Herbert Schildt, “Java: The Complete Reference”, 11th Edition, McGraw Hill Education, 2019.	
<b>REFERENCES:</b>	
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. <a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview</a>	
<b>SOFTWARE REQUIREMENTS:</b>	
1. Java and Eclipse / NetBeans IDE or Equivalent	

<b>22IT202</b>	<b>DATABASE MANAGEMENT SYSTEM (Common to CSE / IT / ADS / CSD)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

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

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

<b>UNIT I</b>	<b>DATABASE CONCEPTS</b>	<b>15</b>
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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

<b>UNIT II</b>	<b>STRUCTURED QUERY LANGUAGE</b>	<b>15</b>
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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)

<b>UNIT III</b>	<b>RELATIONAL ALGEBRA, CALCULUS AND NORMALIZATION</b>	<b>15</b>
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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

<b>UNIT IV</b>	<b>TRANSACTIONS, CONCURRENCY CONTROL AND DATA STORAGE</b>	<b>15</b>
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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.		
<b>List of Exercises:</b>		
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		
<ul style="list-style-type: none"> <li>• Build Entity Model diagram. The diagram should align with the business and functional goals stated in the application.</li> </ul>		
<ul style="list-style-type: none"> <li>• Apply Normalization rules in designing the tables in scope.</li> </ul>		
<ul style="list-style-type: none"> <li>• Prepared applicable views, triggers (for auditing purposes), functions for enabling enterprise grade features.</li> </ul>		
<ul style="list-style-type: none"> <li>• Build PL SQL / Stored Procedures for Complex Functionalities, ex EOD Batch Processing for calculating the EMI for Gold Loan for each eligible Customer.</li> </ul>		
Ability to showcase ACID Properties with sample queries with appropriate settings		
<b>TOTAL: 75 PERIODS</b>		
<b>OUTCOMES:</b>		
<p style="text-align: center;"><b>Upon completion of the course, the students will be able to:</b></p>		
<b>CO1:</b> Map ER model to Relational model to perform database design effectively.		
<b>CO2:</b> Implement SQL and effective relational database design concepts.		
<b>CO3:</b> Apply relational algebra, calculus and normalization techniques in database design.		
<b>CO4:</b> Understand the concepts of transaction processing, concurrency control, recovery procedure and data storage techniques.		
<b>CO5:</b> Apply query optimization techniques and understand advanced databases.		
<b>CO6:</b> Design and deploy an efficient and scalable data storage node for varied kind of application requirements.		
<b>TEXT BOOKS:</b>		
3. Elmasri R. and S. Navathe, “Fundamentals of Database Systems”, Pearson Education, 7th Edition, 2016.		
4. Abraham Silberschatz, Henry F.Korth, “Database System Concepts”, Tata McGraw Hill , 7th Edition, 2021.		
<b>REFERENCES:</b>		
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 <a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01275806667282022456_shared/overview</a>
8. Database Management System Part – 2 <a href="https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0127673005629194241_shared/overview">https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0127673005629194241_shared/overview</a>
9. Online Resources: <a href="https://infyspringboard.onwingspan.com/web/en/page/home">https://infyspringboard.onwingspan.com/web/en/page/home</a>
<b>SOFTWARE REQUIREMENTS:</b>
1. MySql and Eclipse / NetBeans IDE or Equivalent

22ME211	PRODUCT DEVELOPMENT LAB - 2 (Common to All Branches)	L	T	P	C
		0	0	2	1
<p>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.</p> <p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Use the innovative design methodology to articulate the product concepts.</li> <li>• Summarize the requisite Engineering Principles for transforming concepts into products.</li> <li>• Conduct basic tests to extract the qualitative and quantitative performance factors.</li> </ul>					
<p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Study of Basic Engineering Design Concepts.</li> <li>2. Conduct a literature survey on the implementation of the design concepts.</li> <li>3. Prepare the design concepts for an identified literature gap.</li> <li>4. Present the Product Idea Presentation – Phase II.</li> </ol>					
<b>TOTAL: 30 PERIODS</b>					
<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Understand the working and capacity of various engineering systems.  <b>CO2:</b> Infer the outcomes in the product development process.  <b>CO3:</b> Perform basic engineering and material characterization tests.  <b>CO4:</b> Demonstrate the ability to provide conceptual design strategies for a product.  <b>CO5:</b> Implement the Science, Engineering, Technology and Mathematics (STEM) for product design.</p>					

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

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

- Gain knowledge of the environment and various natural resources.
- Identify the Scientific and Technological solutions to pollution issues and waste management.
- Understand the significance of the conservation of biodiversity.
- Recognize the needs and benefits of sustainability and its management.
- Comprehend the effects of human population on the environment.

<b>UNIT I</b>	<b>NATURAL RESOURCES</b>	<b>7</b>
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. <b>Field activity -Tree plantation</b>		
<b>UNIT II</b>	<b>POLLUTION AND WASTE MANAGEMENT</b>	<b>7</b>
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. <b>Waste management-</b> Municipal solid wastes, e- waste, plastic waste. <b>Field study – Solid waste management of the institution</b>		
<b>UNIT III</b>	<b>BIODIVERSITY AND ITS CONSERVATION</b>	<b>6</b>
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. <b>Field study – Biodiversity of the institution</b>		
<b>UNIT IV</b>	<b>SUSTAINABILITY AND MANAGEMENT</b>	<b>5</b>
Sustainability-concept, needs and challenges-Circular economy -Sustainable Development Goals- Concept ofCarbon footprint, Environmental Impact Assessment, Clean Development Mechanism, solutions. <b>Field study – Carbon footprint of the institution</b>		
<b>UNIT V</b>	<b>HUMAN POPULATION</b>	<b>5</b>
Introduction - Population growth, variation among nations,population explosion, Environment and human health – endemic/epidemic/pandemic– Role of information technology in environment and human health. <b>Case Study – Pandemics of 21<sup>st</sup> century</b>		
		<b>TOTAL: 30 PERIODS</b>

**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, 2<sup>nd</sup> 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<sup>rd</sup> 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<sup>th</sup> 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

**III SEMESTER**

<b>22MA301</b>	<b>DISCRETE MATHEMATICS</b> (Common to CSE, IT, CSD, AD) <b>(Theory Course)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		3	1	0	4

**OBJECTIVES:**

The course is designed to:

- 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.

<b>UNIT I</b>	<b>LOGIC AND PROOFS</b>	<b>12</b>
Propositional logic - Propositional equivalences - Predicates and quantifiers - Nested quantifiers - Rules of inference - Introduction to proofs - Proof methods and strategy.		
<b>UNIT II</b>	<b>COMBINATORICS</b>	<b>12</b>
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.		
<b>UNIT III</b>	<b>GRAPHS</b>	<b>12</b>
Graphs and graph models - Graph terminology and special types of graphs - Matrix representation of graphs and graph isomorphism - Connectivity - Euler and Hamilton paths.		
<b>UNIT IV</b>	<b>ALGEBRAIC STRUCTURES</b>	<b>12</b>
Algebraic systems - Semi groups and monoids - Groups - Subgroups - Homomorphism's - Normal subgroup and cosets - Lagrange's theorem - Definitions and examples of Rings and Fields.		
<b>UNIT V</b>	<b>LATTICES AND BOOLEAN ALGEBRA</b>	<b>12</b>
Partial ordering - Posets - Lattices as posets - Properties of lattices - Lattices as algebraic systems - Sub lattices - Direct product and homomorphism - Some special lattices - Boolean algebra.		
<b>TOTAL: 60 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>Upon completion of the course, the students will be able to:</b>		
CO1: Examine the validity of the arguments		
CO2: Apply various proof techniques and principles using analytic and combinatorial methods.		
CO3: Develop the recurrence relation for the given problems.		
CO4: Implement graph theory technique to solve real time problems.		
CO5: Understand groups, Rings and Fields.		
CO6: Solve problems in lattices and Boolean algebra.		
<b>TEXTBOOKS:</b>		
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.
<b>REFERENCES:</b>
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.

22GE301	UNIVERSAL HUMAN VALUES 2: UNDERSTANDING HARMONY	L	T	P	C
		2	0	2	3
<b>OBJECTIVES:</b> The course is designed to: <ul style="list-style-type: none"> <li>• Development of a holistic perspective based on self-exploration about themselves (human beings), family, society and nature/existence.</li> <li>• Understanding (or developing clarity) of the harmony in the human being, family, society, and nature/existence</li> <li>• Strengthening of self-reflection.</li> <li>• Development of commitment and courage to act.</li> </ul>					
<b>UNIT I</b>	<b>NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION</b>	<b>12</b>			
Purpose and motivation for the course - recapitulation from Universal Human Values-I -Self-Exploration–what is it? – It’s content and process; ‘Natural Acceptance’ and Experiential Validation- as the process for self-exploration - Continuous Happiness and Prosperity- A Look at Basic Human Aspirations - Right understanding, Relationship and Physical Facility- the basic requirements for the fulfilment of aspirations of every human being with their correct priority - Understanding Happiness and Prosperity Correctly- A critical appraisal of the current scenario - Method to fulfil the above human aspirations: understanding and living in harmony at various levels.  Practice sessions: To discuss natural acceptance in human beings as the innate acceptance of living with responsibility (living in relationship, harmony, and co-existence) rather than as arbitrariness in choice based on liking-disliking.					
<b>UNIT II</b>	<b>UNDERSTANDING HARMONY IN THE HUMAN BEING – HARMONY IN MYSELF!</b>	<b>12</b>			
Understanding human beings as a co-existence of the sentient ‘I’ and the material ‘Body’ - Understanding the needs of Self (‘I’) and ‘Body’ - happiness and physical facility -Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of ‘I’ and harmony in ‘I’ - ‘Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, the meaning of Prosperity in detail - Programs to ensure Sanyam and Health.					

<p>Practice sessions: To discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss programs for ensuring health vs dealing with the disease.</p>		
<b>UNIT III</b>	<b>UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP</b>	<b>12</b>
<p>Understanding values in a human-human relationship - the meaning of Justice (nine universal values in relationships) and the program for its fulfillment to ensure mutual happiness -Trust and Respect as the foundational values of relationship - Understanding the meaning of Trust; Difference between intention and competence - Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in a relationship - Understanding the harmony in the society (society being an extension of the 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.</p> <p>Practice sessions: To reflect on relationships in family, hostel and institute as extended family, real-life examples, teacher-student relationship, the goal of education etc. Gratitude as a universal value in relationships. Discuss scenarios. Elicit examples from students' lives.</p>		
<b>UNIT IV</b>	<b>UNDERSTANDING HARMONY IN NATURE AND EXISTENCE - WHOLE EXISTENCE AS COEXISTENCE</b>	<b>12</b>
<p>Understanding the harmony in Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as the Co-existence of mutually interacting units in all-pervasive Space - Holistic perception of harmony at all levels of existence.</p> <p>Practice sessions: To discuss human beings as the cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.</p>		
<b>UNIT V</b>	<b>IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY IN PROFESSIONAL ETHICS</b>	<b>12</b>
<p>Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in professional ethics: a. Ability to utilize professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for the above production systems - Case studies of typical holistic technologies, management models and production systems - Strategy for the transition from the present state to Universal Human Order: a. At the level of the individual: as socially and ecologically responsible engineers, technologists, and managers b. At the level of society: as mutually enriching institutions and organizations - Sum up.</p> <p>Practice Exercises and Case Studies e.g. To discuss the conduct as an engineer or scientist etc.</p>		
<b>TOTAL: 60 PERIODS</b>		

**OUTCOMES:**

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

**CO1:** be aware of themselves, and their surroundings (family, society, nature).

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

**CO3:** have better critical ability.

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

**CO5:** 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.

**TEXT BOOKS:**

3. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, ExcelBooks, NewDelhi, 2010

**REFERENCES:**

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful-E. F Schumacher.
6. Slow is Beautiful-Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India – by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi

22CS302	<b>COMPUTER ORGANIZATION AND ARCHITECTURE (Common to CSE, ADS and CSD)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- 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

<b>UNIT I</b>	<b>COMPUTER FUNDAMENTALS</b>	<b>9</b>
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.		
<b>UNIT II</b>	<b>COMPUTER ARITHMETIC</b>	<b>9</b>
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.		
<b>UNIT III</b>	<b>BASIC PROCESSING UNIT AND PIPELINING</b>	<b>9</b>
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.		
<b>UNIT IV</b>	<b>I/O AND MEMORY</b>	<b>9</b>
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.		
<b>UNIT V</b>	<b>PARALLEL PROCESSING AND MULTICORE COMPUTERS</b>	<b>9</b>
Parallel Processing: Use of Multiple Processors - Symmetric Multiprocessors - Multithreading and Chip Multiprocessors - Clusters - Nonuniform Memory Access Computers Vector Computation - Multicore Organization.		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<b>CO1:</b> Explain the basic principles and operations of digital computers.		
<b>CO2:</b> Analyse the performance of computers by identifying factors that contribute to performance.		
<b>CO3:</b> Compare various I/O methods and understand memory management principles.		
<b>CO4:</b> Explain data flow in arithmetic algorithms.		
<b>CO5:</b> Demonstrating the concept of parallelism in hardware and software.		
<b>CO6:</b> Develop software to solve computationally intensive problems.		
<b>TEXT BOOKS:</b>		
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.		
<b>REFERENCES:</b>		
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.		

22CS305	ADVANCED JAVA PROGRAMMING	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>Gain a comprehensive understanding of the Java Collections Framework and its various interfaces and implementations.</li> <li>Learn the details of Java I/O streams and utility classes for managing dates, numbers, and currencies.</li> <li>Develop a thorough understanding of the Stream API introduced in Java 8 and its various operations.</li> <li>Explore advanced object serialization and string tokenizing techniques, including pattern matching with regular expressions.</li> <li>Understand advanced Stream API features and gain proficiency in using regular expressions for text processing.</li> </ul>					
<b>UNIT I</b>	<b>COLLECTIONS FRAMEWORK AND UTILITY CLASSES</b>				<b>9+6</b>
Introduction to Collections Framework - Collection Interface- Methods in Collection Interface - Iterable and Iterator Interfaces - List Interface- ArrayList - LinkedList - Set Interface - HashSet- LinkedHashSet - TreeSet - Map Interface - HashMap - LinkedHashMap- TreeMap - Queue Interface -PriorityQueue - Deque Interface - Utility Classes. <b>List of Experiments</b> <ol style="list-style-type: none"> <li>Write a program that measures the time taken for insertion, deletion, and search operations on ArrayList, LinkedList, HashSet, and TreeSet for varying sizes of input data.</li> <li>Implement a custom data structure that combines features of a list and a set.</li> <li>Write a Java program to create a HashMap where the keys are strings, and the values are integers Add five key-value pairs to the map. Print all the keys and values in the map. Remove an entry by key. Update the value associated with a specific key. Check if the map contains a specific key and a specific value.</li> </ol>					
<b>UNIT II</b>	<b>I/O OPERATIONS, SERIALIZATION, AND DATE HANDLING</b>				<b>9+6</b>
Date – Calendar – Comparable interface – Observer Interface – Streams - Types of Streams - The Byte-stream I/O hierarchy - Character Stream Hierarchy – Random Access File class – the java.io. Console Class – Serialization – Dates - Numbers, and Currency - Working with Dates - Numbers and Currencies. <b>List of Experiments</b> <ol style="list-style-type: none"> <li>Create a class representing a complex object with nested data structures. Serialize the object to a file, then deserialize it back and verify that the object remains intact.</li> <li>Write a program that formats dates and currencies according to different locales.</li> <li>Implement a java program that allows users to open a text file, navigate through it using random access, insert, delete, and modify text at specific positions within the file.</li> </ol>					
<b>UNIT III</b>	<b>STREAM API AND FUNCTIONAL PROGRAMMING PARADIGMS</b>				<b>9+6</b>
Overview of Stream API - Importance of Stream API in Java 8 and Beyond –					

Functional  
 Programming Concepts - Creating Streams - Stream Interface Methods - Stream Operations - Intermediate Filtering (filter)-Mapping (map, flatMap)-Sorting (sorted)-Distinct (distinct) - Limit and Skip (limit, skip) - Terminal Operations -Collecting Results (collect) - Reducing and Summarizing (reduce, summaryStatistics)-Iterating (forEach) - Matching and Finding (anyMatch, allMatch, noneMatch, findFirst, findAny) -Counting (count).

**List of Experiments**

1. Write a program that performs stream operations like filtering, mapping, and reducing.
2. Create an infinite stream generator that generates prime numbers. Implement methods to check for primality and generate the next prime number.
3. Write a program that reads a text file containing sentences. Tokenize each sentence into words, filter out stopwords, and print the remaining words.

<b>UNIT IV</b>	<b>ADVANCED STRING PROCESSING, OBJECT SERIALIZATION, AND I/O TECHNIQUES</b>	<b>9+6</b>
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String Tokenizer – Parsing - Tokenizing and Formatting - Locating Data via Pattern Matching, Tokenizing - Object Serialization - Serializable Interface - Writing and Reading Serializable Objects -Transient Keyword- serialVersionUID - Advanced I/O - Piped Streams (PipedInputStream and PipedOutputStream) – SequenceInputStream -PushbackInputStream and PushbackReader.

**List of Experiments**

1. Write a program that reads a text file and tokenizes it into sentences using the StringTokenizer class.
2. Create a class hierarchy representing different types of objects (e.g., Person, Employee). Serialize instances of these classes to a file using object serialization.
3. Implement a program that uses advanced I/O techniques like PipedInputStream, PipedOutputStream, SequenceInputStream, and PushbackInputStream.

<b>UNIT V</b>	<b>ADVANCED STREAM FEATURES AND REGULAR EXPRESSIONS</b>	<b>9+6</b>
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Importance and Use Cases of Advanced Stream Features - Creating Custom Streams -Stream Generators (Stream.generate, Stream.iterate) - Infinite Streams - Using Spliterators – Advanced Stream Operations - FlatMapping - Chaining Stream Operations - Stream Peeking (peek) - Advanced Filtering Techniques - Introduction to Regular Expressions - Character Classes - Quantifiers - Pattern Matching - Groups and Capturing - Regex in Java - java.util.regex Package Pattern Class - Matcher Class - String Manipulation with Regex - Splitting Strings - Replacing Text (replaceAll, replaceFirst) - Replacing with Backreferences.

**List of Experiments**

1. Implement custom stream generators using Stream.generate and Stream.iterate methods.
2. Write a program that demonstrates advanced stream operations like flatMapping, chaining stream operations, and peeking.
3. Develop a program that utilizes regular expressions to perform string manipulation

tasks such as splitting strings, replacing text, and extracting specific patterns.
<b>TOTAL: 45+30 = 75 PERIODS</b>
<p><b>OUTCOMES:</b></p> <p><b>Upon completion of the course, the students will be able to:</b></p> <p><b>CO1:</b> Implement various data structures by utilizing core Java features and libraries</p> <p><b>CO2:</b> Demonstrate proficiency in handling Java I/O operations, including file manipulation for efficient data storage and retrieval.</p> <p><b>CO3:</b> Apply and Analyze the Stream API for functional programming and data processing.</p> <p><b>CO4:</b> Implement advanced object serialization for complex data structures.</p> <p><b>CO5:</b> Utilize regular expressions for text parsing and string manipulation.</p> <p><b>CO6:</b> Build applications using advanced Java programming techniques.</p>
<p><b>TEXT BOOK:</b></p> <ol style="list-style-type: none"> <li>1. Cay S. Horstmann, "Core Java Volume I--Fundamentals," 12th Edition, 2019.</li> <li>2. Joshua Bloch, "Effective Java," 3rd Edition, 2018.</li> <li>3. Raoul-Gabriel Urma, "Java 8 in Action: Lambdas, Streams, and Functional-Style Programming," 1st Edition, 2014.</li> <li>4. Herbert Schildt, "Java: The Complete Reference," 11th Edition, 2018.</li> <li>5. Alan Mycroft and Martin Odersky, "Programming in Scala," 4th Edition, 2020.</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Bruce Eckel, "Thinking in Java," 4th Edition, 2006.</li> <li>2. Herbert Schildt, "Java: A Beginner's Guide," 8th Edition, 2019.</li> <li>3. Richard Warburton, "Java 8 Lambdas: Pragmatic Functional Programming," 1st Edition, 2014.</li> </ol>
<p><b>SOFTWARE REQUIREMENTS:</b></p> <p>JDK/Eclipse</p>

<b>22CS304</b>	<b>OPERATING SYSTEMS</b> <b>(Common to CSE, IT, ADS and CSD)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<p><b>OBJECTIVES:</b></p> <p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Explain the basic concepts of operating systems and process.</li> <li>• Discuss threads and analyse various CPU scheduling algorithms.</li> <li>• Describe the concept of process synchronization and deadlocks.</li> <li>• Analyse various memory management schemes.</li> <li>• Describe I/O management and file systems.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO OPERATING SYSTEMS AND PROCESSES</b>				<b>6+6</b>
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:**

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
  - 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

<b>UNIT II</b>	<b>THREADS AND CPU SCHEDULING</b>	<b>6+6</b>
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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:**

1. Write a program to implement the following actions using pthreads
  - 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.

<b>UNIT III</b>	<b>PROCESS SYNCHRONISATION AND DEADLOCKS</b>	<b>6+6</b>
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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

<b>UNIT IV</b>	<b>MEMORY MANAGEMENT</b>	<b>6+6</b>
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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**

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
  - 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:** Describe computer system organization, operating system structures, and services.

**CO2:** Demonstrate basic Unix commands and develop programs using shell scripting.

**CO3:** Analyze process concepts and scheduling, and implement interprocess communication using message queues.

**CO4:** Implement CPU scheduling algorithms and use threading models to manage concurrency.

**CO5:** Address process synchronization issues and implement deadlock avoidance techniques.

**CO6:** Understand and Apply Memory and Storage 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.

**SOFTWARE REQUIREMENTS:**

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

22CD301	DESIGN THINKING	L	T	P	C	
		2	0	2	3	
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>• Familiarize design thinking and its phases.</li> <li>• Perform immersion activity in empathize phase of design thinking.</li> <li>• Create problem statements in the define phase of design thinking.</li> <li>• Ideate and find solutions to the problem defined.</li> <li>• Develop a prototype and perform testing.</li> </ul>						
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>6+6</b>
Introduction to design thinking - Importance of design thinking for business – Phases of design thinking – Experiential activity – Case Study <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. LRI Assessment an Individual activity</li> <li>2. Reflection -The Marshmallow Challenge</li> <li>3. The Wallet Challenge -Team Activity</li> </ol>						
<b>UNIT II</b>	<b>EMPATHIZE PHASE</b>					<b>6+6</b>
Empathize phase - Steps involved - Immersion activity- Questionnaire – Empathy map for casestudy <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Creating Empathy maps</li> <li>2. Creating Customer Journey maps</li> </ol>						
<b>UNIT III</b>	<b>DEFINE PHASE</b>					<b>6+6</b>
Creation of personas in define phase – steps in problem statement creation - problem statement definition – Examples – Key problem statements. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Persona Creation &amp; User Research</li> <li>2. Develop &amp; present a 3-Minute Pitch</li> </ol>						
<b>UNIT IV</b>	<b>IDEATION PHASE</b>					<b>6+6</b>
Ideation phase steps – Ideation games – Ideate to find solutions – Doodling – Storytelling in presenting ideas and prototypes. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Thirty circle - Story Telling</li> <li>2. Framing the Design Challenge with mind mapping</li> <li>3. Six Thinking Hats</li> </ol>						
<b>UNIT V</b>	<b>PROTOTYPE AND TESTING</b>					<b>6+6</b>
Importance of prototype in design thinking –Guidelines - Prototyping the idea – Value proposition statement – Testing in design thinking – Prototype testing – Documentation – Design thinking in functional work – Mapping design thinking to agile methodologies. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Make a paper prototype for user testing (mock-up model)</li> <li>2. Develop &amp; Present a 3-Minute Pitch (Sample Pitches)</li> </ol>						
<b>TOTAL: 30+30=60 PERIODS</b>						
<b>OUTCOMES:</b> <b>At the end of this course, the students will be</b>						

**able to:**

**CO1:** Understand the phases of design thinking process.

**CO2:** Conduct an immersion activity to create an empathy map

**CO3:** Define the key problems of the personas created.

**CO4:** Apply the ideation phase steps to present the prototype ideas

**CO5:** Create a prototype with value propositions and test the prototype

**TEXT BOOKS:**

1. Christian Müller-Roterberg, "Handbook of Design Thinking", Kindle Direct Publishing, November 2018.
2. Dan Senor and Saul Singer, "Start-Up Nation", Grand Central Publishing, Twelfth Edition, 2009.

**REFERENCES:**

1. Nir Eyal and Ryan Hoover, "Hooked: How to Build Habit-Forming Products", Library Congress, 2014.
2. Corral, Luis & Fronza, Ilenia, "Design Thinking and Agile Practices for SoftwareEngineering: An Opportunity for Innovation", 2018.

**REQUIREMENTS:**

1. Newspaper sheets
2. Ice cream sticks
3. Tape
4. Glue
5. Scissors
6. Colored papers
7. Pens and Markers
8. String/thread
9. Chart

22ME311	<b>PRODUCT DEVELOPMENT LAB – 3</b> <b>(Design and Analysis Phase)</b> (Common to All Branches)	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		0	0	2	1

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

22CS311	APTITUDE AND CODING SKILLS – I (Common to All Branches)	L	T	P	C
		0	0	2	1
<b>OBJECTIVES:</b>					
<p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Develop vocabulary for effective communication and reading skills.</li> <li>• Build the logical reasoning and quantitative skills.</li> <li>• Develop error correction and debugging skills in programming.</li> </ul>					
<b>List of Exercises:</b>					
<p><b>1. English – Phase I</b> 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><b>2. Logical Reasoning – Phase I</b> 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><b>3. Quantitative Ability - Phase I</b> 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><b>4. Automata Fix – Phase I</b> Logical, Compilation and Code reuse</p>					
					<b>TOTAL: 30 PERIODS</b>
<b>OUTCOMES:</b>					
<b>Upon completion of the course, the students will be able to:</b>					
<b>CO1:</b> Develop vocabulary for effective communication skills.					
<b>CO2:</b> Build the logical reasoning enhance critical thinking.					
<b>CO3:</b> Develop error correction and debugging skills in programming.					

**CO4:** Apply programming skills to develop programs efficiently  
**CO5:** Solve problems using quantitative skills  
**CO6:** Develop effective reading and listening skills.

## SEMESTER IV

22MA401	<b>PROBABILITY AND STATISTICS</b> (Common to CSE, IT, CSD, AD) <b>(Theory Course with Laboratory Component)</b>	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b> The course is designed to: <ul style="list-style-type: none"> <li>● Provide the necessary basic concepts of random variables and to introduce some standard distributions.</li> <li>● Test the hypothesis for small and large samples.</li> <li>● Introduce the concepts of Analysis of Variances.</li> <li>● Understand the concept of statistical quality control.</li> </ul>					
<b>UNIT I</b>	<b>ONE-DIMENSIONAL RANDOM VARIABLES</b>	<b>15</b>			
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.					
<b>List of Exercises using R Programming:</b> <ol style="list-style-type: none"> <li>1. Finding conditional probability.</li> <li>2. Finding mean, variance and standard deviation.</li> </ol>					
<b>UNIT II</b>	<b>TWO-DIMENSIONAL RANDOM VARIABLES</b>	<b>15</b>			
Joint distributions - Marginal and conditional distributions - Covariance - Correlation and linear regression - Transformation of random variables.					
<b>List of Exercises using R Programming:</b> <ol style="list-style-type: none"> <li>1. Finding marginal density functions for discrete random variables.</li> <li>2. Calculating correlation and regression.</li> </ol>					
<b>UNIT III</b>	<b>TESTING OF HYPOTHESIS</b>	<b>15</b>			
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.					
<b>List of Exercises using R Programming:</b> <ol style="list-style-type: none"> <li>1. Testing of hypothesis for given data using Z - test.</li> <li>2. Testing of hypothesis for given data using t - test.</li> </ol>					
<b>UNIT IV</b>	<b>DESIGN OF EXPERIMENTS</b>	<b>15</b>			

One way and Two-way classifications - Completely randomized design - Randomized blockdesign - Latin square design.

**List of Exercises using R Programming:**

1. Perform one-way ANOVA test for the given data.
2. Perform two-way ANOVA test for the given data.

<b>UNIT V</b>	<b>STATISTICAL QUALITY CONTROL</b>	<b>15</b>
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Control charts for measurements ( $\bar{X}$  and R charts) - Control charts for attributes (p, c and npcharts) - Tolerance limits.

**List of Exercises 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.

<b>22IT407</b>	<b>WEB DEVELOPMENT FRAMEWORKS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- To understand web semantics and related tools and framework
- Able to get hands on latest JS based web frameworks
- To develop a scalable and responsive web application

- To develop an industry ready application web enterprise feature

<b>UNIT I</b>	<b>ADVANCED JAVASCRIPT</b>	<b>9+6</b>
<p>Introduction to HTML5 and CSS3, Media Queries, JS, DOM, BootStrap, Variables, Loops, Operators, Scope, Hoisting, Arrays, Spread, REST, DeStructuring</p> <p><b>List of Exercises:</b></p> <p>1) Create a JS Object for Bank Account (w attributes like à customer name, account type, balance, data of creation, bank name, branch name, pan card number). Using JS Object keyword, try to perform following activities</p> <ul style="list-style-type: none"> <li>➤ List down all the entries of the bank object</li> <li>➤ Check the existence of a key</li> <li>➤ If key found, get the value for the key</li> </ul> <p>2) Spread Operator</p> <ul style="list-style-type: none"> <li>➤ Merge Customer and Account Arrays</li> <li>➤ Update the Customer Object with the new values</li> <li>➤ Develop a function that takes an Spread Argument and calculates total balance.</li> </ul>		
<b>UNIT II</b>	<b>INTRODUCTION TO REACTJS</b>	<b>9+6</b>
<p>Class-Inheritance, Methods, Extended Class-Map, filter and Reduce Functions, Functions - Arrow Functions, Lambda Expressions , REST - Introduction, Why JSX, Hello World Apps, Project Structure</p> <p><b>List of Exercises:</b></p> <p>1) Create a list of Bank Objects (same kind of object you used in above lab, but in a array format)</p> <ul style="list-style-type: none"> <li>➤ Display the banks where balance is greater than 200</li> <li>➤ deduct 10% of the Bank account balance, as part of monthly service fees</li> <li>➤ Display the banks where balance is greater than 200 and branch code is "Chennai"</li> <li>➤ Add a new Bank to the given array – Delete a bank from the array (use splice operator)</li> <li>➤ Calculate the total balance of all bank accounts</li> </ul> <p>2) Develop a Scientific calculator that does following operations</p> <ul style="list-style-type: none"> <li>➤ Rounded Value</li> <li>➤ Area of Circle</li> <li>➤ Calculating of Sin, Cos and Tan functions</li> <li>➤ Perimeter of an Rectangle</li> <li>➤ Employ Arrow functions</li> <li>➤ Employ HOC</li> </ul>		
<b>UNIT III</b>	<b>REACT COMPONENTS</b>	<b>9+6</b>
<p>Class vs Functional Components, Lifecycle methods, React Class Based Components – component DidMount, WillUpdate, shouldupdate, didcatchetc - State - UseState, UseRef, USeffect,UseHistory Usage and Props(difference, when to use what, mutable or immutabilty,direction of flow), PropTypes, Auxillary Components, Controlled and Uncontrolled Components,Component Interaction (Parent to Child and Child to Parent), Iteration &amp; Conditional Response</p> <p><b>List of Exercises:</b></p> <p>1)Create a collection of Customer by using</p> <ul style="list-style-type: none"> <li>➤ Weak Map and Map Collection in JS</li> <li>➤ Show Case the different feature set of the same.</li> </ul> <p>2) Add Login Page, Dash Board Page, Admin Page</p> <ul style="list-style-type: none"> <li>➤ Enable React Routing</li> <li>➤ Add React Protected Route, for authorization</li> </ul>		
<b>UNIT IV</b>	<b>REACT LIBRARY - 1</b>	<b>9+6</b>

Event Bubbleup - Component Wrapper - Integration of CSS Modules - Forms Validations(YUP, Formik, Standard), Events Handling, Data Binding - Redux

**List of Exercise/Experiments:**

1. Develop a React application that has User Registration Form w field level validations, data submission to a rest api end point, boot strap for responsive.
  - Use YUP or Formik to implement the same
  - 2) Build a Redux Counter ApplicationRequirements:
  - React application with Redux integrated.
  - A counter with:
    - Increment button
    - Decrement button
    - Reset button
    - Display the current counter value.

**UNIT V**

**REACT LIBRARY - II**

**9+6**

Custom Hooks, HTTP - Fetch, Axios, and Context API, Services, Behaviour Subjects - StateLess, StateFull and Container Components, Error Handling - Build, Env, CORS, Unit Testing w React Testing Library - Introduction to react-native - Introduction to StoryBook

**List of Exercise/Experiments:**

- 1) Employ back end api for Login Page functionality (authentication). Post login, store the user context (received from the back end server) in browser's session storage as objects. And use the same as creds during protected route verification
    - On the dashboard page, have a grid of Students. The data has to be bought from back end api
    - Employ useRef, useEffect & usestate, and useHistory
  - 2) Enable Exception Handling
  - 3) Enable HOC and Aux Components
  - 4) Implement React-Testing Library
  - 5) Basic Context Setup
- Objective: Set up a React Context to manage theme (light or dark).
- Create a ThemeContext using React.createContext.
  - Create a provider component ThemeProvider with state to toggle between "light" and "dark" themes.
  - Use the context in a functional component to display the current theme.
  - Add a button to toggle the theme.

**Business Use Case Implementations**

- 1) Student Management System
- 2) Retail Bank System
- 3) eCommerce System
- 4) Student LMS Management System

**TOTAL: 45 + 30 = 75 PERIODS**

**OUTCOMES:**

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

- CO1:** Personalize web pages using text formatting, graphics, audio, and video.
- CO2:** Hands on knowledge on Rest API , propTypes
- CO3:** Able to develop a web application using latest React Framework
- CO4:** Apply various React features including functions, components, and services.
- CO5:** Able to develop application using ReactJshooks.
- CO6:** Design and integrate complex web components to enhance user interface and user experience in React applications.

**TEXTBOOKS:**

- 1) David Flanagan, Javascript The Definitive Guide, Paperback, 7 th Edition, 2020.
- 2) David Choi ,Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL Paperback – Import, 18 December 2020
- 3) Mehul Mohan, Advanced Web Development with React Paperback – 1 January 2020

**E-RESOURCES:**

- 1.PARENTAL WEBSITE - <https://reactjs.org/>
2. The Road to Learn React: Your journey to master plain yet pragmatic React.js by Robin Wieruch
3. Learning React: Functional Web Development with React and Redux by Alex Banks and Eve Porcello
4. Learning React by KirupaChinnathambi
5. "React Up & Running" by StoyanStefanov
- 6.<https://www.edureka.co/reactjs-redux-certification-training>
- 7.CodePen,
- 8.CodeSandbox (β Preferred)
- 9.Stackblitz.

**SOFTWARE REQUIREMENTS:**

- NodeJS (v9.11.2)
- Github as code repository
- Visual studio code as IDE
- RTL as unit testing framework
- Responsive design w bootstrap
- ReactJS installation (v17)
- Chrome / FIreFox Browsers (latest)
- Responsive using Media Queries & Bootstrap Material&Antdesign
- Design based Apps

22CS306	<b>DESIGN AND ANALYSIS OF ALGORITHMS (Common to CSE, IT, ADS and CSD)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>

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

- 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.

<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9+6</b>
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 <b>List of Exercise/Experiments:</b> <ol style="list-style-type: none"> <li>1. Perform the recursive algorithm analysis.</li> <li>2. Perform the non-recursive algorithm analysis.</li> </ol>		
<b>UNIT II</b>	<b>BRUTE FORCE AND DIVIDE AND CONQUER</b>	<b>9+6</b>
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 <b>List of Exercise/Experiments:</b> <ol style="list-style-type: none"> <li>1. Write a program to search an element using binary search</li> <li>2. Write a program to sort the elements using merge sort and find time complexity.</li> <li>3. Write a program to sort the elements using quick sort and find time complexity.</li> <li>4. Write a program to sort the elements using heap sort</li> </ol>		
<b>UNIT III</b>	<b>DYNAMIC PROGRAMMING</b>	<b>9+6</b>
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. <b>List of Exercise/Experiments:</b> <ol style="list-style-type: none"> <li>1. Solve Floyd's algorithm</li> <li>2. Write a program to find optimal binary search tree for a given list of keys.</li> <li>3. Solve the multi-stage graph to find shortest path using backward and forward approach</li> <li>4. Write a program to find the longest common subsequence</li> </ol>		
<b>UNIT IV</b>	<b>GREEDY TECHNIQUE AND ITERATIVE IMPROVEMENT</b>	<b>9+6</b>
Greedy Technique – Prim's algorithm and Kruskal's Algorithm – Huffman Trees. The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs - The Stable marriage Problem <b>List of Exercise/Experiments:</b> <ol style="list-style-type: none"> <li>1. Write a program to find minimum spanning tree using Prim's algorithm</li> <li>2. Implement Kruskal's algorithm to find minimum spanning tree</li> <li>3. Write a program to solve maximum flow problem</li> </ol>		
<b>UNIT V</b>	<b>BACKTRACKING AND BRANCH AND BOUND</b>	<b>9+6</b>
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: 45+30=75 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the different algorithm design paradigms.

**CO2:** Design algorithms for real world problems using algorithmic design techniques.

**CO3:** Analyse the efficiency of simple recursive and non-recursive algorithms.

**CO4:** Analyse the algorithm’s worst, best and average case behaviour in terms of time and space.

**CO5:** Apply the limits of algorithms and how to cope with them.

**CO6:** Develop applications by selecting suitable design technique in an efficient way.

**TEXT BOOKS:**

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.

**REFERENCES:**

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI Learning Private Limited, 2012.
2. S. Sridhar, Design and Analysis of Algorithms, Oxford university press, 2014.
3. <http://nptel.ac.in/>

**SOFTWARE REQUIREMENTS:**

Standalone PC with C/C++/Java

<b>22CD401</b>	<b>HUMAN COMPUTER INTERACTION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Learn the fundamentals of Human Computer Interaction.</li> <li>• Become familiar with different design software process</li> <li>• Learn various interaction design model</li> <li>• Be aware of mobile design and web interfaces in HCI</li> <li>• Learn different communication and guidelines for interaction</li> </ul>					
<b>UNIT I</b>	<b>FOUNDATIONS OF HCI</b>				<b>6 + 6</b>
Input–output channels, Human memory, Thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning.					
<b>List of Exercises:</b>					

<ol style="list-style-type: none"> <li>1. Design a user interface for Welcome screen.</li> <li>2. Design a user interface for calculator.</li> </ol>		
<b>UNIT II</b>	<b>DESIGN SOFTWARE PROCESS</b>	<b>6 + 6</b>
<p>Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Design a user interface with Layouts for printing the numbers in ascending order and descending order.</li> <li>2. Design a user interface by applying design rules for assigning a grade to students based on the subject marks.</li> </ol>		
<b>UNIT III</b>	<b>INTERACTION DESIGN MODELS</b>	<b>6 + 6</b>
<p>GOMS - CMN-GOMS Analysis, Modeling Structure, State Transition Networks - Three-State Model, Glimpse Model, Physical Models,– Shneiderman's eight golden rules, Norman's Seven principles, Norman's model of interaction, Nielsen's ten heuristics, Heuristic evaluation, contextual evaluation, Cognitive walk-through.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Design a user interface for student registration during admission process.</li> <li>2. Design a user interface for displaying and changing pictures.</li> </ol>		
<b>UNIT IV</b>	<b>MOBILE HCI AND WEB INTERFACE DESIGN</b>	<b>6 + 6</b>
<p>Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies. Designing Web Interfaces – Drag Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Design a user interface with widgets for end semester exam registrations.</li> <li>2. Design forms using drag and drop option.</li> </ol>		
<b>UNIT V</b>	<b>COMMUNICATION</b>	<b>6 + 6</b>
<p>Face-to-face Communication, Conversation, Text-based Communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design: Groupware, Meeting and decision support systems, Shared applications and artifacts, Frameworks for groupware Implementing synchronous groupware, Mixed, Augmented and Virtual Reality.</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Design a user interface with Overlays and Inlays for menu-based application.</li> <li>2. Mini Project.</li> </ol>		
<b>TOTAL: 30+30=60 PERIODS</b>		
<p><b>OUTCOMES:</b></p> <p><b>At the end of this course, the students will be able to:</b></p> <p><b>CO1:</b> Enumerate the basic concepts of human, computer interactions</p> <p><b>CO2:</b> Inspect software design process in human computer interaction</p> <p><b>CO3:</b> Examine various models and theories related to human computer interaction</p> <p><b>CO4:</b> Build meaningful user interface</p> <p><b>CO5:</b> Establish the different levels of communication across the application stakeholders.</p>		

<b>CO6:Understand Augmented and Virtual Reality</b>
<b>TEXT BOOKS:</b>
<ol style="list-style-type: none"> <li>1. A Dix, Janet Finlay, G D Abowd, R Beale., Human-Computer Interaction, 3rd Edition, Pearson Publishers, 2008.</li> <li>2. Brian Fling, Mobile Design and Development, First Edition, O'Reilly Media Inc., 2009. Bill Scott and Theresa Neil, —Designing Web Interfaces II, First Edition, O'Reilly, 2009.</li> </ol>
<b>REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. Shneiderman, Plaisant, Cohen and Jacobs, Designing the User Interface: Strategies for Effective, 2017..</li> <li>2. Human Computer Interaction, 5th Edition, Pearson Publishers, 2010. Hans-Jorg Bullinger, " Human-Computer Interaction", Lawrence Erlbaum Associates, Publishers.</li> </ol>
<b>SOFTWARE REQUIREMENTS:</b>
Front End: Java, .NET Back End : MySQL

22CD402	DESIGN PROGRAMMING	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Provide an idea about Blender interface</li> <li>• Impart a good understanding of materials and textures.</li> <li>• Gain clear knowledge on Nurbs and meta shapes.</li> <li>• Attain insight on Unity Scripts.</li> <li>• Understand decision making in games.</li> </ul>					
<b>UNIT I</b>	<b>BLENDER INTERFACE AND NAVIGATION</b>	<b>9+6</b>			
3D Modeling-The blender Screen- The user preferences window-preset Interface arrangements- The 3D window-Window Modes-Layers-Moving in 3D space-Blender View menu, Controls, windows-Navigation- Creating and editing Objects <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Create and edit an object using Blender.</li> <li>2. Navigate an object in 3D using Blender.</li> </ol>					
<b>UNIT II</b>	<b>MATERIALS AND TEXTURES</b>	<b>9+6</b>			
Material settings -Material Buttons, Colors- Textures-Texture Mapping-Unwrapping with Seams-Texture Paint-World Settings-Lighting and Cameras-Rendering and Ray Tracing <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Formulate 3D scene from primitives.</li> <li>2. Apply Materials and Textures to an 3D object using blender.</li> </ol>					
<b>UNIT III</b>	<b>NURBS AND META SHAPES</b>	<b>9+6</b>			
Introduction to 3D Text-Creating 3D Text in Blender-Converting Text to Mesh Object- Converting text to a curve-Modifiers-Modifiers for generating, deforming, Simulating. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Converting Text to Mesh Object using blender</li> <li>2. With Blender, Convert text to a Curve</li> </ol>					
<b>UNIT IV</b>	<b>UNITY SCRIPTS</b>	<b>9+6</b>			
Basic C# scripting- Introducing scripting in unity- Method instead of function - Introducing					

Classes -Passing values between the classes - Using objects and classes in game script- Understanding component property in scripts - Displaying public variables in inspector panel - Multi-word variable names- Common – built – in variable types - Variable scopes.

**List of Exercises:**

1. Integration of 3D Assets into Unity.
2. Create Scripts to control the movement of game Assets

<b>UNIT V</b>	<b>DECISION MAKING IN GAMES</b>	<b>9+6</b>
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Condition testing using if statement - Usage of for each loop -Usage of while loop - Storing game objects in array -Storing game objects in list- Using dot syntax in unity script - Accessing components own variables and methods - Accessing another game objects and its components.

**List of Exercises:**

1. Construct a GUI in the Game Engine to interact with the Game Assets
2. Design and animate a game character in Unity

**TOTAL: 45+30=75 PERIODS**

**OUTCOMES:**

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

- CO1:** Learn about Blender interface
- CO2:** Understand Texture Mapping and Rendering
- CO3:** Analyse Text to Mesh Object and Curve conversion
- CO4:** Know the scripting fundamentals
- CO5:** Understand accessing game objects
- CO6:** Develop and animate a game character

**TEXT BOOKS:**

1. John M.Blain ,”Complete guide to blender graphics”,4th edition, Taylor & Francis publications, 2020.
2. Terry Norton, “Learning C# by Developing Games with Unity 3D Beginner's Guide”, second edition, Packt Publishing Limited, 2013.

**REFERENCES:**

1. Lee ZhiEng,”Building a Game With Unity and Blender”,1st Edition , Packt Publishing Limited , 2015.
2. Michelle Menard, “Game development with unity”, 2nd edition, Cengage Learning PTR, 2015.
3. VahéKaramian,” Introduction to Game Programming:Using C# and Unity 3D”, Noorcon Inc.2016
4. Michelle Menard, Bryan Wagstaff,”Game development with Unity”, Cengage Learning, 2015.

**SOFTWARE REQUIREMENTS:**

- 1.Unity
- 2.Blender

<b>22ME411</b>	<b>PRODUCT DEVELOPMENT LAB - 4 (Prototype Phase) (Common to All Branches)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		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

22CS411	APTITUDE AND CODING SKILLS – II (Common to All Branches)	L	T	P	C
		0	0	2	1
<b>OBJECTIVES:</b>					
<p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Develop advanced vocabulary for effective communication and reading skills.</li> <li>• Build an enhanced level of logical reasoning and quantitative skills.</li> <li>• To develop error correction and debugging skills in programming.</li> <li>• To apply data structures and algorithms in problem solving.</li> </ul> <p><b>List of Exercises:</b></p> <p><b>1. English – Phase II</b> 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><b>2. Logical Reasoning – Phase II</b> 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><b>3. Quantitative Ability - Phase II</b> 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><b>4. Automata Fix – Phase II</b> Logical, Compilation and Code reuse</p>					

**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 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.

**CO5:** Develop advanced vocabulary for effective reading skills

**CO6:** Apply advanced algorithm design techniques to develop programs

**SEMESTER – V**

22CD501	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	C
		2	0	2	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To grasp the fundamental knowledge of implementing Computer Graphics in 2D.</li> <li>To acquire knowledge in 3D Graphics.</li> <li>To learn the process of implementation of Computer Graphics through Vulkan API.</li> <li>To get familiarity with basic to advanced rendering technique.</li> <li>To become familiar with Animation and Multimedia systems.</li> </ul>					
<b>UNIT I</b>	<b>2D GRAPHICS PROCESSING</b>	<b>6+6</b>			
Video Display devices -Raster Scan System-Graphics Output Primitives-Open GL Point Functions-Open GL Line Functions-Open GL Curve Functions-Implementation Algorithm for Graphics Primitives & Attributes: Line Drawing Algorithm-Parallel Line Algorithm-Circle Generating Algorithm-Ellipse Generating Algorithm-Two-Dimensional Viewing Pipeline-Clipping Algorithm. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>2D primitives (points, lines, circle, ellipse, rectangle, arc)</li> <li>Apply basic transformations on the cube including Translation, Rotation, Scaling.</li> </ol>					
<b>UNIT II</b>	<b>3D GRAPHICS PIPELINE</b>	<b>6+6</b>			
Three-Dimensional Geometric transformation: Translation- Rotation- Scaling-Composite Three-Dimensional Transformations-Other Three-dimensional Transformations-Three-dimensional viewing pipeline-Projection Transformations-Orthogonal Projections-Oblique Parallel Projections-Perspective Projections-OpenGL Three-dimensional Viewing Function. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>Drawing 3D primitive “Cube” and show the cube from different camera angles and perspectives.</li> <li>Setting up the camera, lights and performing viewing transformations. Demonstrate a Simple projection transformation for a primitive.</li> </ol>					
<b>UNIT III</b>	<b>VULKAN GRAPHICS API</b>	<b>6+6</b>			
Overview of Vulkan-Introduction-Instances, Devices and Queues-The Vulkan Instance-Vulkan Physical Devices-Physical Device Memory-Device Queues-Creating a Logical Device-Object Types and Function Conventions- Enhancing Vulkan: Layers – Extensions-Queues and Commands: Device Queue-Creating Command Buffers-Recording Buffer-Recycling Command Buffers -Moving Data: Managing Resource State. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>Install vulkan sdk with c++ in Visual Studio and set up the work environment</li> <li>Understand different types of shaders in Vulkan</li> </ol>					
<b>UNIT IV</b>	<b>RENDERING</b>	<b>6+6</b>			
Lighting and Shading-Light Matter-Light Sources-The Phong Reflection Model-Texture Mapping-Texture Generation-Global Illumination-RayTracing-Radiosity-Parallel Rendering-Volume Rendering- Environment map- Bump mapping- iso surfaces and marching Cubes-Rasterization. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>Applying textures on a Cube</li> <li>Apply textures mapping in geometric objects other than Cube.</li> </ol>					
<b>UNIT V</b>	<b>ANIMATION</b>	<b>6+6</b>			

Design of Animation Sequences-General Computer animation Function-Raster Animations-Computer Animation Languages-Key Frame System- Morphing-Simulating Acceleration-Motion Specification-Direct Motion Specifications-Goal Directed System-Kinematics & Dynamics.

**List of Exercises:**

1. Create and animate simple 3D scene with different objects and attributes
2. Perform Rendering with Environment and Bump maps or using other rendering techniques.

**TOTAL: 30+30 =60 PERIODS**

**OUTCOMES:**

**On Successful completion of the course, Students will be able to**

**CO1:** Implement 2D transformations and algorithms for generating primitives and attributes.

**CO2:** Solve problems in 3D transformations and viewing.

**CO3:** Analyze the process of open source Vulkan API.

**CO4:** Examine rendering techniques and use advanced based rendering.

**CO5:** Apply lighting and shading models to enhance graphical scenes.

**CO6:** Understand the multimedia systems and animation.

**TEXT BOOKS:**

1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, "Computer Graphics with OpenGL", Pearson Education, Fourth Edition, 2014.
2. Graham Sellers, John Kessenich, "Vulkan Programming Guide", 1st Edition, Addison Wesley, 2016.
3. Edward Angel, Dave Shreiner," Interactive Computer Graphics. A Top-Down Approach with WebGL", 7th Edition, 2015

**REFERENCES:**

1. OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V, 9th Edition, Addison Wesley, 2016.
2. <https://vulkan-tutorial.com>

**SOFTWARE REQUIREMENTS:**

Systems with C++ compiler, Vulkan SDK and IDE like Visual Studio.

22CD502	PRODUCT CENTRIC AGILE DEVELOPMENT	L	T	P	C
		2	0	2	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>• To understand agile software development practices</li> <li>• To become familiar Product Centric Value Delivery</li> <li>• To Implement Agile metrics and its working methods</li> <li>• To apply Product Centric Agile Development and have a working knowledge of web services</li> <li>• To obtain knowledge on DevOps and its related concepts.</li> </ul>					
<b>UNIT I</b>	<b>AGILE SOFTWARE DEVELOPMENT PROCESS</b>	<b>6+6</b>			
Introduction to Agile Development- The Agile Mindset – Lean Agile mindset – Mindset awareness and openness to change – thinking lean with House of Lean – Embracing Agility with the Agile Manifesto – Principles of Agile Manifesto- Agile Methodologies – Scrum – Kanban – Scrumban – Spotify – SAFe- Agile engineering practices – Software development – TDD – BDD – Pair Programming – Refactoring – Extreme programming					
<b>List of Exercises:</b>					
1. Write down the problem statement for Student Result Management System. Do requirement analysis and develop Software Requirement Specification (SRS).					

Develop function- oriented Diagrams, User and Structural Diagram. 2. Develop Behavioral, implementation and Environmental view diagram for Student Result Management System.		
<b>UNIT II</b>	<b>PRODUCT CENTRIC VALUE DELIVERY</b>	<b>6+6</b>
Introduction to Agile Product Centric Value Delivery – Overview of Agile Operating Model - Key Product management collaborations – Responsibilities – Exploring markets and users – Connecting with the customer – Defining Product strategy, vision & roadmaps – Managing and Prioritizing ART backlog – Delivering Value- Agile product delivery – Why Agile Product delivery? – Three dimensions of APD – Customer centricity & Design thinking – Develop on Cadence & Release on demand – DevOps and Continuous delivery pipeline- Product Centric Value Delivery Principles - Benefits of Product Centric Value Delivery - Delivering Value with Product Centric Agile Development <b>List of Exercises:</b> 1. Apply design thinking principles & establish product features, product back log as part of Discovery phase for Payment banking system 2. Apply design thinking principles & establish product features, product back log as part of Discovery phase for Retail solution		
<b>UNIT III</b>	<b>AGILE METRICS AND WAYS OF WORKING</b>	<b>6+6</b>
An Introduction to Agile Metrics - Key Benefits of tracking Agile Metrics- Metrics Categories - Ways of Working – Embracing DevOps mindset, Culture & practices – Taking economic view – Systems thinking – Make value without interruptions – Synchronize with cross-domain planning – Organize around value – Decentralize decision making – Assume variability; preserve options <b>List of Exercises:</b> 1. Apply design thinking principles & establish product features, product back log as part of Discovery phase for Health management system 2. Develop product backlog & create user stories – develop detailed sprint plan (Sprint 0 with 5 sprints)		
<b>UNIT IV</b>	<b>APPLYING PRODUCT CENTRIC AGILE DEVELOPMENT</b>	<b>6+6</b>
Application of Product centric agile development – Technology stacks - Introduction to Web Services – The definition of web services, basic operational model of web services, tools and technologies enabling web services, benefits and challenges of using web services. – Cloud Services – Data – Digital - Security and NFRs- Digital Marketing use case – Data modernization use case <b>List of Exercises:</b> 1. Write a program to implement a) Web based service consumer b) Windows application based web service consumer. 2. Set up DevOps environment – Git – Install / Configure Git – Setting up project – pushing changes		
<b>UNIT V</b>	<b>DevOps AND CI/CD</b>	<b>6+6</b>
Understanding the DevOps Movement - Benefits of DevOps - The DevOps Lifecycle - Build Continuous automation, integration-Cloud computing-configuration management-continuous delivery, monitoring, feedback. Tools and technologies: Code repositories -Build tools-Maven-Continuous integration tools-Jenkins-Configuration management tools-Chef-Cloud service providers-Container technology-Docker-Monitoring tools-The DevOps Dashboard-An overview of a sample Java EE application <b>List of Exercises:</b> 1. Explore the environment by Jenkins installation and setup. 2. Develop a simple containerized application using Docker.		
<b>TOTAL: 30+30=60 PERIODS</b>		
<b>OUTCOMES:</b>		

<p><b>At the end of this course, the students will be able to:</b></p> <p><b>CO1:</b> Analyse agile development methods in software development practices.</p> <p><b>CO2:</b> Obtain knowledge on Product Centric Value Delivery.</p> <p><b>CO3:</b> Implement Agile metrics and its ways of working.</p> <p><b>CO4:</b> Apply Product Centric Agile Development to develop web services.</p> <p><b>CO5:</b> Examine DevOps concepts and tools for Web Development.</p> <p><b>CO6:</b> Develop effective collaboration and communication skills essential for working Within agile teams.</p>
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Roger S. Pressman, "Software Engineering: A Practitioner 's Approach", McGraw Hill International Edition, Ninth Edition, 2020</li> <li>2. Developing Java Web Services, R. Nagappan, R. Skoczylas, R.P. Sriganesh, Wiley India, 2003.</li> <li>3. DevOps for Web Development, MiteshSoni, 2016</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Craig Larman, Agile and Iterative Development: A Managers Guide, Addison- Wesley, 2004.</li> <li>2. Kevin C. Desouza, Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.</li> <li>3. Web Services &amp; SOA Principles and Technology, Second Edition, Michael P. Papazoglou, 2012.</li> <li>4. Developing Enterprise Web Services, S. Chatterjee, J. Webber, Pearson Education, 2003.</li> <li>5. <a href="https://v5.scaledagileframework.com/lean-agile-mindset/">https://v5.scaledagileframework.com/lean-agile-mindset/</a></li> <li>6. <a href="https://scaledagileframework.com/product-management/">https://scaledagileframework.com/product-management/</a></li> <li>7. <a href="https://scaledagileframework.com/agile-product-delivery/">https://scaledagileframework.com/agile-product-delivery/</a></li> </ol>
<p><b>SOFTWARE REQUIREMENTS:</b></p> <p>ArgoUML, Azure</p>

<b>22CS501</b>	<b>COMPUTER NETWORKS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<p><b>OBJECTIVES:</b></p> <p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Study the fundamental concepts of computer networks and physical layer.</li> <li>• Apply the knowledge of various protocols and techniques used in the data link layer.</li> <li>• Implement the services of network layer and network layer protocols.</li> <li>• Illustrate different protocols used in the transport layer.</li> <li>• Build applications using the application layer protocols.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION AND PHYSICAL LAYER</b>	<b>9+6</b>			
<p>Data Communications – Network Types – Protocol Layering – Network Models (OSI, TCP/IP)  Networking Devices: Hubs, Bridges, Switches – Performance Metrics – Transmission media  - Guided media -Unguided media- Switching-Circuit Switching - Packet Switching.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Practice different network commands available in Windows and Linux Operating Systems and troubleshoot the network.</li> <li>2. Network configuration commands using Linux.</li> </ol>					
<b>UNIT II</b>	<b>DATA LINK LAYER</b>	<b>9+6</b>			
<p>Introduction – Link-Layer Addressing- Error Detection and Correction - Wired LANs: Ethernet  - Wireless LANs – Introduction – IEEE 802.11, Bluetooth</p> <p><b>List of Exercise/Experiments:</b></p>					

1. Error detection and correction mechanisms.			
2. Flow control mechanisms.			
<b>UNIT III</b>	<b>NETWORK LAYER</b>	<b>9+6</b>	
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.			
<b>List of Exercises/Experiments:</b>			
1. Multi-client chatting in TCP and UDP using Socket programming			
2. Implementation of HTTP, Web Caching, FTP using socket programming.			
<b>UNIT IV</b>	<b>TRANSPORT LAYER</b>	<b>9+6</b>	
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol –Transmission Control Protocol – SCTP.			
<b>List of Exercises/Experiments:</b>			
1. Develop a DNS client server to resolve the given host name or IP address.			
2. Simulation of unicast routing protocols.			
<b>UNIT V</b>	<b>APPLICATION LAYER</b>	<b>9+6</b>	
Application layer-WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.			
<b>List of Exercises/Experiments:</b>			
1. Observing Packets across the network and Performance Analysis of various Routing protocols.			
2. Simulation of Transport layer Protocols and analysis of congestion control techniques in the network.			
<b>TOTAL: 45+30=75 PERIODS</b>			
<b>OUTCOMES:</b>			
<b>At the end of this course, the students will be able to:</b>			
<b>CO1:</b> Explain the fundamental concepts of computer networking and network architecture.			
<b>CO2:</b> Analyze the performance of various network protocols used in data transmission.			
<b>CO3:</b> Design basic network architectures including LAN and WAN using appropriate hardware and software.			
<b>CO4:</b> Develop skills to diagnose common network issues using tools.			
<b>CO5:</b> Analyze the various application layer protocols.			
<b>CO6:</b> Implement protocols used for finding shortest route for data transmission.			
<b>TEXT BOOKS:</b>			
1. Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Ed., 2017.			
<b>REFERENCES:</b>			
1. Computer Networking- A Top Down Approach, James F. Kurose, University of Massachusetts and Amherst Keith Ross, 8th Edition, 2021.			
2. Computer Networks, Andrew S. Tanenbaum, Sixth Edition, Pearson, 2021.			
3. Data Communications and Computer Networks, P.C. Gupta, Prentice-Hall of India, 2006.			
4. Computer Networks: A Systems Approach, L. L. Peterson and B. S. Davie, Morgan Kaufmann, 3rd ed., 2003.			
<b>SOFTWARE REQUIREMENTS:</b>			
C/Java, Ubuntu OS, NS2 simulation tool			

<b>22CS511</b>	<b>ADVANCED APTITUDE AND CODING SKILLS – I</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>OBJECTIVES:</b>					
● To develop vocabulary for effective communication and reading skills.					

<ul style="list-style-type: none"> <li>To build the logical reasoning and quantitative skills.</li> <li>To develop error correction and debugging skills in programming.</li> </ul>
<b>LIST OF EXERCISES:</b>
<b>1. English – Phase I Advanced</b> 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 <b>2. Logical Reasoning – Phase I Advanced</b> 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 <b>3. Quantitative Ability - Phase I Advanced</b> 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 <b>4. Automata Fix – Phase I</b> Logical, Compilation and Code reuse
<b>TOTAL: 30 PERIODS</b>
<b>OUTCOMES:</b>
<b>At the end of this course, the students will be able to:</b> <b>CO1:</b> Develop advanced vocabulary for effective communication skills. <b>CO2:</b> Build an enhanced level of logical reasoning and quantitative skills. <b>CO3:</b> Develop error correction and debugging skills in programming. <b>CO4:</b> Apply advanced data structures and algorithms in problem solving. <b>CO5:</b> Develop coding solutions for real-world problems. <b>CO6:</b> Develop advanced vocabulary for effective reading skills

		<b>INDIAN CONSTITUTION</b>			
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To have some knowledge about Indian Constitution.</li> <li>To understand the concept of fundamental rights</li> <li>To learn about Lok Sabha and Rajya Sabha</li> <li>To have some knowledge about Legislative Assembly and Legislative Council</li> <li>To learn about Local Self Government</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>9</b>
Meaning and Importance of Constitution - Preamble and Salient Features of the Constitution.					
<b>UNIT II</b>	<b>FUNDAMENTAL RIGHTS</b>				<b>9</b>
Fundamental Rights, Right to Equality, Right to Freedom, Right against exploitation, Right to freedom of religion, Cultural and Educational Rights, Right to Constitutional Remedies and Duties, Directive Principles of State Policy.					
<b>UNIT III</b>	<b>LOK SABHA AND RAJYA SABHA</b>				<b>9</b>
Union Government – Lok Sabha and Rajya Sabha Composition, Powers and functions: The President, The Prime Minister and Supreme Court: Role Position and Powers/functions.					
<b>UNIT IV</b>	<b>LEGISLATIVE ASSEMBLY AND LEGISLATIVE COUNCIL</b>				<b>9</b>

State Government - Legislative Assembly and Legislative Council: Composition, Powers and functions: The Governor, Chief Minister and High Court: Role, Position and Powers/ functions.	
<b>UNIT V</b>	<b>LOCAL SELF GOVERNMENT</b> <span style="float: right;"><b>9</b></span>
Local self-Government, Panchayat Raj System in India; Election Commission; Public Service Commissions, Role, powers and function.	
<b>TOTAL : 45 PERIODS</b>	
<b>COURSE OUTCOMES:</b> <b>At the end of this course, the students will be able to:</b> <b>CO1:</b> Interpret the knowledge on Indian Constitution. <b>CO2:</b> Demonstrate the knowledge gained through fundamental rights concept. <b>CO3:</b> Relate the concept of Lok Sabha and Rajya Sabha. <b>CO4:</b> Illustrate the concept of Legislative Assembly and Legislative Council. <b>CO5:</b> Analyze the concept of Local Self Government.	
<b>TEXTBOOKS:</b> 1. M V Pylee, An Introduction to The Constitution of India, Vikas Publishing House Pvt. Ltd., 5th Edition.	
<b>REFERENCES:</b> 1. Durga Das Basu, Introduction to the Constitution of India, 19th Edition Reprint 2009. 2. Sharma, Brij Kishore, "Introduction to the Constitution of India", Prentice Hall of India, 7th Edition, 2015.	

### SEMESTER –VI

22CE701	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To familiarize with Engineering Ethics and Human Values.</li> <li>To impart knowledge on codes of ethics, safety, responsibilities and rights of engineers.</li> <li>To give awareness on global issues related to environmental ethics, computer ethics, weapons development and corporate social responsibility</li> </ul>					
<b>UNIT I</b>	<b>HUMAN VALUES</b>	<b>9</b>			
Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.					
<b>UNIT II</b>	<b>ENGINEERING ETHICS</b>	<b>9</b>			
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.					
<b>UNIT III</b>	<b>ENGINEERING AS SOCIAL EXPERIMENTATION</b>	<b>8</b>			
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law - The Challenger Case Study.					
<b>UNIT IV</b>	<b>SAFETY, RESPONSIBILITIES AND RIGHTS</b>	<b>10</b>			

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Case Studies: Chernobyl and Bhopal Disasters - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

<b>UNIT V</b>	<b>GLOBAL ISSUES</b>	<b>9</b>
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Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

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

- CO1:** Summarize the importance of human values in work place.
- CO2:** Discuss the senses of engineering ethics, moral dilemmas, moral autonomy and uses of ethical theories.
- CO3:** Describe the role of engineers as responsible experimenters and necessity of codes of ethics in engineering.
- CO4:** Explain safety, risk, responsibilities and rights in the society.
- CO5:** Analyze the global issues related to environmental ethics, computer ethics, weapons development and the role of engineers as expert witnesses and advisors.
- CO6:** Apply ethics in society and discuss the ethical issues related to engineering.

**TEXTBOOKS:**

2. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2017.
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2013.

**REFERENCES:**

3. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2012.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2018.
5. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2017.
6. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2008.

<b>22CS602</b>	<b>OBJECT ORIENTED SOFTWARE ENGINEERING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**OBJECTIVES:**

- Explain software engineering principles and activities involved in building large software programs.
- Describe the process of requirements gathering, analysis and unified modeling.
- Illustrate the object oriented design process.
- Analyse various traditional and object oriented testing methods.
- Apply estimation techniques, schedule project activities and compute pricing.

<b>UNIT I</b>	<b>PRODUCT AND PROCESS</b>	<b>6+6</b>
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The Nature of Software – Defining the Discipline – The Software Process – Process models – Prescriptive Process Models – Product and Process – Agility and Process – What is an Agile Process? - Scrum – Other Agile Frameworks – Kanban – DevOps

**List of Exercises/Experiments:**

<ol style="list-style-type: none"> <li>1. Identify a software system that needs to be developed.</li> <li>2. Document the Software Requirements Specification (SRS) for the identified system.</li> </ol>		
<b>UNIT II</b>	<b>REQUIREMENTS AND UNIFIED MODELING</b>	<b>6+6</b>
<p>Requirements Engineering – Establishing the Groundwork: Nonfunctional Requirements – Requirements Gathering – Developing Use Cases – Negotiating and Validating Requirements. Unified Modeling Language – Introduction – Static and Dynamic Models – Modelling – Introduction to the UML – UML Diagrams – UML Class Diagrams – Use-Case Diagram – UML Dynamic Modelling.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Identify use cases and develop the Use Case model.</li> <li>2. Identify the conceptual classes and develop a Domain Model and also derive a ClassDiagram from that.</li> </ol>		
<b>UNIT III</b>	<b>OBJECT ORIENTED ANALYSIS AND DESIGN</b>	<b>6+6</b>
<p>Object oriented Analysis process – Business object Analysis – Use-case driven OOA – Business process modelling – Use case model. Design Concepts – Design Process – Design Concepts – Design Model: Design Principles and Design Elements. Architectural Design – Designing class-based components - Conducting Component Level Design – User Interface Analysis and Design – Pattern-Based Software Design.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams</li> <li>2. Draw relevant State Chart and Activity Diagrams for the same system</li> </ol>		
<b>UNIT IV</b>	<b>SOFTWARE TESTING</b>	<b>6+6</b>
<p>Component Level: A Strategic Approach to Software Testing – White-Box Testing – Black Box Testing - Object Oriented Testing Integration Level: Integration Testing – AI and Regression Testing – Integration Testing in the OO Context Specialized Testing for Mobility: Web application Testing – Web Testing Strategies – Security Testing – Performance Testing–Real time Testing – Testing AI Systems – Testing Virtual Environments.</p> <p><b>List of Exercises/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Implement the system as per the detailed design</li> <li>2. Test the software system for all the scenarios identified as per the usecase diagram</li> </ol>		
<b>UNIT V</b>	<b>SOFTWARE PROJECT MANAGMENT</b>	<b>6+6</b>
<p>Software Metrics and Analytics: Software Measurement – Product Metrics. Creating a Viable Software Plan: The Project Planning Process – Software Scope and Feasibility – Decomposition and Estimation Techniques – Project Scheduling. Risk Management: Reactive Versus Proactive Risk Strategies – Risk Identification – Risk Projection – The RMMM Plan. Software Process Improvement: The SPI Process – The CMMI</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Improve the reusability and maintainability of the software system by applying appropriate design patterns.</li> <li>2. Implement the modified system and test it for various scenarios</li> </ol>		
<p><b>SUGGESTED DOMAINS FOR MINI-PROJECT:</b></p> <ol style="list-style-type: none"> <li>1. Passport automation system.</li> <li>2. Book bank</li> <li>3. Exam registration</li> <li>4. Stock maintenance system.</li> <li>5. Online course reservation system</li> <li>6. Airline/Railway reservation system</li> </ol>		

7. Software personnel management system
8. Credit card processing
9. E-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system
<b>TOTAL: 30+30=60 PERIODS</b>
<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Summarize software engineering principles and activities involved in building large software programs  <b>CO2:</b> Describe the different phases of software development.  <b>CO3:</b> Explain the basics of OOAD and develop software using object oriented design.  <b>CO4:</b> Illustrate the different stages of the design process with a case study.  <b>CO5:</b> Develop miniprojects using the application of object oriented analysis and design.  <b>CO6:</b> Apply different testing strategies to develop efficient projects.</p>
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach" , McGraw Hill International Edition, Ninth Edition, 2020.</li> <li>2. Ali Bahrami, "Object Oriented Systems Development", McGraw Hill International Edition, 2017.</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Micheal Blalh and James Rumbaugh, Object Oriented Modeling and Design with UML, 2nd edition Pearson 2013.</li> <li>2. Ian Sommerville, "Software Engineering", Tenth Edition, Pearson Education, 2016.</li> <li>3. Ivar Jacobson, Harold Bud Lawson, Pan-Wei Ng, Paul E. McMahon, Michael Goedicke, "The Essentials of Modern Software Engineering", Morgan &amp; Claypool Publishers, 2019.</li> <li>4. Booch, G, Jacobson I, Rumbaugh J, "The Unified Modeling Language User Guide", Addison Wesley, 2008.</li> <li>5. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language" 3rd edition, Addison Wesley, 2003.</li> </ol>
<p><b>SOFTWARE REQUIREMENTS:</b>  ArgoUML, Visual Paradigm</p>

<b>22CD601</b>	<b>PRINCIPLES OF UI/UX DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<p><b>OBJECTIVES:</b></p> <ul style="list-style-type: none"> <li>• To explain the principles of User Interface (UI) in order to do design with intention.</li> <li>• To define the User eXperience (UX) and the psychology behind user decision making.</li> <li>• To discuss about UX process and user Psychology.</li> <li>• To apply technology for designing web applications with multimedia effects.</li> <li>• To create a wireframe and prototype.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO UI</b>				<b>9+6</b>

Introduction to UI - Designing Behaviour: Designing with Intention - Conditioning and Addiction - Timing Matters - Gamification - Social/Viral Structure–Trust - Hidden versus Visible. Basic Visual Design Principles: Visual Weight - Contrast - Depth and Size – Color- Layout: Page Framework - Footers - Navigation -Images, and Headlines - Forms - Input Types - Labels and Instructions - Primary and Secondary Buttons - Adaptive and Responsive Design - Touch versus Mouse.

**List of Exercises:**

1. Design UI for a Game website.
2. Design one-page UI for a website.

<b>UNIT II</b>	<b>USER OBSERVATION AND EXPERIENCE</b>	<b>9+6</b>
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User Research - Subjective Research - Objective Research - Three Basic Types of Questions. Observe a user: Watch How They Choose - Interviews - Surveys - Card Sorting - Creating User Profiles - Bad profile - Useful profile.

**List of Exercises:**

1. Design UI for a mobile.
2. Explore the Look and Feel of the new Project developed in Ex1.

<b>UNIT III</b>	<b>INTRODUCTION TO UX</b>	<b>9+6</b>
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Introduction about UX - Five Main Ingredients of UX - Three “Whats” of user Perspective - Pyramid of UX Impact - UX Is a Process - UX - Not an Event or Task. Behaviour Basics: Psychology versus Culture - User Psychology - Experience - Conscious vs Subconscious Experience - Emotions - Gain and Loss – Motivations.

**List of Exercises:**

1. Design a mascot for an imaginary brand.
2. Create a Sample Pattern Library for a product (Mood board, Fonts, Colors based on UI principles).

<b>UNIT IV</b>	<b>WEB INTERFACE DESIGN</b>	<b>9+6</b>
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Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow – Using Motion for UX - Design Pattern: Z-Pattern - F-Pattern - Visual Hierarchy - Lookup patterns – Feedback patterns.

**List of Exercises:**

1. Design a mock-up website for a service sector company.
2. Create a brainstorming feature for proposed product.

<b>UNIT V</b>	<b>WIREFRAMING, PROTOTYPING AND TESTING</b>	<b>9+6</b>
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Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wire flows - Building a Prototype - Building High-Fidelity Mock-ups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

**List of Exercises:**

1. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements.
2. Design a mobile mock-up website for an online store.

**TOTAL: 45+30=75 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the principles of User Interface (UI) Design in order to design with intention.

**CO2:** Analyze the effective User eXperience (UX) and the psychology behind user decision

making.

**CO3:** Examine the importance of UX process and user Psychology.

**CO4:** Elucidate the implications for designing web application with multimedia effects.

**CO5:** Create Wireframe and Prototype.

**CO6:** Develop the ability to work collaboratively within design teams and articulate design ideas and decisions effectively.

**TEXT BOOKS:**

1. Joel Marsh, "UX for Beginners", O'Reilly Media, Inc., 1st Edition 2015.
2. Xia Jiajia, "UI UX Design", O'Reilly, Artpower International, 2016.
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition, O'Reilly 2020

**REFERENCES:**

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition O'Reilly 2020.
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018.
3. <https://www.uxai.design/#:~:text=for%20designers,for%20AI%20products%20and%20services>

**SOFTWARE REQUIREMENTS:**

Javascript, Applets, Equivalent Frontend tools, MySQL, Figma or equivalent.

22CS611	ADVANCED APTITUDE AND CODING SKILLS - II	L	T	P	C
		0	0	2	1
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"><li>● To develop advanced vocabulary for effective communication and reading skills.</li><li>● To build an enhanced level of logical reasoning and quantitative skills.</li><li>● To develop error correction and debugging skills in programming.</li><li>● To apply data structures and algorithms in problem solving.</li></ul>					
<b>LIST OF EXERCISES:</b>					
<b>1.English – Phase II Advanced</b> 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					
<b>2. Logical Reasoning – Phase II Advanced</b> 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					
<b>3. Quantitative Ability - Phase II Advanced</b> 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					
<b>4. Automata Fix – Phase II</b>					

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:

**At the end of this 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.

**CO5:** Develop coding solutions for real-world problems.

**CO6:** Engage in collaborative projects and provide constructive feedback during code reviews.

### SEMESTER –VII

22AI602	AUTOMATION THEORY AND COMPILER DESIGN	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• To introduce the fundamental concepts of automata theory.</li> <li>• To understand deterministic and non-deterministic finite automata.</li> <li>• To elaborate on Regular Expressions and Grammars.</li> <li>• To introduce Push down Automata and Turing Machines.</li> <li>• To introduce the major concepts of language translation and compiler design.</li> <li>• To elaborate the code optimization and code generation in compiler design.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO AUTOMATA THEORY</b>	<b>9</b>			
<p><b>Introduction to Finite Automata:</b> Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems.</p> <p><b>Nondeterministic Finite Automata:</b> Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions.</p> <p><b>Deterministic Finite Automata:</b> Definition of DFA, How A DFA Process Strings, The language of DFA, Conversion of NFA with <math>\epsilon</math>-transitions to NFA without <math>\epsilon</math>-transitions. Conversion of NFA to DFA.</p>					
<b>UNIT II</b>	<b>REGULAR EXPRESSIONS AND CONTEXT FREE GRAMMARS</b>	<b>9</b>			
<p><b>Regular Expressions:</b> Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions.</p> <p><b>Pumping Lemma for Regular Languages:</b> Statement of the pumping lemma, Applications of the Pumping Lemma.</p> <p><b>Context-Free Grammars:</b> Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages.</p>					
<b>UNIT III</b>	<b>PDA AND TURING MACHINES</b>	<b>9</b>			
<p><b>Push Down Automata:</b> Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA and CFG's, Acceptance by final state</p> <p><b>Turing Machines:</b> Introduction to Turing Machine, Formal Description, Instantaneous</p>					

description, The language of a Turing machine .		
<b>UNIT IV</b>	<b>LEXICAL AND SYNTAX ANALYSIS</b>	<b>9</b>
<b>Introduction:</b> The structure of a compiler, <b>Lexical Analysis:</b> The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex, <b>Syntax Analysis:</b> Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom- Up Parsing, Introduction to LR Parsing: Simple LR, More Powerful LR Parsers, Parser Generators YACC.		
<b>UNIT V</b>	<b>CODE GENERATION AND OPTIMIZATION</b>	<b>9</b>
<b>Code generation and optimization:</b> Issues in the design of code generator, a simple code generator, Introduction to code optimization, Basic blocks & flow graphs, DAG representation of basic blocks, Peephole optimization, the principle sources of optimization.		
<b>TOTAL : 45 PERIODS</b>		
<b>OUTCOMES:</b> <b>Upon completion of the course, the students will be able to:</b> <b>CO1:</b> Construct deterministic and non-deterministic finite automata. <b>CO2:</b> Design context free grammars for formal languages using regular expressions. <b>CO3:</b> Use PDA and Turing Machines for recognizing context-free languages. <b>CO4:</b> Design a lexical analyzer. <b>CO5:</b> Design syntax analyzer. <b>CO6:</b> Design a simple code generator and apply different code optimizations.		
<b>TEXT BOOKS:</b> 1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, 3rd Edition, Pearson Education, 2008. 2. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles, Techniques and Tools", Second Edition, Pearson, 2013.		
<b>REFERENCES:</b> 1. K.L.P Mishra and Chandrashekar, Theory of Computer Science – Automata languages and computation, 3 <sup>rd</sup> Edition, PHI, 2007. 2. Elain Rich, "Automata, Computability and complexity", 1 <sup>st</sup> Edition, Pearson Education, 2018. 3. Peter Linz, "An introduction to Formal Languages and Automata", Jones and Bartlett Publishers, 6 <sup>th</sup> Edition, 2016. 4. K Muneeswaran, "Compiler Design", Oxford University Press, 2013. 5. John C Martin, Introduction to Languages and The Theory of Computation, TMH, 4 <sup>th</sup> Edition, 2010.		

<b>22CD701</b>	<b>MOBILE APPLICATION DEVELOPMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<b>OBJECTIVES:</b> <ul style="list-style-type: none"> <li>To understand the need and characteristics of mobile applications model.</li> <li>To design the right user interface for mobile applications.</li> <li>To analyze the design issues in the development of mobile applications.</li> <li>To elucidate the development procedure for mobile applications.</li> <li>To develop mobile applications using various tools and platforms.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>6+6</b>			
Mobile Application Model – Infrastructure and Managing Resources – Mobile Device Profiles – Frameworks and Tools.					

**List of Exercises:**

Explore the impact of efficient resource management strategies on mobile application performance, including battery consumption, network usage, and memory utilization. Evaluate and compare the performance of different mobile application models (native, hybrid, and cross-platform) in terms of responsiveness, resource utilization, and user experience.

<b>UNIT II</b>	<b>USER INTERFACE</b>	<b>6+6</b>
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Generic UI Development - Multimodal and Multichannel UI –Gesture Based UI – Screen Elements and Layouts – Voice XML.

**List of Exercises:**

Implement mobile application using UI toolkits and frameworks.  
Design an application that uses Layout Managers and event listeners.

<b>UNIT III</b>	<b>APPLICATION DESIGN</b>	<b>6+6</b>
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Memory Management – Design Patterns for Limited Memory – Work Flow for Application development – Java API – Dynamic Linking – Plugins and rule of thumb for using DLLs – Concurrency and Resource Management.

**List of Exercises:**

1. Design a mobile application that is aware of the resource constraints of mobile devices.
2. Implement an android application that writes data into the SD card.

<b>UNIT IV</b>	<b>MOBILE OS</b>	<b>6+6</b>
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Mobile OS: Android, iOS – Android Application Architecture – Android basic components – Intents and Services – Storing and Retrieving data – Packaging and Deployment – Security and Hacking.

**List of Exercises:**

1. Develop an application that makes use of mobile database
2. Implement an android application that writes data into the SD card.

<b>UNIT V</b>	<b>APPLICATION DEVELOPMENT</b>	<b>6+6</b>
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Communication via the Web – Notification and Alarms – Graphics and Multimedia: Layer Animation, Event handling and Graphics services – Telephony – Location based services.

**List of Exercises:**

1. Develop web based mobile application that accesses internet and location data.
2. Develop an android application using telephony to send SMS.

**TOTAL : 30+30=60 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand the basics of mobile application development frameworks and tools, able to develop a UI for mobile application

**CO2:** Implement mobile applications that manage memory dynamically.

**CO3:** Design and develop generic, multimodal user interfaces

**CO4:** Build applications based on mobile OS like Android, iOS

**CO5:** Deploy mobile applications, incorporating security measures to protect against hacking and vulnerabilities

**CO6:** Develop layer animation and event handling and location-based services,

**TEXT BOOKS:**

1. Reto Meier, “Professional Android 4 Application Development”, Wiley, First Edition, 2012.

**REFERENCES:**

1. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, "Programming Android", O'Reilly, 2 nd Edition, 2012.  
 2. Alasdair Allan, "iPhone Programming", O'Reilly, First Edition, 2010.

**SOFTWARE REQUIREMENTS:**  
 Android Studio

22CS711	PROFESSIONAL READINESS FOR INNOVATION, EMPLOYABILITY AND ENTREPRENEURSHIP	L	T	P	C
		0	0	6	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To empower students with overall Professional and Technical skills required to solve a real world problem.</li> <li>To mentor the students to approach a solution through various stages of Ideation, Research, Design Thinking, workflows, architecture and building a prototype in keeping with the end-user and client needs.</li> <li>To provide experiential learning to enhance the Entrepreneurship and employability skills of the students.</li> </ul>					
<p>This course is a four months immersive program to keep up with the industry demand and to have critical thinking, team based project experience and timely delivery of modules in a project that solves world problems using emerging technologies.</p> <p>To prepare the students with digital skills for the future, the Experiential Project Based Learning is introduced to give them hands-on experience using digital technologies on open-source platforms with an end-to-end journey to solve a problem. By the end of this course, the student understands the approach to solve a problem with team collaboration with mentoring from Industry and faculties. This is an EEC category course offered as an elective, under the type, "Experiential Project Based Learning".</p>					
<b>Highlights of this course:</b>					
<ul style="list-style-type: none"> <li>Students undergo training on emerging technologies</li> <li>Students develop solutions for real-world use cases</li> <li>Students work with mentors to learn and use industry best practices</li> <li>Students access and use Self-Learning courses on various technologies, approaches, and methodologies.</li> <li>Collaborate in teams with other students working on the same topic</li> <li>Have a dedicated mentor to guide</li> </ul>					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Upskill in emerging technologies and apply to real industry-level use cases					
<b>CO2:</b> Understand agile development process					
<b>CO3:</b> Develop career readiness competencies, Team Skills / Leadership qualities					
<b>CO4:</b> Develop Time management, Project management skills and Communication Skills					
<b>CO5:</b> Use Critical Thinking for Innovative Problem Solving					
<b>CO6:</b> Develop entrepreneurship skills to independently work on products					

The course will involve 40-50 hours of technical training, and 40-50 hours of project development. The activities involved in the project along with duration are given in Table 1.

**TABLE 1 ACTIVITIES**

<b>Activity Name</b>	<b>Activity Description</b>	<b>Time (weeks)</b>
Choosing a Project	Selecting a project from the list of projects categorized various technologies and business domains	2
Team Formation	Students shall form a team of 4 Members before enrolling to a project. Team members shall distribute the project activities among themselves.	1
Hands on Training	Students will be provided with hands-on training on selected technology in which they are going to develop the project.	2
Project Development	Project shall be developed in agile mode. The status of the project shall be updated to the mentors via appropriate platform	6
Code submission, Project Doc and Demo	Project deliverables must include the working code, project document and demonstration video. All the project deliverables are to be uploaded to cloud based repository such as GitHub.	3
Mentor Review and Approval	Mentor will be reviewing the project deliverables as per the milestone schedule and the feedback will be provided to the team.	1
Evaluation and scoring	Evaluators will be assigned to the team to evaluate the project deliverables, and the scoring will be provided based on the evaluation metrics	1
<b>TOTAL</b>		<b>16 WEEKS</b>

	<b>ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>OBJECTIVES:</b>			
<ul style="list-style-type: none"> <li>Facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.</li> <li>Make the students understand the traditional knowledge and analyze it and apply it to their day-to-day life.</li> </ul>			
<b>UNIT I</b>	<b>INTRODUCTION TO TRADITIONAL KNOWLEDGE</b>	<b>9</b>	
Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge			
<b>UNIT II</b>	<b>PROTECTION OF TRADITIONAL KNOWLEDGE</b>	<b>9</b>	
The need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.			
<b>UNIT III</b>	<b>LEGAL FRAMEWORK AND TK</b>	<b>9</b>	
The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFRAct); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.			
<b>UNIT IV</b>	<b>TRADITIONAL KNOWLEDGE AND INTELLECTUAL PROPERTY</b>	<b>9</b>	
Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge.			
<b>UNIT V</b>	<b>TRADITIONAL KNOWLEDGE IN DIFFERENT SECTORS</b>	<b>9</b>	
Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.			
<b>TOTAL : 45 PERIODS</b>			
<b>COURSE OUTCOMES:</b>			
<b>At the end of this course, the students will be able to:</b>			
<b>CO1:</b> Illustrate the concepts of Indian traditional knowledge.			
<b>CO2:</b> Apply the concept of protection of traditional knowledge.			
<b>CO3:</b> Analyze the legal framework and traditional knowledge.			
<b>CO4:</b> Interpret the concept of traditional knowledge and intellectual property.			
<b>CO5:</b> Analyse and apply traditional knowledge to their day-to-day life.			
<b>TEXTBOOKS:</b>			
1. Amit Jha, Traditional Knowledge System in India, Atlantic publishers, 2002.			
<b>REFERENCES:</b>			
1. Kapil Kapoor, Michel Danino, Knowledge Traditions and Practices of India, Central Board of Secondary Education, 2012.			

### PROFESSIONAL ELECTIVE VERTICALS - CREATIVE MEDIA DESIGN

<b>22CD901</b>	<b>DIGITAL AUDIO AND VIDEO DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b>		
<ul style="list-style-type: none"> <li>● Introduce the fundamental principles of audio processing.</li> <li>● Provide an overview of Midi and Synthetic Audio Control.</li> <li>● Review latest trends and future technologies Stereo and Surround Sound.</li> <li>● Introduce the fundamental concepts of video processing.</li> <li>● Learn on Digital Video Processing Techniques and Applications.</li> </ul>		
<b>UNIT I</b>	<b>BASICS OF DIGITAL AUDIO</b>	<b>9</b>
Basics of Digital Audio - Auditory Perception - Noise Reduction. Digital and analogue recording contrasted, A/D and D/A Converter, Pitch Shifting and Time Stretching, Audio Data Reduction.		
<b>UNIT II</b>	<b>MIDI AND SYNTHETIC AUDIO CONTROL</b>	<b>9</b>
MIDI principles- MIDI and digital audio contrasted - Interfacing a computer to a MIDI system- MIDI control of sound generators- Scalable polyphonic MIDI (SPMIDI)- MIDI and synchronisation- MIDI over USB.		
<b>UNIT III</b>	<b>STEREO AND SURROUND SOUND</b>	<b>9</b>
Two-Channel Stereo - Principles of Loudspeaker Stereo - Two-Channel Signal Formats and Microphone techniques, Binaural Recording and Dummy Head Techniques, Surround Sound - Three Channel Stereo, Four Channel Surround, 5.1 Channel Surround, and other Multichannel Configurations. Surround Sound Systems, Matrix Surround Sound Systems, Dolby Digital, DTS, Ambisonics.		
<b>UNIT IV</b>	<b>DIGITAL VIDEO FUNDAMENTALS</b>	<b>9</b>
Basic concepts and Terminology- Analog video standards – Digital video basics – Analog-to Digital conversion – Color representation and chroma subsampling – Digital video formats and standards.		
<b>UNIT V</b>	<b>DIGITAL VIDEO PROCESSING TECHNIQUES AND APPLICATIONS</b>	<b>9</b>
Fundamentals of Motion Estimation and Motion Compensation- General Methodologies in Motion Estimation- Motion Estimation Algorithms- Video Enhancement and Noise Reduction- Noise Reduction in Video- Interframe Filtering Techniques.		
<b>TOTAL : 45 PERIODS</b>		
<b>OUTCOMES:</b>		
At the end of this course, the students will be able to:		
<b>CO1:</b> Introduction of fundamental principles of Audio processing.		
<b>CO2:</b> Provide an overview of Midi and Synthetic Audio Control.		
<b>CO3:</b> Review latest trends and future technologies Stereo and Surround Sound.		
<b>CO4:</b> Introduce the fundamental concepts of Video processing.		
<b>CO5:</b> Learn on Digital Video Processing Techniques and Applications.		
<b>CO6:</b> Implement and evaluate various motion estimation algorithms and assess the impact of various enhancement techniques		
<b>TEXT BOOK:</b>		
1. Francis Rumsey & Tim McCormick "Sound and Recording ", Sixth Edition, 2014, Focal Press, Elsevier Ltd.		
2. Oges Marques, Practical Image and Video Processing Using MATLAB, Wiley-IEEE Press, 2011.		
<b>REFERENCE:</b>		
1. Ian Mcloughlin "Applied Speech and Audio Processing with MATLAB Examples" Cambridge University Press, Cambridge, New York, 2009.		

**SOFTWARE REQUIREMENTS:**

Audacity, Lightworks, VideoPad, HitFilm Express, DaVinci Resolve, VSDC Free Video Editor, OpenShot, Shotcut.

22CD902	3D MODELLING AND DESIGN	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand the basic concepts of modeling.</li> <li>• Gain basic understanding of Lighting and Procedural Textures.</li> <li>• Understand the concepts of curves and nurbs.</li> <li>• Develop 3D Animated Movies.</li> <li>• Acquire knowledge on game engines.</li> </ul>					
<b>UNIT I</b>	<b>MODELING</b>	<b>9</b>			
History and Installation- Modeling- Mesh- Origin Point- Vertices- Edges- Faces- Edit Mode- Some Mesh-Editing Tools- Background Images- Topology- Example Modeling Through Mesh Editing-Sculpt Mode.					
<b>UNIT II</b>	<b>UV MAPPING</b>	<b>9</b>			
Lighting and Procedural Textures- Setting Up a Basic Scene- The Scene Camera- Procedural Materials and Textures- Creating a UV Map- Texture Painting.					
<b>UNIT III</b>	<b>CURVES AND NURBS</b>	<b>9</b>			
Metaballs- Curves- Spin- NURBS- Basic Rigging and Animation- Keyframing with the Timeline- The Dopesheet- Pivot Point: The Center of Rotation- Basic Tracking: Eyes That Follow- Rigging with Bones- Rigging a Simple Character.					
<b>UNIT IV</b>	<b>MAKING MOVIES</b>	<b>9</b>			
Forward Kinematics vs. Inverse Kinetics- Blender 2.5 Rigs- Walk Cycles- Shape Keys- Lip Syncing- Making Movies- The Compositing Node Editor- Lighting Adjustments- A Practical Example of Compositing- The Video Sequence Editor.					
<b>UNIT V</b>	<b>THE GAME ENGINE</b>	<b>9</b>			
Making Particles- Making Hair- Fluid Dynamics- Smoke- Soft Body Physics- The Game Engine- Game Engine Physics- Creating Your Own Droid- Silly Soccer Game- A Change of Scene- Shooting Things.					
<b>TOTAL : 45 PERIODS</b>					
<b>OUTCOMES:</b> <b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Understand the concepts of modeling.					
<b>CO2:</b> Analyze the Lighting and Procedural Textures.					
<b>CO3:</b> Apply the concepts of curves and nurbs.					
<b>CO4:</b> Implement 3D Animated Movies.					
<b>CO5:</b> Create and manipulate particle effects to simulate natural phenomena					
<b>CO6:</b> Develop simple interactive scenes and applications using a game engine.					
<b>TEXT BOOKS:</b>					
1. Lance Flavell, "Beginning Blender: Open-Source 3D Modelling, Animation, and Game Design" Publisher, Apress, 2010.					
<b>REFERENCE:</b>					
1. Michael E.Mortenson "3D Modeling, Animation, and Rendering": An Illustrated Lexicon, Black and White Edition 2010.					
2. Boris Kulagin, "3ds Max 8 from Modelling to Animation", Bpb Publishers, ISBN-10 : 1931769532, Edition 2006.					

3. Michael G, "3D Modelling and Animation: Synthesis and Analysis Techniques for the Human Body", Igi Publishing, 2004.

**SOFTWARE REQUIREMENTS:**

Systems with Blender.

22CD903	MULTIMEDIA SECURITY	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>Learn the basic characteristics of digital watermarking to perform the theoretical analysis and performance measures.</li> <li>Understand the digital authentication and authorization schemes to evaluate security issues related to electronic documents, image and video.</li> <li>Provide a framework to conduct research and development using multimedia security techniques.</li> <li>Impart the knowledge of implementation on digital watermarking and multimedia security techniques.</li> <li>Design a customary multimedia security system to suit real world applications.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO DIGITAL WATERMARKING</b>				<b>9</b>
Digital Watermarking Basics: Models of Watermarking- Basic Message Coding, Error Coding- Digital Watermarking Theoretic Aspects: Mutual information and Channel Capacity- Designing a good digital mark- Theoretical analysis of Digital watermarking					
<b>UNIT II</b>	<b>WATERMARKING SCHEMES AND MEDIA SPECIFIC DIGITAL WATERMARKING</b>				<b>10</b>
Spread Spectrum Watermarking, Transform Domain Watermarking, Quantization Watermarking - Video Watermarking - Audio Watermarking, Binary Image Watermarking, Robustness to Temporal and Geometric Distortions- Affine resistant transformations.					
<b>UNIT III</b>	<b>STEGANOGRAPHY</b>				<b>8</b>
Introduction- Digital Image formats- Modern Steganography-Steganography Channels Steganography Goals					
<b>UNIT IV</b>	<b>STEGANOGRAPHY SCHEMES</b>				<b>9</b>
Image: Substitution- Bit Plane Coding- Transform Domain- Audio: Data Echo Hiding- Phase Coding- Video: Temporal technique- Spatial technique					
<b>UNIT V</b>	<b>MULTIMEDIA ENCRYPTION AND MULTIMEDIA TECHNIQUES</b>				<b>9</b>
Introduction- Goals- Desired Characteristics- Performance metrics- Chaos based- Block based- Transform based techniques					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Understand the basic watermarking techniques to design a good digital mark.					
<b>CO2:</b> Apply the digital authentication and authorization schemes to evaluate security issues related to electronic documents, image and video.					
<b>CO3:</b> Analyze the basic characteristics of digital watermarking to perform the theoretical analysis and performance measures.					
<b>CO4:</b> Acquire the concepts of steganography to access the sensitive information concealing of file, message, image, or video within another file.					
<b>CO5:</b> Obtain a suitable least significant bits construction and dynamic embedding with one-dimensional cellular automata to resist differential attack and support parallel computing.					

**CO6:** Examine the multimedia encryption techniques to address the open issues related to confidentiality of the media content.

**TEXTBOOKS:**

1. Shih, F. Y. (2017). Digital watermarking and steganography: fundamentals and techniques, CRC press.
2. Nematollahi, Mohammad Ali, Vorakulpipat, Chalee, Rosales, Hamurabi Gamboa (2017). Digital Watermarking: Techniques and Trends, Springer, Signals and Communication
3. Pande, Amit, Zambreno, Joseph (2013). Embedded Multimedia Security Systems, Springer, Image Processing
4. Singh, Amit Kumar, Mohan, Anand (2019). Handbook of Multimedia Information Security: Techniques and Applications, Springer, Security and Cryptology.

**REFERENCES:**

1. Cox, I., Miller, M., Bloom, J., Fridrich, J., Kalker, T. (2007). Digital watermarking and steganography. Morgan kaufmann.
2. Yi, Xun, Paulet, Russell, Bertino, Elisa (2014). Homomorphic Encryption and Applications, Springer, Security and Cryptology.

22CD904	INTERACTIVE VISUAL DATA ANALYSIS FOR DESIGNERS	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Acquire the basic knowledge in the concepts of data visualization.</li> <li>• Understand the criteria and the Factors influenced.</li> <li>• Develop the Method and techniques of visualization.</li> <li>• Understand the visualization methods.</li> <li>• Apply support for the visualization.</li> </ul>					
<b>UNIT I</b>	<b>BASIC CONCEPTS OF VISUALIZATION</b>				<b>9</b>
Introduction: Basic Considerations, Visualization, Interaction and Computation, Five Ws of Interactive Visual Data Analysis, Introductory Examples, Starting Simple, Enhancing the Data Analysis, Considering Advanced Techniques					
<b>UNIT II</b>	<b>CRITERIA, FACTORS AND PROCESS MODELS</b>				<b>9</b>
Criteria, Influencing Factors, The Objective: Analysis Tasks, The Context Users and Technologies, Demonstrating Example, Process Models, Design, Data Transformation, Knowledge Generation					
<b>UNIT III</b>	<b>VISUALIZATION METHODS AND TECHNIQUES</b>				<b>9</b>
Visual Encoding and presentation, Encoding data values, presentation, Multivariate data visualization, Visualization of temporal data, Visualization of geo-spatial data, Graph Visualization.					
<b>UNIT IV</b>	<b>INTERACTING WITH VISUALIZATION</b>				<b>9</b>
Human in the loop, Requirements for efficient interaction, basic operations for interaction, interactive selection and accentuation, Navigating zoomable visualizations, interactive lenses, interactive visual comparison, interactive beyond mouse and keyboard					
<b>UNIT V</b>	<b>AUTOMATIC ANALYSIS SUPPORT</b>				<b>9</b>
Decluttering visual Representations, focusing on relevant data, abstracting data, Grouping Similar data elements, Reducing Dimensionality					

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Handle the real-world data sets.

**CO2:** summarize the data transformation and generation.

**CO3:** Identify the outliers in the visualization methods.

**CO4:** Analyze streamline visual representations and decrease dimensionality.

**CO5:** Understand the proficiency in data visualization concepts, techniques, methods and supporting tools.

**TEXTBOOKS:**

1. Interactive Visual Data Analysis, Christian Tominski and Heidrun Schumann AK Peters Visualization Series CRC Press,2020.
2. Visualization of Time – Oriented Data, Wolfgang Aigner, Silvia Miksch, Heidrun Schumann, Christian Tominski, Springer, 2023

**REFERENCES:**

1. Mobile Data Visualization by Bongshin Lee, Raimund Dachsel, Petra Isenberg, Eun Kyong Choe, CRC Press 2022.

22CD905	DESIGN PROCESS AND PERSPECTIVES	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"><li>• Understand design thinking for visual communication</li><li>• Inspect and decide visual compositions</li><li>• Apply design refinement and prototyping</li><li>• Understand the Media Design and Digital Image Printing</li><li>• Learn the concepts of Design for Interactive Media.</li></ul>					
<b>UNIT I</b>	<b>DESIGN THINKING FOR GRAPHICS</b>				<b>9</b>
Role of Graphic Design in Society-Elements of Graphic design: Basic elements-relational elements- Intentional Elements–Principles of Graphic Design-Implications and Impact of Graphic Design –Graphic Design Process: Design thinking Definition – Design thinking stages.					
<b>UNIT II</b>	<b>INSPECTING AND DECIDING VISUAL ELEMENTS</b>				<b>9</b>
Define the problem – Research the problem: Identifying drivers - Information gathering-Target groups – Idea Generation for the problem - Basic design directions-Questions and answers-Themes of thinking – Brainstorming Deciding elements to design - Sketching and Drawing - Lines, shapes, Negative space/white space, Volumes, Value, Color, Texture- Color: Colors Theories-Color wheel - Color Harmonies or Color Schemes- Color Symbolism – Font – Layout.					
<b>UNIT III</b>	<b>REFINEMENT AND PROTOTYPING</b>				<b>9</b>
Refinement of Design: Thinking in images - Thinking in signs - Appropriation - Humor-Personification – Visual metaphors - Modification - Thinking in words- Thinking in technology– Prototyping - Developing designs - ‘Types’ of prototype- Vocabulary – Risk management – Implementation: Format - Materials- Finishing – Case study.					
<b>UNIT IV</b>	<b>MEDIA AND DIGITAL IMAGE PRINTING</b>				<b>9</b>
Digital Imaging and Printing - Advertising Design - Integrated Methods of Advertising - Visuals and their Voice in Advertising - The Stages of Advertising Design - Logo, and Package Development - Campaign Design–Newspaper Design: Newspaper’s Role in					

Modern Advertising: When to Use Newspaper - The Effect of Newsprint on Design Sizing Up Newspaper Columns -Say and look of newspaper - Magazine Design.			
<b>UNIT V</b>	<b>GRAPHIC DESIGN FOR INTERACTIVE MEDIA</b>		<b>9</b>
Graphic Design for Interactive Media - Graphic Design approach - The Design Components That Make Up a Website -Breaking Down the Parts of a Website - Elements to develop website -Designing with HTML- Creating a simple page –Marking up text and tables – Adding links and images – Creating Forms - Basic concept of CSS: Introduction Formatting text-colors-background – Responsive Web Design – Web Image Basics.			
<b>TOTAL: 45 PERIODS</b>			
<b>OUTCOMES:</b>			
<b>At the end of this course, the students will be able to:</b>			
<b>CO1:</b> Understand the various graphic design thinking process and phases.			
<b>CO2:</b> Analyze and choose between various visual compositions			
<b>CO3:</b> Design and communicate various visual components.			
<b>CO4:</b> Apply design concepts for digital imaging, advertising and print media design.			
<b>CO5:</b> Analyze design principles for interactive media			
<b>CO6:</b> Create web applications using different design concepts.			
<b>TEXT BOOKS:</b>			
1. Design Thinking for Visual Communication, Gavin Ambrose, Bloomsbury Publishing, Edition 1, 2017			
2. Advertising Design by Medium a Visual and Verbal Approach, Robyn Blakeman, Taylor and Francis, Edition 1, 2022			
3. Learning Web Design, Jennifer Niederst Robbins, O’ Reilly, 5th Edition, 2018			
<b>REFERENCES:</b>			
1. David Raizman; History of Modern Design, Prentice Hall, 2004.			
2. Handbook of Design Thinking, Christian Mueller-Roterberg, Amazon kindle, 2018.			

<b>22CD934</b>	<b>C# AND .NET PROGRAMMING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Learn basic programming in C# and the object-oriented programming concepts.</li> <li>• Update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.</li> <li>• Study the advanced concepts in data connectivity, WPF, WCF and WWF with C# and .NET 4.5.</li> <li>• Implement mobile applications using .Net compact framework</li> <li>• Understand the working of base class libraries, their operations and manipulation of data using XML.</li> </ul>					
<b>UNIT I</b>	<b>C# LANGUAGE BASICS</b>	<b>6+6</b>			
.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Structs – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers.					
<b>List of Exercises:</b>					
1. Basics of C# and execute simple C# programs.					
2. C# application to print the students list using classes and objects.					
<b>UNIT II</b>	<b>C# ADVANCED FEATURES</b>	<b>6+6</b>			
Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and					

Pointers – Errors and Exceptions – Reflection.		
<b>List of Exercises:</b>		
1. C# application to implement inheritance concepts.		
2. To develop a console application to implement operator overloading concept in C#.		
<b>UNIT III</b>	<b>BASE CLASS LIBRARIES AND DATA MANIPULATION</b>	<b>6+6</b>
Diagnostics -Tasks, Threads and Synchronization – .Net Security – Localization – Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions – ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).		
<b>List of Exercises:</b>		
1. To develop a C# console application to implement threading concepts.		
2. To develop a C# console application to implement the following concepts.		
<b>UNIT IV</b>	<b>WINDOW BASED APPLICATIONS, WCF AND WWF</b>	<b>6+6</b>
Window based applications – Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)- Introduction to Web Services – .Net Remoting – Windows Service – Windows Workflow Foundation (WWF) – Activities – Workflows.		
<b>List of Exercises:</b>		
1. To design a window-based application using C# code in VB.Net.		
2. To implement validating data entered in controls using,		
(a) Windows based application – Manual coding for validation.		
(b) Web based application – Validation Controls.		
<b>UNIT V</b>	<b>.NET FRAMEWORK AND COMPACT FRAMEWORK</b>	<b>6+6</b>
Assemblies – Shared assemblies – Custom Hosting with CLR Objects – Appdomains – Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices		
<b>List of Exercises:</b>		
1. To design a notepad application to implement menus, custom dialog box and MDI concepts.		
2. To design windows-based application to retrieve data from SQL database and to work with disconnected environment in ADO.Net using C#.		
<b>TOTAL : 60 PERIODS</b>		
<b>OUTCOMES:</b>		
Upon completion of the course, the students will be able to:		
<b>CO1:</b> Implement Class and Object concepts using C# Language in the .NET Framework.		
<b>CO2:</b> Develop distributed applications using .NET Framework.		
<b>CO3:</b> Design application using advanced C# features.		
<b>CO4:</b> Understand window-based application, WCF and WWF.		
<b>CO5:</b> Apply assembly management, XAML handling and error resolution		
<b>CO6:</b> Create mobile applications using .NET compact Framework.		
<b>TEXTBOOK:</b>		
1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner. —Professional C# 2012 and .NET 4.5, Wiley, 2012		
2. Harsh Bhasin, —Programming in C#, Oxford University Press, 2014.		
<b>REFERENCE BOOK:</b>		
1. Ian Gariffiths, Mathew Adams, Jesse Liberty, —Programming C# 4.0ll, OReilly, Fourth Edition, 2010.		
2. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.		
3. Andy Wigley, Daniel Moth, Peter Foot, —Mobile Development Handbook, Microsoft Press, 2011.		

**SOFTWARE REQUIREMENTS:**

.Net Framework, Microsoft Visual Studio

22CD906	STREAMING MEDIA TOOLS AND TECHNOLOGIES	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand the basics of Audio and Video Streaming</li> <li>• Study the basics of Streaming media</li> <li>• Know about Streaming Technologies and applications</li> <li>• Learn the concepts of Streaming stages and Tools</li> <li>• Understand Streaming services</li> </ul>					
<b>UNIT I</b>	<b>BASICS OF AUDIO AND VIDEO STREAMING</b>				<b>9</b>
Introduction – IP networks – World wide web – Video formats – Video compression – Audio compression					
<b>UNIT II</b>	<b>BASICS OF STREAMING MEDIA</b>				<b>9</b>
Introduction to streaming media – Video streaming – Audio Streaming - Stream serving – Live Web casting – Media Players					
<b>UNIT III</b>	<b>STREAMING TECHNOLOGIES AND APPLICATIONS</b>				<b>9</b>
Associated Technologies and Applications – Rights Management – Content Distribution – Applications of Streaming Media					
<b>UNIT IV</b>	<b>STREAMING STAGES AND TOOLS</b>				<b>9</b>
Broadcasting Area – setting up your home studio – Preparing stage – starting your first video broadcast – Top live streaming third party apps: vMix v.2x – OBS studio – FFSplit – VidBalsterX –Xsplit – ManyCam – Wirecast v.7 studio					
<b>UNIT V</b>	<b>STREAMING SERVICES</b>				<b>9</b>
Software as a Service websites – Top 7 live streaming websites: Light stream – Smiletime – BlueJeans – BeLive Tv – Vidpresso Live -Zoom webinar addon – Crowdcast					
<b>TOTAL : 45 PERIODS</b>					
<b>OUTCOMES:</b> <b>Upon completion of the course, the students will be able to:</b>					
<b>CO1:</b> Understand the basics of Audio and Video Streaming					
<b>CO2:</b> Develop Streaming media Applications					
<b>CO3:</b> Apply concepts of Streaming Technologies on applications					
<b>CO4:</b> Hands on experience on streaming tools					
<b>CO5:</b> Analyze streaming services					
<b>CO6:</b> Implement SaaS website development integrating live streaming platforms					
<b>TEXT BOOKS:</b>					
1. David Austerberry, The Technology of Audio and Video Streaming, Second Edition, Taylor and Francis 2013.					
2. Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series, 2017.					
<b>REFERENCES:</b>					
1. Helen M Heneveld Audio, Video and Streaming Media Technologies, Smart Home and office technologies, 2018.					

2. Yun-Qing Shi, Image And Video Compression For Multimedia Engineering Fundamentals Algorithms And Standards, Taylor & Francis,2019
3. Jim Simpson, Audio, Video, and Streaming Media Technologies BOOK, McGraw-Hill, Bedrock Learning, E-book.
4. Tay Vaughan, Multimedia: Making it Work, McGraw Hill Education, Ninth Edition, 2017.
5. Lenald Best, Best's Guide to Live Stream Video Broadcasting, BCB Live Teaching series,2017.

22CD907	FILM MAKING	L	T	P	C	
		2	0	2	3	
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>● Understand the fundamentals of short film Making.</li> <li>● Know the working of pre-production</li> <li>● Acquire knowledge about the pre-production and kit.</li> <li>● Know the working of post-production and distribution.</li> <li>● Inculcate the working of scripts and insider</li> </ul>						
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>6+6</b>
Introduction –The Writer- Characters- Storytelling- Writer’s Craft- Software Focus-Screenwriting- The Producer- Small Fish-Cutting Diamonds- The Director. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Create a Power point presentation on Current public issues topics.</li> <li>2. Implement Song mixing using sound Editing tool.</li> </ol>						
<b>UNIT II</b>	<b>PRE-PRODUCTION</b>					<b>6+6</b>
Scheduling and Budgeting-Insurance-Trade Unions-United Kingdom-Crown Funding-Starting a company-Actors Agencies-Screen Agencies-Location Libraries-Finance-Crewing-Casting-Locations. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Creating new sound effects and voice over for the short film using sound editing tool.</li> <li>2. Creating graphics for titles using drawing tool.</li> </ol>						
<b>UNIT III</b>	<b>PRODUCTION AND KIT</b>					<b>6+6</b>
Camera – Lights- Fill Light- Back Light- Lighting equipment- Common lighting terms and accessories- Sounds. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Implementing various transition animation using Unity.</li> <li>2. Editing short film using editing tool.</li> </ol>						
<b>UNIT IV</b>	<b>POST PRODUCTION AND DISTRIBUTION</b>					<b>6+6</b>
Editor – Music – Marketing - Festivals and Distributors - Hybrid Distribution. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Creating Lighting effects using special effects tools.</li> <li>2. Working on color correction and color exposure using Image editing tool.</li> </ol>						
<b>UNIT V</b>	<b>SCRIPTS AND INSIDER</b>					<b>6+6</b>
Making an Oscar nominated short- Secrets of high-production values on a low budget - Noise Control- Storyboarding a silent film. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Preparing shooting script and Editing Script.</li> <li>2. Develop a short film based on current public issues as mini project.</li> </ol>						

**TOTAL : 30 +30=60 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand storytelling, screenwriting, and film production essentials.

**CO2:** Know film production logistics, financing, and leveraging industry resources.

**CO3:** Acquire knowledge about the lighting techniques, sound management and related equipment in film production.

**CO4:** Understand the marketing strategies and distribution, including hybrid models..

**CO5:** Inculcate the working of an Oscar-nominated short.

**CO6:** Learn to create high-quality films on a limited budget

**TEXT BOOKS:**

1. Max Thurlow & Clifford Thurlow, "Making Short Films – The Complete Guide from Script to Screen", Bloomsbury, 2013.

**REFERENCES:**

1. James R. Matin, "Create Documentary Films, telling Techniques Videos and Multimedia: A Comprehensive Guide to Using Documentary Storytelling Techniques for Film Video, The internet and Digital Media Nonfiction project", Real Deal Press, 2010.
2. Michael Rabiger, "Directing the Documentary", Focal Press, 2004.
3. Daniel Faltsek, "Selling Social Media the Political Economy of Social Networking", Bloomsbury Academic, 2018.

**SOFTWARE REQUIREMENTS:**

Lightworks, VideoPad, VSDC Free Video Editor, HitFilm Express or equivalent.

22CD908	ROBOTIC PROCESS AUTOMATION(RPA)	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand the basic concepts of Robotic Process Automation</li> <li>• Expose to the key RPA design and development strategies and methodologies.</li> <li>• Learn the fundamental RPA logic and structure</li> <li>• Explore the Exception Handling, Debugging and Logging operations in RPA</li> <li>• Learn to deploy and maintain the software bot</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO ROBOTIC PROCESS AUTOMATION</b>				<b>9</b>
Emergence of Robotic Process Automation, Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.					
<b>UNIT II</b>	<b>AUTOMATION PROCESS ACTIVITIES</b>				<b>9</b>
Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events					
<b>UNIT III</b>	<b>APP INTEGRATION, RECORDING AND SCRAPING</b>				<b>9</b>
App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV.					

<b>UNIT IV</b>	<b>EXCEPTION HANDLING AND CODE MANAGEMENT</b>	<b>9</b>
Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.		
<b>UNIT V</b>	<b>DEPLOYMENT AND MAINTENANCE</b>	<b>9</b>
Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors – Open Source RPA, Future of RPA		
<b>TOTAL: 45 PERIODS</b>		
<b>COURSE OUTCOMES:</b>		
At the end of this course, the students will be able to:		
<b>CO1:</b> Enunciate the key distinctions between RPA and existing automation techniques and platforms.		
<b>CO2:</b> Apply UiPath to design control flows and work flows for the target process		
<b>CO3:</b> Implement recording, web scraping and process mining by automation		
<b>CO4:</b> Use UiPath Studio to detect, and handle exceptions in automation processes		
<b>CO5:</b> Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.		
<b>CO6:</b> Gain proficiency in deploying and managing software bot.		
<b>TEXT BOOKS:</b>		
1. Alok Mani Tripathi “Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath”, Packt Publishing, 2018.		
2. Tom Taulli , “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress publications, 2020.		
<b>REFERENCES:</b>		
1. Frank Casale, Rebecca Dilla, Heidi Jaynes , Lauren Livingston, ”Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation”, Amazon Asia-Pacific Holdings Private Limited, 2018		
2. Richard Murdoch, “Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Amazon Asia-Pacific Holdings Private Limited, 2018		
3. A Gerardus Blokdyk, “Robotic Process Automation - A Complete Guide “, 2020		

**PROFESSIONAL ELECTIVE VERTICALS - VIRTUAL AND AUGMENTED REALITY**

<b>22CD918</b>	<b>AUGMENTED AND VIRTUAL REALITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Get exposure on Augmented Reality.</li> <li>• Introduce Virtual Reality and input and output devices.</li> <li>• Acquire knowledge on computing architectures and modelling.</li> <li>• Explore Virtual Reality programming and human factors.</li> <li>• Learn various applications of Virtual Reality.</li> </ul>					
<b>UNIT I</b>	<b>AUGMENTED REALITY (AR)</b>	<b>6+6</b>			
Introduction to Augmented Reality-Computer vision for AR-Interaction- Modelling and Annotation-Navigation-Wearable devices.					
<b>List of Exercises:</b>					

<p>1. Develop simple AR Application like snapchat. 2. Develop AR enabled simple applications like human anatomy visualization, DNA/RNA structure visualization.</p>		
<b>UNIT II</b>	<b>INTRODUCTION TO VIRTUAL REALITY (VR) AND INPUT AND OUTPUT DEVICES</b>	<b>6+6</b>
<p>Introduction: The three I's of Virtual Reality - - Early commercial VR technology - The five classic components of a VR system. Input devices: Three-Dimensional position trackers - tracker performance parameters - ultrasonic trackers - optical trackers - Navigation and manipulation interfaces - gesture interfaces. Output devices: graphics displays - large-volume displays - sound displays. <b>List of Exercises:</b> 1. Study of tools like Unity, Maya/3DS MAX/Blender. 2. Use the primitive objects and apply various projection types by handling camera.</p>		
<b>UNIT III</b>	<b>COMPUTING ARCHITECTURES AND MODELING OF A VR SYSTEM</b>	<b>6+6</b>
<p>Computing architectures for VR: The rendering pipeline - The graphics rendering pipeline - The haptics rendering pipeline - PC graphics architecture - PC graphics accelerators - Graphics benchmarks - Distributed VR architectures - Multipipeline synchronization - Colocated rendering pipelines. Modeling: geometric modeling - kinematics modeling - physical and behavior modelling <b>List of Exercises:</b> 1. Download objects from asset store and apply various lighting and shading effects. 2. Model three dimensional objects using various modelling techniques and apply textures over them</p>		
<b>UNIT IV</b>	<b>VR PROGRAMMING AND HUMAN FACTORS</b>	<b>6+6</b>
<p>Toolkits and scene graphs - WorldToolKit - Model geometry and appearance - The WTK scene graph - Sensors and action functions - WTK networking - Java 3D - Model geometry and appearance - Java 3D scene graph - Sensors and behaviors - Java 3D networking - WTK and Java 3D performance comparison –Human factors in VR: Methodology and terminology - user performance studies - VR health and safety issues - VR and society <b>List of Exercises:</b> 1. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity. 2. Add audio and text special effects to the developed application</p>		
<b>UNIT V</b>	<b>APPLICATIONS OF VR</b>	<b>6+6</b>
<p>Medical Application of VR - Virtual anatomy-Triage and diagnostic - Surgery - VR in education - VR and the Arts - Entertainment applications of VR - military VR applications - Army use of VR - VR applications in the Navy - Air force use of VR - Applications of VR in Robotics - Robot programming - Robot teleoperation <b>List of Exercises:</b> 1. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity. 2. Develop VR/AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.</p>		
<b>TOTAL = 30+30=60 PERIODS</b>		
<p><b>OUTCOMES:</b> Upon completion of the course, the students will be able to: <b>CO1:</b> Understand Augmented Reality. <b>CO2:</b> Explore different input and output devices used in Virtual Reality system. <b>CO3:</b> Model the VR system. <b>CO4:</b> Analyze about Google Toolkit's and Scene Graph.</p>		

<b>CO5:</b> Apply virtual reality in a variety of sectors..
<b>CO6:</b> Assess the effectiveness of VR in improving training outcomes and operational readiness
<b>TEXT BOOKS:</b>
1. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016.
2. Grigore C. Burdea, Philippe Coiffet, "Virtual reality technology", Wiley, Second Edition, 2017.
<b>REFERENCE BOOKS:</b>
1. Sherman, William R & Craig, Alan B, "Understanding Virtual reality", Elsevier India Private Limited, Noida, 2018.
2. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.
<b>SOFTWARE REQUIREMENTS:</b>
Unity, Maya/3DS MAX/Blender.

22CD919	GAME DESIGN	L	T	P	C
		2	0	2	3
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>Understand the Fundamental principles of Game Design and Development ·</li> <li>Know the importance and application of Game AI ·</li> <li>Learn the detailed processes of typical Game Engine ·</li> <li>Apply simple 2D games using the design and development process learnt ·</li> <li>Implement simple 3D games using the design and development process learnt.</li> </ul>					
<b>UNIT I</b>	<b>GAME DESIGN FUNDAMENTALS</b>	<b>6+6</b>			
Role of Game Designer, Structure of Games, major genres, game concepts, game worlds, working with formal elements, dramatic elements and system dynamics, storytelling, game play, core mechanics, game balancing, principles of Level Design, Conceptualization, prototyping, playtesting. <b>List of Exercises:</b> (Note: Students can work in small teams of 2 or 3 for the experiments) 1. Install any Game Engine (Ex: Godot engine / equivalent) and understand the features and functions. 2. Install Blender and learn basic 3D graphics including rendering pipeline, textures, coordinate systems, lighting, simple animation					
<b>UNIT II</b>	<b>GAME AI</b>	<b>6+6</b>			
Game AI, AI model, algorithms for Movement, Path finding, Decision making, Tactical and Strategic AI, Procedural Content Generation, Board Games. <b>List of Exercises:</b> 1. Implement path finding algorithm and incorporate the same in the 2D game. 2. Implement simple board game.					
<b>UNIT III</b>	<b>GAME ENGINE</b>	<b>6+6</b>			
Rendering engine and pipeline, Scene Graph, Level of Detail, sorting, Animation Systems, Collision and Rigid Body dynamics. <b>List of Exercises:</b> 1. Experiment with creating and importing simple 2D / 3D characters, into the work environment 2. Create and implement simple animation using blender/equivalent tools.					
<b>UNIT IV</b>	<b>2D GAME DESIGN AND IMPLEMENTATION</b>	<b>6+6</b>			

GoDot game engine Designing and Prototyping a simple 2D Game, including character design, storytelling, levels. Implementing the Game in pygame or Godot engine or equivalent. <b>List of Exercises:</b> 1. Design and document a simple 2D game, following the principles of game design, including genre, characters, game world, characters, game mechanics, levels. 2. Implement the 2D game using pygame / equivalent tools.				
<b>UNIT V</b>	<b>3D GAME DESIGN AND IMPLEMENTATION</b>			<b>6+6</b>
Designing and Prototyping a simple 3D Game, including character design, storytelling, levels. Implementing the Game in pygame or Godot engine or Blender or equivalent. <b>List of Exercises:</b> 1. Design and document a simple 3D game, following the principles of game design, including genre, characters, game world, characters, game mechanics, levels. 2. Implement the 3D game using Blender / equivalent tools.				
<b>TOTAL: 30+30=60 PERIODS</b>				
<b>OUTCOMES:</b> <b>At the end of this course, the students will be able to:</b> <b>CO1:</b> Use the Fundamental principles of Game Design and Development in context. <b>CO2:</b> Able to apply AI techniques in Game Design and Development. <b>CO3:</b> Thoroughly understand the detailed processes of the Game Engine. <b>CO4:</b> Design simple 2D games using the design and development process learnt. <b>CO5:</b> Implement simple 3D games using the design and development process learnt. <b>CO6:</b> Understand the principles of character modeling, texturing, and rigging.				
<b>TEXT BOOKS:</b> 1. Ernest Adams, "Fundamentals of Game Design", 3rd Edition, Pearson Education, 2015. 2. Ian Millington, "AI for Games", CRC Press, 3rd edition, 2019. 3. Jung Hyun Han, "3D Graphics for Game Programming", Delmar Cengage Learning, 2011.				
<b>REFERENCES:</b> 1. Tracy Fullerton: Game Design Workshop, A Play centric Approach to Creating Innovative Games, 4th Edition, CRC Press, 2018. 2. Jason Gregory, "Game Engine Architecture", CRC Press, Third Edition, 2018. 3. Ernest Adams and Joris Dormans, "Game Mechanics: Advanced Game Design", New Riders Press, 2012. 4. Jesse Schell, "The Art of Game Design, A Book of Lenses", Third Edition, CRC Press, 2019. 5. <a href="https://godotengine.org/">https://godotengine.org/</a> 6. <a href="https://www.pygame.org">https://www.pygame.org</a> 7. <a href="https://www.blender.org/">https://www.blender.org/</a>				
<b>SOFTWARE REQUIREMENTS:</b> Standalone desktops with Blender/Equivalent tools.				

<b>22AI922</b>	<b>GPU COMPUTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>Understand the basics of GPU Architectures and CUDA Programming.</li> <li>Analyze synchronization using CUDA.</li> <li>Discuss memories and its impact on performance.</li> </ul>					

<ul style="list-style-type: none"> <li>Understand the various parallel algorithms on GPU.</li> <li>Apply the basics of OPENCL.</li> </ul>			
<b>UNIT I</b>	<b>GPU ARCHITECTURES AND CUDA PROGRAMMING</b>	<b>9</b>	
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.			
<b>UNIT II</b>	<b>MULTI-DIMENSIONAL DATA &amp; SYNCHRONIZATION</b>	<b>9</b>	
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.			
<b>UNIT III</b>	<b>CUDA MEMORIES &amp; PERFORMANCE</b>	<b>9</b>	
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.			
<b>UNIT IV</b>	<b>ALGORITHMS ON GPU</b>	<b>9</b>	
Parallel Patterns: Convolution – Prefix Sum – Sparse Matrix – Vector Multiplication.			
<b>UNIT V</b>	<b>OPENCL BASICS</b>	<b>9</b>	
Introduction – OpenCL Platform Model – Execution Model – Programming model – Memory Model – OpenCL Runtime.			
<b>TOTAL: 45 PERIODS</b>			
<b>OUTCOMES:</b>			
<b>Upon completion of the course, the students will be able to:</b>			
<b>CO1:</b> Understand the basics of GPU Architectures and implement simple CUDA Programs.			
<b>CO2:</b> Discuss synchronization using CUDA.			
<b>CO3:</b> Elaborate CUDA memories and its impact on performance.			
<b>CO4:</b> Design various parallel algorithms on GPU.			
<b>CO5:</b> Solve simple problems using parallel algorithms.			
<b>CO6:</b> Apply OpenCL to solve programs and improve performance.			
<b>TEXT BOOKS:</b>			
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.			
<b>REFERENCES:</b>			
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: <ul style="list-style-type: none"> <li>a. GPU Architectures And Programming - <a href="https://onlinecourses.nptel.ac.in/noc23_cs61/preview">https://onlinecourses.nptel.ac.in/noc23_cs61/preview</a></li> </ul>			

<b>22CD924</b>	<b>INFORMATION DESIGN AND VISUALIZATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>OBJECTIVES:</b>		
<b>The Course will enable learners to:</b>		
<ul style="list-style-type: none"> <li>• Understand the basic concepts of design</li> <li>• Develop the knowledge on the basis of design controlling</li> <li>• Illustrate the role of python libraries for visualization</li> <li>• Learn and organize different data visualization techniques</li> <li>• Discuss, analyze and evaluate visualization models</li> </ul>		
<b>UNIT I</b>	<b>INTRODUCTION TO DESIGN FUNDAMENTALS</b>	<b>9</b>
Exploration of Complex Information Spaces, Orientation in Complex Information Spaces, Fisheye Views: A Step Towards Abstraction, Applications of Fisheye Views, Fisheye Views for 3D Data, Enrichment and Reuse of Geometric Models, Requirement Analysis, Approach to Reuse and Enrich Models.		
<b>UNIT II</b>	<b>DESIGN CONTROLLING</b>	<b>9</b>
Rendering line Drawings for Illustrative Purposes, An Analytic Rendering Pipeline, Hidden Line Elimination, Drawing the Lines – Shading, Illustrating with Lines, Measuring and Highlighting in Graphics, Approaches and Techniques in Paintings, Theoretical Background, Measuring Colour Contrasts, Animation Analysis, Colour Discontinuity, Discontinuity in Motion, Emphasizing Objects		
<b>UNIT III</b>	<b>PYTHON LIBRARIES FOR VISUALIZATION</b>	<b>9</b>
Exploratory Data Analysis Fundamentals, The Significance of EDA, Launching the IPython Shell - Launching the Jupyter Notebook - IPython Magic Commands – Making Sense of data, The Basics of NumPy Arrays-Pandas, SciPy, Matplotlib.		
<b>UNIT IV</b>	<b>DATA VISUALIZATION</b>	<b>9</b>
Overview-Visualization Design Principles - Univariate Data Visualization- Bivariate Data Visualization- Multivariate Data Visualization-Visualizing Groups-Dynamic Techniques- Overview Data Brushing, Nearness Selection, Sorting and Rearranging, Searching and Filtering		
<b>UNIT V</b>	<b>MODEL DEVELOPMENT AND EVALUATION</b>	<b>9</b>
Hypothesis testing and regression- Hypothesis testing, p-hacking, understanding regression, Model development and evaluation, Understanding Supervised Learning, Understanding unsupervised Learning, Reinforcement Learning, Machine Learning workflow.		
<b>TOTAL : 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Identify the characteristics of Design Fundamentals.		
<b>CO2:</b> Understand the design controlling process.		
<b>CO3:</b> Apply the python libraries for Visualization.		
<b>CO4:</b> Examine the data visualization process.		
<b>CO5:</b> Describe the methods of a visualization model.		
<b>CO6:</b> Elaborate on model development and evaluation.		
<b>TEXT BOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Thomas Strothotte, Computational Visualization Graphics, Abstraction, and Interactivity, Springer-Verlag Berlin Heidelberg New York, 2011</li> <li>2. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt publishing , March 2020.</li> <li>3. Glenn J. Myatt, Wayne P. Johnson, Making sense of data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications,2008.</li> </ol>		

**REFERENCES:**

1. Chaomei Chan, "Information Visualization: Beyond the Horizon", 2nd edition, Springer Verlag, 2004.
2. Suresh Kumar Mukhiya and Usman Ahmed, "Hands-on Exploratory Data Analysis with Python", Packt publishing, March 2020.
3. Danyel Fisher & Miriah Meyer, "Making Data Visual: A Practical Guide To Using Visualization For Insight", O'reilly publications, 2018.

22CD921	INTERNET OF THINGS	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand the fundamentals of Internet of Things.</li> <li>• Discuss the IoT topologies and types.</li> <li>• Describe about the basics of IOT protocols.</li> <li>• Build a small low-cost embedded system using Raspberry Pi.</li> <li>• Apply the concept of Internet of Things in the real-world scenario.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO IoT</b>				<b>9</b>
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M					
<b>UNIT II</b>	<b>EVOLUTION OF IoT</b>				<b>9</b>
Emergence of IoT – IoT versus M2M, IoT versus CPS, IoT versus WoT, IoT Sensing and Actuation –sensor characteristics, sensing types, actuator characteristics, types, IoT Processing Topologies and Types					
<b>UNIT III</b>	<b>IoT PROTOCOLS</b>				<b>9</b>
IoT Connectivity Technologies –IEEE 802.15.4, Zigbee, Thread, Z-wave, wireless HART, IoT Communication Technologies: Introduction – Infrastructure protocols – IPv6, RPL, QUIC, Micro internet protocol, Discovery protocols – Data protocols -MQTT, AMQP, XMPP, Identification protocols – Device management – Semantic protocols					
<b>UNIT IV</b>	<b>BUILDING IoT WITH RASPBERRY PI &amp; ARDUINO</b>				<b>9</b>
Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Devices - Arduino.					
<b>UNIT V</b>	<b>IoT AND FUTURE TRENDS</b>				<b>9</b>
Agricultural IoT - Vehicular IoT - Healthcare IoT – Paradigms, challenges and future.					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Understand the fundamentals of Internet of Things.					
<b>CO2:</b> Apply the significance of evolution of IoT topologies and types.					
<b>CO3:</b> Analyze various protocols for IoT.					
<b>CO4:</b> Design a portable IoT using Raspberry Pi.					
<b>CO5:</b> Develop applications of IoT in real time scenario.					
<b>CO6:</b> Assess security, privacy, and ethical impacts of IoT deployments and recommend best practices to mitigate risks.					
<b>TEXT BOOKS:</b>					
1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015.					

- Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press, 2021.

**REFERENCES:**

- 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.
- Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
- Srinivasa K.G., Siddesh G.M., Hanumantha Raju R., "Internet of Things", Cengage Learning India Pvt Ltd, First Edition, 2018.
- Mohammed A. Matin, "Wireless Sensor Networks: Technology and Protocols", InTech, 2012.
- Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
- Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
- Jan Ho" ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.

22CD922	METAVERSE	L	T	P	C
		2	0	2	3
<p><b>OBJECTIVES:</b></p> <p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>Understand the History of Metaverse.</li> <li>Explore the role of Metaverse to connect the real world and blockchain.</li> <li>Analyze the advanced development of blockchain in the future.</li> <li>Examine an open ecosystem of smart properties and assets.</li> <li>Explore the integration of futuristic technologies such as blockchain, crypto currency, DAO, AR/VR.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO METAVERSE</b>	<b>6+6</b>			
<p>Introduction to Metaverse and immersive experience- History of Metaverse- Metaverse value chain with 7 layers.</p> <p><b>List of Exercise:</b></p> <p>Installations: Hardware Required: Android phone, Cardboard Viewer, PC with Dedicated Graphics Card and atleast 32GB RAM. Software required: Android Studio, Cardboard SDK, Android NDK, Google Carboard XR plugin for Unity, Unity, Nethereum library to (as needed)</p>					
<b>UNIT II</b>	<b>TECHNOLOGIES INVOLVED IN THE METAVERSE</b>	<b>6+6</b>			
<p>Metaverse as a product of Extended Reality- Augmented Reality (AR)- Virtual Reality (VR)- Benefits of AR/VR-Difference between AR/ VR - Mixed Reality (MR)-Artificial Intelligence (AI) Introduction in Metaverse-Financial and Economics of Metaverse-Benefits of Metaverse.</p> <p><b>List of Exercise:</b></p> <p>Using Google Cardboard SDK for Creating simple AR/VR (XR) applications in Unity.</p>					
<b>UNIT III</b>	<b>BLOCKCHAIN ADOPTION IN METAVERSE</b>	<b>6+6</b>			
<p>Blockchain Overview-History of Blockchain-Need of Decentralization in MV-Smart Contract Capabilities in Blockchain - Blockchain in Metaverse -Understanding Tokens-Understanding the NFT-NFT Token Standards-NFTs in MV-Cryptocurrency in MV.</p> <p><b>List of Exercise:</b></p>					

Creating blockchain applications in metaverse, by creating virtual assets, smart Contracts for exchange of assets using utility tokens and NFTs.			
<b>UNIT IV</b>	<b>AR, VR, AND MR IN METAVERSE</b>	<b>6+6</b>	
Everything about VR (Virtual Reality)-Everything about AR (Augmented Reality)-Everything about MR (Mixed Reality)-Block chain Identity Management in Metaverse -NFT (non-fungible token) for Metaverse-Introduction to NFTs-History of NFTs-Benefits of NFTs. <b>List of Exercise:</b> Create any Metaverse based application by picking one usecase.			
<b>UNIT V</b>	<b>USE-CASES</b>	<b>6+6</b>	
Gaming in Metaverse-Meetings in Metaverse- Virtual Learning in Metaverse- Social Interactions in Metaverse- Virtual Real-estate in Metaverse- e-commerce in Metaverse- Travel in Metaverse- Personalized Avatars- Digital Identity in Metaverse. <b>List of Exercise:</b> Create any Metaverse based application use cases like Gaming, Entertainment, Education and Learning, Healthcare, Banking and Financial.			
<b>TOTAL: 30+30 PERIODS</b>			
<b>OUTCOMES:</b> <b>At the end of this course, the students will be able to:</b> <b>CO1:</b> Understand the history of Metaverse. <b>CO2:</b> Examine the Metaverse technologies to connect the real world and blockchain. <b>CO3:</b> Apply the advanced development of blockchain in the future. <b>CO4:</b> Explore the open ecosystem of smart properties and assets. <b>CO5:</b> Integrate futuristic technologies such as blockchain, cryptocurrency, DAO, AR/VR. <b>CO6:</b> Analyze the societal and ethical implications of the Metaverse, including issues related to privacy, security, and digital identity.			
<b>TEXT BOOKS:</b> 1. The Metaverse: And How It Will Revolutionize Everything Kindle Edition by Matthew Ball , Publisher : Liveright, 2022 2. The Metaverse Handbook: Innovating for the Internet& #39;s Next Tectonic Shift Kindle Edition by QuHarrison Terry (Author), Scott Keeney (Author), Paris Hilton (Foreword), Publisher: Wiley; 1st edition ,2022			
<b>REFERENCES:</b> 1. The Wearable Technology Handbook, Haider Raad, scholar publications, 2017 2. Metaverse Made Easy: A Beginner's Guide to the Metaverse, Dr.Liew Voon Kiong,Publisher, Liew Voon Kiong, 2022 3. Metaverse For Beginners and Advanced: A Complete Journey Into the Metaverse Virtual World (Web 3.0), Darell Freeman,Publisher Darell Freeman, 2022 4. Metaverse Glossary - Your Gateway to the Future , Ravindra Dastikop, Evincepub Publishing, 2022 5. The Metaverse: Prepare Now for the Next Big Thing Paperback , Terry Winters , Winters media Publiaction, 2021			
<b>SOFTWARE REQUIREMENTS:</b> Blender/Unity/Unreal Engine/Equivalent Tools			

<b>22CD923</b>	<b>3D PRINTING AND DESIGN</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>OBJECTIVES:</b>		
<p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Understand the basics of 3D Modelling and viewing.</li> <li>• Demonstrate the principles of 3D processing technique and application.</li> <li>• Design and illustrate the working principle of inkjet technology.</li> <li>• Acquire the knowledge of laser technology and Printing machines.</li> <li>• Apply the knowledge in manufacturing, healthcare and medical applications.</li> </ul>		
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>9</b>
Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats.		
<b>UNIT II</b>	<b>PRINCIPLE</b>	<b>9</b>
Processes – Extrusion, Wire, Granular, Lamination, Photo polymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations.		
<b>UNIT III</b>	<b>INKJET TECHNOLOGY</b>	<b>9</b>
Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continuous jet, Multijet; Powder based fabrication – Colourjet.		
<b>UNIT IV</b>	<b>LASER TECHNOLOGY</b>	<b>9</b>
Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow – Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed Movement, Support structures.		
<b>UNIT V</b>	<b>INDUSTRIAL APPLICATIONS</b>	<b>9</b>
Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends;		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Outline and examine the basic concepts of 3D printing technology.		
<b>CO2:</b> Develop 3D printing workflow.		
<b>CO3:</b> Examine and categorise the concepts and working principles of 3D printing using inkjet technique.		
<b>CO4:</b> Describe the working principles of 3D printing using laser technique.		
<b>CO5:</b> Apply various method for designing and modeling for industrial applications.		
<b>CO6:</b> Assess the impacts of 3D printing technologies and recommend sustainable practices for their industrial use.		
<b>TEXT BOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.</li> <li>2. Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley &amp; Sons, 2013.</li> </ol>		
<b>REFERENCES:</b>		
<ol style="list-style-type: none"> <li>1. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010.</li> <li>2. Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007.</li> <li>3. Joan Horvath, Mastering 3D Printing, APress, 2014.</li> </ol>		

22CD920	DIGITAL MARKETING	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Explain the role of digital marketing in overall marketing strategy.</li> <li>• Understand website designing and optimization methods in digital marketing.</li> <li>• Deploy Search Engine Marketing Platforms.</li> <li>• Apply various Social Media Marketing strategies.</li> <li>• Implement the concepts of Web Analytics and various types of report generation.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO DIGITAL MARKETING</b>				<b>9</b>
Digital marketing - Importance of digital marketing-Difference between traditional and digital marketing- Digital marketing platforms- recent trends and current scenario of the industry - digital marketing as a tool for students, professionals and businesses-Tools.					
<b>UNIT II</b>	<b>WEBSITE DESIGNING AND OPTIMIZATION</b>				<b>9</b>
On Page Optimisation (OPO)- HTML and CSS basics- Meta tags usage- Using Javascript - Contextual interlinking - Microformats & schemas - Off-Page Optimization - Linking Strategies - Competitor Analysis-Sculpting-Link baiting - Social Book Marking and Promotions- Directory submissions -Search Engine Optimization (SEO)- Growth of SEO-Ecosystem of a search engine SEO Tools.					
<b>UNIT III</b>	<b>SEARCH ENGINE MARKETING</b>				<b>9</b>
SEM platforms- Google Adwords – Ad creation process- Keyword grouping-Bidding techniques – Site targeting & keyword targeting -Ad approval process – Ad extensions- Site, Demographic targeting, CPC-based, CPA-based & CPM-based accounts					
<b>UNIT IV</b>	<b>SOCIAL MEDIA MARKETING</b>				<b>9</b>
Social Media Marketing- Email Marketing- Mobile Marketing - Adsense, Blogging and Affiliate Marketing.					
<b>UNIT V</b>	<b>WEB ANALYTICS</b>				<b>9</b>
Introduction to Web Analytics- GA Terminology (Dimensions & Metrics)- Introduction to Reports - Audience Reports, Traffic Sources and Content Reports- Campaign Tagging & Reporting - Dashboard- Linking and Using Data from Google Adwords- Case studies on digital marketing strategies.					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Explain the role and importance of digital marketing in a rapidly changing business landscape					
<b>CO2:</b> Apply the marketing research metrics and do market segments, market targets and brand positioning.					
<b>CO3:</b> Examine website designing and optimization.					
<b>CO4:</b> Analyze the various SEM platforms for digital marketing.					
<b>CO5:</b> Discuss the marketing strategies used in social media, then design and manage the Integrated Marketing Channels					
<b>CO6:</b> Examine the web and generate various types of reports for real time application.					
<b>TEXT BOOKS:</b>					
<ol style="list-style-type: none"> <li>1. Seema Gupta, Digital Marketing, McGraw Hill, 2nd Edition, 2020.</li> <li>2. Subhankar Das, Search Engine Optimization and Marketing a Recipe for Success in Digital Marketing, CRC Press, 2021.</li> </ol>					

3. Chuck Hemann, Ken Burbary, Digital Marketing Analytics, Pearson, Second Edition, 2019

**REFERENCES:**

1. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice 7th Edition, Pearson, 2019.
2. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaign, Wiley, 2016.
3. Rob Stokes, eMarketing The Essential Guide to Marketing in a digital world, Quirk eMarketing.
4. Shivani Karwal, Digital Marketing Handbook: A Guide to Search Engine Optimization, 2015.
5. Jacobson, Howie, McDonald, Joel and McDonald, Kristie, Google AdWords for Dummies, 3rd Edition, O'Reilly, 2011.
6. <http://www.gbv.de/dms/zbw/865712123.pdf>
7. [https://www.redandyellow.co.za/content/uploads/woocommerce\\_uploads/2017/10/e-marketing-textbook-download.pdf](https://www.redandyellow.co.za/content/uploads/woocommerce_uploads/2017/10/e-marketing-textbook-download.pdf)

22CD925	MOBILE VR AND AI IN MODULEY	L	T	P	C	
		3	0	0	3	
<b>OBJECTIVES:</b>						
<p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Experience hands-on exposure to mobile virtual reality in Moduley.</li> <li>• Analyze basic AI algorithms in virtual reality.</li> <li>• Understand fundamentals of game designs in virtual reality.</li> <li>• Acquire knowledge on different types of learning.</li> <li>• Discuss on reinforcement learning in moduley.</li> </ul>						
<b>UNIT I</b>	<b>MODULEY</b>					<b>9</b>
Introduction to Moduley, Moduley Editor, Moving a Cube, Lights, Particle Systems, Applying Physics, and Moduley Asset Store, C# Coding Introduction, Variables, Methods, If Blocks, Loops, Hello Mammoth, User Interaction in Moduley, Inputs Introduction Preview, Key Presses, Moving a Player, Jumping, Moving Forward, Cycling Cameras, Prefabs Introduction, What are Prefabs?, Instantiating Objects, Random Angles, Destroying Objects, Explosion Effects, Adding Explosion Effects.						
<b>UNIT II</b>	<b>STARTING THE GAME</b>					<b>9</b>
Developing a Pathfinding Game, How to Set Up a Project, Node, String Map, A* Algorithm Setup, A* Algorithm Loop, Auxiliary Methods, Finishing the Algorithm, Importing 2D Assets, Building a Level, From Console to Visual, Adding Tanks, Identifying Nodes, Moving the Tank, Visually Moving Tank, Smooth Movement, Smooth Rotation, Ordering Tank to Move, Speeding up Player, Spawning Logic, Crate Visuals, Adding Crates to Valid Positions, Collecting Crates, Score Counting, Game Interface, Starting the Game, Game Over Screen, Scoring, Sounds.						
<b>UNIT III</b>	<b>VR INTRODUCTION</b>					<b>9</b>
VR Introduction - Moduley, Activating VR, Building a Castle, Camera Changing Position, Lowering Castle Doors, Triggering Events Interface, Blender, Download and Install Blender, Introduction & Customizing Settings, Controlling Blender Camera, Emulate Numpad Camera, Manipulating Objects, Common Tools, Mirroring 1 Side of Object. Case Study: Flappy bird Moduley game, First person shooter game, Kart Moduley game.						
<b>UNIT IV</b>	<b>MACHINE LEARNING</b>					<b>9</b>

Introduction to Moduley-ML, Why Machine Learning, different kinds of learnings, Neural Networks (NNs), Training a NN, Optimizer, Convolutional layers, Transfer learning, Imitation learning in Moduley, Training the kart in kart game via IL, Testing the drive.	
<b>UNIT V</b>	<b>REINFORCEMENT LEARNING IN MODULEY</b> <span style="float: right;"><b>9</b></span>
Introduction to Reinforcement Learning in Moduley-ML, Reinforcement Learning, Initial state, training a policy, The PPO algorithm, Evolutional Strategies, Reward, training a kart in the kart game with RL, Tensor board analysis, Testing results.	
<b>TOTAL : 45 PERIODS</b>	
<b>OUTCOMES:</b> <b>Upon completion of the course, the students will be able to:</b> <b>CO1:</b> Apply code for game development in Moduley C# <b>CO2:</b> Understand the fundamentals of game design. <b>CO3:</b> Analyze the use AI algorithms (A*, IL, and RL) in Moduley-ML. <b>CO4:</b> Acquire knowledge on different types of learning. <b>CO5:</b> Implement reinforcement learning in moduley. <b>CO6:</b> Develop the ability to use Moduley-ML for implementing and experimenting with RL algorithms.	
<b>TEXT BOOKS:</b> 1. Linowes, J., & Schoen, M. (2016). Cardboard VR Projects for Android. Packt Publishing Ltd.	
<b>REFERENCES:</b> 1. Lanham, M. (2019). Hands-On Deep Learning for Games: Leverage the power of neural networks and reinforcement learning to build intelligent games. Packt Publishing Ltd. 2. Aversa, D., Kyaw, A. S., & Peters, C. (2018). Moduley Artificial Intelligence Programming: Add powerful, believable, and fun AI entities in your game with the power of Moduley 2018! Packt Publishing Ltd.	

### PROFESSIONAL ELECTIVE VERTICALS - CYBER SECURITY

22CS901	ETHICAL HACKING	L	T	P	C
		2	0	2	3
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>• Understand Information Security, Cyber threats, attacks, web security.</li> <li>• Know about different modes of hacking tools and phases of penetration tests and Methodologies.</li> <li>• Gain the knowledge of the use and availability of tools to support an ethical hack.</li> <li>• Gain the knowledge of interpreting the results of a controlled attack.</li> </ul>					
<b>UNIT I</b>	<b>FUNDAMENTALS OF ETHICAL HACKING</b>	<b>6+6</b>			
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. <b>List of Exercises/Experiments:</b> 1. Setup a honey pot and monitor the honey pot on network 2. Write a script or code to demonstrate SQL injection attacks 3. Write a code to demonstrate DoS attacks					
<b>UNIT II</b>	<b>HACKING METHODOLOGY RECONNAISSANCE</b>	<b>6+6</b>			
Foot printing: Reconnaissance - Footprinting theory – Penetration test – Phases of					

<p>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.</p> <p><b>List of Exercises/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. 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.</li> <li>2. Create a social networking website login page using phishing techniques</li> </ol>		
<b>UNIT III</b>	<b>SCANNING AND ENUMERATION</b>	<b>6+6</b>
<p>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</p> <p><b>List of Exercises/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Implement Passive scanning, active scanning, session hijacking, cookies extraction using Burp suit tool</li> <li>2. Use port scanning. network scanning tools,IDS tool, sniffing tool and generate reports.</li> </ol>		
<b>UNIT IV</b>	<b>SYSTEM AND NETWORK VULNERABILITY</b>	<b>6+6</b>
<p>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</p> <p><b>List of Exercises/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Penetration Testing using Metasploit and metasploitable</li> <li>2. Creating a simple keylogger in python</li> <li>3. Creating a virus</li> <li>4. Creating a trojan.</li> <li>5. Install rootkits and study variety of options</li> </ol>		
<b>UNIT V</b>	<b>SOFTWARE VULNERABILITY (OWASP 10)</b>	<b>6+6</b>
<p>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.</p> <p><b>List of Exercises/Experiments:</b></p> <ol style="list-style-type: none"> <li>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</li> <li>2. Hacking a website by Remote File Inclusion</li> <li>3. Disguise as Google Bot to view hidden content of a website</li> <li>4. To use Kaspersky for Lifetime without Patch</li> </ol>		
<b>TOTAL: 60 PERIODS</b>		

<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Identify cybersecurity threats and network vulnerabilities to enhance data and system security.  <b>CO2:</b> Perform Penetration Testing using tools Metasploit and Nmap to evaluate system defenses.  <b>CO3:</b> Apply ethical hacking techniques reconnaissance, scanning, and enumeration to evaluate security posture.  <b>CO4:</b> Detect and exploit vulnerabilities in networks and systems while adhering to ethical standards.  <b>CO5:</b> Analyze Software Vulnerabilities and mitigate risks.  <b>CO6:</b> Develop and implement countermeasures against attacks such as SQL injection, DoS, and malware.</p>
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1. McClure, S., Scambray, J. and Kurtz, G., 2012. Hacking Exposed Network Security Secrets and Solutions. New York: McGraw-Hill.</li> <li>2. Engebretson, P., 2013. The Basics Of Hacking And Penetration Testing. Amsterdam: Syngress, an imprint of Elsevier.</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Zaid Sabih, Learn Ethical Hacking from Scratch, 2018, PACKT publishing, ISBN: 978-1-78862-205-9</li> <li>2. Harsh Bothra, Hacking be a hacker with ethics, Khanna Publishing, 2016, ISBN: 978-03-86173-05-8</li> </ol>
<p><b>LIST OF SOFTWARE:</b></p> <ol style="list-style-type: none"> <li>1. Metasploit Framework (MSF)</li> <li>2. WireShar</li> <li>3. Nmap</li> <li>4. John the Ripper</li> <li>5. Burp suite or OWASP ZAP</li> <li>6. Kali Linux</li> </ol>

22CS902	SOCIAL NETWORK SECURITY	L	T	P	C
		2	0	2	3
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Learn the Concepts of Social Network Security</li> <li>• Understand the methods of Social Network Anonymization.</li> <li>• Learn the techniques for security and privacy in social networks</li> <li>• Learn the security challenges in social networks</li> <li>• Explore the Tools to learn about the social network security implementation</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO SOCIAL NETWORK SECURITY</b>	<b>6+6</b>			
<p>Introduction – Social Networking Applications – Social media Websites – Social Network Representation –Building Social Authority –Privacy and Information sharing – Controlling Application privacy – Cybercrime – Information Leakage – False information – Content Management in Social Networks</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Explore a Social network analysis tools to learn about the users and networks</li> <li>2. Learn a program / tool to illustrate information leakage</li> </ol>					
<b>UNIT II</b>	<b>SOCIAL NETWORK ANONYMIZATION</b>	<b>6+6</b>			
Social Networks - Privacy in Social Networks – Social Network Representation – Social					

<p>Network Analysis - Data Anonymization – Challenges in Anonymization – Privacy preservation – Social Network Anonymization Factors – Anonymization Algorithms – Link Anonymization techniques –Background Knowledge Attacks – Anonymity in Modern Social Networks</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Experiment a link anonymization technique</li> <li>2. Explore ARX anonymization tool</li> </ol>		
<b>UNIT III</b>	<b>ANALYZING AND SECURING SOCIAL NETWORKS</b>	<b>6+6</b>
<p>Supporting Technologies - Aspects of Analyzing and Securing Social Networks - Techniques and Tools for Social Network Analytics - Social Network Analytics and Privacy Considerations - Access Control and Inference for Social Networks - Social Media Integration and Analytics Systems - Social Media Application Systems - Secure Social Media Systems - Secure Social Media Directions.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Implement a program for network access control to illustrate malware attacks</li> <li>2. Create a simple social network application to show authentication mechanisms</li> <li>3. Create an application for the following scenario: “Social networking users are presented with two apparently similar emails or websites. They must first identify the differences between them and then decide which one is a scam attempting to steal their information or money.”</li> </ol>		
<b>UNIT IV</b>	<b>SECURITY CHALLENGES IN SOCIAL NETWORKS</b>	<b>6+6</b>
<p>Identity manipulation – Threats from third party applications - Trust in Social Networking Sites - Viruses, Phishing Attacks and Malwares–Tracking users – Privacy of Data – Identity Federation Challenges –Social media threats – Location disclosure – Spoofing – Profile cloning – Fake product sale – Cyber bullying – Prevention Strategies</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Implement a program in python to estimate trust of social network users group</li> <li>2. Write a SQL injection program in python/JAVA to handle session hijacking</li> <li>3. Create an application using any social network platform to demonstrate profile cloning concept.</li> </ol>		
<b>UNIT V</b>	<b>SOCIAL NETWORK SECURITY TOOLS</b>	<b>6+6</b>
<p>Analysis Tools for Social Media - AutoMap – Gephi – ORA Lite – ORA Pro – Wolfram Alpha – Social Media Data Collection –Blog Trackers –Crowd Tangle – MalTego – Pulse – SCRAAWL – Fact and Image Trackers – Google Fact Check Tools – Bot Mitigation – BotSlayer – Social Cyber Security</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Perform fact checking of social networking content using google fact checking tools</li> <li>2. Explore a tool that helps protect websites from bot traffic and bot attacks.</li> <li>3. Create a fake news tracker program to collect, detect and help visualize fake news data from any social network</li> </ol>		
<b>TOTAL:60 PERIODS</b>		

<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Develop security applications of social networks.  <b>CO2:</b> Implement data anonymization techniques  <b>CO3:</b> Analyze and secure social networks  <b>CO4:</b> Handle security challenges in social networks  <b>CO5:</b> Develop security tools for social networks  <b>CO6:</b> Create newer social networking applications</p>
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Brij B. Gupta, Somya Ranjan Sahoo, "Online Social Networks Security-Principles, Algorithm, Applications, and Perspectives", First Edition, 2021.</li> <li>2. Bhavani Thuraisingham, SatyenAbrol, Raymond Heatherly, Murat Kantarcioglu, Vaibhav Khadilkar, Latifur Khan, "Analyzing and Securing Social Networks", First Edition, 2020.</li> <li>3. B. K. Tripathy, Kiran Baktha, "Security, Privacy, and Anonymization in Social Networks: Emerging Research and Opportunities", IGI Global Publication, 2019.</li> <li>4. Michael Cross, "Social Media Security, Leveraging Social Networking While Mitigating Risk", Elsevier Publication, First Edition, 2013.</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. El-Sayed M. El-Alfy ; Mohamed Eltoweissy ;Errin W. Fulp ; Wojciech Mazurczyk, "Nature-Inspired Cyber Security and Resiliency: Fundamentals, Techniques and Applications", IET Publication, 2019.</li> <li>2. <a href="https://sites.google.com/view/social-cybersec/tools?pli=1">https://sites.google.com/view/social-cybersec/tools?pli=1</a></li> <li>3. Yaniv Altshuler, "Security and Privacy in Social Networks", Springer , 2013.</li> </ol>
<p><b>LIST OF EQUIPMENTS:</b></p> <ol style="list-style-type: none"> <li>1. Software Required: Python</li> <li>2. Software Tools Required: Shield Square BotSlayer GOOGLE FACT CHECK TOOLS ORA-PRO</li> </ol>

22CS930	ENTERPRISE CYBER SECURITY	L	T	P	C
		3	0	0	3
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Learn the fundamentals of cryptography.</li> <li>• Learn the key management techniques and authentication approaches.</li> <li>• Explore the network and transport layer security techniques.</li> <li>• Understand the application layer security standards.</li> <li>• Learn the real time security practices.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO CYBERSECURITY</b>	<b>9</b>			
<p>Cyber Security – Need of Cybersecurity in Organizations – CIA Triad- Confidentiality, Integrity, Availability; Reason for Cyber Crime –Need for Cyber Security – History of Cyber Crime; Cybercriminals – Classification of Cybercrimes– A Global Perspective on Cyber Crimes; Cyber Laws – The Indian IT Act – Cybercrime and Punishment.</p>					
<b>UNIT II</b>	<b>NETWORK SECURITY BASICS</b>	<b>9</b>			

Network Security Concepts- Basics of Networks- Common Types of Network Attacks- Introduction to Firewalls- Types of Firewalls- IDS/IPS- Virtual Private Networks (VPN's)- Secure configuration and management of network devices. Case Study: Install Kali Linux on Virtual box.		
<b>UNIT III</b>	<b>SECURE COMMUNICATION PROTOCOLS</b>	<b>9</b>
Encryption Principles- Cryptography, Cryptanalysis, Feistel Cipher Structure. Block Encryption algorithms: DES, triple DES, and AES. Transport-Level Security: Secure Sockets Layer (SSL), Transport Layer Security TLS). Electronic Mail Security- Pretty Good Privacy (PGP), S/MIME. Securing wireless networks: WPA, WPA2, WPA3.		
<b>UNIT IV</b>	<b>INTRUSION DETECTION AND PREVENTION SYSTEMS</b>	<b>9</b>
IDPS- Need of Intrusion Detection Systems in Cyber Security- Types of IDPS: Network-based and Host-based. Configuring and Managing IDPS for threat detection using Honeypots. Case Study: Setup a honey pot and monitor the honey pot on network.		
<b>UNIT V</b>	<b>WEB APPLICATION SECURITY</b>	<b>9</b>
Introduction to Web Application Vulnerabilities – Cross Site Scripting (XSS) – SQL injection- Denial of Service (DoS)- Web Application Testing - Types of Penetration Tests- OWASP and OWASP Top.		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<b>CO1:</b> Understanding the core concepts and importance of cybersecurity in organizational settings.		
<b>CO2:</b> Acquire the knowledge common network attacks and deploy appropriate security measures.		
<b>CO3:</b> Implement encryption and secure communication protocols for data integrity and confidentiality.		
<b>CO4:</b> Deploy and manage Intrusion Detection and Prevention Systems for threat detection.		
<b>CO5:</b> Identify and mitigate common web application vulnerabilities.		
<b>CO6:</b> Conduct penetration tests to evaluate the security posture of web applications.		
<b>TEXTBOOKS:</b>		
1. Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021.		
2. Network Security Essentials (Applications and Standards) by William Stallings Pearson Education, 2018.		
<b>REFERENCES:</b>		
1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.		
2. Ravi Das and Greg Johnson, "Testing and Securing Web Applications", 2021.		
3. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for Modern Web Applications, O'Reilly Media, Inc, 2020.		

<b>22CS904</b>	<b>CLOUD AND DATA SECURITY</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>OBJECTIVES:</b>		
<b>The Course will enable learners to:</b>		
<ul style="list-style-type: none"> <li>• Learn the basics of cloud security, including the shared responsibility model and identity management.</li> <li>• Set up a secure cloud infrastructure with features like virtual private clouds and security groups.</li> <li>• Develop skills for identifying and managing security incidents in the cloud, adhering to best practices.</li> <li>• Safeguard application data at rest and in transit using encryption.</li> <li>• Understand the features of Database Security and Security in Data Warehouses.</li> </ul>		
<b>UNIT I</b>	<b>INTRODUCTION TO SECURITY IN CLOUD</b>	<b>9</b>
Introduction to Security, Security in the Cloud, Security design principles, Shared responsibility model, Activity: Shared Responsibility Model, Identity and Access Management (IAM) fundamentals, Authenticating and Authorizing with IAM, Examples of authorizing with IAM, Additional authentication and access management services, Using Organizations.		
<b>UNIT II</b>	<b>SECURING INFRASTRUCTURE</b>	<b>9</b>
Structure of a three-tier web application, virtual private cloud (VPC), Setting up public and private subnets and internet protocols, Security groups, Network access control lists (ACLs), Load balancers, Protecting compute resources- Cloud service models: IaaS, PaaS, SaaS.		
<b>UNIT III</b>	<b>INCIDENT RESPONSE AND RISK MANAGEMENT</b>	<b>9</b>
Identifying an incident, Services that support the discovery and recognition phase, AWS Config and AWS Lambda, Services that support the resolution and recovery phase, Best practices for handling an incident.		
<b>UNIT IV</b>	<b>SECURING CLOUD: DATA SECURITY</b>	<b>9</b>
Overview of Data Security in Cloud Computing- Common Risks with Cloud Data Security- Data Encryption: Applications and Limits- Cloud Data Security: Sensitive Data Categorization- Authentication and Identity- Data Categorization and the Use of Data Labels- Cloud Data Storage.		
<b>UNIT V</b>	<b>DATABASE SECURITY</b>	<b>9</b>
Database Security: Recent Advances in Access Control, Access Control Models for XML, Database Issues in Trust Management and Trust Negotiation, Security in Data Warehouses and OLAP Systems.		
<b>TOTAL:45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<p><b>CO1:</b> Understand security principles in cloud computing.</p> <p><b>CO2:</b> Implement infrastructure security measures in cloud environments.</p> <p><b>CO3:</b> Demonstrate incident response and risk management techniques in cloud systems.</p> <p><b>CO4:</b> Apply data security practices to protect cloud-based information.</p> <p><b>CO5:</b> Evaluate database security mechanisms for cloud-based data management.</p> <p><b>CO6:</b> Integrate ethical considerations into cloud security practices.</p>		
<b>TEXTBOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance", O'Reilly Media 2009.</li> <li>2. Vic (J.R.) Winkler, "Securing the Cloud, Cloud Computer Security Techniques and Tactics", Syngress, April 2011.</li> </ol>		

**REFERENCES:**

1. Michael Gertz, Sushil Jajodia," Handbook on Database security: Applications and Trends", Springer, 2010.
2. John R. Vacca, "Cloud Computing Security", CRC Press, 2016.
3. Giulio D'Agostino, "Data Security in Cloud Computing, Volume I", Momentum Press, 2019.

22CS905	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Learn how to acquire digital forensic evidence.</li> <li>• Learn how to investigate different digital artifacts and write reports</li> <li>• Understand network forensics processes and procedures</li> <li>• Understand mobile forensics processes and procedures.</li> <li>• Able to analyze SIM cards and analyze mobile file systems.</li> </ul>					
<b>UNIT I</b>	<b>ACQUIRING DIGITAL FORENSICS EVIDENCE</b>				<b>9</b>
Types of Computer-Based Investigations - The Forensic Analysis Process- Acquisition of Evidence - Computer Systems- Case Study: Use The Sleuth Kit and Autopsy to retrieve data from file disk					
<b>UNIT II</b>	<b>DIGITAL FORENSICS INVESTIGATION&amp; REPORTING</b>				<b>9</b>
Computer Investigation Process–Windows Artifact Analysis–RAM Memory Forensic Analysis–Email Forensics-Investigation Techniques–Internet Artifacts- Case Study: Use DumpIt to acquire memory					
<b>UNIT III</b>	<b>NETWORKING FORENSICS</b>				<b>9</b>
Characteristics in the network world–Identifying threats to the enterprise–Data breach surveys–Defining network forensics–Differentiating between computer forensics and network forensics–Digital footprints–Collecting network traffic using tcp dump–Collecting network traffic using Wireshark–Collecting network logs–Acquiring memory using FTK Imager–Tapping into network traffic–Packet sniffing and analysis using Wireshark–Packet sniffing and analysis using Network Miner					
<b>UNIT IV</b>	<b>MOBILE FORENSICS FUNDAMENTALS</b>				<b>9</b>
Mobile Devices vs. Computer Devices in the World of Forensics–Living in the Cloud: The Place to Hide and Store Mobile Data–Preparing, Protecting, and Seizing Digital Device Evidence					
<b>UNIT V</b>	<b>ANALYSING MOBILE INTERNALS</b>				<b>9</b>
Analyzing SIM Cards - Advanced Android Analysis - Advanced iOS Analysis-Case Study: Use Andriller or equivalent to extract data from Android					
<b>TOTAL: 45 PERIODS</b>					

<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Understand how to acquire digital forensic evidence.  <b>CO2:</b> Understand how to investigate different digital artifacts and write reports  <b>CO3:</b> Understand network forensics processes and procedures.  <b>CO4:</b> Understand mobile forensics processes and procedures.  <b>CO5:</b> Analyze SIM cards and analyze mobile file systems.  <b>CO6:</b> Understand Digital forensic techniques for comprehensive documentation and reporting.</p>
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1. William Oettinger, "Learn Computer Forensics: A beginner's guide to searching, analyzing, and securing digital evidence", Packt Publishing, 1<sup>st</sup>Edition, 2020</li> <li>2. Samir Datt, "Learning Network Forensics", Packt Publishing, 1<sup>st</sup> Edition, 2016</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Lee Reiber, "Mobile Forensic Investigations: A Guide to Evidence Collection, Analysis, and Presentation", McGraw Hill, 2<sup>nd</sup>Edition, 2018.</li> <li>2. Rohit Tamma, Oleg Skulkin, Heather Mahalik, Satish Bommisetty, "Practical Mobile Forensics", Packt Publishing, 3<sup>rd</sup>Edition, 2018</li> <li>3. Gerard Johansen, "Digital Forensics and Incident Response: Incident response tools and techniques for effective cyber threat response", Packt Publishing, 3<sup>rd</sup>Edition, 2022</li> </ol>

<b>22CS906</b>	<b>VULNERABILITY ANALYSIS AND PENETRATION TESTING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• To learn the tools that can be used to perform information gathering.</li> <li>• To identify operating systems, server applications to widen the attack surface and perform vulnerability assessment activity and exploitation phase.</li> <li>• To learn how vulnerability assessment can be carried out by means of automatic tools or manual investigation.</li> <li>• To learn the web application attacks starting from information gathering to exploitation phases.</li> <li>• To learn how to metasploit and meterpreter are used to automate the attacks and penetration testing techniques.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>9</b>
Introduction- Vulnerability Assessment- Understanding the Risks Posed by Vulnerabilities Detecting Vulnerabilities via Security Technologies- Categories of Penetration Testing - Types of Penetration Test – Structure of Penetration Testing Reports - Information Gathering Techniques - Active, Passive and Sources of Information Gathering - Approaches and Tools - Traceroutes, Neotrace, Whatweb, Netcraft, Xcode Exploit Scanner and NSlookup. Host discovery - Scanning for open ports and services - Types of Port.					
<b>UNIT II</b>	<b>NETWORK VULNERABILITY ASSESSMENT</b>				<b>9</b>
Project Scoping-Assessing Vulnerability assessment timeline-NVAT-Prioritizing risks and threats Assessment Methodology-Top down and Bottom up Examination-Case study with assessment report- Case Study: Web Based Email Attacks.					
<b>UNIT III</b>	<b>MOBILE APPLICATION SECURITY</b>				<b>9</b>
Types of Mobile Application Key challenges in Mobile Application and its impact Need for					

mobile application penetration testing Mobile application penetration testing methodology Android and ios Vulnerabilities - OWASP mobile security risk - Exploiting WM - BlackBerry Vulnerabilities - Vulnerability Landscape for Symbian - Exploit Prevention - Handheld Exploitation	
<b>UNIT IV</b>	<b>WIRELESS NETWORK VULNERABILITY ANALYSIS</b> <span style="float: right;"><b>9</b></span>
WLAN and its inherent insecurities Bypassing WLAN Authentication uncovering hidden SSIDs MAC Filters Bypassing open and shard authentication - Attacking the client latte attack Deauthenticating the client cracking WEP with the hirte attack AP-less WPA cracking - Advanced WLAN Attacks Wireless eavesdropping using MITM session hijacking over wireless - WLAN Penetration Test Methodology	
<b>UNIT V</b>	<b>PENETRATION TESTING</b> <span style="float: right;"><b>9</b></span>
Introduction to Kali and Backtrack-Linux tools – Attack Machine- Phases of penetration test-reconnaissance extracting information from DNS-scanning-pings and ping sweeps-port scanning- NMap-Vulnerability scanning.	
<b>TOTAL: 45 PERIODS</b>	
<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Understand vulnerability assessment principles and methods.  <b>CO2:</b> Analyze network vulnerabilities and prioritize risks.  <b>CO3:</b> Evaluate mobile application security challenges and methodologies.  <b>CO4:</b> Assess wireless network vulnerabilities and conduct penetration testing.  <b>CO5:</b> Apply penetration testing methodologies using appropriate tools.  <b>CO6:</b> Demonstrate ethical considerations in penetration testing practices.</p>	
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Rafay Baloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2015.</li> <li>2. Dr. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing made easy, Syngress publications, Elsevier, 2013.</li> </ol>	
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Steve Manzuik, Andre Gold, Chris Gatford, “Network Security Assessment from Vulnerability to Patch”, Syngress Publishing Incorporation, 2007.</li> <li>2. Mastering Modern Web Penetration Testing By Prakhar Prasad, October 2016.</li> <li>3. Kali Linux 2: Windows Penetration Testing, By Wolf Halton, Bo Weaver, June 2016.</li> </ol>	

<b>22CS927</b>	<b>ENGINEERING SECURE SOFTWARE SYSTEMS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Know the importance and need for software security.</li> <li>• Know about various attacks.</li> <li>• Learn about secure software design.</li> <li>• Understand risk management in secure software development.</li> <li>• Know the working of tools related to software security.</li> </ul>					
<b>UNIT I</b>	<b>NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS</b>	<b>9</b>			

Software Assurance and Software Security – Threats to software security – Sources of software insecurity – Benefits of Detecting Software Security – Properties of Secure Software – Memory Based Attacks: Low-Level Attacks Against Heap and Stack – Defense Against Memory-Based Attacks		
<b>UNIT II</b>	<b>SECURE SOFTWARE DESIGN</b>	<b>9</b>
Requirements Engineering for secure software- SQUARE process Model- Tools- SQUARE Final Results- Requirement Elicitation and Prioritization- The Critical Role of Architecture and Design- Issues and Challenges - Software Characterization - Threat Analysis - Architectural Vulnerability Assessment.		
<b>UNIT III</b>	<b>SECURITY RISK MANAGEMENT</b>	<b>9</b>
Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.		
<b>UNIT IV</b>	<b>SECURITY TESTING</b>	<b>9</b>
Software Security Testing- Contrasting Software Testing and Software Security Testing- Functional Testing- Risk-Based Testing-Secure Software Development Life Cycle- Unit Testing, Testing Libraries and Executable Files, Integration Testing, System Testing.		
<b>UNIT V</b>	<b>SECURE PROJECT MANAGEMENT</b>	<b>9</b>
Governance and security – Adopting an enterprise software security framework – Security and project management – Maturity of Practice-Case Study: Implement the SQL Injection attack and Buffer Overflow attack..		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<b>CO1:</b> Analyze low-level memory attacks and implement corresponding defenses.		
<b>CO2:</b> Implement requirements engineering and architectural vulnerability assessment.		
<b>CO3:</b> Evaluate and mitigate risks throughout the software development lifecycle.		
<b>CO4:</b> Implement various testing techniques to ensure software security		
<b>CO5:</b> Apply enterprise security frameworks in project governance.		
<b>CO6:</b> Analyze case studies to understand real-world security threats in project management.		
<b>TEXTBOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Julia H. Allen, Software Security Engineering, Pearson Education, 2009.</li> <li>2. Evan Wheeler, Security Risk Management: Building an Information Security Risk Management Program from the Ground Up, First edition, Syngress Publishing, 2011.</li> </ol>		
<b>REFERENCES:</b>		
<ol style="list-style-type: none"> <li>1. Rajib Mall, " Fundamentals Of Software Engineering", 5th Edition, PHI Learning, 2018.</li> <li>2. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.</li> <li>3. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First Edition, Syngress Publishing, 2012.</li> <li>4. Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition, McGraw Hill, 2012.</li> <li>5. Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing, 2012.</li> <li>6. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison-Wesley Professional, 2006.</li> </ol>		

22CS928	NETWORK DESIGN AND PROGRAMMING	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Understand the basic networking principles.</li> <li>• Explore various networking devices and protocols required for network design and management.</li> <li>• Gain knowledge in logical and physical designs for scalable LAN and WAN networks</li> <li>• Study two novel networking technologies: SDN and DTN.</li> <li>• Learn network programming in UNIX C.</li> </ul>					
<b>UNIT I</b>	<b>NETWORKING PRINCIPLES</b>				<b>9</b>
Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Collision detection and collision avoidance, Hidden and Exposed Terminals – Switched networks – Datagrams, Virtual circuits, Cell switching and Label switching – Wireless Networks – Infrastructure based, ad hoc and hybrid – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions.					
<b>UNIT II</b>	<b>PHYSICAL NETWORK DESIGN</b>				<b>9</b>
LAN cabling topologies – Ethernet Switches – High speed and Gigabit and 10Gbps – Building cabling topologies and Campus cabling topologies – Routers, Firewalls and L3 switches –Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP - WAN Design and Enterprise Networks – Core networks, distribution networks and access networks					
<b>UNIT III</b>	<b>LOGICAL DESIGN AND MANAGEMENT</b>				<b>9</b>
IPv4 and IPv6 Dynamic Addressing –Hierarchical routing – VLSM and CIDR – Transition from IPv4 to IPv6 – NAT and DHCP – Static and Dynamic routes – RIP, OSPF and BGP – VPN –RMON and SNMP					
<b>UNIT IV</b>	<b>INNOVATIVE NETWORKS</b>				<b>9</b>
Software Defined Networks – Evolution of switches and control planes – Centralized and distributed data and control planes – OpenFlow and SDN Controllers – Network Function Virtualization – Needs of the Data Centres – SDN solutions for data centres - Delay Tolerant Networks – Overlay architecture – Bundle Protocol – Opportunistic routing and Epidemic routing					
<b>UNIT V</b>	<b>NETWORK PROGRAMMING IN UNIX C</b>				<b>9</b>
Socket address structures – Byte ordering and byte manipulation functions – Elementary TCP sockets – socket, connect, bind, listen, accept and close functions – TCP client and server – Elementary UDP sockets –recvfrom and sendto functions , connect function with UDP – Raw sockets – Client-server design alternatives – Iterative and Concurrent servers.					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>Upon completion of the course, the students will be able to:</b>					
<b>CO1:</b> Understand advanced multiplexing methods like DWDM and OFDM.					
<b>CO2:</b> Evaluate network protocols for efficient data transmission.					
<b>CO3:</b> Develop logical and physical designs for scalable LAN and WAN networks.					
<b>CO4:</b> Apply strategies for transitioning from IPv4 to IPv6.					
<b>CO5:</b> Investigate Software Defined Networks and Delay Tolerant Networks.					
<b>CO6:</b> Gain proficiency in network programming using socket APIs in C.					
<b>TEXTBOOKS:</b>					

1. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", 5th edition, Morgan Kauffman, 2011
2. ParitoshPuri, M.P.Singh,"A survey paper on routing in delay tolerant networks", International Conference on Information and Computer Networks (ISCON), 2013.

**REFERENCES:**

1. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", Morgan Kauffman, 2016.
2. W.Richard Stevens, Bill Fenner and Andrew M Rudoff, "Unix Network Programming: The Sockets Networking API: Volume 1 ", 3rd Edition, Addison Wesley, 2003.
3. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 2011.

22CS929	FAULT TOLERANT COMPUTING	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Create understanding of the fundamental concepts of fault tolerance systems</li> <li>• Learn basic techniques for achieving fault tolerance in hardware</li> <li>• Have in-depth understanding in software fault tolerance systems</li> <li>• Gain knowledge in design &amp; testing of fault tolerance systems</li> <li>• Develop skills in modelling and evaluating fault tolerant architectures in Real time systems</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>9</b>
Faults, Errors and Failures - Levels of Fault tolerance - Dependability measures - Dependability evaluation - Fault Tolerant techniques - Hardware redundancy - Information redundancy - Software redundancy- Time redundancy -Software Testing.					
<b>UNIT II</b>	<b>HARDWARE FAULT TOLERANCE</b>				<b>9</b>
The Rate of Hardware Failures - Failure Rate, Reliability, and Mean Time to Failure - Canonical and Resilient Structures - Poisson Processes - Markov Models Fault-Tolerance Processor-Level Techniques - Byzantine failures.					
<b>UNIT III</b>	<b>SOFTWARE FAULT TOLERANCE</b>				<b>9</b>
Single-Version Fault Tolerance – N Version programming - Recovery Block Approach - Exception-Handling - Software Reliability Models - Check pointing - Optimal Checkpointing - Checkpointing in Distributed Systems, Shared-Memory Systems and Real-Time Systems.					
<b>UNIT IV</b>	<b>DESIGN DIVERSITY &amp; TESTING</b>				<b>9</b>
Fault tolerant Control and coordination algorithms design – F-T system abstractions and functions- Pitfalls- Practical application- Modeling and analysing F-T Distributed systems - Software fault insertion testing- Fault manager- Categorization of Software faults, Errors, and failures- SIFT methodology and Test plans.					
<b>UNIT V</b>	<b>FAULT TOLERANCE IN REAL TIME SYSTEMS</b>				<b>9</b>
Time- Space tradeoff – Fault tolerant scheduling algorithms – Fault tolerant ATM switches – Fault tolerant Routing and sparing Techniques – Yield and reliability enhancement for VLSI/WSI array processors. Case studies: Non-stop systems, Stratus systems, Cassini command and data sub system, IBM G5, Itanium.					
					<b>TOTAL : 45 PERIODS</b>

<p><b>OUTCOMES:</b>  <b>Upon completion of the course, the students will be able to:</b>  <b>CO1:</b> Understand the need for fault tolerance systems.  <b>CO2:</b> Evaluate hardware fault tolerance techniques and their reliability metrics.  <b>CO3:</b> Apply software redundancy and fault tolerance methods in program design.  <b>CO4:</b> Develop fault-tolerant algorithms and architectures for dependable systems.  <b>CO5:</b> Design and implement fault injection testing methodologies for software reliability.  <b>CO6:</b> Implement fault-tolerant algorithms for real-time applications and analyze their tradeoffs.</p>
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>1. E.Dubrova, "Fault-Tolerant Design", Springer, 2013.</li> <li>2. I. Korenand, M.Krishna, "Fault Tolerant Systems", Morgan Kaufmann, 2<sup>nd</sup> Edition, November 2020.</li> </ol>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Kjetil Norvag, "An Introduction to fault tolerant systems", IDI Technical report, July 2000.</li> <li>2. Olga Goloubeva , Maurizio Rebaudengo , Matteo Sonza Reorda , Massimo Violante, "Software-Implemented Hardware Fault Tolerance", Springer, 2006.</li> </ol>

22CS903	BLOCK CHAIN TECHNOLOGY	L	T	P	C	
		3	0	0	3	
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• To understand block chain system's fundamental components, how they fit together and examine a decentralization using block chain.</li> <li>• To explain how Crypto currency works.</li> <li>• To explain the components of Ethereum and Programming Languages for Ethere</li> <li>• To study the basics of Web3 and Hyper ledger.</li> <li>• To give an insight of alternative block chains and its emerging trends.</li> </ul>						
<b>UNIT I</b>	<b>INTRODUCTION TO BLOCKCHAIN</b>					<b>9</b>
History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization – Symmetric Cryptography - Mathematics – Asymmetric Cryptography – public and private keys – Elliptic curve cryptography – Discrete logarithm problem in ECC.						
<b>UNIT II</b>	<b>INTRODUCTION TO CRYPTOCURRENCY</b>					<b>9</b>
Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments Wallets – innovation in Bitcoin – Alternative Coins – Theoretical Foundations – Bitcoin. Case study - Web3j.						
<b>UNIT III</b>	<b>ETHEREUM</b>					<b>9</b>
The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code – Blocks and Blockchain – Fee Schedule – Supporting Protocols – Solidity Language.						
<b>UNIT IV</b>	<b>WEB3 AND HYPERLEDGER</b>					<b>9</b>
Introduction to Web3 – Contract Deployment – POST Requests – Development frameworks Hyperledger as a protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Case study - Corda.						

<b>UNIT V</b>	<b>ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS</b>	<b>9</b>
Kadena – Ripple- Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research - Case Study - Install IPFS locally on our machine, initialize your node, view the nodes in network.		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Understand the technology components of Blockchain and how it works behind the scenes.		
<b>CO2:</b> Understand the Bitcoin and its limitations by comparing with other alternative coins.		
<b>CO3:</b> Develop deep understanding of the Ethereum model, its consensus model, code execution.		
<b>CO4:</b> Understand the architectural components of a Hyperledger and its development framework.		
<b>CO5:</b> Explore the alternative blockchains and its emerging trends.		
<b>CO6:</b> Understand blockchain technology, including Bitcoin, Ethereum, and alternative blockchains.		
<b>TEXT BOOKS:</b>		
1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.		
2. Arshdeep Bahga, Vijay Madiseti, “Blockchain Applications: A Hands-On Approach”, VPT, 2017.		
<b>REFERENCES:</b>		
1. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly Publishing, 2014.		
2. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing Platform, 2016.		
3. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.		
4. Alex Leverington, “Ethereum Programming”, Packt Publishing, 2017.		
5. Antony Lewis “The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them”, Mango Publishing 2018.		
6. Andreas M. Antonopoulos, “Mastering Bitcoin: Programming the Open Block chain”, O’Reilly Publishing, 2017.		
7. Massimo Ragnedda, Giuseppe Destefanis, “Blockchain and Web 3.0: Social, Economic, and Technological Challenges”, Routledge, 2019.		

<b>22IT910</b>	<b>REST APPLICATION DEVELOPMENT USING SPRING BOOT AND JPA (Lab Integrated)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

## OBJECTIVES:

### The Course will enable learners to:

- Provide comprehensive knowledge of RESTful APIs and the HTTP methods used in the Spring Boot framework.
- Cover advanced querying techniques using JPA, including LIKE queries, and to manage CRUD operations using JPQL.
- Explore various relational mappings in JPA, such as one-to-one and one-to-many associations, and their practical implementations.
- Implement and manage Spring AOP applications using annotation-based configurations for method interception and post-execution operations.
- Build production-grade Spring Boot applications with integrated security using JWT, detailed API documentation with SwaggerUI and OpenUI, and effective logging practices.

### UNIT I | INTRODUCTION TO REST API

6+6

RESTful APIs – overview about data exchange between client and server - separating concerns between handling HTTP requests and executing business logic - retrieving server resources via HTTP requests - injection of property values - self-contained application - serialization and deserialization – JSON properties - managing data access.

#### List of Exercises/Experiments:

1. Develop a RESTful API for retrieving a welcome message, emphasizing the basics of data exchange between client and server.
2. Implement a RESTful API to acknowledge the user's favorite color choice, highlighting property value injection principles.
3. Create a Spring Boot application that retrieves and displays application information, demonstrating the usage of the @Value annotation to inject property values from the application configuration file.
4. Construct a RESTful API for student details retrieval, illustrating the utilization of @JsonIgnore annotation, focusing on advanced JSON property handling and data access control

### UNIT II | ADVANCED DATA MANAGEMENT WITH JAVA AND MYSQL

6+6

Build production-grade applications – MYSQL - mapping Java classes to relational database - repository interface - data access operations – retrieving data from the database –mapping of request body to entity - retrieve an entity - capture data from API requests - building complex queries using keywords.

#### List of Exercises/Experiments:

1. Develop a web application for managing patient details using RESTful APIs, implementing POST and GET operations.
2. Create a web application for managing product details using RESTful APIs, enabling POST and GET operations.
3. Build an application for managing employee details using RESTful APIs, supporting POST, PUT, and DELETE operations.

### UNIT III | ADVANCED JPA QUERIES AND ANNOTATIONS

6+6

Pagination & Sorting using JPA, @Transient Annotation, Queries using JPA, Starts and Ends with query using JPA, JPQL with @Query Annotation, custom JPQL queries.

#### List of Exercises/Experiments:

1. Develop a web application for pagination and sorting of children details using RESTful APIs, implementing POST and GET operations.
2. Create a web application for managing Person details using JPA methods via RESTful APIs, enabling POST and GET operations.
3. Retrieve person details using JPQL with conditions for names starting or ending with specific patterns.
4. Build a web application for managing Person details using custom JPQL queries via RESTful

APIs, supporting POST and GET operations.

<b>UNIT IV</b>	<b>JPA ASSOCIATIONS AND MAPPING</b>	<b>6+6</b>
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JPA Mapping of One-to-One Associations - fetching entities using queries – Loading optimization technique - Two-way One-to-One Relationship Mapping with JPA - single entity instance associated with multiple instances - Adding Data with One-to-One and One-to-Many Associations using JPA.

List of Exercises/Experiments:

1. Develop a Spring Boot application with "Person" and "Address" entities, where each person has exactly one address. Utilize Spring JPA to establish a one-to-one mapping between these entities.
2. Create a Spring Boot application with "Author" and "Book" entities, where each author can have multiple books, and each book belongs to only one author. Use Spring JPA to establish a one-to-many bidirectional mapping between these entities.
3. Build a Spring Boot application with "Employee" and "Address" entities, ensuring that each employee has exactly one address, and each address belongs to only one employee. Establish a one-to-one mapping between these entities using Spring JPA and utilize the Criteria API to retrieve employee details efficiently

<b>UNIT V</b>	<b>SPRING BOOT ESSENTIALS: API SECURITY, LOGGING, AOP, AND BUILD MANAGEMENT</b>	<b>6+6</b>
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SwaggerUI with Spring Boot, OpenUI with Spring Boot, Logging with Spring Boot, Changing Log Level, Logging Request and Response- Managing Spring Boot Logging Configuration - Aspect-Oriented Programming (AOP) Concepts – Method Parameter Handling - Post- Execution Operations - Returning Data Handling - Comprehensive Advice Handling. API security using JWT, Gradle for build management, Sonar Lint for coding standards and guidelines.

**List of Exercises/Experiments:**

1. Develop a web application for managing Employee and Payroll details via RESTful APIs. Utilize Spring JPA to establish a one-to-one mapping between Employee and Payroll entities. Demonstrate the usage of Swagger for API documentation and interaction.
2. Develop a Spring Boot application focused on handling person details and integrate comprehensive logging capabilities to track application activities effectively.
3. Explore the implementation of Aspect-Oriented Programming (AOP) in a Spring application to enhance the behavior of a service method and demonstrate its impact on application functionality.

**TOTAL: 30+30=60 PERIODS**

**OUTCOMES:**

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

- CO1:** Create simple applications using RESTful APIs and effectively manage HTTP methods within the Spring Boot framework.
- CO2:** Apply database connectivity with JPA, utilizing advanced queries to interact with the database.
- CO3:** Build applications using Spring Boot and perform CRUD operations efficiently using JPQL
- CO4:** Demonstrate the implementation of various relational mappings in JPA, including one-to-one and one-to-many associations
- CO5:** Develop real-time applications that integrate user interfaces and utilize Spring AOP for method interception and advice handling.
- CO6:** Apply security measures to REST APIs using Spring Security and JWT to protect sensitive data and ensure secure communication between clients and servers.

**TEXTBOOKS:**

1. Raja CSP Raman, Ludovic Dewailly, "Building RESTful Web Services with Spring 5", Packt Publishing, 2018.
2. Leonard Richardson, Sam Ruby "RESTful Web Services" O'Reilly Media, 2008.

3. Ludovic Dewailly, "Building a RESTful Web Service with Spring: A hands-on guide to building an enterprise-grade, scalable RESTful web service using the Spring Framework", Packt Publishing, 2015
4. Raja CSP Raman, Ludovic Dewailly, "Building RESTful Web Services with Spring 5 – Second Edition
5. Leverage the power of Spring 5.0, Java SE 9, and Spring Boot 2.0", Packt Publishing, 2018

**REFERENCES:**

1. Ranga Karanam, "Master Java Web Services and REST API with Spring Boot", Packt Publishing, 2018.
2. Balaji Varanasi, Sudha Belida, "Spring REST", Apress, 2015.
3. Greg L. Turnquist, "Learning Spring Boot 2.0", Packt Publishing, 2021
4. Sourabh Sharma, "Modern API Development with Spring and Spring Boot", Packt Publishing, 2021

**LIST OF EQUIPMENTS/SOFTWARE:**

Java Persistence API, Spring Boot

**PROFESSIONAL ELECTIVE VERTICALS - CLOUD COMPUTING**

<b>22CS907</b>	<b>CLOUD FOUNDATIONS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

**OBJECTIVES:**

- 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.

<b>UNIT I</b>	<b>INTRODUCTION TO CLOUD</b>	<b>6+6</b>
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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:**

1. Install and configure cloud SDK.
2. Connect to computing resources hosted on Cloud via Cloud Shell.

<b>UNIT II</b>	<b>COMPUTE AND STORAGE</b>	<b>6+6</b>
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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:**

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.

	<ol style="list-style-type: none"> <li>4. Deploy a containerized application.</li> <li>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.</li> </ol>	
<b>UNIT III</b>	<b>APIs AND SECURITY IN THE CLOUD</b>	<b>6+6</b>
<p>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.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Deploy a sample API with any of the API service.</li> <li>2. Publish messages with managed message service using the Python client library.</li> <li>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.</li> </ol>		
<b>UNIT IV</b>	<b>NETWORKING, AUTOMATION AND MANGAEMENT TOOLS</b>	<b>6+6</b>
<p>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.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Create several VPC networks and VM instances and test connectivity across networks.</li> <li>2. Create two nginx web servers and control external HTTP access to the web servers using tagged firewall rules.</li> <li>3. Configure a HTTP Load Balancer with global backends. Stress test the Load Balancer and denylist the stress test IP.</li> <li>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.</li> <li>5. Monitor a Compute Engine virtual machine (VM) instance with Cloud Monitoring by creating uptime check, alerting policy, dashboard and chart.</li> </ol>		
<b>UNIT V</b>	<b>BIG DATA AND MACHINE LEARNING SERVICES</b>	<b>6+6</b>
<p>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.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Create a cluster, run a simple Apache Spark job in the cluster, then modify the number of workers in the cluster.</li> <li>2. Create a streaming pipeline using one of the cloud service.</li> <li>3. Set up your Python development environment, get the relevant SDK for Python, and run an example pipeline using the Cloud Console.</li> <li>4. Use cloud-based data preparation tool to manipulate a dataset. Import datasets, correct mismatched data, transform data, and join data.</li> <li>5. Utyilize 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.</li> </ol>		
<b>TOTAL: 60 PERIODS</b>		
<p><b>OUTCOMES:</b>  <b>At the end of this course, the students will be able to:</b></p>		

<p><b>CO1:</b> Describe the different ways a user can interact with Cloud.</p> <p><b>CO2:</b> Discover the different compute options in Cloud and implement a variety of structured and unstructured storage models.</p> <p><b>CO3:</b> Discuss the different application managed service options in the cloud and outline how security in the cloud is administered in Cloud.</p> <p><b>CO4:</b> Demonstrate how to build secure networks in the cloud and identify cloud automation and management tools.</p> <p><b>CO5:</b> Discover a variety of managed big data services in the cloud.</p> <p><b>CO6:</b> Use Cloud services to build applications.</p>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li><a href="https://cloud.google.com/docs">https://cloud.google.com/docs</a></li> <li><a href="https://www.cloudskillsboost.google/paths/36">https://www.cloudskillsboost.google/paths/36</a></li> <li><a href="https://nptel.ac.in/courses/106105223">https://nptel.ac.in/courses/106105223</a></li> <li>Anthony J. Sequeira, "AWS Certified Cloud Practitioner (CLF-C01) Cert Guide", First Edition, Pearson Education, 2020.</li> <li><a href="https://aws.amazon.com/documentation/">AWS Documentation (amazon.com)</a></li> <li><a href="https://aws.amazon.com/skillbuilder/">AWS Skill Builder</a></li> <li>AWS Academy Cloud Foundations Course - <a href="https://www.awsacademy.com/vforcesite/LMS_Login">https://www.awsacademy.com/vforcesite/LMS_Login</a></li> </ol>
<p><b>LIST OF EQUIPMENTS:</b> GCP / CloudSkillBoost Platform/AWS Console /AWS Academy Learner Lab.</p>

22CS908	CLOUD ARCHITECTING	L	T	P	C
		2	0	2	3
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners:</b></p> <ul style="list-style-type: none"> <li>To make architectural decisions based on AWS architectural principles and best practices.</li> <li>To describe the features and benefits of Amazon EC2 instances, and compare and contrast managed and unmanaged database services.</li> <li>To create a secure and scalable AWS network environment with VPC, and configure IAM for improved security and efficiency.</li> <li>To use AWS services to make infrastructure scalable, reliable, and highly available.</li> <li>To use AWS managed services to enable greater flexibility and resiliency in an infrastructure.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCING CLOUD ARCHITECTING AND STORAGE LAYER</b>	<b>6+6</b>			
<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><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>Creating a Static Website for the Café.</li> <li>Configure an S3 bucket to automatically encrypt all uploaded objects.</li> <li>Set up a cross-region replication configuration for an S3 bucket.</li> </ol>					
<b>UNIT II</b>	<b>COMPUTE LAYER AND DATABASE LAYER</b>	<b>6+6</b>			
<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</p>					

<p>Relational Database Service (Amazon RDS) - Amazon DynamoDB - Database security controls - Migrating data into AWS databases.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Creating a Dynamic Website for the Café.</li> <li>2. Creating an Amazon RDS database.</li> <li>3. Migrating a Database to Amazon RDS.</li> <li>4. Create a web application that stores data in a managed database using EC2 instances and Amazon RDS.</li> </ol>		
<b>UNIT III</b>	<b>CREATING AND CONNECTING NETWORKS</b>	<b>6+6</b>
<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 - 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.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Creating a Virtual Private Cloud.</li> <li>2. Creating a VPC Networking Environment for the Café.</li> <li>3. Creating a VPC Peering Connection.</li> <li>4. Configure a VPC with subnets, an internet gateway, route tables, and a security group, and connect an on-premises network to the VPC.</li> </ol>		
<b>UNIT IV</b>	<b>RESILIENT CLOUD ARCHITECTURE</b>	<b>6+6</b>
<p>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.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Controlling Account Access by Using IAM.</li> <li>2. Creating Scaling Policies for Amazon EC2 Auto Scaling.</li> <li>3. Creating a Highly Available Web Application.</li> <li>4. Creating a Scalable and Highly Available Environment for the Café.</li> <li>5. Streaming Dynamic Content Using Amazon CloudFront.</li> </ol>		
<b>UNIT V</b>	<b>BUILDING DECOUPLED ARCHITECTURES, MICROSERVICES AND SERVERLESS ARCHITECTURE</b>	<b>6+6</b>
<p>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.</p> <p><b>List of Exercise/Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Breaking a Monolithic Node.js Application into Microservices.</li> <li>2. Implementing a Serverless Architecture on AWS.</li> <li>3. Implementing a Serverless Architecture for the Café.</li> </ol>		

4. Creating an AWS Lambda Function and explore using AWS Lambda with Amazon S3.
<b>TOTAL: 60 PERIODS</b>
<p><b>OUTCOMES:</b>  <b>Upon Completion of this course, the students will be able to:</b></p> <p><b>CO1:</b> Make architectural decisions based on AWS architectural principles and best practices</p> <p><b>CO2:</b> Describe the features and benefits of Amazon EC2 instances, and compare and contrast managed and unmanaged database services.</p> <p><b>CO3:</b> Create a secure and scalable AWS network environment with VPC, and configure IAM for improved security and efficiency.</p> <p><b>CO4:</b> Use AWS services to make infrastructure scalable, reliable, and highly available</p> <p><b>CO5:</b> Use AWS managed services to enable greater flexibility and resiliency in an infrastructure</p> <p><b>CO6:</b> Develop disaster recovery strategies for AWS environments.</p>
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. AWS Certified Solutions Architect Official Study Guide by Joe Baron, Hisham Baz, Tim Bixler</li> <li>2. Architecting the Cloud by Michael Kavis.</li> <li>3. <a href="https://aws.amazon.com/documentation/">AWS Documentation (amazon.com)</a></li> <li>4. <a href="https://aws.amazon.com/skillbuilder/">AWS Skill Builder</a></li> <li>5. AWS Academy Cloud Architecting Course - <a href="https://www.awsacademy.com/vforcesite/LMS_Login">https://www.awsacademy.com/vforcesite/LMS_Login</a></li> </ol>
<p><b>LIST OF EQUIPMENTS:</b>  AWS Console Account/AWS Academy Learner Lab.</p>

22CS909	VIRTUALIZATION	L	T	P	C	
		3	0	0	3	
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Explain the fundamental concepts of virtualization</li> <li>• Analyze the role of hypervisors in hardware virtualization</li> <li>• Apply the understanding of CPU, memory (MMU), and I/O virtualization techniques</li> <li>• Assess security considerations of virtualized environments</li> <li>• Discuss strategies for protecting VMs and data centers</li> </ul>						
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
Virtualization - Virtual Machines - Hypervisors - Type-1 and Type-2 Hypervisors - Multiplexing and Emulation - Approaches to Virtualization and Paravirtualization - Benefits of Using Virtual Machines. Working with Virtual Machines.						
<b>UNIT II</b>	<b>HARDWARE VIRTUALIZATION</b>					<b>9</b>
The Popek/Goldberg Theorem - Virtualization without Architectural Support: Full Virtualization - Paravirtualization - Designs Options for Type-1 Hypervisors. Hypervisors: Describing a Hypervisor - Role of Hypervisor - VMWare ESX - Citrix Hypervisor - Microsoft Hyper-V.						
<b>UNIT III</b>	<b>TYPES OF VIRTUALIZATIONS</b>					<b>10</b>

CPU Virtualization with VT-x: Design requirements - The VT-x Architecture - KVM. MMU Virtualization: Extended Paging - Virtualizing Memory in KVM. I/O Virtualization: Benefits of I/O Interposition - Physical I/O - Virtual I/O Without Hardware Support- Virtual I/O with Hardware Support. Virtualization Support in ARM Processors.			
<b>UNIT IV</b>	<b>VIRTUALIZATION SECURITY</b>	<b>9</b>	
Fundamentals of Virtualization Security: Virtualization Architecture - Threats to a Virtualized Environment. Securing Hypervisors: Hypervisor Configuration and Security. Designing Virtual Networks for Security: Comparing Virtual and Physical Networks - Virtual Network Security Considerations - Configuring Virtual Switches for Security.			
<b>UNIT V</b>	<b>VIRTUALIZATION AND AVAILABILITY</b>	<b>8</b>	
Availability - Protecting a Virtual Machine - Protecting Multiple Virtual Machines - Protecting Datacenters - Deploying Applications in a Virtual Environment - Recent Trends in Virtualization.			
<b>TOTAL: 45 PERIODS</b>			
<b>OUTCOMES:</b>			
<b>At the end of this course, the students will be able to:</b>			
<b>CO1:</b> Understand the basics of virtualization and its benefits.			
<b>CO2:</b> Assess the significance of hypervisors in hardware virtualization, examining their roles and implications for system efficiency and performance			
<b>CO3:</b> Utilize knowledge of virtualization technologies to solve practical problems and implement effective solutions			
<b>CO4:</b> Analyze security threats and design secure virtual networks			
<b>CO5:</b> Discuss strategies to improve availability in virtual environment and for protecting VMs and data centers			
<b>CO6:</b> Use virtualization technology effectively to optimize system performance and resource usage in real-world settings			
<b>TEXTBOOKS:</b>			
1. Edouard Bugnion, Jason Nieh, Dan Tsafir, "Hardware and Software Support for Virtualization", Morgan & Claypool Publishers, 2017.			
2. Matthew Portnoy, "Virtualization Essentials", Third Edition, Sybex - John Wiley & Sons, 2023.			
<b>REFERENCES:</b>			
1. Dave Shackelford, "Virtualization Security: Protecting Virtualized Environments", Sybex - John Wiley & Sons, 2012.			
2. Nelson Ruest, Danielle Ruest, Virtualization, A beginners guide, 2009, McGrawHill.			
3. Nadeau, Tim Cerng, Je Buller, Chuck Enstall, Richard Ruiz, Mastering Microsoft Virtualization, Wiley Publication, 2010.			
4. William Von Hagen, Professional Xen Virtualization, Wiley Publication, 2008.			

<b>22CS910</b>	<b>DEVOPS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>Bridge the gap between development and operations for faster, more reliable software releases.</li> </ul>					

<ul style="list-style-type: none"> <li>• Automate software delivery with CI/CD pipelines.</li> <li>• Package and deploy apps efficiently using Docker containers.</li> <li>• Automate infrastructure with Infrastructure as Code (IaC).</li> <li>• Monitor and troubleshoot applications in production.</li> </ul>		
<b>UNIT I</b>	<b>INTRODUCTION TO DEVOPS</b>	<b>9</b>
Software Development Methodologies - Operations Methodologies - Systems Methodologies - Development, Release, and Deployment Concepts - Infrastructure Concepts. What is DevOps? - DevOps importance and benefits -DevOps principles and practices - 7 C's of DevOps lifecycle for business agility - DevOps and continuous testing. How to choose right DevOps tools? - Challenges with DevOps implementation.		
<b>UNIT II</b>	<b>VERSION CONTROL WITH GIT</b>	<b>9</b>
Introduction to Git version control system - Git commands for basic operations (clone, commit, push, pull) - Branching and merging strategies - Collaboration using Git workflows.		
<b>UNIT III</b>	<b>CONTINUOUS INTEGRATION AND DELIVERY (CI/CD)</b>	<b>9</b>
Introduction to CI/CD pipelines - Benefits of CI/CD for faster deployments - Setting up a CI/CD pipeline with Jenkins - Automating builds, tests, and deployments.		
<b>UNIT IV</b>	<b>CONTAINERIZATION WITH DOCKER</b>	<b>9</b>
Introduction to containerization and its benefits - Understanding Docker concepts: images, containers, registries - Building and managing Docker containers - Docker Compose for multi-container applications - Introduction to container orchestration with Docker Swarm or Kubernetes.		
<b>UNIT V</b>	<b>INFRASTRUCTURE AS CODE (IAC) AND MONITORING</b>	<b>9</b>
Introduction to Infrastructure as Code (IaC) - Benefits of using IaC for repeatable infrastructure provisioning - Learning IaC with Terraform - Setting up infrastructure configurations with Terraform - Introduction to monitoring and logging tools for applications - Alerting and troubleshooting techniques.		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
CO1: Understand the core principles and philosophies of DevOps.		
CO2: Implement version control systems for code management and collaboration.		
CO3: Automate software delivery pipelines using CI/CD tools.		
CO4: Utilize containerization technologies for packaging and deploying applications.		
CO5: Configure infrastructure as code (IaC) for repeatable deployments.		
CO6: Monitor and maintain applications in a production environment.		
<b>TEXT BOOKS:</b>		
2. Deepak Gaikwad, Viral Thakkar, "DevOps Tools: from Practitioner's Point of View", Wiley, 2019.		
3. Jennifer Davis, Ryn Daniels, "Effective DevOps", O'Reilly Media, 2016.		
<b>REFERENCES:</b>		
1. Gene Kim, Jez Humble, Patrick Debois, "The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations", IT Revolution Press, 2016.		
2. Jez Humble, Gene Kim, "Continuous Delivery: Reliable Software Releases Through Build, Test, and Deployment Automation", Addison-Wesley, 2010.		
3. Yevgeniy Brikman, "Terraform: Up & Running: Writing Infrastructure as Code", O'Reilly Media, 2019.		
4. Joseph Muli, "Beginning DevOps with Docker", Packt Publishing, 2018.		

22CS911	DATA ENGINEERING IN CLOUD	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>Grasp the fundamentals of data engineering, emphasizing cloud-based data access.</li> <li>Construct robust and secure data pipelines using Cloud services.</li> <li>Select and implement appropriate data storage solutions while prioritizing pipeline security.</li> <li>Utilize cloud tools for handling extensive data for machine learning purposes.</li> <li>Efficiently analyze, visualize, and automate data pipelines to streamline operations.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>8</b>
Introduction to data Engineering - The Data Engineering Life Cycle - Data Engineering and Data Science - Data-Driven Organizations: Data-driven decisions - The data pipeline - The role of the data engineer in data-driven organizations - Modern data strategies - The Elements of Data: The five Vs of data – volume, velocity, variety, veracity, and value. Demo: Accessing and Analyzing Data by Using Amazon S3.					
<b>UNIT II</b>	<b>SECURE AND SCALABLE DATA PIPELINES</b>				<b>10</b>
The evolution of data architectures - Modern data architecture on AWS - Modern data architecture pipeline: Ingestion and storage - Processing and consumption - Streaming analytics pipeline - Security of analytics workloads - Scaling - Creating a scalable infrastructure and components. ETL and ELT comparison - Data wrangling.					
<b>UNIT III</b>	<b>STORING AND ORGANIZING DATA</b>				<b>9</b>
Comparing batch and stream ingestion - Batch ingestion processing - Purpose-built ingestion tools - AWS Glue for batch ingestion processing - Kinesis for stream processing - Scaling considerations for batch processing and stream processing - Storage in the modern data architecture - Data lake storage - Data warehouse storage - Purpose-built databases - Storage in support of the pipeline - Securing storage.					
<b>UNIT IV</b>	<b>PROCESSING BIG DATA AND DATA FOR ML</b>				<b>10</b>
Big data processing concepts - Apache Hadoop - Apache Spark - Amazon EMR - Managing your Amazon EMR clusters - Apache Hudi - The ML lifecycle - Collecting data - Applying labels to training data with known targets - Preprocessing data - Feature engineering - Developing a model - Deploying a model - ML infrastructure on AWS - SageMaker - Amazon CodeWhisperer - AI/ML services on AWS. Monitor a Compute Engine virtual machine (VM) instance with Cloud Monitoring by creating uptime check, alerting policy, dashboard and chart.					
<b>UNIT V</b>	<b>DATA ANALYSIS AND VISUALIZATION</b>				<b>8</b>
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.					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Understand data engineering, pipelines & access data in the cloud. <b>CO2:</b> Build secure & scalable data pipelines using AWS services.					

- CO3:** Choose the right data storage & secure your data pipelines.
- CO4:** Process big data for machine learning with cloud tools.
- CO5:** Analyze & visualize data and automate data pipelines.
- CO6:** Apply best practices in data governance, compliance, and ethics throughout the data engineering process, ensuring responsible handling and usage of data.

**TEXT BOOKS:**

1. Martin Kleppman, "Data Engineering: Building Reliable Scalable Data Systems", O'Reilly Media, 2017.
2. Wes McKinney, "Python for Data Analysis", 2<sup>nd</sup> Edition, O'Reilly Media, 2017.

**REFERENCES:**

1. Martin Kleppman, "Designing Data-Intensive Applications", O'Reilly Media, 2017.
2. [AWS Documentation \(amazon.com\)](https://aws.amazon.com/documentation/)
3. [AWS Skill Builder](https://aws.amazon.com/skillbuilder/)
4. AWS Academy Data Engineering Course - [https://www.awsacademy.com/vforcesite/LMS\\_Login](https://www.awsacademy.com/vforcesite/LMS_Login)

22CS912	CLOUD SECURITY FOUNDATIONS	L	T	P	C
		3	0	0	3
<p><b>OBJECTIVES:</b>  <b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Learn the basics of cloud security, including the shared responsibility model and identity management.</li> <li>• Set up a secure cloud infrastructure with features like virtual private clouds and security groups.</li> <li>• Safeguard application data at rest and in transit using encryption and Amazon S3 protection features.</li> <li>• Learn to capture and analyze log data using AWS services like CloudTrail and CloudWatch.</li> <li>• Develop skills for identifying and managing security incidents in the cloud, adhering to best practices.</li> </ul>					
<b>UNIT I</b>	<b>SECURITY IN CLOUD</b>	<b>9</b>			
Introduction to Security, Security in the Cloud, Security design principles, Shared responsibility model, Activity: Shared Responsibility Model, Identity and Access Management (IAM) fundamentals, Authenticating and Authorizing with IAM, Examples of authorizing with IAM, Additional authentication and access management services, Using Organizations.					
<b>UNIT II</b>	<b>SECURING INFRASTRUCTURE</b>	<b>9</b>			
Structure of a three-tier web application, virtual private cloud (VPC), Setting up public and private subnets and internet protocols, Security groups, Network access control lists (ACLs), Load balancers, Protecting compute resources.					
<b>UNIT III</b>	<b>PROTECTING APPLICATION DATA</b>	<b>9</b>			
Basics on Data Protection, Protect data at rest, Amazon S3 protection features, Protection through encryption, Protect data in transit, protect data in Amazon S3, additional data protection services.					
<b>UNIT IV</b>	<b>LOGGING AND MONITORING</b>	<b>9</b>			
Importance of logging and monitoring, Capture and collect, Reading a Log File, AWS services with built-in logs, Monitor and report, CloudTrail and Amazon CloudWatch, methods for logging and monitoring, additional AWS services for logging and monitoring, AWS Security					

Hub.	
<b>UNIT V</b>	<b>RESPONDING AND MANAGING AN INCIDENT</b>
<b>9</b>	
Identifying an incident, Services that support the discovery and recognition phase, AWS Config and AWS Lambda, Services that support the resolution and recovery phase, Best practices for handling an incident.	
<b>TOTAL: 45 PERIODS</b>	
<b>OUTCOMES:</b>	
<b>Upon completion of the course, the students will be able to:</b>	
<b>CO1:</b> Learn essential cloud security principles and identity management fundamentals.	
<b>CO2:</b> Design and implement secure cloud infrastructure components for effective resource protection.	
<b>CO3:</b> Explore methods for securing application data stored in the cloud, including encryption techniques and data protection features.	
<b>CO4:</b> Gain proficiency in implementing logging and monitoring practices to detect and respond to security events efficiently in cloud environments.	
<b>CO5:</b> Acquire skills to identify and manage security incidents in the cloud, utilizing appropriate tools and techniques for incident detection, analysis, and resolution.	
<b>CO6:</b> Proficiently ensure the protection of cloud environments by applying strong security measures across all aspects, ensuring resilience and compliance.	
<b>TEXT BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy, An Enterprise Perspective on Risks and Compliance", Oreilly Media 2009.</li> <li>2. Vic (J.R.) Winkler, "Securing the Cloud, Cloud Computer Security Techniques and Tactics", Syngress, April 2011.</li> </ol>	
<b>REFERENCES:</b>	
<ol style="list-style-type: none"> <li>1. Rajkumar Buyya, James Broberg, Andrzej, "Cloud Computing: Principles and Paradigms", Wiley India Publications 2011.</li> <li>2. Arshdeep Bahga and Vijay Madiseti, "Cloud Computing –A Hands on Approach", Universities Press (India) Pvt Ltd. 2014.</li> </ol>	

<b>22CS934</b>	<b>CLOUD SERVICES MANAGEMENT</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>✓ Introduce Cloud Service Management terminology, definition &amp; concepts</li> <li>✓ Compare and contrast cloud service management with traditional IT service management</li> <li>✓ Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services</li> <li>✓ Select appropriate structures for designing, deploying and running cloud-based services in a business environment</li> <li>✓ Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems</li> </ul>					
<b>UNIT I</b>	<b>CLOUD SERVICE MANAGEMENT FUNDAMENTALS</b>	<b>9</b>			
Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.					
<b>UNIT II</b>	<b>CLOUD SERVICES STRATEGY</b>	<b>9</b>			

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.	
<b>UNIT III</b>	<b>CLOUD SERVICE MANAGEMENT</b> <span style="float: right;"><b>9</b></span>
Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.	
<b>UNIT IV</b>	<b>CLOUD SERVICE ECONOMICS</b> <span style="float: right;"><b>9</b></span>
Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.	
<b>UNIT V</b>	<b>CLOUD SERVICE GOVERNANCE &amp; VALUE</b> <span style="float: right;"><b>9</b></span>
IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.	
<b>TOTAL: 45 PERIODS</b>	
<b>OUTCOMES:</b> <b>At the end of this course, the students will be able to:</b> <b>CO1:</b> Exhibit cloud-design skills to build and automate business solutions using cloud technologies. <b>CO2:</b> Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services <b>CO3:</b> Solve the real world problems using Cloud services and technologies <b>CO4:</b> Develop and deploy services on the cloud and set up a cloud environment <b>CO5:</b> Explain security challenges in the cloud environment <b>CO6:</b> Demonstrate proficiency in integrating cloud technologies and services to address diverse business challenges effectively.	
<b>TEXT BOOKS:</b> 1. Enamul Haque, "Cloud Service Management and Governance: Smart Service Management in Cloud Era", Enel Publications, 2023. 1. Thomas Erl, Ricardo Puttini, Zaigham Mohammad, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall, 2013.	
<b>REFERENCES:</b> 1. Thomas Erl, Robert Cope, Amin Naserpour, "Cloud Computing Design Patterns", Prentice Hall, 2015. 2. Praveen Ayyappa, "Economics of Cloud Computing", LAP Lambert Academic Publishing, 2020. 2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing Foundations and Applications Programming", Elsevier, 2013.	

<b>22CS932</b>	<b>STORAGE TECHNOLOGIES</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b> <b>The Course will enable learners to:</b> <ul style="list-style-type: none"> <li>✓ Characterize the functionalities of logical and physical components of storage</li> <li>✓ Describe various storage networking technologies</li> </ul>					

<ul style="list-style-type: none"> <li>✓ Identify different storage virtualization technologies</li> <li>✓ Discuss the different backup and recovery strategies</li> <li>✓ Understand common storage management activities and solutions</li> </ul>		
<b>UNIT I</b>	<b>STORAGE SYSTEMS</b>	<b>9</b>
<p>Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.</p>		
<b>UNIT II</b>	<b>INTELLIGENT STORAGE SYSTEMS AND RAID</b>	<b>8</b>
<p>Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale-out storage Architecture. Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage.</p>		
<b>UNIT III</b>	<b>STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION</b>	<b>10</b>
<p>Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.</p>		
<b>UNIT IV</b>	<b>BACKUP, ARCHIVE AND REPLICATION</b>	<b>10</b>
<p>Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).</p>		
<b>UNIT V</b>	<b>SECURING STORAGE INFRASTRUCTURE</b>	<b>8</b>
<p>Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.</p>		
<b>TOTAL: 45 PERIODS</b>		
<p><b>OUTCOMES:</b>  <b>At the end of this course, the students will be able to:</b>  <b>CO1:</b> Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment  <b>CO2:</b> Illustrate the usage of advanced intelligent storage systems and RAID  <b>CO3:</b> Interpret various storage networking architectures - SAN, including storage subsystems  and virtualization  <b>CO4:</b> Examine the different role in providing disaster recovery and remote replication technologies  <b>CO5:</b> Infer the security needs and security measures to be employed in information storage management  <b>CO6:</b> Synthesize and apply comprehensive strategies for optimizing information storage infrastructure resilience and security.</p>		
<p><b>TEXTBOOKS:</b>  1. EMC Corporation, Information Storage and Management, Wiley, India.</p>		

2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017.

**REFERENCES:**

1. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained, Second Edition, Wiley, 2009.

<b>22CS933</b>	<b>MACHINE LEARNING FOR NLP IN CLOUD</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- Illustrate how to apply the ML pipeline to NLP.
- Implement text extraction to obtain data from web pages.
- Build a solution that uses AWS services to transcribe and translate text from multimedia.
- Build a solution using a combination of algorithms and Amazon Machine Learning (Amazon ML) services.
- Identify use cases to use generative AI and LLMs.
- Use LLMs with AWS generative AI services.

<b>UNIT I</b>	<b>Introduction to NLP</b>	<b>8</b>
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NLP – Business Problems Solved by NLP – NLP Roles - NLP and ML – Common NLP tasks – Apply ML to NLP problem - Evolution of NLP architectures.

<b>UNIT II</b>	<b>Processing Text for NLP</b>	<b>10</b>
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Text processing overview - Getting text - Extracting Text from Webpages and Images - Text preprocessing - Vectorizing text - Encoding and Vectorizing Text - Advanced processing - Storing and visualizing unstructured data – Implement Sentiment Analysis - Identifying the steps for text processing - Examining the algorithms for sentiment analysis.

<b>UNIT III</b>	<b>Information Extraction</b>	<b>9</b>
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Information extraction overview - Types of information extraction - Implementing information extraction – Working with Entities - Topic Modeling - Identifying the approach - Implementing Topic Modeling with Amazon Comprehend, Neural Topic Model (NTM).

<b>UNIT IV</b>	<b>Translating Languages</b>	<b>9</b>
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Working with language issues - Detecting and translating languages - Transcribing and vocalizing text with AWS services - Implementing a Multilingual Solution.

<b>UNIT V</b>	<b>Generative AI</b>	<b>9</b>
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Generative AI - Amazon Bedrock Overview - Introducing foundations models and large language models - Transformer architecture - LLMs configuration parameters - Introducing prompt engineering - Use LLMs to Perform NLP Tasks - Adapting LLMs - Application Integration.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

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

- CO1:** Apply the ML pipeline to NLP.
- CO2:** Implement text extraction to obtain data from webpages.
- CO3:** Build a solution that uses AWS services to transcribe and translate text from multimedia.
- CO4:** Build a solution using a combination of algorithms and Amazon Machine Learning (Amazon ML) services.
- CO5:** Identify use cases to use generative AI and LLMs.
- CO6:** Use LLMs with AWS generative AI services.

**TEXT BOOKS:**

1. Mona M, Premkumar Rangarajan, Natural Language Processing with AWS AI Services,

**REFERENCES:**

1. Saket S R Mengle, Maximo Gurmendez, Mastering Machine Learning on AWS: Advanced machine learning in Python using SageMaker, Apache Spark, and TensorFlow, Packt Publications, 2019.
2. AWS Documentation (amazon.com)
3. AWS Skill Builder
4. AWS Academy Machine Learning for Natural Language Processing Course - [https://www.awsacademy.com/vforcesite/LMS\\_Login](https://www.awsacademy.com/vforcesite/LMS_Login)

22CS931	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	9
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>✓ Understand the need for SDN and its data plane operations</li> <li>✓ Understand the functions of control plane</li> <li>✓ Comprehend the migration of networking functions to SDN environment</li> <li>✓ Explore various techniques of network function virtualization</li> <li>✓ Summarize the concepts behind network virtualization</li> </ul>					
<b>UNIT I</b>	<b>SDN: INTRODUCTION</b>				<b>9</b>
Evolving Network Requirements – The SDN Approach – SDN architecture - SDN Data Plane, Control plane and Application Plane.					
<b>UNIT II</b>	<b>SDN DATA PLANE AND CONTROL PLANE</b>				<b>9</b>
Data Plane functions and protocols - OpenFlow Protocol - Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers.					
<b>UNIT III</b>	<b>SDN APPLICATIONS</b>				<b>9</b>
SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking.					
<b>UNIT IV</b>	<b>NETWORK FUNCTION VIRTUALIZATION</b>				<b>9</b>
Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture.					
<b>UNIT V</b>	<b>NFV FUNCTIONALITY</b>				<b>9</b>
NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV. Case Study: Implement SDN for Network optimization.					
<b>TOTAL: 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>At the end of this course, the students will be able to:</b>					
<b>CO1:</b> Describe the motivation behind SDN					
<b>CO2:</b> Identify the functions of the data plane and control plane					
<b>CO3:</b> Design and develop network applications using SDN					
<b>CO4:</b> Orchestrate network services using NFV					
<b>CO5:</b> Explain various use cases of SDN and NFV					
<b>CO6:</b> Integrate SDN and NFV principles to effectively tackle diverse challenges in network virtualization.					
<b>TEXTBOOKS:</b>					
1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2022.					
<b>REFERENCES:</b>					

1. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
2. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
3. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
4. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
5. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

### PROFESSIONAL ELECTIVE VERTICALS - ARTIFICIAL INTELLIGENCE

22AI301	ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	2	4
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>Understand the various Intelligent agents and search strategies in AI.</li> <li>Learn about different problem-solving strategies using heuristic function.</li> <li>Learn about knowledge-based agents and first order logics.</li> <li>Understand knowledge representation and planning.</li> <li>Know about the expert system.</li> </ul>					
<b>UNIT I</b>	<b>ARTIFICIAL INTELLIGENCE AND INTELLIGENT AGENTS</b>	<b>9+6</b>			
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 <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Implement basic search strategies – 8-Puzzle, 8 - Queens problem.</li> <li>2. Implement Breadth First Search &amp; Depth first Search Algorithm</li> <li>3. Implement Water Jug problem.</li> <li>4. Solve Tic-Tac-Toe problem.</li> </ol>					
<b>UNIT II</b>	<b>PROBLEM SOLVING</b>	<b>9+6</b>			
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 <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Implement A* and memory bounded A* algorithms.</li> <li>2. Implement Minimax algorithm &amp; Alpha-Beta pruning for game playing.</li> <li>3. Constraint Satisfaction Problem</li> <li>4. Mini Project – Chess. Sudoku.</li> </ol>					
<b>UNIT III</b>	<b>LOGICAL AGENTS</b>	<b>9+6</b>			
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. <b>List of Exercises:</b> <ol style="list-style-type: none"> <li>1. Implement Unification algorithm for the given logic.</li> </ol>					

2. Implement forward chaining and backward chaining using Python.	
<b>UNIT IV</b>	<b>KNOWLEDGE REPRESENTATION AND PLANNING</b> <span style="float: right;"><b>9+6</b></span>
<p>Ontological engineering – Categories and objects – Events – Mental objects and modal logic – Reasoning systems for categories – Reasoning with default information</p> <p>Classical planning – Algorithms for classical planning – Heuristics for planning – Hierarchical planning – non-deterministic domains – Time, schedule, and resources – Analysis</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Implementation of object detection.</li> <li>2. Implement classical planning algorithms.</li> </ol>	
<b>UNIT V</b>	<b>LEARNING AND EXPERT SYSTEMS</b> <span style="float: right;"><b>9+6</b></span>
<p>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.</p> <p>Expert Systems: Functions – Main structure – if-then rules for representing knowledge – developing the shell – Dealing with uncertainty</p> <p><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Develop an Expert system.</li> <li>2. Mini-Project – Develop Machine Learning based classification Models.</li> </ol>	
<b>TOTAL: 45+30 = 75 PERIODS</b>	
<p><b>OUTCOMES:</b></p> <p><b>At the end of this course, the students will be able to:</b></p> <p><b>CO1:</b> Illustrate the structure of agents and to implement various Intelligent agents.</p> <p><b>CO2:</b> Apply search strategies in problem solving and game playing using heuristic function.</p> <p><b>CO3:</b> Implement logical agents and first-order logic problems.</p> <p><b>CO4:</b> Apply problem-solving strategies with knowledge representation mechanism for solving hard problems.</p> <p><b>CO5:</b> Demonstrate the basics of expert systems and to develop models using machine learning techniques.</p>	
<p><b>TEXT BOOKS:</b></p> <ol style="list-style-type: none"> <li>1. Peter Norvig and Stuart Russel, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition, 2020.</li> <li>2. Bratko, Prolog: Programming for Artificial Intelligencell, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.</li> </ol>	
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>1. Elaine Rich, Kevin Knight and B.Nair, Artificial Intelligence 3rd Edition, McGraw Hill, 2017.</li> <li>2. Melanie Mitchell, Artificial Intelligence: A Guide for Thinking Humans. Series: Pelican Books, 2020</li> <li>3. Ernest Friedman-Hill, Jess in Action, Rule-Based Systems in Java, Manning Publications, 2003</li> <li>4. Nils J. Nilsson, The Quest for Artificial Intelligence, Cambridge University Press, 2009.</li> <li>5. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, 1st Edition by Patterson, Pearson, India, 2015.</li> </ol>	

<b>22AI302</b>	<b>DATA SCIENCE USING PYTHON (Lab Integrated)</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>

<b>OBJECTIVES:</b>		
<p><b>The Course will enable learners to:</b></p> <ul style="list-style-type: none"> <li>• Learn the fundamentals of Data Science.</li> <li>• Experiment and implement python libraries for data science Learn the tools and packages in Python for Data Science.</li> <li>• Apply and implement basic classification algorithms</li> <li>• Apply clustering and outlier detection approaches.</li> <li>• Present and interpret data using visualization libraries in Python</li> </ul>		
<b>UNIT I</b>	<b>INTRODUCTION</b>	<b>6+6</b>
<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><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Download, install and explore the features of R/Python for data analytics <ul style="list-style-type: none"> <li>• Installing Anaconda</li> <li>• Basic Operations in Jupiter Notebook</li> <li>• Basic Data Handling</li> </ul> </li> </ol>		
<b>UNIT II</b>	<b>PYTHON LIBRARIES FOR DATA SCIENCE</b>	<b>6+6</b>
<p>Introduction to Numpy - Multidimensional Ndarrays – Indexing – Properties – Constants – Data Visualization: Narray 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><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>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.</li> <li>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()).</li> <li>3. Perform the Statistics operation for the data (the sum, product, median, minimum and maximum, quantiles, arg min, arg max etc.).</li> <li>4. Use any data set compute the mean ,standard deviation, Percentile.</li> </ol>		
<b>UNIT III</b>	<b>CLASSIFICATION</b>	<b>6+6</b>
<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><b>List of Exercises:</b></p> <ol style="list-style-type: none"> <li>1. Apply Decision Tree algorithms on any data set.</li> <li>2. Apply SVM on any data set</li> <li>3. Implement K-Nearest-Neighbor Classifiers</li> </ol>		
<b>UNIT IV</b>	<b>CLUSTERING AND OUTLIER DETECTION</b>	<b>6+6</b>

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

22AI921	SOFT COMPUTING	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>To learn the basic concepts of Soft Computing.</li> <li>To understand artificial neural networks.</li> <li>To elaborate fuzzy systems.</li> <li>To illustrate Genetic Algorithms.</li> <li>To discuss the various Hybrid algorithms and various Swarm Intelligence algorithms.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>9</b>
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.					
<b>UNIT II</b>	<b>ARTIFICIAL NEURAL NETWORKS</b>				<b>9</b>
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.					
<b>UNIT III</b>	<b>FUZZY SYSTEMS</b>				<b>9</b>
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.					
<b>UNIT IV</b>	<b>GENETIC ALGORITHMS</b>				<b>9</b>
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.					
<b>UNIT V</b>	<b>HYBRID SOFT COMPUTING AND SWARM INTELLIGENCE ALGORITHMS</b>				<b>9</b>
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.					
<b>TOTAL : 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>Upon completion of the course, the students will be able to:</b>					
<b>CO1:</b> Elaborate the basic concepts of Soft Computing.					
<b>CO2:</b> Discuss Artificial neural networks and its applications.					
<b>CO3:</b> Apply Fuzzy logic to solve different applications.					
<b>CO4:</b> Solving problems using Genetic algorithms.					
<b>CO5:</b> Discuss various algorithms in Soft computing with its applications and limitations.					
<b>CO6:</b> Use various algorithms in Soft computing to solve real-world problems.					
<b>TEXT BOOKS:</b>					
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:**

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 ApplicationsII, 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:
  - a. Introduction To Soft Computing -  
[https://onlinecourses.nptel.ac.in/noc23\\_cs40/preview](https://onlinecourses.nptel.ac.in/noc23_cs40/preview)

22CD929	COMPUTER VISION	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>• To analyse the building blocks of how images are captured and manipulated on computers.</li> <li>• To uncover object detection utilizing deep learning techniques.</li> <li>• To develop skills in interpreting the extracted visual data</li> <li>• To understand how to align and track movement within images.</li> <li>• To explore how to build 3D structures and create realistic visuals from images.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO IMAGE FORMATION AND PROCESSING</b>				<b>9</b>
computer vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Geometric primitives and transformations - Photometric image formation - The digital camera					
<b>UNIT II</b>	<b>MODEL FITTING AND DEEP LEARNING</b>				<b>9</b>
Scattered data interpolation - Variational methods and regularization - Markov random fields - Supervised learning - Unsupervised learning - Deep neural networks - Convolutional networks - More complex models					
<b>UNIT III</b>	<b>RECOGNITION AND FEATURE DETECTION</b>				<b>9</b>
Instance recognition - Image classification - Object detection - Semantic segmentation - Video understanding - Vision and language - Points and patches - Edges and contours - Contour tracking - Lines and vanishing points - Segmentation					
<b>UNIT IV</b>	<b>IMAGE ALIGNMENT AND MOTION ESTIMATION</b>				<b>9</b>
Pairwise alignment - Image stitching - Global alignment - Compositing - Translational alignment - Parametric motion - Optical flow - Layered motion					
<b>UNIT V</b>	<b>3D RECONSTRUCTION AND IMAGE-BASED RENDERING</b>				<b>9</b>
Shape from X - 3D scanning - Surface representations - Point-based representations - Volumetric representations - Model-based reconstruction - Recovering texture maps and albedos - View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering - Neural rendering					
<b>TOTAL:</b>					<b>45 PERIODS</b>

**OUTCOMES:**

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

**CO1:** Apply interpolation techniques and variational methods in image processing

**CO2:** Develop techniques for instance recognition, image classification, and object detection utilizing deep learning techniques.

**CO3:** Exploit machine learning methods for computer vision tasks.

**CO4:** Analyze and interpret video data and integrate vision with language processing and reconstruct 3D shapes and represent surfaces from image data.

**CO5:** Apply advanced rendering techniques including view interpolation and neural rendering.

**CO6:** Apply the knowledge in solving high level vision problems like object recognition, image classification, Image alignment ,Motion and Estimation etc.

**TEXT BOOKS:**

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2021.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2015.

**REFERENCES:**

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison- Wesley, 1992.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

22CD928	DEEP LEARNING	L	T	P	C	
		3	0	0	3	
<b>OBJECTIVES:</b>						
<ul style="list-style-type: none"> <li>• To understand the basics of deep neural networks.</li> <li>• To implement deep learning models.</li> <li>• To elaborate CNN and RNN architectures of deep neural networks.</li> <li>• To familiarize auto encoders in neural networks.</li> <li>• To learn about the deep generative models.</li> <li>• To apply Deep Learning to solve real-world problems.</li> </ul>						
<b>UNIT I</b>	<b>DEEP NETWORKS</b>					<b>9</b>
Challenges motivating deep learning - Deep feedforward networks - Learning XOR - Gradient based learning - Hidden Units – Architecture Design – Back Propagation – Regularization – Parameter Norm Penalties – Constrained Optimization – Under-Constrained Problems – Dataset Augmentation – Noise Robustness – Semi-Supervised Learning – Multi-Task Learning – Early Stopping – Parameter Tying and Sharing – Bagging and Other Ensemble methods – Dropout – Adversarial Training.						
<b>UNIT II</b>	<b>OPTIMIZATION FOR TRAINING DEEP MODELS</b>					<b>9</b>
Pure optimization – Challenges – Basic Algorithms – Parameter initialization Strategies – Algorithms with Adaptive Learning Rates – Approximate Second-Order methods – Optimization Strategies and Meta Algorithms.						
<b>UNIT III</b>	<b>CONVOLUTIONAL AND RECURRENT NEURAL NETWORKS</b>					<b>9</b>
Convolution Operation – motivation – Pooling – Infinitely Strong prior – Variants – Structured						

Output – Data Types – Efficient Convolutional Algorithms – Random or Unsupervised features – Neuroscientific Basis - Deep Learning – Sequence Modelling - Computational Graphs - RNN - Bidirectional RNN – Encoder-Decoder - Sequence to Sequence RNN - Deep Recurrent Networks - Recursive Neural Networks - Long Term Dependencies; Leaky Units - Strategies for multiple time scales – LSTM and Gated RNNs - Optimization for Long Term Dependencies.

<b>UNIT IV</b>	<b>AUTOENCODERS</b>	<b>9</b>
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Autoencoders: Undercomplete autoencoders - Regularized autoencoders – Power, Layer Size and Depth - Stochastic encoders and decoders – Denoising Autoencoders - Learning with autoencoders – contractive Autoencoders – Applications of autoencoders.

<b>UNIT V</b>	<b>DEEP GENERATIVE MODELS</b>	<b>9</b>
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Boltzmann Machine – Restricted Boltzmann Machine – Deep Belief Networks – Deep Boltzmann Machines - Boltzmann Machines for Real-Valued Data – Convolutional Boltzmann Machines - Boltzmann Machine for Structured or Sequential Outputs – Directed Generative Nets – Evaluating Generative Models.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Demonstrate the basics of deep neural networks to solve real world problems.

**CO2:** Implement deep learning models.

**CO3:** Elaborate CNN and RNN architectures of deep neural networks.

**CO4:** Use autoencoders in neural networks.

**CO5:** Illustrate the various deep generative models.

**CO6:** Apply deep generative models to solve real world problems.

**TEXT BOOKS:**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

**REFERENCES:**

1. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 2018.

2. Yoav Goldberg, “Neural Network Methods for Natural Language Processing”, Synthesis Lectures on Human Language Technologies, Morgan & Claypool publishers, 2017.

3. Francois Chollet, “Deep Learning with Python”, Manning Publications Co, 2018.

4. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner's Approach”, O'Reilly Media, 2017.

5. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.

6. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, John Wiley & Sons Inc., 2007.

<b>22CS937</b>	<b>REINFORCEMENT AND ENSEMBLE LEARNING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**OBJECTIVES:**

**The Course will enable learners to:**

- Outline the concepts of Reinforcement Learning
- Solve problems using Monte Carlo Decision Process and Dynamic Programming.
- Implement problems using temporal difference learning.
- Apply functional approximation in reinforcement learning.

<b>UNIT I</b>	<b>INTRODUCITON</b>	<b>9</b>
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Introduction - Elements of RL, History of RL- Limitation and Scope - Examples – Multi-arm Bandits – k-armed Bandit Problem – Action-Value Methods – Incremental Implementation – Nonstationary Problem – Optimistic Initial Values – Upper Confidence Bound Action Selection – Gradient Bandit Algorithms – Contextual Bandits.		
<b>UNIT II</b>	<b>TABULAR SOLUTION METHODS</b>	<b>9</b>
Finite Markov Decision Processes – Dynamic Programming – Monte Carlo Methods – Temporal Difference Learning.		
<b>UNIT III</b>	<b>FUNCTION APPROXIMATION METHODS</b>	<b>9</b>
On-Policy Prediction with Approximation: Value-function Approximation – The Prediction Objective – Stochastic-gradient and Semi-gradient Methods - Linear Methods – Feature Construction for Linear Methods - Eligibility Traces: The $\lambda$ -return – TD( $\lambda$ ).		
<b>UNIT IV</b>	<b>CORE ENSEMBLE METHODS</b>	<b>9</b>
Boosting - Boosting procedure – AdaBoost Algorithm – Examples and Issues - Bagging - Algorithm – Examples and Issues – Random tree Ensembles -Combination Methods - Averaging – Voting – Combining by learning – Other Combination methods – Relevant methods.		
<b>UNIT V</b>	<b>ADVANCED ENSEMBLE METHODS</b>	<b>9</b>
Ensemble Pruning - Categories – Ordering based – Clustering based – Optimization based Clustering Ensembles - Categories – Similarity based – Graph based – Relabeling based – Transformation based.		
<b>TOTAL : 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Analyze the basics and history of reinforcement learning using examples like Multi-arm Bandits		
<b>CO2:</b> Use tabular methods for solving Markov Decision Processes.		
<b>CO3:</b> Evaluate function approximation methods for on-policy prediction.		
<b>CO4:</b> Design and compare ensemble methods like boosting and bagging		
<b>CO5:</b> Analyze and combine advanced ensemble methods for pruning and clustering		
<b>CO6:</b> Apply ethical principles and communicate effectively in presenting learning methods		
<b>TEXT BOOKS:</b>		
1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press, SecondEdition, 2020.		
2. Zhi-Hua Zhou. Ensemble Methods Foundations and Algorithms, First Edition, Chapman & Hall/CRC Machine Learning & Pattern Recognition, 2012.		
<b>REFERENCES:</b>		
1. Kevin Murphy, "Machine Learning - A Probabilistic Perspective", MIT press, 2012.		
2. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.		
1. Phil Winder, "Reinforcement Learning: Industrial Applications of Intelligent Agents". Oreilly, 2021.		

<b>22AI903</b>	<b>TEXT AND SPEECH ANALYTICS</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To introduce the tools and techniques for performing text and speech analytics in diverse contexts.</li> <li>To understand the tools and technologies involved in developing text and speech applications.</li> <li>To demonstrate the use of computing for building applications in text and speech processing.</li> </ul>					

	<ul style="list-style-type: none"> <li>To use information Retrieval Techniques to build and evaluate text processing systems.</li> <li>To apply advanced speech recognition methodologies in practical applications.</li> </ul>	
<b>UNIT I</b>	<b>TEXT PROCESSING</b>	<b>9</b>
Speech and Language Processing - Regular Expression - Text normalization – Edit Distance - Lemmatization – Stemming – N-gram Language Models - Vector Semantics and Embeddings.		
<b>UNIT II</b>	<b>TEXT CLASSIFICATION</b>	<b>9</b>
Text Classification Tasks – Language Model – Neural Language Models – RNNs as Language Models – Transformers and Large Language Models.		
<b>UNIT III</b>	<b>QUESTION ANSWERING AND DIALOGUE SYSTEMS</b>	<b>9</b>
Information Retrieval – Dense Vectors – Neural IR for Question Answering – Evaluating Retrieval-based Question Answering – Frame-based Dialogue Systems – Dialogue Acts and Dialogue State – Chatbots – Dialogue System Design.		
<b>UNIT IV</b>	<b>TEXT TO SPEECH SYNTHESIS</b>	<b>9</b>
Automatic Speech Recognition Task – Feature Extraction for ASR: Log Mel Spectrum – Speech Recognition Architecture – CTC - ASR Evaluation: Word Error Rate – TTS – Speech Tasks.		
<b>UNIT V</b>	<b>SPEECH RECOGNITION</b>	<b>9</b>
LPC for speech recognition - Hidden Markov Model (HMM) - Training procedure for HMM-subword unit model based on HMM - Language models for large vocabulary speech recognition - Overall recognition system based on subword units - Context dependent subword units-Semantic post processor for speech recognition.		
<b>TOTAL : 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Apply the fundamental techniques in text processing for various NLP tasks.		
<b>CO2:</b> Implement advanced language models and improves text classification accuracy.		
<b>CO3:</b> Designing text processing systems using state-of-the-art techniques.		
<b>CO4:</b> Design, implement, and evaluate ASR and TTS systems.		
<b>CO5:</b> Apply advanced speech recognition methodologies in practical applications.		
<b>CO6:</b> Use information Retrieval Techniques to build and evaluate text processing systems.		
<b>TEXT BOOKS:</b>		
2. Jurafsky, D. and J. H. Martin, Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition Pearson Publication, Third Edition, 2022.		
3. Lawrence Rabiner, Bing-Hwang Juang and B.Yegnanarayana, “Fundamentals of Speech Recognition”, Pearson Education, 2009.		
<b>REFERENCES:</b>		
1. John Atkinson-Abutridy, Text Analytics: An Introduction to the Science and Applications of Unstructured Information Analysis, CRC Press, 2022.		
2. Jim Schwoebel, NeuroLex, Introduction to Voice Computing in Python, 2018		
3. Lawrence R. Rabiner, Ronald W. Schafer, Theory and Applications of Digital Speech Processing, First Edition, Pearson, 2010.		
4. Srinivasa-Desikan, Bhargav. Natural Language Processing and Computational Linguistics: A practical guide to text analysis with Python, Gensim, spaCy, and Keras. Packt Publishing Ltd, 2018.		

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<b>22CS920</b>	<b>GENERATIVE AI FUNDAMENTALS</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>	
<b>OBJECTIVES:</b>						
<b>The Course will enable learners to:</b>						
<ul style="list-style-type: none"> <li>• Understand the basic concepts of Generative AI.</li> <li>• Build Generative AI systems to generate images.</li> <li>• Understand the concept used in Generative AI Models.</li> <li>• Use various Generative AI models.</li> <li>• Compare and use the various Large Language Models.</li> <li>• Understand the basics of Prompt Engineering.</li> </ul>						
<b>UNIT I</b>	<b>INTRODUCTION</b>					<b>9</b>
Generative Models – Image transformation – Challenges - Deep Neural Networks Perceptron – back propagation – CNN – RNN – Optimizer.						
<b>UNIT II</b>	<b>IMAGE GENERATION</b>					<b>9</b>
Creating encodings of images – variational objective – Inverse Autoregressive flow - Importing CIFAR – Creating the network from TensorFlow 2.						
<b>UNIT III</b>	<b>GENERATIVE ADVERSARIAL NETWORKS</b>					<b>9</b>
Generative Adversarial Networks – Vanilla GAN – Improved GANs – Progressive GAN – Challenges – Paired style transfer – Unpaired style transfer – Deepfakes – Modes of operation – key feature set – High level flow – Replacement – Re-enactment.						
<b>UNIT IV</b>	<b>LARGE LANGUAGE MODELS</b>					<b>9</b>
Overview of LLMs - Transformers – GPT – Types of LLMs – Key concepts – other Transformers – T5 – Generative Pre-Training Models – Multi-modal Models – DALL.E 2						
<b>UNIT V</b>	<b>PROMPT ENGINEERING</b>					<b>9</b>
Basics – In-Context Learning – In-Context Prompting – Techniques – Image Prompting – Prompt Hijacking – Challenges.						
<b>TOTAL: 45 PERIODS</b>						
<b>OUTCOMES:</b>						
<b>Upon completion of the course, the students will be able to:</b>						
<b>CO1:</b> Elaborate the basic concepts of Generative AI.						
<b>CO2:</b> Build Generative AI systems to generate images.						
<b>CO3:</b> Apply the concepts used in Generative AI Models.						
<b>CO4:</b> Use various Generative AI models.						
<b>CO5:</b> Compare and use the various Large Language Models.						
<b>CO6:</b> Analyze the basics of Prompt Engineering.						
<b>TEXT BOOKS:</b>						
1. Ben Auffarth, Generative AI with LangChain, Packt Publishing, 2023. Amit Bahree, Generative AI in Action, Manning Publication, First Edition, 2023.						
<b>REFERENCES:</b>						
1. David Foster, Generative Deep Learning, 2nd Edition, O'Reilly Media, 2023.						
2. Numa Dhamani and Maggie Engler, Introduction to Generative AI, Manning Publication, First Edition, 2024.						
3. Valentina Alto, Modern Generative AI with ChatGPT and OpenAI Models, Packtpublications, 2024.						

<b>22CD926</b>	<b>DATA EXPLORATION, FEATURE ENGINEERING AND VISUALIZATION</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>OBJECTIVES:</b>		
<b>The Course will enable learners to:</b>		
<ul style="list-style-type: none"> <li>• To outline exploratory data analysis and the phases involved in data analysis.</li> <li>• To discuss various statistical techniques for data analysis.</li> <li>• To demonstrate the basics of feature engineering on different types of data.</li> <li>• To perform data analysis and apply visualization techniques.</li> <li>• To apply the methods of time series analysis.</li> <li>• To formulate dashboards using different datasets by applying data engineering and feature extraction techniques.</li> </ul>		
<b>UNIT I</b>	<b>EXPLORATORY DATA ANALYSIS</b>	<b>9</b>
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.		
<b>UNIT II</b>	<b>FEATURE ENGINEERING</b>	<b>9</b>
Text Data – Visual Data – Feature-based Time-Series Analysis – Data Streams – Feature Selection and Evaluation.		
<b>UNIT III</b>	<b>VISUALIZING DATA</b>	<b>9</b>
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.		
<b>UNIT IV</b>	<b>TIME SERIES ANALYSIS</b>	<b>9</b>
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.		
<b>UNIT V</b>	<b>TREES, HIERARCHIES, AND RECURSION</b>	<b>9</b>
Treemaps - treemap library, directory structure, maintaining context, file item, folder item, Networks and Graphs-approaching network problems-advanced graph example, Acquiring data, Parsing data.		
<b>TOTAL : 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>Upon completion of the course, the students will be able to:</b>		
<b>CO1:</b> Outline exploratory data analysis and the phases involved in data analysis.		
<b>CO2:</b> Demonstrate various statistical techniques for data analysis.		
<b>CO3:</b> Present the basics of feature engineering on different types of data.		
<b>CO4:</b> Perform data analysis and apply visualization techniques.		
<b>CO5:</b> Apply the methods of time series analysis.		
<b>CO6:</b> Develop dashboards using different datasets by applying data engineering and feature extraction techniques.		
<b>TEXT BOOKS:</b>		
<ol style="list-style-type: none"> <li>1. Suresh Kumar Mukhiya and Usman Ahmed, “Hands-on Exploratory Data Analysis with Python”, Packt Publishing , First Edition, March 2020.</li> <li>2. Guozhu Dong, Huan Liu, "Feature Engineering for Machine Learning and Data Analytics", First Publication, CRC Press, First edition, 2018.</li> <li>3. Ben Fry, “Visualizing Data”, O’reilly Publications, First Edition, 2007.</li> </ol>		

<b>REFERENCES:</b>
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.

22CD927	MACHINE LEARNING	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To discuss the basics of Machine Learning and model evaluation.</li> <li>To study dimensionality reduction techniques.</li> <li>To understand the various classification algorithms.</li> <li>To elaborate on unsupervised learning techniques.</li> <li>To discuss the basics of neural networks and various types of learning.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION</b>				<b>9</b>
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.					
<b>UNIT II</b>	<b>FEATURE ENGINEERING AND DIMENSIONALITY REDUCTION</b>				<b>9</b>
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.					
<b>UNIT III</b>	<b>SUPERVISED LEARNING</b>				<b>9</b>
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.					
<b>UNIT IV</b>	<b>UNSUPERVISED LEARNING</b>				<b>9</b>
Clustering – Types – Applications - Partitioning Methods – K-means Algorithm – K-Medoids – Hierarchical methods – Density based methods DBSCAN – Finding patterns using Association Rules – Hidden Markov Model.					
<b>UNIT V</b>	<b>NEURAL NETWORKS AND TYPES OF LEARNING</b>				<b>9</b>
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.					
<b>TOTAL : 45 PERIODS</b>					

**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](https://onlinecourses.nptel.ac.in/noc23_cs18/preview)

**MINOR DEGREE CURRICULUM OFFERED BY  
DEPARTMENT OF COMPUTER SCIENCE AND DESIGN  
(FOR OTHER B.E. / B.TECH PROGRAMMES)  
MINOR DEGREE IN VIRTUAL AND AUGMENTED REALITY**

22CD930	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To grasp the fundamental knowledge of implementing Computer Graphics in 2D.</li> <li>To acquire knowledge in 3D Graphics.</li> <li>To learn the process of implementation of Computer Graphics through Vulkan API.</li> <li>To get familiarity with basic to advanced rendering technique.</li> <li>To become familiar with Animation and Multimedia systems.</li> </ul>					
<b>UNIT I</b>	<b>2D GRAPHICS PROCESSING</b>				<b>9</b>
Video Display devices -Raster Scan System-Graphics Output Primitives-Open GL Point Functions-Open GL Line Functions-Open GL Curve Functions-Implementation Algorithm for Graphics Primitives & Attributes: Line Drawing Algorithm-Parallel Line Algorithm-Circle Generating Algorithm-Ellipse Generating Algorithm-Two-Dimensional Viewing Pipeline-Clipping Algorithm.					
<b>UNIT II</b>	<b>3D GRAPHICS PIPELINE</b>				<b>9</b>
Three-Dimensional Geometric transformation: Translation- Rotation- Scaling-Composite Three-Dimensional Transformations-Other Three-dimensional Transformations-Three-dimensional viewing pipeline-Projection Transformations-Orthogonal Projections-Oblique Parallel Projections-Perspective Projections-OpenGL Three-dimensional Viewing Function.					
<b>UNIT III</b>	<b>VULKAN GRAPHICS API</b>				<b>9</b>
Overview of Vulkan-Introduction-Instances, Devices and Queues-The Vulkan Instance-Vulkan Physical Devices-Physical Device Memory-Device Queues-Creating a Logical Device-Object Types and Function Conventions- Enhancing Vulkan: Layers – Extensions-Queues and Commands: Device Queue-Creating Command Buffers-Recording Buffer-Recycling Command Buffers -Moving Data: Managing Resource State.					
<b>UNIT IV</b>	<b>RENDERING</b>				<b>9</b>
Lighting and Shading-Light Matter-Light Sources-The Phong Reflection Model-Texture Mapping-Texture Generation-Global Illumination-RayTracing-Radiosity-Parallel Rendering-Volume Rendering- Environment map- Bump mapping- iso surfaces and marching Cubes-Rasterization.					
<b>UNIT V</b>	<b>ANIMATION</b>				<b>9</b>
Design of Animation Sequences-General Computer animation Function-Raster Animations-Computer Animation Languages-Key Frame System- Morphing-Simulating Acceleration-Motion Specification-Direct Motion Specifications-Goal Directed System-Kinematics & Dynamics.					
<b>TOTAL : 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>On Successful completion of the course, Students will be able to</b>					
<b>CO1:</b> Implement 2D transformations and algorithms for generating primitives and attributes.					
<b>CO2:</b> Solve problems in 3D transformations and viewing.					
<b>CO3:</b> Analyze the process of open source Vulkan API.					
<b>CO4:</b> Examine rendering techniques and use advanced based rendering.					
<b>CO5:</b> Apply lighting and shading models to enhance graphical scenes.					
<b>CO6:</b> Understand the multimedia systems and animation.					

**TEXT BOOKS:**

1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, "Computer Graphics with OpenGL", Pearson Education, Fourth Edition, 2014.
2. Graham Sellers, John Kessenich, "Vulkan Programming Guide", 1st Edition, Addison Wesley, 2016.
3. Edward Angel, Dave Shreiner, "Interactive Computer Graphics. A Top-Down Approach with WebGL", 7th Edition, 2015

**REFERENCES:**

1. OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V, 9th Edition, Addison Wesley, 2016.
2. <https://vulkan-tutorial.com>.

22CD931	AUGMENTED AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Get exposure on Augmented Reality.</li> <li>• Introduce Virtual Reality and input and output devices.</li> <li>• Acquire knowledge on computing architectures and modelling.</li> <li>• Explore Virtual Reality programming and human factors.</li> <li>• Learn various applications of Virtual Reality.</li> </ul>					
<b>UNIT I</b>	<b>AUGMENTED REALITY (AR)</b>				<b>9</b>
Introduction to Augmented Reality-Computer vision for AR-Interaction- Modelling and Annotation-Navigation-Wearable devices.					
<b>UNIT II</b>	<b>INTRODUCTION TO VIRTUAL REALITY (VR) AND INPUT AND OUTPUT DEVICES</b>				<b>9</b>
Introduction: The three I's of Virtual Reality - - Early commercial VR technology - The five classic components of a VR system. Input devices: Three-Dimensional position trackers - tracker performance parameters - ultrasonic trackers - optical trackers - Navigation and manipulation interfaces - gesture interfaces. Output devices: graphics displays - large-volume displays - sound displays.					
<b>UNIT III</b>	<b>COMPUTING ARCHITECTURES AND MODELING OF A VR SYSTEM</b>				<b>9</b>
Computing architectures for VR: The rendering pipeline - The graphics rendering pipeline - The haptics rendering pipeline - PC graphics architecture - PC graphics accelerators - Graphics benchmarks - Distributed VR architectures - Multipipeline synchronization - Colocated rendering pipelines. Modeling: geometric modeling - kinematics modeling - physical and behavior modelling					
<b>UNIT IV</b>	<b>VR PROGRAMMING AND HUMAN FACTORS</b>				<b>9</b>
Toolkits and scene graphs - WorldToolKit - Model geometry and appearance - The WTK scene graph - Sensors and action functions - WTK networking - Java 3D - Model geometry and appearance - Java 3D scene graph - Sensors and behaviors - Java 3D networking - WTK and Java 3D performance comparison -Human factors in VR: Methodology and terminology - user performance studies - VR health and safety issues - VR and society					
<b>UNIT V</b>	<b>APPLICATIONS OF VR</b>				<b>9</b>

Medical Application of VR - Virtual anatomy-Triage and diagnostic - Surgery - VR in education - VR and the Arts - Entertainment applications of VR - military VR applications - Army use of VR - VR applications in the Navy - Air force use of VR - Applications of VR in Robotics - Robot programming - Robot teleoperation

**TOTAL = 45 PERIODS**

**OUTCOMES:**

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

**CO1:** Understand Augmented Reality.

**CO2:** Explore different input and output devices used in Virtual Reality system.

**CO3:** Model the VR system.

**CO4:** Analyze about Google Toolkit's and Scene Graph.

**CO5:** Apply virtual reality in a variety of sectors..

**CO6:** Assess the effectiveness of VR in improving training outcomes and operational readines

**TEXT BOOKS:**

1. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016.

2. Grigore C. Burdea, Philippe Coiffet, "Virtual reality technology", Wiley, Second Edition, 2017.

**REFERENCE BOOKS:**

1.Sherman, William R & Craig, Alan B, "Understanding Virtual reality", Elsevier India Private Limited, Noida, 2018.

2.Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create compelling VR experiences for mobile", Packt Publisher, 2018.

22CD932	GAME DESIGN	L	T	P	C	
		3	0	0	3	
<b>OBJECTIVES:</b>						
<b>The Course will enable learners to:</b>						
<ul style="list-style-type: none"> <li>Understand the Fundamental principles of Game Design and Development ·</li> <li>Know the importance and application of Game AI ·</li> <li>Learn the detailed processes of typical Game Engine ·</li> <li>Implement simple 2D games using the design and development process learnt ·</li> <li>Implement simple 3D games using the design and development process learnt.</li> </ul>						
<b>UNIT I</b>	<b>GAME DESIGN FUNDAMENTALS</b>					<b>9</b>
Role of Game Designer, Structure of Games, major genres, game concepts, game worlds, working with formal elements, dramatic elements and system dynamics, storytelling, game play, core mechanics, game balancing, principles of Level Design, Conceptualization, prototyping, playtesting.						
<b>UNIT II</b>	<b>GAME AI</b>					<b>9</b>
Game AI, AI model, algorithms for Movement, Path finding, Decision making, Tactical and Strategic AI, Procedural Content Generation, Board Games.						
<b>UNIT III</b>	<b>GAME ENGINE</b>					<b>9</b>
Rendering engine and pipeline, Scene Graph, Level of Detail, sorting, Animation Systems, Collision and Rigid Body dynamics.						
<b>UNIT IV</b>	<b>2D GAME DESIGN AND IMPLEMENTATION</b>					<b>9</b>
GoDot game engine Designing and Prototyping a simple 2D Game, including character						

design, storytelling, levels. Implementing the Game in pygame or Godot engine or equivalent.	
<b>UNIT V</b>	<b>3D GAME DESIGN AND IMPLEMENTATION</b>
Designing and Prototyping a simple 3D Game, including character design, storytelling, levels. Implementing the Game in pygame or Godot engine or Blender or equivalent.	
<b>TOTAL: 45 PERIODS</b>	
<b>OUTCOMES:</b>	
<b>At the end of this course, the students will be able to:</b>	
<b>CO1:</b> Use the Fundamental principles of Game Design and Development in context.	
<b>CO2:</b> Able to apply AI techniques in Game Design and Development.	
<b>CO3:</b> Thoroughly understand the detailed processes of the Game Engine.	
<b>CO4:</b> Design simple 2D games using the design and development process learnt.	
<b>CO5:</b> Implement simple 3D games using the design and development process learnt.	
<b>CO6:</b> Understand the principles of character modeling, texturing, and rigging.	
<b>TEXT BOOKS:</b>	
1. Ernest Adams, "Fundamentals of Game Design", 3rd Edition, Pearson Education, 2015.	
2. Ian Millington, "AI for Games", CRC Press, 3rd edition, 2019.	
3. Jung Hyun Han, "3D Graphics for Game Programming", Delmar Cengage Learning, 2011.	
<b>REFERENCES:</b>	
1. Tracy Fullerton: Game Design Workshop, A Play centric Approach to Creating Innovative Games, 4th Edition, CRC Press, 2018.	
2. Jason Gregory, "Game Engine Architecture", CRC Press, Third Edition, 2018.	
3. Ernest Adams and Joris Dormans, "Game Mechanics: Advanced Game Design", New Riders Press, 2012.	
4. Jesse Schell, "The Art of Game Design, A Book of Lenses", Third Edition, CRC Press, 2019.	
5. <a href="https://godotengine.org/">https://godotengine.org/</a>	
6. <a href="https://www.pygame.org">https://www.pygame.org</a>	
7. <a href="https://www.blender.org/">https://www.blender.org/</a>	

<b>22CD933</b>	<b>DIGITAL MARKETING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To explain the role of digital marketing in overall marketing strategy.</li> <li>To understand website designing and optimization methods in digital marketing.</li> <li>To deploy Search Engine Marketing Platforms.</li> <li>To apply various Social Media Marketing strategies.</li> <li>To implement the concepts of Web Analytics and various types of report generation.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO DIGITAL MARKETING</b>	<b>9</b>			
Digital marketing - Importance of digital marketing-Difference between traditional and digital marketing- Digital marketing platforms- recent trends and current scenario of the industry - digital marketing as a tool for students, professionals and businesses-Tools.					
<b>UNIT II</b>	<b>WEBSITE DESIGNING AND OPTIMIZATION</b>	<b>9</b>			
On Page Optimisation (OPO)- HTML and CSS basics- Meta tags usage- Using Javascript - Contextual interlinking - Microformats & schemas - Off-Page Optimization - Linking Strategies - Competitor Analysis-Sculpting-Link baiting - Social Book Marking and Promotions- Directory submissions -Search Engine Optimization (SEO)- Growth of SEO-Ecosystem of a search engine SEO Tools.					

<b>UNIT III</b>	<b>SEARCH ENGINE MARKETING</b>	<b>9</b>
SEM platforms- Google Adwords – Ad creation process- Keyword grouping-Bidding techniques – Site targeting & keyword targeting -Ad approval process – Ad extensions- Site, Demographic targeting, CPC-based, CPA-based & CPM-based accounts		
<b>UNIT IV</b>	<b>SOCIAL MEDIA MARKETING</b>	<b>9</b>
Social Media Marketing- Email Marketing- Mobile Marketing - Adsense, Blogging and Affiliate Marketing.		
<b>UNIT V</b>	<b>WEB ANALYTICS</b>	<b>9</b>
Introduction to Web Analytics- GA Terminology (Dimensions & Metrics)- Introduction to Reports - Audience Reports, Traffic Sources and Content Reports- Campaign Tagging & Reporting - Dashboard- Linking and Using Data from Google Adwords- Case studies on digital marketing strategies.		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Explain the role and importance of digital marketing in a rapidly changing business landscape		
<b>CO2:</b> Apply the marketing research metrics and do market segments, market targets and brand positioning.		
<b>CO3:</b> Examine website designing and optimization.		
<b>CO4:</b> Analyze the various SEM platforms for digital marketing.		
<b>CO5:</b> Discuss the marketing strategies used in social media, then design and manage the Integrated Marketing Channels		
<b>CO6:</b> Analyze the web and generate various types of reports for real time application.		
<b>TEXT BOOKS:</b>		
4. Seema Gupta, Digital Marketing, McGraw Hill, 2nd Edition, 2020.		
5. Subhankar Das, Search Engine Optimization and Marketing a Recipe for Success in Digital Marketing, CRC Press, 2021.		
6. Chuck Hemann, Ken Burbary, Digital Marketing Analytics, Pearson, Second Edition, 2019		
<b>REFERENCES:</b>		
8. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice 7th Edition, Pearson, 2019.		
9. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaign, Wiley, 2016.		
10. Rob Stokes, eMarketing The Essential Guide to Marketing in a digital world, Quirk eMarketing.		
11. Shivani Karwal, Digital Marketing Handbook: A Guide to Search Engine Optimization, 2015.		
12. Jacobson, Howie, McDonald, Joel and McDonald, Kristie, Google AdWords for Dummies, 3rd Edition, O'Reilly, 2011.		
13. <a href="http://www.gbv.de/dms/zbw/865712123.pdf">http://www.gbv.de/dms/zbw/865712123.pdf</a>		
14. <a href="https://www.redandyellow.co.za/content/uploads/woocommerce_uploads/2017/10/e-marketing-textbook-download.pdf">https://www.redandyellow.co.za/content/uploads/woocommerce_uploads/2017/10/e-marketing-textbook-download.pdf</a>		

**OPEN ELECTIVE OFFERED BY CSD TO OTHER DEPARTMENTS**

22CD001	COMPUTER GRAPHICS AND MULTIMEDIA	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>To grasp the fundamental knowledge of implementing Computer Graphics in 2D.</li> <li>To acquire knowledge in 3D Graphics.</li> <li>To learn the process of implementation of Computer Graphics through Vulkan API.</li> <li>To get familiarity with basic to advanced rendering technique.</li> <li>To become familiar with Animation and Multimedia systems.</li> </ul>					
<b>UNIT I</b>	<b>2D GRAPHICS PROCESSING</b>				<b>9</b>
Video Display devices -Raster Scan System-Graphics Output Primitives-Open GL Point Functions-Open GL Line Functions-Open GL Curve Functions-Implementation Algorithm for Graphics Primitives & Attributes: Line Drawing Algorithm-Parallel Line Algorithm-Circle Generating Algorithm-Ellipse Generating Algorithm-Two-Dimensional Viewing Pipeline-Clipping Algorithm.					
<b>UNIT II</b>	<b>3D GRAPHICS PIPELINE</b>				<b>9</b>
Three-Dimensional Geometric transformation: Translation- Rotation- Scaling-Composite Three-Dimensional Transformations-Other Three-dimensional Transformations-Three-dimensional viewing pipeline-Projection Transformations-Orthogonal Projections-Oblique Parallel Projections-Perspective Projections-OpenGL Three-dimensional Viewing Function.					
<b>UNIT III</b>	<b>VULKAN GRAPHICS API</b>				<b>9</b>
Overview of Vulkan-Introduction-Instances, Devices and Queues-The Vulkan Instance-Vulkan Physical Devices-Physical Device Memory-Device Queues-Creating a Logical Device-Object Types and Function Conventions- Enhancing Vulkan: Layers – Extensions-Queues and Commands: Device Queue-Creating Command Buffers-Recording Buffer-Recycling Command Buffers -Moving Data: Managing Resource State.					
<b>UNIT IV</b>	<b>RENDERING</b>				<b>9</b>
Lighting and Shading-Light Matter-Light Sources-The Phong Reflection Model-Texture Mapping-Texture Generation-Global Illumination-RayTracing-Radiosity-Parallel Rendering-Volume Rendering- Environment map- Bump mapping- iso surfaces and marching Cubes-Rasterization.					
<b>UNIT V</b>	<b>ANIMATION</b>				<b>9</b>
Design of Animation Sequences-General Computer animation Function-Raster Animations-Computer Animation Languages-Key Frame System- Morphing-Simulating Acceleration-Motion Specification-Direct Motion Specifications-Goal Directed System-Kinematics & Dynamics.					
<b>TOTAL : 45 PERIODS</b>					
<b>OUTCOMES:</b>					
<b>On Successful completion of the course, Students will be able to</b>					
<b>CO1:</b> Implement 2D transformations and algorithms for generating primitives and attributes.					
<b>CO2:</b> Solve problems in 3D transformations and viewing.					
<b>CO3:</b> Analyze the process of open source Vulkan API.					
<b>CO4:</b> Examine rendering techniques and use advanced based rendering.					
<b>CO5:</b> Apply lighting and shading models to enhance graphical scenes.					
<b>CO6:</b> Understand the multimedia systems and animation.					

**TEXT BOOKS:**

1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, "Computer Graphics with OpenGL", Pearson Education, Fourth Edition, 2014.
2. Graham Sellers, John Kessenich, "Vulkan Programming Guide", 1st Edition, Addison Wesley, 2016.
3. Edward Angel, Dave Shreiner," Interactive Computer Graphics. A Top-Down Approach with WebGL", 7th Edition, 2015

**REFERENCES:**

1. OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.5 with SPIR-V, 9th Edition, Addison Wesley, 2016.
2. <https://vulkan-tutorial.com>.

22CD002	PRINCIPLES OF UI/UX DESIGN	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<ul style="list-style-type: none"> <li>• To explain the principles of User Interface (UI) in order to do design with intention.</li> <li>• To define the User eXperience (UX) and the psychology behind user decision making.</li> <li>• To discuss about UX process and user Psychology.</li> <li>• To apply technology for designing web applications with multimedia effects.</li> <li>• To create a wireframe and prototype.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO UI</b>				<b>9</b>
Introduction to UI - Designing Behaviour: Designing with Intention - Conditioning and Addiction - Timing Matters - Gamification - Social/Viral Structure–Trust - Hidden versus Visible. Basic Visual Design Principles: Visual Weight - Contrast - Depth and Size – Color-Layout: Page Framework - Footers - Navigation -Images, and Headlines - Forms - Input Types - Labels and Instructions - Primary and Secondary Buttons - Adaptive and Responsive Design - Touch versus Mouse.					
<b>UNIT II</b>	<b>USER OBSERVATION AND EXPERIENCE</b>				<b>9</b>
User Research - Subjective Research - Objective Research - Three Basic Types of Questions. Observe a user: Watch How They Choose - Interviews - Surveys - Card Sorting - Creating User Profiles - Bad profile - Useful profile.					
<b>UNIT III</b>	<b>INTRODUCTION TO UX</b>				<b>9</b>
Introduction about UX - Five Main Ingredients of UX - Three “Whats” of user Perspective - Pyramid of UX Impact - UX Is a Process - UX - Not an Event or Task. Behaviour Basics: Psychology versus Culture - User Psychology - Experience - Conscious vs Subconscious Experience - Emotions - Gain and Loss – Motivations.					
<b>UNIT IV</b>	<b>WEB INTERFACE DESIGN</b>				<b>9</b>
Designing Web Interfaces – Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow – Using Motion for UX - Design Pattern: Z-Pattern - F-Pattern - Visual Hierarchy - Lookup patterns – Feedback patterns.					
<b>UNIT V</b>	<b>WIREFRAMING, PROTOTYPING AND TESTING</b>				<b>9</b>
Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wire flows - Building a Prototype - Building High-Fidelity Mock-ups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.					
					<b>TOTAL : 45 PERIODS</b>

**OUTCOMES:**

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

**CO1:** Understand the principles of User Interface (UI) Design in order to design with intention.

**CO2:** Analyze the effective User eXperience (UX) and the psychology behind user decision making.

**CO3:** Examine the importance of UX process and user Psychology.

**CO4:** Elucidate the implications for designing web application with multimedia effects.

**CO5:** Create Wireframe and Prototype.

**CO6:** Develop the ability to work collaboratively within design teams and articulate design ideas and decisions effectively.

**TEXT BOOKS:**

1. Joel Marsh, "UX for Beginners", O'Reilly Media, Inc., 1st Edition 2015.
2. Xia Jiajia, "UI UX Design", O'Reilly, Artpower International, 2016.
4. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition, O'Reilly 2020

**REFERENCES:**

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, "Designing Interface" 3rd Edition O'Reilly 2020.
2. Steve Schoger, Adam Wathan "Refactoring UI", 2018.
3. <https://www.uxai.design/#:~:text=for%20designers,for%20AI%20products%20and%20services>

22CD003	MULTIMEDIA SECURITY	L	T	P	C
		3	0	0	3
<b>OBJECTIVES:</b>					
<b>The Course will enable learners to:</b>					
<ul style="list-style-type: none"> <li>• Learn the basic characteristics of digital watermarking to perform the theoretical analysis and performance measures.</li> <li>• Understand the digital authentication and authorization schemes to evaluate security issues related to electronic documents, image and video.</li> <li>• Provide a framework to conduct research and development using multimedia security techniques.</li> <li>• Impart the knowledge of implementation on digital watermarking and multimedia security techniques.</li> <li>• Design a customary multimedia security system to suit real world applications.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO DIGITAL WATERMARKING</b>				<b>9</b>
Digital Watermarking Basics: Models of Watermarking- Basic Message Coding, Error Coding- Digital Watermarking Theoretic Aspects: Mutual information and Channel Capacity- Designing a good digital mark- Theoretical analysis of Digital watermarking					
<b>UNIT II</b>	<b>WATERMARKING SCHEMES AND MEDIA SPECIFIC DIGITAL WATERMARKING</b>				<b>10</b>
Spread Spectrum Watermarking, Transform Domain Watermarking, Quantization Watermarking - Video Watermarking - Audio Watermarking, Binary Image Watermarking, Robustness to Temporal and Geometric Distortions- Affine resistant transformations.					
<b>UNIT III</b>	<b>STEGANOGRAPHY</b>				<b>8</b>
Introduction- Digital Image formats- Modern Steganography- Steganography Channels Steganography Goals					

<b>UNIT IV</b>	<b>STEGANOGRAPHY SCHEMES</b>	<b>9</b>
Image: Substitution- Bit Plane Coding- Transform Domain- Audio: Data Echo Hiding- Phase Coding- Video: Temporal technique- Spatial technique		
<b>UNIT V</b>	<b>MULTIMEDIA ENCRYPTION AND MULTIMEDIA TECHNIQUES</b>	<b>9</b>
Introduction- Goals- Desired Characteristics- Performance metrics- Chaos based- Block based- Transform based techniques		
<b>TOTAL : 45 PERIODS</b>		
<p><b>OUTCOMES:</b>  <b>At the end of this course, the students will be able to:</b>  <b>CO1:</b> Learn the basic watermarking techniques to design a good digital mark.  <b>CO2:</b> Study the digital authentication and authorization schemes to evaluate security issues related to electronic documents, image and video.  <b>CO3:</b> Analyze the basic characteristics of digital watermarking to perform the theoretical analysis and performance measures.  <b>CO4:</b> Acquire the concepts of steganography to access the sensitive information concealing of file, message, image, or video within another file.  <b>CO5:</b> Obtain a suitable least significant bits construction and dynamic embedding with one-dimensional cellular automata to resist differential attack and support parallel computing.  <b>CO6:</b> Examine the multimedia encryption techniques to address the open issues related to confidentiality of the media content.</p>		
<p><b>TEXTBOOKS:</b></p> <ol style="list-style-type: none"> <li>Shih, F. Y. (2017). Digital watermarking and steganography: fundamentals and techniques, CRC press.</li> <li>Nematollahi, Mohammad Ali, Vorakulpipat, Chalee, Rosales, Hamurabi Gamboa (2017). Digital Watermarking: Techniques and Trends, Springer, Signals and Communication</li> <li>Pande, Amit, Zambreno, Joseph (2013). Embedded Multimedia Security Systems, Springer, Image Processing</li> <li>Singh, Amit Kumar, Mohan, Anand (2019). Handbook of Multimedia Information Security: Techniques and Applications, Springer, Security and Cryptology.</li> </ol>		
<p><b>REFERENCES:</b></p> <ol style="list-style-type: none"> <li>Cox, I., Miller, M., Bloom, J., Fridrich, J., Kalker, T. (2007). Digital watermarking and steganography. Morgan kaufmann.</li> <li>Yi, Xun, Paulet, Russell, Bertino, Elisa (2014). Homomorphic Encryption and Applications, Springer, Security and Cryptology.</li> </ol>		

<b>20CD004</b>	<b>DIGITAL MARKETING</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<p><b>OBJECTIVES:</b></p> <ul style="list-style-type: none"> <li>To explain the role of digital marketing in overall marketing strategy.</li> <li>To understand website designing and optimization methods in digital marketing.</li> <li>To deploy Search Engine Marketing Platforms.</li> <li>To apply various Social Media Marketing strategies.</li> <li>To implement the concepts of Web Analytics and various types of report generation.</li> </ul>					
<b>UNIT I</b>	<b>INTRODUCTION TO DIGITAL MARKETING</b>	<b>9</b>			
Digital marketing - Importance of digital marketing-Difference between traditional and digital marketing- Digital marketing platforms- recent trends and current scenario of the industry - digital marketing as a tool for students, professionals and businesses-Tools.					
<b>UNIT II</b>	<b>WEBSITE DESIGNING AND OPTIMIZATION</b>	<b>9</b>			

On Page Optimisation (OPO)- HTML and CSS basics- Meta tags usage- Using Javascript - Contextual interlinking - Microformats & schemas - Off-Page Optimization - Linking Strategies - Competitor Analysis-Sculpting-Link baiting - Social Book Marking and Promotions- Directory submissions -Search Engine Optimization (SEO)- Growth of SEO-Ecosystem of a search engine SEO Tools.		
<b>UNIT III</b>	<b>SEARCH ENGINE MARKETING</b>	<b>9</b>
SEM platforms- Google Adwords – Ad creation process- Keyword grouping-Bidding techniques – Site targeting & keyword targeting -Ad approval process – Ad extensions- Site, Demographic targeting, CPC-based, CPA-based & CPM-based accounts		
<b>UNIT IV</b>	<b>SOCIAL MEDIA MARKETING</b>	<b>9</b>
Social Media Marketing- Email Marketing- Mobile Marketing - Adsense, Blogging and Affiliate Marketing.		
<b>UNIT V</b>	<b>WEB ANALYTICS</b>	<b>9</b>
Introduction to Web Analytics- GA Terminology (Dimensions & Metrics)- Introduction to Reports - Audience Reports, Traffic Sources and Content Reports- Campaign Tagging & Reporting - Dashboard- Linking and Using Data from Google Adwords- Case studies on digital marketing strategies.		
<b>TOTAL: 45 PERIODS</b>		
<b>OUTCOMES:</b>		
<b>At the end of this course, the students will be able to:</b>		
<b>CO1:</b> Explain the role and importance of digital marketing in a rapidly changing business landscape		
<b>CO2:</b> Apply the marketing research metrics and do market segments, market targets and brand positioning.		
<b>CO3:</b> Examine website designing and optimization.		
<b>CO4:</b> Analyze the various SEM platforms for digital marketing.		
<b>CO5:</b> Discuss the marketing strategies used in social media, then design and manage the Integrated Marketing Channels		
<b>CO6:</b> Analyze the web and generate various types of reports for real time application.		
<b>TEXT BOOKS:</b>		
1. Seema Gupta, Digital Marketing, McGraw Hill, 2nd Edition, 2020.		
2. Subhankar Das, Search Engine Optimization and Marketing a Recipe for Success in Digital Marketing, CRC Press, 2021.		
3. Chuck Hemann, Ken Burbary, Digital Marketing Analytics, Pearson, Second Edition, 2019		
<b>REFERENCES:</b>		
1. Dave Chaffey, Fiona Ellis-Chadwick, Digital Marketing: Strategy, Implementation and Practice 7th Edition, Pearson, 2019.		
2. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaign, Wiley, 2016.		
3. Rob Stokes, eMarketing The Essential Guide to Marketing in a digital world, Quirk eMarketing.		
4. Shivani Karwal, Digital Marketing Handbook: A Guide to Search Engine Optimization, 2015.		
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