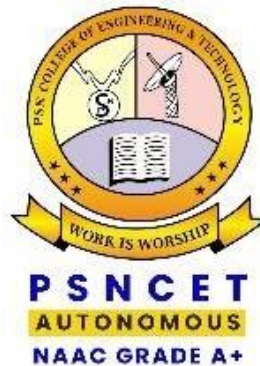


PSN College of Engineering and Technology



Department of Computer Science and Engineering

R 2022- Curriculum (I to VIII Semester)
and
Syllabus (V, and VI Semester)

Vision and Mission of the Institute

Vision

Emerge as a pioneer institute inculcating engineering education and skills, research, values and ethics.

Mission

- **To achieve greater heights of excellence in technical knowledge and skill development through innovative teaching and learning practices.**
- **To develop the state of art infrastructure to meet the demands of technological revolution.**
- **To improve and foster research in all dimensions for betterment of society.**
- **To develop individual competencies to enhance innovation, employability and entrepreneurship among students.**
- **To instill higher standards of discipline among students, inculcating ethical and moral values for societal harmony and peace**

Vision and Mission of the Department

Vision

To emerge as a preeminence program to produce quality Computer Science and Engineering graduates.

Mission

- **To enhance professional and entrepreneurial skills through industry institute interaction to enable them in getting better placement**
- **To promote research and continuing education**
- **To train the students according to their discipline to meet dynamic needs of the society**

Program Outcomes (POs)

PO's No	KNOWLEDGE	STATEMENTS
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, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design / Development of Solutions:	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct Investigations of Complex Problems:	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5	Modern Tool usage:	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an UN 2 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.

Program Educational Objectives (PEOs)

S.No	Topic	PEOs
PEO1	Fundamental Knowledge	Graduates will be able to perform in technical and managerial roles ranging from design, development and problem solving to suit to the industrial needs
PEO2	Career Development	Graduates will be able to successfully pursue higher education and also Graduates will have the ability to adapt, contribute and innovate new technologies in different domains of Computer Science and Engineering
PEO3	Social Identity	Graduates will be ethically and socially responsible engineers in Computer Science and Engineering disciplines

Program Specific Outcomes (PSOs)

Graduating student shall be able to:

PSO1	The computer science and Engineering graduates are able to analyze, design, develop, test and apply Management strategy, Mathematical concept in the development of computational solutions, make them expert in computer software and hardware.
PSO2	Proficient and Innovative with a strong cognizance in the IOT, through the application of acquired knowledge and skills.

CURRICULAM
B.E. COMPUTER SCIENCE AND ENGINEERING
 Regulation R2022

Sl.No	Course code	Course Name	Category		L	T	P	C
1	IC610001	Professional English I	ICC	Theory	2	0	0	2
2	IC610002	Matrices and Calculus	ICC	Theory	2	1	0	3
3	IC610003	Engineering Physics	ICC	Theory	3	0	0	3
4	IC610004	Engineering Chemistry	ICC	Theory	3	0	0	3
5	CS610005	Problem Solving and 'C' Programming	ICC	Theory	3	0	0	3
6	ME610006	Engineering Graphics with CAD	ICC	Theory with Practical Component	2	0	2	3
7	IP610101	Physics & Chemistry Laboratory	ICC	Practical	0	0	3	1.5
8	IP610102	Programming in 'C' Laboratory	ICC	Practical	0	0	3	1.5
9		NCC/NSS/NSO *	IMC	Institute Mandatory	1*	0	0	0
10	IC610007	Tamil marabu/Heritage of Tamil	ICC	Theory	1	0	0	1
		Total			17	1	8	21

Sem - 02

11	IC620008	Professional English II	ICC	Theory with Practical Component	2	0	2	3
12	IC620009	Transforms & Partial Differential Equations	ICC	Theory	2	1	0	3
13	IC620010	Engineering Materials (for Non Circuit Branches)	ICC	Theory	3	0	0	3
	IC620011	Semiconductor Physics(for Circuit Branches)			3	0	0	
14	ME620012	Engineering Mechanics(for Non Circuit Branches)	PCC	Theory	3	0	0	3
	CS620013	Fundamentals of Artificial Intelligence (for Circuit Branches)			3	0	0	

15	CS620014	Python Programming	ICC	Theory	3	0	0	3
16	EE620015	Basic Engineering	ICC	Theory	3	0	0	3
17	IP620103	Python Laboratory	ICC	Practical	0	0	3	1.5
18	IP620104	Engineering practice laboratory	ICC	Practical	0	0	3	1.5
19	IM610401	Environmental Studies	IMC	Institute Mandatory	2*	0	0	0
20	IC620016	Tamils and technology	ICC	Theory	1	0	0	1
		Total			19	1	8	22

Sem - 03

21	IC630017	Numerical Methods and Statistics	ICC	Theory	3	0	0	3
22	CS630201	Computer Organization and Architecture	PCC	Theory with Practical Component	2	0	2	3
23	CS630202	Data Structures using C++	PCC	Theory	3	0	0	3
24	CS630203	Database Management Systems	PCC	Theory	3	0	0	3
25	CS630204	Operating Systems	PCC	Theory	3	0	0	3
26		Professional elective-1	PEC	Theory	3	0	0	3
27	CS630301	Data Structures using C++ laboratory	PCC	Practical	0	0	3	1.5
28	CS630302	Database Application laboratory	PCC	Practical	0	0	3	1.5
29	CS630501	Integrated Aptitude Skills - I (Lower)	EEC	skill based course	0	0	1	0.5#
30	IM630402	Universal Human Values	IMC	Institute Mandatory	2*	0	0	0
		Total			19	0	9	21

Sem - 04

31	IC640018	Boundary value problems and probability distributions	ICC	Theory	3	0	0	3
32	EC640907	Digital Electronics and Microprocessor	PCC	Theory with Practical Component	2	0	2	3
33		Object Oriented Programming	PCC	Theory	3	0	0	3

	CS640205	using JAVA						
34	CS640206	Software Engineering	PCC	Theory	3	0	0	3
35		Professional elective-2	PEC	Theory	3	0	0	3
36		Institute elective -1	IEC	Theory	3	0	0	3
37	CS640303	Java Programming laboratory	PCC	Practical	0	0	3	1.5
38	CS640304	Office Automation Laboratory	PCC	Practical	0	0	3	1.5
39	CS640502	Integrated Aptitude Skills - II (Lower)	EEC	skill based course	0	0	1	0.5 [#]
40		Inplant Training (2 Weeks)	IMC	Institute Mandatory				0
		Total			17	0	9	21

Sem - 05

41	CS650207	Computer Networks and Management	PCC	Theory with Practical Component	2	0	2	3
42	CS650208	Web Programming	PCC	Theory	3	0	0	3
43	CS650209	Object Oriented Analysis and Design	PCC	Theory	3	0	0	3
44		Institute elective -2	IEC	Theory	3	0	0	3
45		Professional elective-3	PEC	Theory	3	0	0	3
46		Professional elective-4	PEC	Theory	3	0	0	3
47	CS650305	Web Application development laboratory	PCC	Practical	0	0	3	1.5
48	CS650306	Object Oriented Analysis and Design laboratory	PCC	Practical	0	0	3	1.5
49	CS650503	Integrated Aptitude Skills - I (Higher)	EEC	skill based course	0	0	2	1 [#]
50	CS650801	IT Project Management	PMC	Programme Mandatory	2*	0	0	0
		Total			20	0	8	21

Sem - 06

51	CS660210	Computer Graphics and Multimedia	PCC	Theory with Practical Component	2	0	2	3
52	CS660211	Cloud Technologies	PCC	Theory	3	0	0	3

53	CS660212	Machine Learning	PCC	Theory	3	0	0	3
54		Institute elective -3	IEC	Theory	3	0	0	3
55		Professional elective-5	PEC	Theory	3	0	0	3
56		Professional elective-6	PEC	Theory	3	0	0	3
57	CS660307	Cloud Technologies laboratory	PCC	Practical	0	0	3	1.5
58	CS660308	Machine Learning laboratory	PCC	Practical	0	0	3	1.5
59	CS660504	Training in IoT using arduino	EEC	skill based course	0	0	2	1 [#]
60	IM660403	Professional Ethics	IMC	Institute Mandatory	2*	0	0	0
61		Internship	IMC	Institute Mandatory				0
		Total			19	0	10	21

Sem - 07

62	CS670213	Artificial Intelligence with Machine Learning	PCC	Theory with Practical Component	2	0	2	3
63	CS670214	Industry 4.0: Augmented Reality	PCC	Theory	3	0	0	3
64	CS670215	Deep Learning	PCC	Theory	3	0	0	3
65		Institute elective -3	IEC	Theory	3	0	0	3
66		Professional elective-7	PEC	Theory	3	0	0	3
67		Professional elective-8	PEC	Theory	3	0	0	3
68	CS670309	Artificial Intelligence with Machine Learning laboratory	PCC	Practical	0	0	3	1.5
69	CS670310	Advance Python Programming laboratory	PCC	Practical	0	0	3	1.5
70	MG670019	Innovation Entrepreneurship and Startups	ICC	Theory	3	0	0	3
71	CS670505	Advanced career development	EEC	skill based course	0	0	2	1 [#]
		Total			20	0	10	24

Sem - 08

72	CS680506	Project Work	EEC	Practical	0	0	20	10
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The credits will not be included for CGPA calculation.

*Mandatory courses for which no credits are assigned.

Semester wise Total credits									
SEM	I	II	III	IV	V	VI	VII	VIII	Total
Credit	21	22	21	21	21	21	24	10	161

Abbreviation	Particulars
ICC	Institute Core Course (includes Basic science, Engineering science, humanities & social science including management course)
PCC	Professional Core Course
PE	Professional Elective Course
IE	Institute Elective (open electives)
EEC	Employability Enhancement course
IMC	Institute Mandatory Course
PMC	Programme Mandatory Course

Vertical 1 : Full Stack Development

1	CS606101	Design And Analysis of Algorithms (NPTEL)	PE	Theory	3	0	0	3
2	CS606102	App Development	PE	Theory	3	0	0	3
3	CS606103	PHP Programming	PE	Theory	3	0	0	3
4	CS606104	UI and UX Design	PE	Theory	3	0	0	3
5	CS606105	Software Testing (NPTEL)	PE	Theory	3	0	0	3
6	CS606106	Web Application Security	PE	Theory	3	0	0	3
7	CS606107	Dev-ops	PE	Theory	3	0	0	3
8	CS606108	Principles of Programming Languages	PE	Theory	3	0	0	3
9	CS606109	Social Networks (NPTEL)	PE	Theory	3	0	0	3
10	CS606110	Multimedia Technology	PE	Theory	3	0	0	3

Vertical 2: Cloud and Data Science

1	CS606201	Cloud Computing (NPTEL)	PE	Theory	3	0	0	3
2	CS606202	Virtualization	PE	Theory	3	0	0	3
3	CS606203	Cloud Computing And Distributed Systems (NPTEL)	PE	Theory	3	0	0	3
4	CS606204	Data Warehousing	PE	Theory	3	0	0	3
5	CS606205	Storage Technologies	PE	Theory	3	0	0	3
6	CS606206	Software Defined Networks (Common to ECE&CSE)	PE	Theory	3	0	0	3
7	CS606207	Grid Computing	PE	Theory	3	0	0	3
8	CS606208	Security and Privacy in Cloud	PE	Theory	3	0	0	3
9	CS606209	IoT and Cloud	PE	Theory	3	0	0	3
10	CS606210	Google Cloud Computing Foundations (NPTEL)	PE	Theory	3	0	0	3

Vertical 3: Cyber Security

1	CS606301	Ethical Hacking (NPTEL)	PE	Theory	3	0	0	3
2	CS606302	Digital and Mobile Forensics	PE	Theory	3	0	0	3
3	CS606303	Systems And Usable Security (NPTEL)	PE	Theory	3	0	0	3
4	CS606304	Modern Cryptography	PE	Theory	3	0	0	3
5	CS606305	Engineering Secure software systems	PE	Theory	3	0	0	3
6	CS606306	Crypto currency and Block chain Technologies	PE	Theory	3	0	0	3
7	CS606307	Cryptography And Network Security (NPTEL)	PE	Theory	3	0	0	3
8	CS606308	Network Management	PE	Theory	3	0	0	3
9	CS606309	Cyber Crime And Laws	PE	Theory	3	0	0	3
10	CS606310	Design of Network Router	PE	Theory	3	0	0	3

Vertical 4: INTERNET OF THINGS (Common to ECE&CSE)

1	CS606401	Introduction to Internet Of Things (NPTEL)	PE	Theory	3	0	0	3
2	CS606402	IoT Architecture and Framework	PE	Theory	3	0	0	3
3	CS606403	Communication Protocols For IoT	PE	Theory	3	0	0	3
4	CS606404	Cloud Services for IoT	PE	Theory	3	0	0	3
5	CS606405	Computer Networks And Internet Protocol (NPTEL)	PE	Theory	3	0	0	3
6	CS606406	Privacy and Security in IoT	PE	Theory	3	0	0	3
7	CS606407	IoT Platform for Smart City Planning	PE	Theory	3	0	0	3
8	CS606408	IoT for Smart Grids	PE	Theory	3	0	0	3
9	CS606409	IoT and its Applications	PE	Theory	3	0	0	3
10	CS606410	Introduction To Industry 4.0 And Industrial Internet Of Things (NPTEL)	PE	Theory	3	0	0	3

Vertical 5: Block chain

1	CS606501	Foundations of Cryptography (NPTEL)	PE	Theory	3	0	0	3
2	CS606502	Blockchain And Its Applications (NPTEL)	PE	Theory	3	0	0	3
3	CS606503	Blockchain Technologies	PE	Theory	3	0	0	3
4	CS606504	Blockchain Architecture Design And Use Cases (NPTEL)	PE	Theory	3	0	0	3
5	CS606505	Blockchain Platforms	PE	Theory	3	0	0	3
6	CS606506	Blockchain Forensics	PE	Theory	3	0	0	3
7	CS606507	Robot Manipulator Control	PE	Theory	3	0	0	3
8	CS606508	Computer Vision With Open cv	PE	Theory	3	0	0	3
9	CS606509	Internet Security	PE	Theory	3	0	0	3
10	CS606510	Intelligent Transport Systems	PE	Theory	3	0	0	3

Vertical 6: DIVERSIFIED COURSES

1	CS606601	Data Analytics With Python (NPTEL)	PE	Theory	3	0	0	3
2	CS606602	Problem Solving Using Python	PE	Theory	3	0	0	3
3	CS606603	Data Science For Engineers (NPTEL)	PE	Theory	3	0	0	3
4	CS606604	Database Design (NPTEL)	PE	Theory	3	0	0	3
5	CS606605	Matlab Programming For Engineers	PE	Theory	3	0	0	3
6	CS606606	Robotics And Its Applications	PE	Theory	3	0	0	3
7	CS606607	Adhoc Networks	PE	Theory	3	0	0	3
8	CS606608	Principles of Distributed Systems	PE	Theory	3	0	0	3
9	CS606609	Python Scripting	PE	Theory	3	0	0	3
10	CS606610	Implement Rust	PE	Theory	3	0	0	3

Vertical 7: Artificial Intelligence

1	CS606701	Artificial Intelligence In Finance	PE	Theory	3	0	0	3
2	CS606702	Optimization For Machine Learning (Nptel)	PE	Theory	3	0	0	3
3	CS606703	Design Thinking In Artificial Intelligence	PE	Theory	3	0	0	3
4	CS606704	Artificial Intelligence And Reinforcement Learning	PE	Theory	3	0	0	3
5	CS606705	Machine Learning For Soil And Crop Management (Nptel)	PE	Theory	3	0	0	3
6	CS606706	Computational Intelligence	PE	Theory	3	0	0	3
7	CS606707	Deep Learning For Visual Computing (Nptel)	PE	Theory	3	0	0	3
8	CS606708	Soft Computing	PE	Theory	3	0	0	3
9	CS606709	Text And Speech Analysis	PE	Theory	3	0	0	3
10	CS606710	Machine Learning Techniques	PE	Theory	3	0	0	3

INSTITUTE ELECTIVE I

S.No	Course code	Course Name	Dept	Classification	L	T	P	C
1	CS607106	Augmented Reality / Virtual Reality	CSE	IE Theory	3	0	0	3
2	CS607107	Robotic Process Automation	CSE	IE Theory	3	0	0	3

INSTITUTE ELECTIVE II

S.No	Course code	Course Name	Dept	Classification	L	T	P	C
1	CS607205	Neural Networks and Deep Learning	CSE	IE Theory	3	0	0	3
2	CS607206	Cyber security	CSE	IE Theory	3	0	0	3

INSTITUTE ELECTIVE III

S.No	Course code	Course Name	Dept	Classification	L	T	P	C
1	CS607305	Front End Development	CSE	IE Theory	3	0	0	3
2	CS607306	Block Chain Architecture	CSE	IE Theory	3	0	0	3
3	CS607307	Optimization Techniques	CSE	IE Theory	3	0	0	3

INSTITUTE ELECTIVE IV

S.No	Course code	Course Name	Dept	Classification	L	T	P	C
1	CS607404	Decision Making Methods	CSE	IE Theory	3	0	0	3
2	CS607405	Web Design And Development	CSE	IE Theory	3	0	0	3
3	CS607406	JAVA Programming	CSE	IE Theory	3	0	0	3

SEMESTER – V

Syllabus

CS650207 - COMPUTER NETWORKS AND MANAGEMENT					
Course Category: Programme Core	Course Type: Theory with Practical Component	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand the concepts of physical layer • To study the concepts of data link layer • To introduce function with network layer • To make the students get familiarized with transport and Application layer • To understand the principles of network management. 					
UNIT 1: INTRODUCTION AND PHYSICAL LAYER					6
Introduction: Data Communication-Network types - Reference models: The OSI reference model – The TCP/IP reference model - The Physical layer: Data and Signals					
UNIT 2: DATA LINK LAYER					6
Introduction to Data link layer- Error detection and correction: Introduction-Block Coding-Cyclic Codes-Checksum –Data Link Control: DLC Services- Framing - Flow and Error control - Connectionless and Connection Oriented-Data Link Layer Protocols: Simple Protocol-Stop and Wait Protocol-HDLC					
UNIT 3: NETWORK LAYER					6
Network layer services – Packet switching – Network layer performance - IPv4: Address space – Classful addressing – Classless addressing – Forwarding of IP packets – Network layer protocols: Internet Protocol – Unicast routing: Introduction - Routing algorithms – Unicast routing protocols					
UNIT 4: TRANSPORT AND APPLICATION LAYER					6
Introduction: Transport Layer Services – Transport layer protocols-Transmission control protocol- Stop and wait protocol – Go back N protocol – Selective repeat Introduction – Client server programming – Standard client server protocols - Electronic mail: Architecture – Web based email – Telnet: Local Vs Remote Logging					
UNIT 5: NETWORK MANAGEMENT					6
Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.					
TOTAL: 30 PERIODS					
LAB EXPERIMENTS:					
<ul style="list-style-type: none"> • Implementation of RPC • Implementation of RMI • Simulation of Network Management Protocols • Implementation of PING Service • Program for Remote Command Execution • Simulation using Wireshark tool - Analyze the network traffic using Wireshark tools • Simulation using Packet Tracer - Design a Network using Packet Tracer 					

TOTAL : 15 PERIODS

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

CO1: Understand the basic concepts of Physical Layer and its functions

CO2: Understand the concept of Data Link Layer and its functions

CO3: Analyze the various methods in network layer and its functions.

CO4: Analyze the different techniques on Transport layer & Application layer and its functions

CO5: Understand fundamental goals, organization, and functions of network management

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2									2	2	
CO2	1		2									2	2	
CO3	1				2							2	2	
CO4	2	2										2	2	
CO5	3		3						1				2	

1- low, 2 - medium, 3 - high, '-' no correlation

I) TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and networking", Fifth Edition, McGraw-Hill Education (India) Pvt. Ltd. 2017
2. Mani Subramanian, Network Management Principles and Practice, 2nd Edition, Pearson Education, 2010

II) REFERENCE BOOKS:

1. William S.Stallings, "Data and Computer Communications", 10th Edition, Prentice-Hall, 2013.
2. Tanenbaum and David Wetherall, "Computer Networks", Global Edition, 2021
3. Computer Networking Bible: [3 in 1] The Complete Crash Course to Effectively Design, Implement and Manage Networks. Including Sections on Security, Performance and Scalability, by Rick C. Worley, 2023

III) AICTE FREE BOOKS:

Computer Networks: Theory & Practicals, Author Name-Dr. Brijendra Pratap Singh, <https://ekumbh.aicte-india.org/allbook.php>

IV) ONLINE LEARNING:

<https://archive.nptel.ac.in/courses/106/105/106105183/>

V) WEB RESOURCES:

1. <https://csc-knu.github.io/sys-prog/books/Andrew%20S.%20Tanenbaum%20-%20Computer%20Networks.pdf>

2. <https://www.tutorialspoint.com/what-is-network-management>

VI) VIRTUAL PLATFORMS

<http://vlabs.iitkgp.ac.in/ant/1/>

CS650208 - WEB PROGRAMMING							
Course Category: Programme Core	Course Type: Theory		L	T	P	C	
			3	0	0	3	
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> To understand the basics of Web development To learn about different frontend development languages To understand the concept of backend development and database To understand the basics of testing and web hosting To learn about the web design 							
UNIT 1: INTRODUCTION TO WEB DEVELOPMENT							9
Internet Basics: WWW and its evolution- concept of internet-Internet Protocols- browsers – internet explorer, Netscape navigator, opera, Firefox, chrome, Mozilla. search engine, web saver- HTTP and HTTPS protocol - web sessions and cookies							
UNIT 2: FRONTEND DEVELOPMENT							9
HTML5: HTML elements, tags, and attributes- HTML5 Page layout and navigation- Tables, Forms and Media- CSS Basics & Properties- CSS syntax, selectors, properties - CSS frameworks – JavaScript: JavaScript’s core concepts, including variables, data types, and control structures – JS DOM – React JS - Jquery							
UNIT 3: BACKGROUND DEVELOPMENT							9
PHP Hyper Text Preprocessor: syntax and capabilities. SQL & MySQL: fundamental component of database management-renowned relational database management system (RDBMS) - Integrating PHP and MySQL - Database Interaction – CRUD Operation – Dynamic web application. Intro to Programming with the Use of JavaScript: Functions, closures, and asynchronous programming. - Testing: Testing frameworks							
UNIT 4: HOSTING AND DEPLOYMENT							9
- Web Components - code reusability and maintainability - Web App Optimizations - Cross-platform Apps: Mobile application - Desktop application. Website Structure and Hosting: Static Websites - Website architecture - domain registration - various web hosting providers. - Serverless Development: AWS Lambda or Azure Functions platforms. Software deployment tool – Web hosting - Deploy and Host the Content-Driven Web App							
UNIT 5: WEB DEVELOPMENT CASE STUDIES							9
WordPress Web Design - eCommerce Web Design-Small Business Web Design-Mid Market Web Design-Large Business Web Design-Nonprofit Web Design - Spexster Web - BetterCloud - OpenBanking - Kitimat Bound - AspiryTech							
TOTAL: 45 PERIODS							
COURSE OUTCOMES: At the end of the course, the student will be able to,							
CO1: Understand the basic concepts of Web development.							
CO2: Design a HTML, CSS and JavaScript frameworks in web front end development.							
CO3: Develop the backend development of an application.							

CO4: Analyze the concept of testing frameworks and web hosting.

CO5: Evaluating the different techniques of web development and its application

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1											3	1	
CO2	2	2	3		3							2	2	
CO3	2	3	3		3							2	2	
CO4	2		2		3							2	1	
CO5	2	2			2							2	2	

1- low, 2 - medium, 3 - high, '-' no correlation

I) TEXT BOOKS:

1. Prakash Mahanwar, "WEB PROGRAMMING", UNIVERSITY OF MUMBA, May 2021.
2. John Dean, "Web Programming with HTML5, CSS, and JavaScript", Jones & Bartlett Learning, Jan 2018.

II) REFERENCE BOOKS:

1. Chris Bates, "Web Programming Building Internet Applications", Third Edition, Sheffield Hallam University, 2012.
2. Boryana Deliyaska, "Introduction to Web Programming", November 2018.
3. John Dean, "Web Programming with HTML, CSS and JavaScript", Jones & Bartlett Learning, Park University, 2019.

III) WEB RESOURCES:

1. <https://scrimba.com/>
2. <https://www.w3schools.com/>

IV) AICTE FREE BOOKS:

1. <https://ekumbh.aicte-india.org/allbook.php>

V) ONLINE LEARNING:

1. <https://archive.nptel.ac.in/courses/106/106/106106156/>
2. <https://www.geeksforgeeks.org/internet-and-web-programming/>

CS650209 - OBJECT ORIENTED ANALYSIS AND DESIGN					
Course Category: PC	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To provide a brief, hands-on overview of object-oriented concepts and its life cycle for software development. To understand modeling the software and to design them using UML diagrams To analyze the problem domain and to identify the objects from the problem specification. To develop our ability with how to apply design axioms and corollaries for the classes and object relational systems. To inculcate necessary skills to handle open source tools for Computer Aided Software Engineering 					
UNIT 1: INTRODUCTION					9
An overview – Object basics – Object state and properties – Behaviour – Methods – Messages – Information hiding – Class hierarchy – Relationships – Associations – Aggregations- Identity – Dynamic binding – Persistence – Meta classes – Object oriented system development life cycle.					
UNIT 2: METHODOLOGY AND UML					9
Introduction – Survey – Rumbaugh, Booch, Jacobson methods – Unified modelling language – Static and Dynamic models – Rational Rose Suite - UML diagrams – Static diagram : Class diagram – Use case diagrams – Behaviour Diagram : Interaction diagram – State chart diagram – Activity diagram - Implementation diagram: Component diagram – Deployment diagram – example - Design of online railway reservation system using UML diagrams - Dynamic modelling – Model organization – Extensibility.					
UNIT 3: OBJECT ORIENTED ANALYSIS					9
Identifying Use case – Business object analysis – Use case driven object oriented analysis – Use case model – Developing effective documentation – Classification – Identifying object, relationships, attributes, methods – Super-sub class – A part of relationships Identifying attributes and methods – Object responsibility – construction of class diagram for generalization, aggregation – example – vehicle class.					
UNIT 4: OBJECT ORIENTED DESIGN					9
Design process and benchmarking – Axioms – Corollaries – Designing classes – Class visibility – Refining attributes – Methods and protocols – Object storage and object interoperability – Databases – Object relational systems – Design patterns -Designing interface objects – Macro and Micro level processes – The purpose of a view layer interface-OOUI - MVC Architectural Pattern and Design – Designing the system.					

UNIT 5: CASE TOOLS	9											
Railway domain : Platform assignment system for the trains in a railway station - Academic domain : Student Marks Analysing System - ATM system - Stock maintenance - Quiz System - E-mail Client system - Cryptanalysis – Health Care Systems. Use Open source CASE Tools: StarUML/ UML Graph for the above case studies.												
TOTAL: 45 PERIODS												
COURSE OUTCOMES: At the end of the course, the student will be able to												
CO1 :Apply object oriented life cycle model for a project.												
CO2: Design static and dynamic models using UML diagrams.												
CO3: Perform object oriented analysis to identify the objects from the problem specification.												
CO4: Identify and refine the attributes and methods for designing the object oriented system.												
CO5: Learn the open source CASE tools and to apply them in various domains												
CO PO MAPPING:												
COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2					2		3
CO2	3		2		2							2
CO3	3	2	2	2	2							2
CO4	3	2			2					2		1
CO5	3	1	1	2	2							3
I.TEXT BOOKS:												
1.Craig Larman, "Applying UML and Patterns: An Introduction to object- oriented Analysis and Design and iterative development", Third Edition ,Pearson Education, 2012												
2. Grady Booch, James Rumbaugh, Ivar Jacobson (2009), The Unified Modeling Language User guide, 2nd edition, Pearson Education, New Delhi, India												
II.REFERENCE BOOKS:												
1. . Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 2008												
2. Cay Horstmann (2004), Object-Oriented Design and Patterns, Wiley India edition, New Delhi, India.												
3. Meilir Page-Jones (2000), Fundamentals of Object Oriented Design in UML, Pearson Education and NewYork.												
III.AICTE FREE BOOKS												
https://www.oodeesign.com												
IV.ONLINE LEARNING												
NPTEL : https://archive.nptel.ac.in/courses/106/105/106105153/												
SPOKEN TUTORIAL: https://spoken-tutorial.org/tutorial-search/?search_foss=OpenModelica&search_language=English												
V.WEB RESOURCES												
https://link.springer.com/chapter/10.1007/1-85233-856-3_2												
https://ieeexplore.ieee.org/document/7474471												

CS650305 - Web Application Development laboratory

Course Category: Programme Core	Course Type: Practical		L	T	P	C	
			0	0	3	1.5	
COURSE OBJECTIVES:							
<ul style="list-style-type: none"> • To understand the basic concepts of HTML tags • To learn how to embedded CSS and JS with HTML • To understand the concepts of React JS • To understand the usage of JQuery. • To learn about application development with database 							
Pre-requisites, if any: Basic Knowledge about Web development							
LIST OF EXPERIMENTS:							
<ol style="list-style-type: none"> 1. Create a simple web site for your college. Use various basic formatting tags, Hyperlinks, lists, tables and frames. 2. Develop static pages (using only HTML) of an online Book store. The website should consist of the following pages. Home page, Registration and user Login, Books catalog, Shopping cart, Payment by credit card, order Confirmation. 3. Create a webpage using HTML. <ol style="list-style-type: none"> I. To embed an image map in a web page. II. To fix the hot spots. III. Show all the related information when the hotspots are clicked. 4. Write a program to create a website using HTML, CSS and JavaScript 5. Write a program to build a Chat module using HTML CSS and JavaScript 6. Create a Simple Login form using Reactjs 7. Write a program to create a simple calculator Application using React JS 8. Write a program to create a voting application using React JS 9. Write a program to create and Build a Password Strength Check using JQuery 10. Create a project on Grocery delivery application 11. Connecting our TODO React JS Project with Firebase 							
TOTAL: 45 PERIODS							
COURSE OUTCOMES: At the end of the course, the student will be able to,							
CO1: Understand the various HTML tags for creating website.							
CO2: Implement a program with HTML, CSS and JavaScript.							
CO3: Implement a program by using React JS.							
CO4: Create web application with validation.							
CO5: Create a web or mobile application and launching concept.							

CO-PO MAPPING														PSO1	PSO2
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	1	2	2		1							1	1		
CO2	2	2	2		1							2	2		
CO3	2	3	3		2							2	2		
CO4		3	2		2							3	3		
CO5	2	2	2		3							3	3		

1- low, 2 - medium, 3 - high, '-' no correlation

Hardware Requirements:

- Processor: Recommended 2GHz or more
- Ethernet connection (LAN)
- Hard Drive: 64 GB or more
- Memory (RAM): 4 GB or above

Software Requirements:

- Windows Operating System.
- Web Browser: Google Chrome
- MySQL Server (back-end)

I) TEXT BOOKS:

1. Prakash Mahanwar, "WEB PROGRAMMING", UNIVERSITY OF MUMBA, May 2021.
2. John Dean, "Web Programming with HTML5, CSS, and JavaScript", Jones & Bartlett Learning, Jan 2018.

II) REFERENCE BOOKS:

1. Chris Bates, "Web Programming Building Internet Applications", Third Edition, Sheffield Hallam University, 2012.
2. Boryana Deliyaska, "Introduction to Web Programming", November 2018.
3. John Dean, "Web Programming with HTML, CSS and JavaScript", Jones & Bartlett Learning, Park University, 2019.

III) WEB RESOURCES:

1. <https://mrcet.com/pdf/Lab%20Manuals/Full%20Stack%20Lab.pdf>
2. <https://mjcollege.ac.in/documents/wp-lab-manual.pdf>

IV) VIRTUAL PLATFORM:

1. <https://fliplet.com/blog/9-web-application-development-platforms-to-build-a-free-web-app/>
2. <https://www.zoho.com/creator/application-development/web.html>
3. <https://code.org/educate/weblab>

**CS650306 - OBJECT ORIENTED ANALYSIS AND DESIGN
LABORATORY**

Course Category: PC	Course Type: Practical	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:
<ul style="list-style-type: none"> To identify a real world problem and develop requirements specification document To provide the necessary knowledge and skills in using object-oriented CASE tools. To learn to write test cases and to draw the use-case diagrams and Design process. To identify and refine the attributes and methods for designing the object oriented system. To learn the open source CASE tools and to apply them in various domains

LIST OF EXPERIMENTS
1. Passport automation system.
2. Book bank
3. Exam Registration
4. Stock maintenance system.
5. Online course reservation system
6. E-ticketing
7. Online Quiz
8. e-book management system
9. Recruitment system
10. Foreign trading system

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, the student will be able to
CO1: Create software requirements specification document for a real world problem
CO2: Apply UML to design static and dynamic model for the solution
CO3: Apply appropriate design patterns and create code from design.
CO4: Identify and refine the attributes and methods for designing the object oriented system.
CO5: Test the product to meet the identified requirements

CO PO MAPPING:												
COs	POs											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	2					2		3
CO2	3		2		2							2
CO3	3	2	2	2	2							2
CO4	3	2			2					2		1
CO5	3	1	1	2	2							3

<p>Hardware/Software Required for a Batch of 30 Students</p> <p>Hardware</p> <ul style="list-style-type: none"> LAN System with 30 nodes(OR)Stand alone PCs–30 Nos. <p>Software Tools:</p> <ul style="list-style-type: none"> OS–Windows 2000 Professional / XP , Windows 7 or Higher Visual

Paradigm, Visual case and Rational Suite <ul style="list-style-type: none"> • ArgoUML , • Selenium , • JUnit or Apache JMeter • Eclipse IDE JUnit
I.TEXT BOOKS:
1.Craig Larman, "Applying UML and Patterns: An Introduction to object- oriented Analysis and Design and iterative development", Third Edition ,Pearson Education, 2012
2.Grady Booch, James Rumbaugh, Ivar Jacobson (2009), The Unified Modeling Language User guide, 2nd edition, Pearson Education, New Delhi, India
II.REFERENCE BOOKS:
1.Ali Bahrami, "Object Oriented System Development", McGraw Hill International Edition, 2008 .
2.Brahma Dathan, Sarnath Ramnath, "Object-Oriented Analysis, Design and Implementation", Universities Press, 2010
3.Cay Horstmann (2004), Object-Oriented Design and Patterns, Wiley India edition, New Delhi, India.
III.ONLINE LEARNING
NPTEL : https://archive.nptel.ac.in/courses/106/105/106105153/
SPOKEN TUTORIAL : https://spoken-tutorial.org/tutorial-search/?search_foss=OpenModelica&search_language=English
IV.WEB RESOURCES
https://link.springer.com/chapter/10.1007/1-85233-856-3_2
https://ieeexplore.ieee.org/document/7474471
V.VIRTUAL PLATFORM
https://online.visual-paradigm.com/diagrams/features/uml-tool/

CS650503 - INTEGRATED APTITUDE SKILLS - I (HIGHER)					
Course Category: EEC	Course Type: Skill Based Course	L	T	P	C
		0	0	2	1
COURSE OBJECTIVES:					
<p>To impart knowledge on the following Topics,</p> <ul style="list-style-type: none"> • Solve aptitude, logical and questions. • Excel the talents of students in logical Verbal reasoning Analysis • The non-verbal Reasoning Analysis • enable the students to speak and write in English without making any mistakes • Excel the students in mock interview, group discussion. 					
UNIT 1: QUANTITATIVE APTITUDE				6	
Percentage - Ratio & Proportions - Pipes & Cisterns - Permutations & Combinations - Partnership - Allegation (Or) Mixture - Races & Games - Stocks & Shares - Height & Distance - True Discount & Banker's Discount - Probability - Mensuration (Area, Volume & Surface Area) - Interest (Simple Interest, Compound Interest) - Logarithm - Chain Rule - Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)					
UNIT 2: LOGICAL REASONING- VERBAL REASONING				6	
Logic - Statement – Argument, Assumptions, Courses of action, Conclusion - Deriving Conclusion from passages - Theme Detection - Cause and Effect reasoning					
UNIT 3: LOGICAL REASONING- NONVERBAL REASONING:				6	
Series - Analogy - Classification - Analytical Reasoning - Mirror Images - Water Images - Spotting out the embedded figures - Completion of incomplete patterns - Figure Matrix - Paper Folding - Paper Cutting - Rule Detection - Grouping of identical figures - Cubes and Dice - Dot Situation - Construction of squares and triangles - Figure formation and analysis					
UNIT 4: VERBAL ABILITY				6	
Concord - Cloze Passage - Analogies or Reverse Analogies - Jumbled Sentences - Error Deduction - Reading Comprehension - Paragraph Formation - Completing Statements - Usage of Prepositions - Inference - Verification of Truth from the Statements - Change of Speech					
UNIT V: PRACTICALS				6	
Extempore speech, Group Discussion, Mock Interview					
TOTAL: 30 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1	Understand the basic concepts of quantitative ability.				
CO2	Understand the basic concepts of verbal logical reasoning Skills.				

CO3	Acquire satisfactory competency in use of nonverbal reasoning.													
CO4	Understand the concepts in verbal ability													
CO5	Acquire satisfactory competency in Group Discussion and Mock Interview													
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2	2	2	2	2	3	2	2	2	-	-
CO2	3	3	2	3	3	2	2	2	2	3	1	2	-	-
CO3	2	3	2	3	2	2	2	2	3	2	2	1	-	-
CO4	2	3	2	2	2	2	3	3	2	2	1	2	-	-
CO5	2	3	3	3	2	3	3	3	2	2	2	3	-	-
1- Low, 2 - Medium, 3 - High, ,-' No Correlation														
I) TEXT BOOKS:														
<ol style="list-style-type: none"> 1. Legal Reasoning for CLAT, AILET, SLAT & Other Law Entrance Exams (3rd Edition, 2022) by Disha Experts, Disha Publications, ISBN: 9789355642219 2. Quantitative Aptitude for Competitive Examinations (2023 Edition) by R.S. Aggarwal, S.Chand & Company Pvt. Ltd. 														
II) REFERENCE BOOKS:														
<ol style="list-style-type: none"> 1. Quantitative Aptitude for Competitive Examinations (2023 Edition) by Anand P. A., Wiley India Pvt. Ltd.. 2. How to Crack Test of Reasoning: In All Competitive Exams (2023 Edition) by Jaikishan and Premkishan, Arihant Publications India Limited 														
III) AICTE FREE BOOKS :														
https://free.aicte-india.org/Quantitative-Aptitude-Basics.php														
IV) ONLINE LEARNING:														
NPTEL: Developing Soft Skills and Personality (NPTEL) https://nptel.ac.in/courses/109104107														
V) WEB RESOURCES:														
Aptitude Skills <ol style="list-style-type: none"> 1. https://www.udemy.com/course/quant_apitud_tricks_and_shortcuts Reasoning <ol style="list-style-type: none"> 2. https://aptitudeclass.com/ Practical Aptitude tests <ol style="list-style-type: none"> 3. http://www.practiceaptitudetests.com/ 														

CS650801 - IT PROJECT MANAGEMENT							
Course Category: Programme Mandatory	Course Type: Theory		L	T	P	C	
			2	0	0	0	
COURSEOBJECTIVES:		1. To effectively plan, manage, execute, and control projects within the stipulated time 2. To effectively manage cost targets with a focus on Information Technology and Service Sector 3. To understand various agile project management techniques such as Scrum and DevOps. 4. To Learn the Various terminologies used in Scrum. 5. To Understand the Devops Concepts.					
UNIT1:Project Overview and Project Scheduling							6
Project Identification, Market and Demand Analysis, Project Cost Estimate, Financial Appraisal., Project Scheduling, Introduction to PERT and CPM, Critical Path Calculation, Precedence Relationship, Difference between PERT and CPM, Float Calculation and its importance, Cost reduction by Crashing of activity.							
UNIT2: Cost Control and Project Management Features							6
Project Cost Control (PERT/Cost), Resource Scheduling & Resource Levelling, Risk Analysis, Project Control, Project Audit and Project Termination.							
UNIT3Agile Project Management							6
Introduction, Agile Principles, Agile methodologies, Relationship between Agile Scrum, Lean, DevOps and IT Service Management (ITIL).							
UNIT4: Scrum							6
Various terminologies used in Scrum (Sprint, product backlog, sprint backlog, sprint review, retro Perspective), various roles (Roles in Scrum), Best practices of Scrum.							
UNIT5: DevOps							6
Overview and its Components, Containerization Using Docker, Managing Source Code and Automating Builds, Automated Testing and Test-Driven Development, Continuous Integration, Configuration Management, Continuous Deployment, Automated Monitoring, Other Agile Methodologies: Introduction to XP, FDD, DSDM, Crystal.							
TOTAL: 30 PERIODS							
COURSE OUTCOMES: At the end of the course, the student will be able to,							
CO1:Understand Project Management activities and to identify basic project management skills with a strong emphasis on issues and problems associated with delivering successful IT projects.							
CO2: Develop activity network to use PERT and to manage project risks such as Resource scheduling and cost control.							
CO3:Classify the concept of Agile Project Management and IT Service Management.							

CO4:Apply the various terminologies and best practices followed in scrum.

CO5:Identify the concept of Devops and its Working, Automated testing and test-driven methods and continuous deployment.

CO-POMAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	2				1	2	2	3	2	
CO2	2	1	2	1	2				1	2	3	3	2	
CO3	2	2	2	1	2				2	2	3	3	2	
CO4	1	2	2	1	2				2	2	3	3	1	
CO5	2	2	2	2	2				2	2	3	3	2	

1-low,2-medium,3- high, "-" No Correlation

I. TEXTBOOKS:

1.Mike Cohn, Succeeding with Agile: Software Development Using Scrum, 2015, 1stEdition Addison-Wesley Professional.

2.Software Project Management: A Concise Study, KELKAR, S. A,Edition : THIRD EDITION

II. REFERENCE BOOKS:

1.Roman Pichler, Agile Product Management with Scrum: Creating Products that Customers Love, 2.2011, First edition , Addison-Wesley.

2.Schwaber, Agile Project Management with Scrum, 2014,1st edition, Microsoft Press US.

3.Ashish K. Bhattacharya, Principles & Practices of Cost Accounting, A. H. Wheeler publisher

III. AICTE FREE BOOKS

1.<https://ekumbh.aicte-india.org/book.php#>

IV. ONLINE LEARNING

https://onlinecourses.nptel.ac.in/noc24_mg01/preview

V. WEB RESOURCES

1.<https://www.mindtools.com/>

2.<https://www.projectmanager.com/guides/it-project-management>

SEMESTER – VI

Syllabus

CS660210 - COMPUTER GRAPHICS AND MULTIMEDIA					
Course Category: Programme Core	Course Type: : Theory with practical Component	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To learn 2D transformation objects To understand the concepts of 3D objects and color models To know the basics of multimedia system To know the concepts of compression techniques and multimedia technologies To understand the basic concepts of related to hypermedia in multimedia systems 					
UNIT 1: OUTPUT PRIMITIVES					6
Basic – Line – Curve and ellipse drawing algorithms – Attributes – TwoDimensional geometric transformations – Two-Dimensional clipping and viewing – Input techniques.					
UNIT 2: THREE-DIMENSIONAL CONCEPTS					6
Three-Dimensional object representations – Three-Dimensional geometric and modeling Transformations – Three-Dimensional viewing – Hidden surface elimination – Color models – Animation.					
UNIT 3: MULTIMEDIA SYSTEMS DESIGN					6
Multimedia basics – Multimedia applications – Multimedia system architecture – Evolving technologies for multimedia – Defining objects for multimedia systems – Multimedia data interface standards – Multimedia databases.					
UNIT 4: MULTIMEDIA FILE HANDLING					6
Compression and decompression – Data and file format standards – Multimedia I/O technologies – Digital voice and audio – Video image and animation – Full motion video – Storage and retrieval technologies.					
UNIT 5: HYPERMEDIA					6
Multimedia authoring and user interface – Hypermedia messaging – Mobile messaging – Hypermedia message component – Creating hypermedia message – Integrated multimedia message standards – Integrated document management – Distributed multimedia systems.					
TOTAL: 30 PERIODS					
LIST OF EXPERIMENTS					
<ol style="list-style-type: none"> To implement Bresenham’s algorithms for line, circle and ellipse drawing. To perform 2D Transformations such as translation, rotation, scaling, reflection and sharing. To implement Cohen-Sutherland 2D clipping and window-viewport mapping. To perform 3D Transformations such as translation, rotation and scaling. To visualize projections of 3D images and Hidden Surface Elimination. To convert between color models. To implement text compression algorithm. To implement image compression algorithm. To perform animation using any Animation software. To perform basic operations on image using any image editing software. 					
TOTAL: 15 PERIODS					
TOTAL: 30+15=45 PERIODS					

COURSE OUTCOMES: At the end of the course, the student will be able to,														
CO1: Recognize the 2D transformation objects														
CO2: Understand the concepts of 3D objects and color models														
CO3: Implement the multimedia system														
CO4: Differentiate compression techniques and multimedia technologies														
CO5: Asses the basic concepts of related to hypermedia in multimedia systems														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1									2	2	
CO2	3	3	3	2	2							2	2	
CO3	3	3	3	2	3						2	2	2	
CO4	2	2	2	2	3						2	2	2	
CO5	3	2	2	2	3						2	2	2	
1- low, 2 - medium, 3 - high, '-' no correlation														
I. TEXT BOOKS:														
1. Donald Hearn, M. Pauline Baker and warren carithers, “Computer Graphics with open GL”, Pearson Education, 2013.														
2. Donald Hearn, M. Pauline Baker, “ Computer Graphics C version” , Pearson Education, 2014														
II. REFERENCE BOOKS:														
1. John F Hughes;Andries Van Dam;Morgan McGuire;David F Sklar;James D Foley;Steven K Feiner;Kurt Akeley , “Computer graphics Principles and Practice”: Third Edition, 2018														
2. Atul P.Godse and Deepali A.Godse , “Computer Graphics and Multimedia”, Technical Publication,2019.														
3. Jeffrey McConnel, Computer Graphics: Theory into Practice, Jones and Bartlett Publishers, 2006.														
III. AICTE FREE BOOK														
1. https://www.aicteindia.org/sites/default/files/bvoc/Graphics%20&%20Multi media.pdf														
IV. ONLINE LEARNING														
1. https://www.classcentral.com/subject/computer-graphics														
2. https://archive.nptel.ac.in/courses/106/102/106102065/														
V. WEB RESOURCE														
1. https://www.reddit.com/r/GraphicsProgramming/comments/iiveq7/computer_graphics_learning_resources/?rdt=41391														

CS660211 - CLOUD TECHNOLOGY					
Course Category: Programme Core	Course Type: : Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To introduce the broad perceptive of cloud architecture and model • To understand the concept of Virtualization and design of cloud Services • To provide the security & risk management of cloud Computing system • To apply different cloud programming model as per need. • To be familiar with the lead players in cloud. 					
UNIT 1: CLOUD ARCHITECTURE AND MODEL					9
. Technologies for Network-Based System – System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture. Cloud Models:- Characteristics– Cloud Services – Cloud models (IaaS, PaaS, SaaS) – Public vs Private Cloud –Cloud Solutions - Cloud ecosystem – Service management – Computing on demand.					
UNIT 2: VIRTUALIZATION					9
Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU, Memory, I/O Devices - Virtual Clusters and Resource management – Virtualization for Data-center Automation - Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development.					
UNIT 3: SECURITY IN THE CLOUD					9
Security Overview – Cloud Security Challenges and Risks – Software-as-a-Service Security– Security Governance – Risk Management – Security Monitoring – Security Architecture Design – DataSecurity – Application Security – Virtual Machine Security – Identity Management and Access Control – Autonomic Security.					
UNIT 4: PROGRAMMING MODEL					9
Parallel and Distributed Programming Paradigms – MapReduce, Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments -Eucalyptus, Open Nebula, OpenStack, Aneka, CloudSim.					
UNIT 5: CASE STUDIES					9
Software as a Service (SaaS) - Big Data Analytics -Software-Defined Wide Area Networking (SD-WAN) - Private/Public/Hybrid Cloud - Infrastructure as a Service (IaaS) -Test and Development-Virtual Desktops (VDI) / Desktop as a Service (DaaS)-Email-Disaster Recovery as a Service (DRaaS)- Backup as a Service (BaaS)					
TOTAL: 45 PERIODS					

COURSE OUTCOMES: At the end of the course, the student will be able to,														
CO1: Identify the architecture, infrastructure and delivery models of cloud computing														
CO2: Apply suitable virtualization concept														
CO3: Address the core issues of cloud computing such as security, privacy and interoperability														
CO4: Choose the appropriate cloud player, Programming Models and approach.														
CO5: Design Cloud Services and Set a private cloud														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2			1					1		2	2	1
CO2		2	2		1					2		2	1	1
CO3		1		3	2					1		2	1	2
CO4		2		3	2					2		2	2	1
CO5		1		2	2					1		2	1	2
1- low, 2 - medium, 3 - high, '-' no correlation														
I) TEXT BOOKS:														
<ol style="list-style-type: none"> 1. “Cloud Computing: Concepts, Technology, Security & Architecture” by Thomas Erl , The Pearson Digital Enterprises Series , Oct 2023. 2. “Cloud Computing”, by <u>Kris Jamsa</u>, The Jones & Bartlett Learning, Mar 2022. 														
II) REFERENCE BOOKS:														
<ol style="list-style-type: none"> 1. TobyVelte,AnthonyVelte,RobertElsenpeter,"CloudComputing,APracticalApproach", July 2017. 2. “Mastering Cloud Computing”, by <u>Buyya</u>, <u>Vecchiola</u>, <u>Selvi</u>, July 2017. 3. “Grid And Cloud Computing”, by <u>D Janakiram</u> (Author), Jan 2016. 														
III) AICTE FREE BOOK														
<ol style="list-style-type: none"> 1. Essentials of Cloud Computing, K. Chandrasekaran 2. Cloud Computing, Pandey & Choudhary 														
IV) ONLINE LEARNING														
https://onlinecourses.nptel.ac.in/noc21_cs14/preview														
V) WEB RESOURCE														
<ol style="list-style-type: none"> 1. http://tagoreiet.ac.in/uploads/corner/qbcse/CS8711.pdf 2. https://www.researchgate.net/publication/277860117_Cloud_Computing 														

CS660212 - Machine Learning

Course Category: Program Core	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand the basic concepts of machine learning • To understand and build supervised learning models • To understand and build unsupervised learning models • To evaluate the algorithms based on corresponding metrics identified 					
UNIT I INTRODUCTION TO MACHINE LEARNING					9
Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik- Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off					
UNIT II SUPERVISED LEARNING					9
Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests					
UNIT III ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING					9
Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization					
UNIT IV NEURAL NETWORKS					9
Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout					
UNIT V DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS					9
Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar’s test, K-fold CV paired t test					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to,					
CO1: Explain the basic concepts of machine learning.					

CO2: Construct supervised learning models														
CO3: Construct unsupervised learning algorithms.														
CO4: Evaluate and compare different models.														
CO5: Analysis of classification algorithms														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	2	1	3		1			1	1	2	1
CO2	2	2	3	2	1	3		1			2	1	1	1
CO3	2	2	3	2	1	3		1			1	1	2	
CO4	2	3	3	2	3	3		1			1	2	1	1
CO5	2	2	2		1			1			2	1	2	
1- low, 2 - medium, 3 - high, '-' no correlation														
I) TEXT BOOKS:														
<ol style="list-style-type: none"> 1. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020. 2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective, “Second Edition”, CRC Press, 2014 														
II) REFERENCE BOOKS:														
<ol style="list-style-type: none"> 1. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997 2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2012, 2018 3. Sebastain Raschka, Vahid Mirjalili , “Python Machine Learning”, Packt publishing 3rd Edition, 2019 														
III) ONLINE LEARNING:														
<ol style="list-style-type: none"> 1. https://archive.nptel.ac.in/courses/106/106/106106139/g 														
IV) WEB RESOURCES :														
<ol style="list-style-type: none"> 1. https://faculty.ucmerced.edu/mcarreira-perpnan/teaching/CSE176/lecturenotes.pdf 2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SIT1305.pdf 														

CS660307 - CLOUD TECHNOLOGY LABORATORY

Course Category: Programme Core	Course Type: : Practical	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To develop the concept of Virtualization and design of cloud Services
- To develop web applications in cloud.
- To learn the design and development process involved in creating a cloud based application.
- To simulate a cloud environment to implement new schedulers.
- To develop Hadoop single node cluster and run simple applications.

LIST OF EXPERIMENTS

1. Install Virtual box/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount

TOTAL : 45 PERIODS

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

CO1: Configure various virtualization tools such as Virtual Box, VMware workstation.

CO2: Design and deploy a web application in a PaaS environment.

CO3: Learn how to simulate a cloud environment to implement new schedulers.

CO4: Manipulate large data sets in a parallel environment.

CO5: Install and use a generic cloud environment that can be used as a private cloud

CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2			1					1		2	2	1
CO2		2	2		1					2		2	1	1
CO3		1		3	2					1		2	1	2
CO4		2		3	2					2		2	2	1
CO5		1		2	2					1		2	1	2
1- low, 2 - medium, 3 - high, '-' no correlation														
I) TEXT BOOKS:														
<ol style="list-style-type: none"> 1. “Cloud Computing: Concepts, Technology, Security & Architecture” by Thomas Erl , The Pearson Digital Enterprise Series , Oct 2023. 2. “Cloud Computing A Practical Approach” by <u>Toby Velte</u> , <u>Anthony Velte</u>, <u>Robert Elsenpeter</u> ,Jul 2017. 														
II) REFERENCE BOOKS:														
<ol style="list-style-type: none"> 1. “Cloud and Distributed Computing: Algorithms and Systems”, by <u>RajivMisra</u>, <u>Yashwant Singh Patel</u> , Kindle Edition, April 2020. 2. “Cloud Computing: Theory and Practice”, by <u>Dan C. Marinescu</u>, 2nd Edition Nov 2017. 3. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, Fourth Edition, 2015. 														
III) VIRTUAL PLATFORMS:														
https://cloudlabs.ai/virtual-labs														

CS660308 - Machine Learning Laboratory						
Course Category: Programme Core	Course Type: Practical	L	T	P	C	
		0	0	3	1.5	
COURSE OBJECTIVES:		<ul style="list-style-type: none"> • Learning basic concepts of Python through illustrative examples and small exercises. • To prepare students to become Familiarity with the Python programming in AI environment • To provide student with an academic environment aware of various AI Algorithms. • To train Students with python programming as to comprehend, analyze, design and create AI platforms and solutions for the real life problems 				
LIST OF EXPERIMENTS:		<ol style="list-style-type: none"> 1. Write a python program to import and export data using Pandas library functions 2. Demonstrate various data pre-processing techniques for a given dataset 3. Implement Dimensionality reduction using Principle Component Analysis (PCA) method 4. Write a Python program to demonstrate various Data Visualization Techniques 5. Implement Simple and Multiple Linear Regression Models 6. Develop Logistic Regression Model for a given dataset 7. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample. 8. Implement Naïve Bayes Classification in Python 9. Build KNN Classification model for a given dataset. 10. Build Artificial Neural Network model with back propagation on a given dataset. 11. Implement Random forest ensemble method on a given dataset and Implement Boosting ensemble method on a given dataset 12. Write a python program to implement K-Means clustering Algorithm <p style="text-align: right;">Total: 45 Periods</p>				
COURSE OUTCOMES: At the end of the course, the student will be able to,						
CO1: Apply various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction,)						
CO2: Understand the fundamentals of knowledge representation, inference.						
CO3: Understand the fundamentals of theorem proving using AI tools.						
CO4: Demonstrate working knowledge of reasoning in the presence of incomplete information						
CO5: Demonstrate working knowledge of reasoning in the presence of uncertain information						
LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS						
HARDWARE REQUIREMENT:						
<ul style="list-style-type: none"> • 1 Desktop Systems - Pentium IV with 2 GB RAM • 160 GB HARD Disk • Monitor 1024 x 768 color 						

SOFTWARE REQUIREMENT:

- Operating systems: Windows* 7 or later, macOS, and Linux.
- Python* versions: 2.7.X, 3.6.X.,3.8.X

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1	2	1	3		1			1	1	2	1
CO2	2	2	1	2	1	2		1			2	1	1	1
CO3	1	2	2	2	1	3		1			1	1	2	
CO4	2	1	3	2	1	1		1			1	2	1	1
CO5	1	2	2		1			1			2	1	2	

I) TEXT BOOKS:

1. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective, “Second Edition”, CRC Press, 2014

II) REFERENCE BOOKS:

1. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition, 1997
2. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2012, 2018
3. Sebastain Raschka, Vahid Mirjalili , “Python Machine Learning”, Packt publishing 3rd Edition, 2019

III) VIRTUAL PLATFORM:

1. <https://python-iitk.vlabs.ac.in/>

CS660504-TRAINING IN IOT USING ARDUINO						
Course Category: EEC	Course Type: Theory	L	T	P	C	
		0	0	2	1	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To program Arduino to control lights, motors, and other devices • To learn Arduino's architecture, including inputs and connectors for add-on devices. • To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality. • To understand various options in programming languages, from C to drag-and-drop languages • To test, debug, and deploy the Arduino to solve real world problems. 						
FUNDAMENTALS OF IoT						9
<p>Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack– Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects, Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming</p>						
LIST OF EXERCISES						
<ol style="list-style-type: none"> 1. Controlling the light Emitting Diode(LED) with a Push button. 2. Interfacing the RGB LED with the Arduino. 3. Controlling the LED blink rate with the Potentiometer interfacing with Arduino. 4. Detection of the light using photo register. 5. Interfacing of temperature sensor LM35 with arduino. 6. Interfacing servo motor with the arduino 7. Interfacing of the Active buzzer and relay with arduino 						
						TOTAL: 30 PERIODS
COURSE OUTCOMES: At the end of the course, the student will be able to,						
CO1- Recall the basics of sensors, its functioning.						
CO2- Execute basic and advanced assembly language programs.						
CO3- Learn the ways to interface I/O devices with processor for task sharing.						
CO4- Illustrate the basics of co-processor and its ways to handle float values by its instruction set.						
CO5- propose the functionality of micro controller, latest version processors and its applications						

CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1		1		1				1	1	1	2	1	3
CO2	2		1		2				2	1	2	1	1	3
CO3	1		1		2				2	1	2	1	1	3
CO4	1		2		3				2	1	2	2	1	3
CO5	3		2		1				2	1	3	1	1	3
1- low, 2 - medium, 3 - high, '-' no correlation														
I. TEXT BOOKS:														
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, —IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017														
2. "Practical Internet of Things Security", Brian Russell Drew Van Duren, Packt Publishing, 2016														
II. REFERENCE BOOKS:														
1. Kamal, R., "Internet of Things – Architecture and Design Principles," 1st Edition, McgrawHill,2017.														
2. Simone Cirani," Internet of Things- Architectures, Protocols and Standards", WILEY,2018														
3. Arshdeep Bahga, Vijay Madiseti, —Internet of Things – A hands-on approachll, Universities Press, 2015.														
III. AICTE FREE BOOK														
1. https://books.google.co.in/books?id=L6YEEAAAQBAJ&printsec=frontcover#v=onepage&q&f=false														
IV. ONLINE LEARNING														
1. https://onlinecourses.nptel.ac.in/noc24_cs35/preview														
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/internet-of-things-iot-batch-2/?v=c86ee0d9d7ed														
V. WEB RESOURCE:														
1. https://online.stanford.edu/courses/xee100-introduction-internet-things														

PROGRAMME ELECTIVES

VERTICAL I FULL STACK DEVELOPMENT

CS606101 - Design And Analysis of Algorithms (NPTEL)						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To gain an idea about how to analyze algorithms To understand Divide and Conquer & Decrease and Conquer techniques and solve some problems using these techniques To understand Dynamic Programming technique and solve some problems using this technique To understand Branch and Bound technique and solve some problems using this technique To learn some basic approximation algorithms for NP-Hard Problems 						
Week 1 Module 1: Introduction Module 2: Examples and motivation Module 3: Examples and motivation Module 4: Asymptotic complexity: informal concepts Module 5: Asymptotic complexity: formal notation Module 6: Asymptotic complexity: examples Assignments MCQ/Fill in blanks (unique answer)						
Week 2 Module 1: Searching in list: binary search Module 2: Sorting: insertion sort Module 3: Sorting: selection sort Module 4: Sorting: merge sort Module 5: Sorting: quicksort Module 6: Sorting: stability and other issues Assignments MCQ/Fill in blanks, programming assignment						
Week 3 Module 1: Graphs: Motivation Module 2: Graph exploration: BFS Module 3: Graph exploration: DFS Module 4: DFS numbering and applications Module 5: Directed acyclic graphs Module 6: Directed acyclic graphs Assignments MCQ/Fill in blanks, programming assignment						
Week 4 Module 1: Shortest paths: unweighted and weighted Module 2: Single source shortest paths: Dijkstra Module 3: Single source shortest paths: Dijkstra Module 4: Minimum cost spanning trees: Prim's algorithm Module 5: Minimum cost spanning trees: Kruskal's Algorithm Module 6: Union-Find data structure Assignments MCQ/Fill in blanks, programming assignment						
Week 5 Module 1: Divide and conquer: counting inversions Module 2: Divide and conquer: nearest pair of points Module 3: Priority queues, heaps Module 4: Priority queues, heaps Module 5: Dijkstra/Prims revisited using heaps Module 6: Search Trees: Introduction Assignments MCQ/Fill in blanks, programming assignment						
Week 6 Module 1: Search Trees: Traversals, insertions, deletions Module 2: Search Trees: Balancing Module 3: Greedy : Interval scheduling Module 4: Greedy : Proof strategies Module 5: Greedy : Huffman coding Module 6: Dynamic Programming: weighted interval scheduling Assignments MCQ/Fill in blanks, programming assignment						
Week 7 Module 1: Dynamic Programming: memoization Module 2: Dynamic Programming: edit distance Module 3: Dynamic Programming: longest ascending subsequence Module 4: Dynamic Programming: matrix multiplication Module 5: Dynamic Programming: shortest paths: Bellman-Ford Module 6: Dynamic Programming: shortest paths: Floyd Warshall Assignments MCQ/Fill in blanks, programming assignment						
Week 8 Module 1: Intractability: NP-completeness Module 2: Intractability: reductions Module 3: Intractability: examples Module 4: Intractability: more examples Module 5: Misc topics Module 6: Misc topics Assignments MCQ/Fill in blanks						
TOTAL: 45 PERIODS						

COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Interpret the fundamental needs of algorithms in problem solving														
CO2: Classify the different algorithm design techniques for problem solving														
CO3: Develop algorithms for various computing problems														
CO4: Analyze the time and space complexity of various algorithms														
CO5: Identify the limitations of algorithms in problem solving														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2						2		2	3	
CO2	3	3		3						2		2	3	
CO3	3	3	2							2		2	3	
CO4	3	3	3	3						2		2	3	
CO5	3	3	3	3						2		2	3	
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. AnanyLevitin, "Introduction to the Design And Analysis of Algorithms", Third Edition, Pearson Education														
2. Design and Analysis of Algorithms by ParagHimanshu Dave (Author), HimanshuBhalchandra Dave (Author)														
3. Design and analysis of algorithms By S. Sridhar (Author)														
REFERENCE BOOKS:														
1. AlfredV.Aho, JohnE. Hopcroft, Jeffrey D.Ullman "The Design and Analysis of Computer Algorithms", 1st Edition														
2. SachinDevGoyal, "Design and Analysis of Algorithm", First edition, University Science Press, 2009														
3. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.														
WEB RESOURCES:														
1. https://onlinecourses.nptel.ac.in/noc20_cs10/preview#:~:text=This%20course%20provides%20an%20introduction,used%20to%20solve%20these%20problems.														
2. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/														

CS606102 - APP DEVELOPMENT															
Course Category: Programme Elective							Course Type: Theory			L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To introduce Application Development & Designing. To work with Android Storing and Retrieving Data To know about Android Networking and Web To develop a Graphics & Mobility and Location Based Services To understand Security and Hacking 															
UNIT 1: INTRODUCTION														9	
Introduction to Mobile Computing - Android Development Environment - Mobile Software Engineering. Frameworks and Tools - Generic UI Development - Android User - VUIs and Mobile Apps - Designing the Right UI - Multichannel and Multimodal UIs															
UNIT 2: INTENTS AND SERVICES														9	
Android Intents and Services - Characteristics of Mobile Applications - Successful Mobile Development - Storing and Retrieving Data: Synchronization and Replication of Mobile Data - Getting the Model Right - Android Storing and Retrieving Data - Working with a Content Provider															
UNIT 3: WEB COMMUNICATION AND TELEPHONY														9	
Communications Via Network and the Web : State Machine - Correct Communications Model - Android Networking and Web – Telephony : Deciding Scope of an App - Wireless Connectivity and Mobile Apps - Android Telephony - . Notifications and Alarms : Performance - Performance and Memory Management - Android Notifications and Alarms.															
UNIT 4: GRAPHICS AND MULTIMEDIA														9	
Graphics : Performance and Multithreading - Graphics and UI Performance - Android Graphics - . Multimedia : Mobile Agents and Peer-to-Peer Architecture - Android Multimedia – Location : Mobility and Location Based Services – Android.															
UNIT 5: SECURITY AND HACKING														9	
Security and Hacking : Active Transactions - More on Security - Hacking Android - Platforms and Additional Issues : Development Process – Architecture – Design - Technology Selection - Mobile App Development Hurdles – Testing.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1 : Create simple Application Development & Designing.															
CO2 : Create programs using Android Storing and Retrieving Data															
CO3 : Explore the usage of Android Networking and Web															
CO4 : Implement a Graphics & Mobility and Location Based Services															
CO5 : Implement Security and Hacking															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	1		1		2	1			2			3		
CO2	2	1			3	1	1			2			3		
CO3	2		3	1	2	1		1		2			3		
CO4	1	1	2	2	1	1	1			2			3		
CO5	1	2	1	2	2	1		1		2			3		
1- low, 2 - medium, 3 - high, '-' no correlation															

TEXT BOOKS:
1.Rick Rogers , John Lambardo “Android Application Development” 2018.
2.Android Application Development (With Kitkat Support) by Pradeep Kothari (Author), Kogent Learning Solutions Inc. (Author) 2014
3.Learning Android: Develop Mobile Apps Using Java and Eclipse, 2nd Edition,MarkoGargenta and Masumi Nakamura
REFERENCE BOOKS:
1.RavinderGoud&Gopichand “Mobile Application Development”
2.BenFeigin “Mobile Application Development”
WEB RESOURCES:
1. https://developer.android.com/?gclid=CjwKCAjw586hBhBrEiwAQYEnHQLEPhnP3_mYwjOUygwEhO4WH90BSCnOPMun_aK6SZxfeCgIidT1LhoCG-QQAvD_BwE&gclid=aw.ds
2. https://flutter.dev

CS606103 - PHP Programming					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To introduce web development with PHP To work with various operations in PHP To model the design in a web environment To develop a webpage with database To test and work with a PHP application 					
UNIT 1: INTRODUCTION TO PHP				9	
PHP – History and Evolution – Installation – Language Basics – Lexical Structure – Datatypes – Variables – Expression & Operators – Flow Control statements – embedding PHP in web pages					
UNIT 2: FUNCTIONS & STRINGS				9	
Calling a function – Defining a function – Variable scope – function parameters – return values – variable functions – Strings – Quoting string constants – Printing string – cleaning strings – encoding and escaping – comparing strings – manipulating and searching strings					
UNIT 3: ARRAYS & OBJECTS				9	
Indexed versus Associative Arrays – Identifying elements of an array – Storing data in arrays – Multidimensional arrays –Extracting multiple values – Conversion between arrays and variables – Traversing arrays – Sorting – Working with arrays – Objects – Creation – Accessing Properties and methods – Declaration of class – Introspection					
UNIT 4: WEB TECHNIQUES, GRAPHICS & SECURITY				9	
HTTP basics – Server Information – Processing Forms –Setting Response Headers – Maintaining State – SSL – Graphics – Embed an image – Create and draw images – Images with text – Dynamic buttons – Color handling – Security – Cross site scripting – File uploads and Access					
UNIT 5: DATABASE ACCESS & APPLICATION				9	
PHP to access a database – Relational databases and SQL – MySQL object interface – Connectivity – Direct file level manipulation – Application techniques – code libraries – handing output - error reporting and suppression – performance tuning					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Create simple basic PHP programs					
CO2: Create programs using functions and strings					
CO3: Explore the usage of arrays and objects					
CO4: Implement graphics, security and web techniques in designing					
CO5: Implement database connectivity with PHP					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		1		1	1						2	
CO2	2	2		1		2	1	1					2	
CO3	3	1	2	2	1	1		1					2	2
CO4	1		3	2	2	1		1					1	2
CO5	2	1		2	2	1	1						1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Kevin Tatroe, Peter MacIntyre & Rasmus Lerdorf, "Programming PHP", Creating Dynamic Web Pages, O'Reilly Media, 3rd Edition, 2013

2. Programming PHP: Creating Dynamic Web Pages, 4th Edition, Kevin Tatroe, Peter MacIntyre.

3. PHP: The Complete Reference for Beginners, Anshul Saini, 2023

REFERENCE BOOKS:

1. Steven Holzner, "PHP: The Complete Reference", McGraw Hill Education, 2008

2. Timothy Boronczyk, Martin E. Psinas, "PHP and MySQL: Create - Modify - Reuse", Wiley India Private Limited, 2008

3. Matt Doyle, "Beginning PHP 5.3", Wiley Publishing Inc., 2009

WEB RESOURCES:

1. <https://www.cloudkampus.com/>

2. <https://www.codecademy.com/>

CS606104 - UI and UX Design					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To provide students with the knowledge of user- centered design To understand user -centered methods in design, simulation and prototyping techniques To organize information about users into useful summaries with affinity diagrams. To convey user research and user experience design To understand wire framing and Prototyping software in the various UI/UX Design tools. 					
UNIT 1: INTRODUCTION TO THE UI				9	
User Interface Design (UI) -The Relationship Between UI and UX , Roles in UI/UX, A Brief Historical Overview of Interface Design, Interface Conventions, Approaches to Screen Based UI, Template vs Content.					
UNIT 2: UI INTERFACE DESIGN				9	
Formal Elements of Interface Design, Active Elements of Interface Design, Composing the Elements of Interface Design, UI Design Process, Visual Communication design component in Interface Design.					
UNIT 3: INTRODUCTION TO UX				9	
UX Basics- Foundation of UX design, Good and poor design, Understanding Your Users, Designing the Experience Elements of user Experience. I vs UX – Roles in UX.Careers option in UX - Design Careers - Research Careers - Strategy Careers - Career in UX					
UNIT 4: DESIGN AND TESTING				9	
Visual Design Principles, Functional Layout, Interaction design, Introduction to the Interface, Navigation Design, User Testing, Developing and Releasing Your Design - UX Techniques - Gather and Analyse User Ideation techniques - Scenarios and storyboarding - Paper Prototype design and testing - development cycle.					
UNIT 5: UI/ UX DESIGN TOOL				9	
User Study- Interviews, writing personas: user and device personas, User Context, Building Low Fidelity Wireframe and High-Fidelity Polished Wireframe Using wire framing Tools, Creating the working Prototype using Prototyping tools, Sharing and Exporting Design					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Understand iterative user-centered design of graphical user interfaces					
CO2: Apply the user Interfaces to different devices and requirements					
CO3:Create high quality professional documents and artifacts related to the design process.					
CO4: Understand Design and Research Careers.					
CO5: Create UI/UX Design Tools.					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									1		1	1	1
CO2	1									1		1	1	1
CO3	1	1	1							1		1	1	1
CO4	1	1	1							1		1	1	1
CO5	1	1	1							1		1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.A Project Guide to UX Design: For user experience designers in the field or in the making (2nd. ed.). Russ Unger and Carolyn Chandler. New Riders Publishing, USA, 2012														
2.The Elements of User Experience: User-Centered Design for the Web and Beyond, Second Edition Jesse James Garrett, Pearson Education. 2011.														
REFERENCE BOOKS:														
1.The Essential Guide to User Interface Design: An Introduction to GUI Design Principles and Techniques, Third Edition Wilbert O. Galitz , Wiley Publishing, 2007.														
2.The UX Book Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson and Pardha S. Pyla, Elsevier, 2012														
WEB RESOURCES:														
1. https://www.cloudkampus.com/														
2. https://www.codecademy.com/														

CS606105 - Software Testing (NPTEL)														
Course Category: Programme Elective	Course Type: Theory						L	T	P	C				
							3	0	0	3				
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To learn the criteria for test cases. To learn the design of test cases. To understand test management and test automation techniques. To apply test metrics and measurements. 														
Week 1 : Introduction – Level of Testing – Basic Concepts of Testing – Unit Testing.														
Week 2 : Equivalence and BV Testing – Special Value Testing Combinational Testing – Pairwise Testing – White Box Testing														
Week 3 : MC/DC Testing – Path testing – Dataflow and Mutation Testing														
Week 4 : Integration Testing – System Testing – Regression Testing														
Week 5: Testing Object Oriented Programing														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:Design test cases suitable for a software development for different domains.														
CO2:Identify suitable tests to be carried out.														
CO3:Prepare test planning based on the document.														
CO4:Document test plans and test cases designed.														
CO5:Use automatic testing tools.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3							2			3	
CO2	2	3	3							2			2	
CO3	2		2							2			2	2
CO4		2	3							2			2	2
CO5		2	2							2			2	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Srinivasan Desikan and Gopalswamy Ramesh, —Software Testing – Principles and Practices, Pearson Education, 2006.														
2. Ron Patton, —Software Testing, Second Edition, Sams Publishing, Pearson Education, 2007. AU Library.com														
REFERENCE BOOKS:														
1. Ilene Burnstein, —Practical Software Testing, Springer International Edition, 2003.														
2. Edward Kit,Software Testing in the Real World – Improving the Process, Pearson Education, 1995.														
3. Boris Beizer, Software Testing Techniques – 2nd Edition, Van Nostrand Reinhold, New York, 1990.														
WEB RESOURCES:														
1. https://www.besanttechnologies.com/														
2. https://www.rejinpaul.com/														

CS606106 - Web Application Security					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To reveal the underlying in web application. To identify and aid in fixing any security vulnerabilities during the web development process. To understand the security principles in developing a reliable web application. To Understand penetration testing to improve the security of web applications To Use industry standard tools for web application security. 					
UNIT 1: OVERVIEW OF WEB APPLICATIONS & SECURITY				9	
Introduction history of web applications interface ad structure benefits and drawbacks of web applications Web application Vs Cloud application - Security Fundamentals: Input Validation - Attack Surface Reduction - Web Rules of Thumb- Classifying and Prioritizing Threads					
UNIT 2: SECURITY PRINCIPLES				9	
Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting and Cross-Site Request Forgery - Reflected XSS - HTML Injection - Clickjacking - DNS rebinding - Flash security - Java applet security - Single-sign-on solution and security - IPv6 impact on web security.					
UNIT 3: WEB APPLICATION VULNERABILITIES				9	
Understanding vulnerabilities in traditional client server application and web applications, client state manipulation, cookie based attacks, SQL injection, cross domain attack (XSS/XSRF/XSSI) http header injection. SSL vulnerabilities and testing - Proper encryption use in web application - Session vulnerabilities and testing - Cross-site request forgery					
UNIT 4: WEB APPLICATION MITIGATIONS				9	
Http request , http response, rendering and events , html image tags, image tag security, issue, java script on error , Java script timing , port scanning , remote scripting , running remote code, frame and iframe , browser sandbox, policy goals, same origin policy, library import, domain relaxation					
UNIT 5: SECURE WEBSITE DESIGN				9	
Secure website design : Architecture and Design Issues for Web Applications, Deployment Considerations Input Validation, Authentication, Authorization, Configuration Management ,Sensitive Data, Session Management, Cryptography, Parameter Manipulation, Exception Management, Auditing and Logging, Design Guidelines, Forms and validity, Technical implementation					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Understand the underlying in web application.					
CO2: Identify and aid in fixing any security vulnerabilities during the web development process.					
CO3: Understand the security principles in developing a reliable web application.					

CO4:Understand penetration testing to improve the security of web applications														
CO5:Create standard tools for web application security.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2								2		2	2	
CO2	2	2								2		2	2	
CO3	2	2						1		2		2	2	
CO4	2	2						1		2		2	2	
CO5	2	2								2		2	2	
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Sullivan, Bryan, and Vincent Liu. Web Application Security, A Beginner's Guide. McGraw Hill Professional, 2011.														
2.Web Application Security,by Andrew Hoffman,2020														
REFERENCE BOOKS:														
1.Stuttard, Dafydd, and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws. John Wiley Sons, 2011														
2.Developing Web Applications,by M.T. Savaliya ,2013														
WEB RESOURCES:														
1. https://leveetech.com/														
2. https://www.guvi.in/														

CS606107 - Dev-ops															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To provide students with the knowledge of DevOps To understand Cloud and virtualization architecture To know about Jenkins and its architecture To know about Docker and its technology To know about Kubernetes Cluster Architecture 															
UNIT 1: INTRODUCTION													9		
DevOps Principles in detail - DevOps Engineer Skills in the market - Knowing DevOps Delivery Pipeline - Market trend of DevOps - DevOps Technical Challenges - Tools we use in DevOps.															
UNIT 2: DEVOPS ON CLOUD													9		
Essentials of Cloud computing - Cloud and virtualization architecture - Cloud deployment architecture - Cloud providers – An overview - Introducing to Amazon web services.															
UNIT 3: JENKINS													9		
Essentials of Continuous Integration - Jenkins and its architecture - Jenkins tool Management - User management in Jenkins – Authentication: Jenkins own database user creation – Authorization: Matrix based authorization - Project based authorization															
UNIT 4: WEB APPLICATION MITIGATIONS													9		
Introduction - Real-world Shipping Transportation Challenges - Docker and its technology - Docker images and containers - Working with container: Share and copy a container - Container Life Cycle - Base Image and customize - Creation of Docker File - Publish Image on Docker Hub															
UNIT 5: KUBERNETES													9		
Introduction to Kubernetes - Kubernetes Cluster Architecture — An overview - Understanding concepts of Pods, Replica sets, deployments and namespaces - concepts of services and networking - Persistent volumes and persistent volume claims —an overview - Design of Pods - labels, selectors, jobs, and schedulers															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Understand with the knowledge of DevOps															
CO2: Create Cloud and virtualization architecture															
CO3: Understand Jenkins and its architecture & own database user creation															
CO4: Creation of Docker File and its technology															
CO5: Understand concepts of Pods, Replica sets, deployments and namespaces															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	1	2	1		1		2	2	1		1		3		
CO2	2	3	2	3	1		1	1			2		2		
CO3	1	2	3	3	2		2	1	2		2		3		
CO4	2	1	2	2	2		2	1			1		3		
CO5	1		2	2	2		3	1	2		2		3		
1- low, 2 - medium, 3 - high, '-' no correlation															

TEXT BOOKS:
1. Joseph Joyner , MihalisKonoplovs “DevOps for Beineers” 2015
2. MikaelKrief “Learning DevOps – Complete Guide” Packt Publications , 2019
REFERENCE BOOKS:
1. IshaqAzhar Mohammed , DhayaSindhuBattina , Dr.Mehul Patel “Introduction to DevOps” 2021
2. Effective DevOps,By Jennifer Davis, Ryn Daniels · 2016
WEB RESOURCES:
1. https://www.simplilearn.com/
2. https://intellipaat.com/

CS606108 - Principles of Programming Languages					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To know the knowledge of Programming To understand Basic Knowledge of Names, Bindings, and Scopes To know about Subprograms and Blocks To know about Concurrency in Function Languages To know about Functional Programming & Scripting Languages 					
UNIT 1: PRELIMINARY CONCEPTS				9	
Concepts of Programming Languages, Programming Domains, Language Evaluation Criteria, Influences on Language Design, Language Categories, Language Design Trade-Offs, Implementation Methods, Programming Environments - General Problem of Describing Syntax and Semantics, Formal Methods of Describing Syntax, Attribute Grammars, Describing the Meanings of Programs.					
UNIT 2: NAMES, BINDINGS, AND SCOPES				9	
Introduction, Names, Variables, Concept of Binding, Scope, Scope and Lifetime, Referencing Environments, Named Constants - introduction, Primitive Data Types, Character String Types, User Defined Ordinal Types, Array, Associative Arrays, Record, Union, Tuple Types, List Types, Pointer and Reference Types, Type Checking, Strong Typing, Type Equivalence.					
UNIT 3: SUBPROGRAMS AND BLOCKS				9	
Fundamentals of Sub-Programs, Design Issues for Subprograms, Local Referencing Environments, Parameter Passing Methods, Parameters that Are Subprograms, Calling Subprograms Indirectly, Overloaded Subprograms, Generic Subprograms, Design Issues for Functions, User Defined Overloaded Operators, Closures, Co routines					
UNIT 4: CONCURRENCY				9	
Introduction, Introduction to Subprogram Level Concurrency, Semaphores, Monitors, Message Passing, Java Threads, Concurrency in Function Languages, Statement Level Concurrency. Exception Handling and Event Handling: Introduction, Exception Handling in Ada, C++, Java, Introduction to Event Handling, Event Handling with Java and C#.					
UNIT 5: FUNCTIONAL PROGRAMMING LANGUAGES				9	
Introduction, Mathematical Functions, Fundamentals of Functional Programming Language, LISP, Support for Functional Programming in Primarily Imperative Languages, Comparison of Functional and Imperative Languages - Scripting Language: Pragmatics, Key Concepts, Case Study: Python – Values and Types, Variables, Storage and Control, Bindings and Scope, Procedural Abstraction, Data Abstraction, Separate Compilation, Module Library.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1:Acquire the skills for expressing syntax and semantics in formal notation					
CO2:Identify and apply a suitable programming paradigm for a given computing application					
CO3:Gain knowledge of and able to compare the features of various programming languages					

CO4:Understand Statement Level Concurrency

CO5:Create Functional Programming in Primarily Imperative Languages

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3							2			3	
CO2	2	3	3							2			2	
CO3	2		2	3	3					2			2	2
CO4		2	3		2					2			2	2
CO5		2	2		3					2			2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Concepts of Programming Languages Robert. W. Sebesta 10/E, Pearson Education.

2. Programming Language Design Concepts, D. A. Watt, Wiley Dreamtech, 2007

REFERENCE BOOKS:

1. Programming Languages, 2nd Edition, A.B. Tucker, R. E. Noonan, TMH.

2. Programming Languages, K. C. Loudon, 2nd Edition, Thomson, 2003

WEB RESOURCES:

1. <https://www.simplilearn.com/>

2. <https://intellipaat.com/>

CS606109 - Social Networks (NPTEL)														
Course Category: Programme Elective					Course Type: Theory					L	T	P	C	
										3	0	0	3	
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> • Build and strengthen your brand • Increase your traffic • Connect with your audience • Drive conversions • Increase your presence 														
Week 1: Introduction														
Week 2: Handling Real-world Network Datasets														
Week 3: Strength of Weak Ties														
Week 4: Strong and Weak Relationships (Continued) & Homophily														
Week 5: Homophily Continued and +Ve / -Ve Relationships														
Week 6: Link Analysis														
Week 7: Cascading Behaviour in Networks														
Week 8: Link Analysis (Continued)														
Week 9: Power Laws and Rich-Get-Richer Phenomena														
Week 10: Power law (contd..) and Epidemics														
Week 11: Small World Phenomenon														
Week 12: Pseudo core (How to go viral on web)														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Driving Traffic														
CO2: Enhancing the Customer Experience														
CO3: Learning and Education														
CO4: Motivating Young People														
CO5: Creativity														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2							2			2	
CO2	2	2	2							2			2	
CO3	2	2	2							2			2	
CO4	2	2	2							2			2	
CO5	2	2	2							2			2	
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Social Networking And Cyberspirituality Towards A Theology of Networks by Rev Jim M R Paul, Christian World Imprints														
2. Social Networking by Kenneth Partridge														
REFERENCE BOOKS:														
1. All About Social Networking by Patti Richards, Apr 2018														
2. Social Network Analysis for Start-ups, October 2015 by Maksim Tsvetovat (Author), Alexander Kouznetsov (Author)														

WEB RESOURCES:
https://www.frontiersin.org/
https://digitalcommons.unl.edu/libphilprac/3727/

CS606110 - MULTIMEDIA TECHNOLOGY					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To examine the notions of multimedia, graphics and image data, video data, and audio data To learn about digital audio and its compression To learn the various multimedia data compression techniques To know the idea behind the image and video compression techniques To learn network protocols, multimedia content distribution and CBIR multimedia 					
UNIT 1: INTRODUCTION					9
Multimedia – Definitions, components. Multimedia software tools – Multimedia presentation – Data compression –Multimedia production – Multimedia sharing and distribution. Graphics and Image data representations					
UNIT-2 : DIGITAL AUDIO AND COMPRESSION					9
Basics of digital audio – Digitization of sound – MIDI – Quantization and Transmission of Audio - Basic audiocompression techniques: ADPCM in speech coding – MPEG audio compression.					
UNIT-3 : MULTIMEDIA DATA COMPRESSION					9
Lossless compression algorithms: Run-length coding, variable-length coding, dictionary-based coding, arithmetic coding. Lossless image compression. Lossy compression algorithms: Quantization, transform coding, wavelet-based coding, wavelet packets, embedded Zerotree of wavelet coefficients.					
UNIT-4 : IMAGE COMPRESSION					9
Color models in images - Image compression standards: JPEG standard, JPEG2000 standard: Main steps, Region-of-Interest coding – JPEG-LS standard - Bi-level image compression standards.					
UNIT-5 : VIDEO COMPRESSION					9
Color models in Video - Basic video compression techniques: Video compression based on motion compensation, search for motion vectors, H.261 and H.263 – New video coding standards					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Identify suitable data representations for use in appropriate multimedia applications					
CO2: Work with the various audio compression techniques					
CO3: Select suitable data compression technique for respective application					
CO4: Interpret the image and video compression standards and techniques					
CO5: Examine the protocols for multimedia transmission and content distribution					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO2	2	2	2	2	2	-	-	-	-	2	-	2	-	-
CO3	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO4	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO5	2	2	-	2	2	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Ze-Nian Li, Mark S. Drew, and Jiangchuan Liu, “Fundamentals of Multimedia”, Second Edition, Springer, 2014.

2.Tay Vaughan, “Multimedia: Making It Work”, McGraw-Hill Education, ninth edition, 2014.

REFERENCE BOOKS:

1.Ralf Steinmetz and KlaraNahrstedt, “Multimedia: Computing, Communications and Applications”,Pearson Education, 2012.

2.Banerji Ashok &GhoshAnanda Mohan, “Multimedia Technologies”, Tata McGraw Hill, New Delhi 2010.

WEB RESOURCES:

1.<https://core.ac.uk/download/pdf/82176089.pdf>

2.<https://developer.mozilla.org/en-US/docs/Web/Media>

VERTICAL II

CLOUD AND DATA SCIENCE

CS606201 - CLOUD COMPUTING (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To know about Cloud Architecture and Virtualization To learn Management Level and Google Cloud Platform To know about Clouconomics and Security Level Implementation To apply Fog Computing and Sensor Cloud Computing To analyse various VM Migration Techniques used in Cloud Computing. 					
UNIT 1:INTRODUCTION					9
Overview –Introduction – Architecture – Deployment Models – Virtualization – XML Basics I - XML Basics – II – Web Services – Service Oriented Architecture					
UNIT-2 : SERVICE LEVEL MANAGEMENT					9
Service Level Management – Cloud Computing – Managing Data – Introduction to Mapreduce – Open Stack – Open Stack Demo – Cloud Microsoft Azure – Google Cloud Platform					
UNIT-3 : CLOUD COMPUTING SECURITY					9
SLA – Clouconomics – Mapreduce – Resource Management – I , Resource Management –II , Cloud Computing Security – I , II , III – Security Issues in Colloborative SaaS Cloud – Broker for Cloud Marketplace					
UNIT-4 : FOG COMPUTING					9

Mobile Computing I ,II – Fog Computing I , II – Use case: Geo Spatial Cloud – Introduction to Docker Container – Green Cloud – Sensor Cloud Computing – IoT Cloud – Course Summary and Research Areas.

UNIT-5 : VM MIGRATION 9

Cloud Federation – VM Migration – basic Migration Strategies – Containers Container based virtualization Kubernetes Docker Container - Demo

TOTAL: 45 PERIODS

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

CO1: Describe about Cloud Architecture and Virtualization

CO2: Apply Management Level and Google Cloud Platform

CO3: Demonstrate about Cloudonomics and Security Level Implementation

CO4: Analyse Fog Computing and Sensor Cloud Computing Techniques

CO5: Evaluate various VM Migration Techniques used in Cloud Computing.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3						3	2		3		2
CO2	3	2	2							3			2	3
CO3	2	3	3						2	2		2		
CO4	3	2	3							2			2	2
CO5	3	3	2						2	3		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Prof.Soumya Kanti Ghosh ,”Cloud Computing” Department of Computer Science and Engineering,IIT Guwahati,2017.

2.Lizhe Wang, Rajiv Ranjan, Jinjun Chen, Boualem Benatallah,” Cloud Computing”, CRC Press,2017.

3.Thomas Erl , Zalgharm Mahmood , Richard Puttini,”Cloud Computing – Concepts,Technology and Architecture”PearsonPublication,First Edition,201

REFERENCE BOOKS:

1) A.Srinivasan , J.Suresh , “Cloud Computing – A Practical approach for Learning and Implementation” Pearson Publication , First Edition ,2014.

2) Kailash Jayaswal,JagannathKallakurchi,DonaldJ.Houde,Dr.DevenShah,”Cloud Computing – Black Book”Dreamtech Press,2014.

3)Anthony T.Velte , Toby J.Velte , Robert Elsenpeter , “Cloud Computing-A Practical Approach”,Tata McGraw Hill Education,2017.(Indian Edition)

WEB RESOURCES:

1.<https://www.knowledgehut.com/blog/cloud-computing/top-cloud-computing-resources>

2.<https://westportlibrary.libguides.com/CloudComputing>

CS606202 - VIRTUALIZATION					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To understand the concept of Virtualization To know the virtualization infrastructure To build the cloud deployment models To know the Hadoop Framework To know the Cloud Infrastructure security 					
UNIT 1: VIRTUALIZATION					9
Basics of Virtual Machines - Process Virtual Machines System Virtual Machines – Emulation– Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization– Management Virtualization — Hardware Maximization – Architectures – Virtualization Management– Storage Virtualization– Network Virtualization					
UNIT 2: VIRTUALIZATION INFRASTRUCTURE					9
Comprehensive Analysis– Resource Pool – Testing Environment – Server Virtualization– Virtual Workloads – Provision Virtual Machines– Desktop Virtualization – Application Virtualization - Implementation levels of virtualization– virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management– Virtualization for data center automation.					
UNIT 3: CLOUD PLATFORM ARCHITECTURE					9
Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design– Layered cloud Architectural Development– Virtualization Support and Disaster Recovery– Architectural Design Challenges - Public Cloud Platforms : GAE,AWS– Inter-cloud Resource Management					
UNIT 4: PROGRAMMING MODEL					9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications -Design of Hadoop file system– Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus					
UNIT 5: CLOUD SECURITY					9
Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Security and Trust Management					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Deploy the concepts of virtualization strategies and virtual machines					
CO2: Apply the concept of virtualization infrastructure in the cloud computing					
CO3: Identify the architecture and deployment models of cloud computing					
CO4: Develop cloud services using cloud computing for real time environment					
CO5: Apply the security models in the cloud environment					

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	2		1					3	2		2	1
CO2	2	3	3						2	2		1		2
CO3	2	1	3							3	1		1	
CO4	3	2	1		2				2	3		2		1
CO5	3	2	1		2					2	2	2	2	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner's Guide, McGraw-Hill Osborne Media, 2009.2.

2. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.3.

3. John W. Rittinghouse and James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.

REFERENCE BOOKS:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.5.

2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy", O'Reilly Media, Inc., 2009.6.

3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.7.

WEB RESOURCES:

1. www.ibm.com/in-en/topics/virtualization

2. <https://www.sciencedirect.com/topics/computer-science/virtualized-resource>.

CS606203 - CLOUD COMPUTING AND DISTRIBUTED SYSTEMS (NPTEL)															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To discuss the fundamental concepts of Cloud Computing To analyse different algorithms in Cloud Computing To simulate the different Cloud Data Centers. To get the knowledge of Key and HBase. To know about peer-to-peer and Spark Technique. 															
UNIT 1: OVERVIEW													9		
<u>Introduction to Cloud Computing - Virtualization - Hotspot Mitigation for Virtual Machine Migration - Server Virtualization - Software Defined Network - Geo-distributed Cloud Data Centers.</u>															
UNIT 2: DISTRIBUTED ALGORITHM													9		
<u>Leader Election in Rings (Classical Distributed Algorithms) - Leader Election (Ring LE & Bully LE Algorithm) - Design of Zookeeper</u>															
UNIT 3: CLOUD DATA CENTERS													9		
<u>Time and Clock Synchronization in Cloud Data Centers - Global State and Snapshot Recording Algorithms - Distributed Mutual Exclusion - Consensus in Cloud Computing and Paxos</u>															
UNIT 4: KEY AND HBASE													9		
<u>Design of Key-Value Stores - Design of HBase - Introduction to Kafka</u>															
UNIT 5: SPARK													9		
<u>Peer to Peer Systems in Cloud Computing - MapReduce - Introduction to Spark</u>															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Build the fundamental concepts of Cloud Computing															
CO2: Apply different algorithms in Cloud Computing															
CO3:Develop the different Cloud Data Centers.															
CO4: Learn the knowledge of Key and HBase															
CO5: Apply about peer-to-peer and Spark Technique.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	3	3						2	3		2		3	
CO2	3	2	2						3	2			3		
CO3	2	3	2							3		3		2	
CO4	3	2	3							2		2	3		
CO5	2	3	2						2	3		3		3	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1.Prof.Rajiv Mishra , “Cloud Computing and Distributed Systems” Department of Computer Science and Engineering,IIT Patna,2021.															
2.Kai Hwang , Geoffrey C.Fox , Jack J.Dongarra , “Distributed and Cloud Computing” Morgan Kaufmann Publisher,First Edition,2013.															

3.Rajiv Mishra,Yashwant Singh Patel,”Cloud and Distributed Computing – Algorithms and Systems”, Wiley Publisher,2020.

REFERENCE BOOKS:

1.Raj Kumar Bayya , James broberg , Andrzej Goscinski ,”Cloud Computing – Principles and Paradigms”, Wiley Publisher, First Edition,2018.

2.Kenneth P.Birman , “Guide to Reliable Distributed Systems”, Springer Publisher,2012.

3.Christian Vecchiola , S.Thamarai Selvi,Rajkumar Bayya , “Mastering Cloud Computing ”MorganKaufmann, First Edition.,2013.

WEB RESOURCES:

1.https://onlinecourses.nptel.ac.in/noc21_cs15/preview

2.<https://www.classcentral.com/course/swayam-cloud-computing-and-distributed-systems-17544>

CS606204 - DATA WAREHOUSING					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To understand data warehouse concepts, architecture, business analysis and tools To understand data pre-processing and data visualization techniques To study algorithms for finding hidden and interesting patterns in data To understand and apply various classification and clustering techniques using tools. To Know about the Weka Tool 					
UNIT 1: DATA WAREHOUSING-INTRODUCTION				9	
Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies - Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.					
UNIT 2: DATA MINING – INTRODUCTION				9	
Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.					
UNIT 3: DATA MINING - FREQUENT PATTERN ANALYSIS				9	
Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns					
UNIT 4: CLASSIFICATION AND CLUSTERING				9	
Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines — Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy. Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.					
UNIT 5: WEKA TOOL				9	
Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database - Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Design a Data warehouse system and perform business analysis with OLAP tools.					
CO2: Apply suitable pre-processing and visualization techniques for data analysis					
CO3 : Apply the algorithms for finding hidden and interesting patterns in data.					
CO4: Apply various classification and clustering techniques using tools.					
CO5: Know about the Weka Tool					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2		2				2	2	2			
CO2	3	2	1							3		2	1	2
CO3	2	3	3		1				1	2	1	1	2	1
CO4	3	2	3							3				1
CO5	2	3	2		1				1	3	2	2	2	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

- 1.Jiawei Han, Micheline Kamber, JianPai, “DataMining: Concepts and Techniques”, Morgan Kaufman Publishers, Third Edition, 2012.
- 2.Nenad Jukic, SusanVrbsky, SvetlozarNestorov,” DatabaseSystems: Introduction to Database and Data Warehouses”, Prospect Press,1st Edition,2020.
- 3.Pang-Nong Tan, MichaelSteinbach,Anuj Karpatne,Vipin Kumar ,”Introduction to Data Mining”Pearson,Second Edition,2021.

REFERENCE BOOKS:

- 1.Bharat Bhushan Agarwal, Sumit Prakash Tayal, “Data Mining and Data Warehousing”, University Science, First Edition, 2009.
- 2.Mehmed Kantardzic, “DataMining Concepts, Models, Methods and Algorithms”, Wiley Publications, Second Edition,2011.
- 3.Khushboo Saxena , Sandeep Saxena , AkashSaxena ,”Data Mining and Data Warehousing”BPB Publications,2014.

WEB RESOURCES:

- 1.www.topcoder.com/thrive/articles/data-warehousing-data-mining.
- 2.<https://www.simplelearn.com/data-warehouse-article>.

CS606205 - STORAGE TECHNOLOGIES														
Course Category: Programme Elective							Course Type: Theory		L	T	P	C		
									3	0	0	3		
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To understand the underlying principles of spoilage and storage To provide knowledge on different storage methods and packaging techniques To Learn Functions of Packaging Materials To apply package material testing To implement Special Packaging Techniques 														
UNIT 1: SPOILAGE AND STORAGE												9		
Direct damages, Indirect damages of perishable and durable commodities – control measures - factors affecting storage – types of storage – Losses in storage and estimation of losses.														
UNIT 2: STORAGE METHODS												9		
Improved storage methods for grain-modern storage structures-infestation-temperature and moisture changes in storage structures-CAP storage-CA storage of grains and perishables construction operation and maintenance of CA storage facilities														
UNIT 3: FUNCTIONS OF PACKAGING MATERIALS												9		
Introduction – packaging strategies for various environment – functions of package – packaging materials – cushioning materials – bio degradable packaging materials – shrink and stretch packaging materials.														
UNIT 4: FOOD PACKAGING MATERIALS AND TESTING												9		
Introduction – paper and paper boards - flexible - plastics - glass containers – cans – aluminium foils - package material testing-tensile, bursting and tear strength.														
UNIT 5:SPECIAL PACKAGING TECHNIQUES												9		
Vacuum and gas packaging - aseptic packaging - retort pouching – edible film packaging – tetra packaging – antimicrobial packaging – shrink and stretch packaging.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Understand the underlying principles of spoilage and storage														
CO2: Provide knowledge on different storage methods and packaging techniques														
CO3: Learn Functions Of Packaging Materials														
CO4: Apply package material testing														
CO5: Implement Special Packaging Techniques														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2				2	3		1	2	
CO2	3	2	3	2						2	2	2		1
CO3	3	1	3		1				1	3			1	
CO4	3	2	3							3	2			1
CO5	1	2	3		1				3	2	2	2	2	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Sahay, K.M. and K.K.Singh. 1996. Unit operations of agricultural processing. Vikas Publishing House Pvt. Ltd., New Delhi.														

2. Food Packaging Technology, Hand book, 2004. NIIR Board, New Delhi
3.Pandey, P.H.2002. Post harvest engineering of horticultural crops through objectives. SarojPrakasam. Allahabad.
REFERENCE BOOKS:
1.Himangshu Barman. 2008, Post Harvest Food grain storage. Agrobios (India), Jodhpur.
2.Chakaraverty, A. 2000. 3rd edition. Post harvest technology of cereals, pulses and oil seeds. Oxford & IBH publishing &Co.Pvt.Ltd. New Delhi.
3.P.Komarnicki,Pio Alessandro Lombadi,Z.A.Styczynski “Storage Technologies and Systems”,April 2017.
WEB RESOURCES:
1. https://www.researchgate.net/publication/318169073_Storage_Technologies_and_Systems .
2. https://www.sciencedirect.com/topics/computer-science/storage-resource .

CS606206 - SOFTWARE DEFINED NETWORKS														
Course Category: Programme Elective				Course Type: Theory				L	T	P	C			
								3	0	0	3			
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To learn the fundamentals of software defined networks To understand the separation of the data plane and the control plane. To Know about data center concepts To study about the SDN Programming To study about the various applications of SDN 														
UNIT 1: INTRODUCTION											9			
History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes														
UNIT 2: OPEN FLOW & SDN CONTROLLERS											9			
Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts														
UNIT 3: FUNCTIONS OF PACKAGING MATERIALS											9			
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE														
UNIT 4: SDN PROGRAMMING											9			
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications														
UNIT 5: SDN											9			
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Know the undying principle of Software Defined Networks														
CO2: Analyse the separation of data plane and control plane														
CO3: Learn the data center concepts														
CO4: Know SDN Programming in detail														
CO5: Learn various SDN Applications														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2		1				3	3	1	1	2	1
CO2	2	1	3		1				2	2	2			2
CO3	2	3	3							2				
CO4	2	3	2						2	3	1	2	2	
CO5	3	2	3		2				1	2	2	2		1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Paul Goransson and Chuck Black, Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.														

2.Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.
3.Dr.Arati A.Dandavate , I.A.Dhotre “Software Defined Networks” Technical Publications, Feb 2023.
REFERENCE BOOKS:
1.Siamak Azodolmolky, —Software Defined Networking with Open Flow, Packet Publishing, 2013
2. Vivek Tiwari, —SDN and Open Flow for Beginners, Amazon Digital Services, Inc., 2013.
3.Fei Hu, Editor, —Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.
WEB RESOURCES:
1. https://www.vmware.com/topics/glossary/content/software-defined-networking.html
2. https://www.opensource.com/resources/what-is-software-defined-networking

CS606207 - GRID COMPUTING														
Course Category: Programme Elective							Course Type: Theory		L	T	P	C		
									3	0	0	3		
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To understand about the basic fundamentals of Grid computing. To gain knowledge about the standards of messaging in Grid Computing To understand about the key concepts of Grid service Architecture. To understand how to proceed basic services of Grid computing. To learn about the architecture and model of Globus Toolkit. 														
UNIT 1: INTRODUCTION												9		
Early Grid Activities-Current Grid Activities-An Overview of Grid business Areas-Grid Computing Organizations and Their Roles														
UNIT 2: MESSAGING												9		
Merging the Grid Services Architecture with the Web Services Architecture: Service-Oriented Architecture - Web Service Architecture–XML Messages and Enveloping														
UNIT 3: OPEN GRID SERVICES												9		
OGSA–CDC–NFS-Online Media and Entertainment - OGS A Platform Components -Open Grid Services Infrastructure														
UNIT 4: OGSA BASIC SERVICES												9		
Common Management Model(CMM) -Service domains -Policy Architecture- Security Architecture-Metering and Accounting														
UNIT 5: GLOBUS TOOL KIT												9		
Architecture- GT3 Software Architecture Model- Programming Model– Service Programming Model-Sample Implementation														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Define the fundamentals of downstream processing for product recovery														
CO2: Understand the requirements for successful operations of downstream processing														
CO3 Describe the components of downstream equipment and explain the purpose of each														
CO4: Apply principles of various unit operations used in downstream processing and enhance problem solving techniques														
CO5: Understand the concept of Globus Toolkit.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2		2				1	2	2			2
CO2	3	2	3	1						2		2	2	
CO3	3	1	2		1				2	3		1		1
CO4	2	3	2							3	2			
CO5	1	3	2		1				3	2		2	1	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Belter, P.A., E.L. Cussler and Wei-Houhu Bioseparations – Downstream Processing for Biotechnology, John Wiley, 1988.														

2.Sivasankar, B. Bioseparations: Principles and Techniques. PHI, 2005.
3.Asenjo, Juan A. Separation Processes in Biotechnology. CRC / Taylor and Francis, 1990.
REFERENCE BOOKS:
1.Ghosh, Raja Principles of Bioseparations Engineering. World Scientific, 2006
2.Product Recovery in Bioprocess Technology. (BIOTOL – Biotechnology by Open Learning Series). Butterworth – Heinmann / Elsevier, 2004.
3.Frederic Magoules,JiePan,Kiat-An Tan,AbhinitKumar,”Introduction to Grid Computing”CRC Press,2009.
WEB RESOURCES:
1. https://www.computerworld.com/article/2586983/grid-computing-resources.html
2. https://www.ig-global.com/dictionary/grid-computing/12534

CS606208 - SECURITY AND PRIVACY IN CLOUD					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To understand the concepts of virtualization and virtual machines. To gain expertise in virtualization infrastructure To understand architecture and deployment models of cloud computing. To understand the various services in cloud computing. To get the idea of security models in the cloud environment 					
UNIT 1: INTRODUCTION					9
Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.					
UNIT 2: CLOUD ENABLING TECHNOLOGIES					9
Service Oriented Architecture – REST and Systems of Systems – Web Services – PublishSubscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices –Virtualization Support and Disaster Recovery.					
UNIT 3: CLOUD ARCHITECTURE, SERVICES AND STORAGE					9
Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds – IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers					
UNIT 4: RESOURCE MANAGEMENT AND SECURITY IN CLOUD					9
Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges –Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.					
UNIT 5: CLOUD TECHNOLOGIES AND ADVANCEMENTS					9
Hadoop – MapReduce – Virtual Box — Google App Engine – Programming Environment for Google App Engine — Open Stack –Federation in the Cloud – Four Levels of Federation –Federated Services and Applications – Future of Federation.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Deploy the concepts of virtualization strategies and virtual machines					
CO2: Apply the concept of virtualization infrastructure in the cloud computing					
CO3: Identify the architecture and deployment models of cloud computing					
CO4: Develop cloud services using cloud computing for real time environment					
CO5 Apply the security models in the cloud environment					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1		1					3	1		2	2
CO2	2	3	2	1						2		2	2	
CO3	1	3	3		1					2	2	1		2
CO4	2	3	1		2					3				
CO5	1	2	3	1						3	2		1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

- 1.Chopra, Rajiv “Cloud Computing”, New Age International (P) Ltd Publishers, First Edition, 2017
- 2.Tim Mather,Subra Kumaraswamy,Shahed Latif.”Cloud Security and Privacy-An Enterprise Perspective on Risks and Compliance”Shroff Publishers,First Edition,2009.
- 3.Siani Pearson , George Yee , “Privacy and Security for Cloud Computing” Springer,2013.

REFERENCE BOOKS:

- 1.Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A PracticalApproach", McGraw-Hill Osborne Media., 2009.
- 2.Barrie Sosinsky, “Cloud Computing Bible”, Kindle Edition, Wiley Publication, 2011.
- 3.Natte Jenner,” CloudSecurity: Introduction to CloudSecurity and Data Protection” Createspace Independent Pub,2018.

WEB RESOURCES:

- 1.<https://www.mdpi.com/1999-5903/14/1/11>
- 2.<http://pubs.sciepub.com/ajss/4/1/2/index.html>.

CS606209 - IOT AND CLOUD					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand Smart Objects and IoT Architectures. • To learn about various IoT-related protocols To build simple IoT Systems using Arduino and Raspberry Pi.. • To understand data analytics and cloud in the context of IoT • To develop IoT infrastructure for popular applications 					
UNIT 1: FUNDAMENTALS OF IoT					9
Evolution of Internet of Things - Enabling Technologies - IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models - Simplified IoT Architecture and Core IoT Functional Stack - Fog, Edge and Cloud in IoT - Functional blocks of an IoT ecosystem - Sensors, Actuators, Smart Objects and Connecting Smart Objects					
UNIT 2: IoT PROTOCOLS					9
IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11 ah and LoRaWAN - Network Layer: IP versions, Constrained Nodes and Constrained Networks - Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks - Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT					
UNIT 3: DESIGN AND DEVELOPMENT					9
Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.					
UNIT 4: DATA ANALYTICS AND SUPPORTING SERVICES					9
Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for IoT, Python Web Application Framework - Django -AWS for IoT - System Management with NETGONF-YANG					
UNIT 5: CASE STUDIES/INDUSTRIAL APPLICATIONS					9
Cisco IoT system - IBM Watson IoT platform - Manufacturing - Converged Plantwide Ethernet Model (CPwE) - Power Utility Industry - GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Understand the concept of IoT.					
CO2:Analyze various protocols for IoT					
CO3 : Design a Poe of an +o"T system using Rasperry Pi/Arduino					
CO4: Apply data analytics and use cloud offerings related to IoT					

CO5: Analyze applications of IoT in real time scenario

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	3		2					2				1
CO2	3	2	3							3	2	1	2	2
CO3	2	3	3		3					2	1		1	
CO4	3	2	2							2	1	2		1
CO5	2	2	3		1					3		2	2	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017
2. Arshdeep Bahga, Vijay Madiseti, —Internet of Things – A hands-on approach, Universities Press, 2015
3. Olivier Hersent, David Boswarthick, Omar Elloumi, —The Internet of Things – Key applications and Protocols, Wiley, 2012 (for Unit 2)

REFERENCE BOOKS:

1. Jan Höller, Vlasios Tsiatsis, 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.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
3. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance your projects, 2nd Edition, O'Reilly Media, 2011.

WEB RESOURCES:

1. <https://www.geeksforgreeks.org/iot-and-cloud-computing/amp/>
2. <https://www.knowledgehut.com/blog/cloud-computing/cloud-computing-and-internet-of-things>

CS606210 - GOOGLE CLOUD COMPUTING FOUNDATIONS (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To discuss the fundamental concepts of google cloud computing. To know about cloud functions and its applications To simulate the software query language with google cloud. To get the knowledge of cloud application programming interface To describe the security issues of google cloud computing with virtual private networks. 					
UNIT 1: INTRODUCTION					9
<u>Introduction to Cloud - Cloud Computing - Cloud vs Traditional Architecture - Iaas, PaaS and SaaS - Google Cloud Architecture -Cloud Computing Recap Quiz - Summary - Cloud Computing - Introduction - Start with a Solid Platform - The GCP Console - Understanding Projects - Billing in GCP - Install and Configure Cloud SDK - Use Cloud Shell [With Labs] - GCP APIs - Cloud Console Mobile App - Recap Quiz - Start with a Solid Foundation</u>					
UNIT 2: CLOUD FUNCTIONS					9
Introduction-Compute Options in the Cloud-Exploring IaaS with Compute Engine [With Lab]-Configuring Elastic Apps with Autos calling- <u>Exploring PaaS with App Engine [With Lab]-Event Driven Programs with Cloud Functions [With Lab]-Containerizing and Orchestrating Apps with GKE-Summary</u>					
UNIT 3: SOFTWARE QUERY LANGUAGE					9
Introduction-Storage Options in the Cloud-Structured and Unstructured Storage in the Cloud-Unstructured Storage using Cloud Storage [With Lab]- SQL Managed Services- <u>Exploring Cloud SQL [With Lab]-Cloud Spanner as a Managed Service-No SQL Managed Services Options-Cloud Data store a No SQL Document Store [With Lab]-Cloud Big table as a No SQL Option-Summary</u>					
UNIT 4: APPLICATION PROGRAMMING INTERFACE					9
Introduction to API-The Purpose of APIs-Cloud Endpoints [With Lab]-Using Apigee-Managed Message Services-Cloud Pub/Sub [With Lab]-Recap Quiz - There's an API for that!-Introduction - Cloud Security-Introduction to security in the cloud-Understanding the shared security model-Explore encryption options-Understand authentication and authorization [With Lab]-Identify best practices for authorization-Recap Quiz Security-Summary - Security.					
UNIT 5: GOOGLE CLOUD SECURITY					9
Introduction-Intro to Networking in the Cloud-Defining a Virtual Private Cloud-Public and Private IP Address Basics-Google's Network Architecture-Routes and Firewall Rules in the Cloud [With Lab]- Multiple VPC Networks [With Lab]-Building Hybrid Clouds-Different Options for Load Balancing [With Labs]-Recap Quiz-Summary					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1 : Build the fundamental concepts of google cloud computing					
CO2 : Handle about cloud functions and its applications					
CO3 : Develop the software query language with google cloud.					
CO4 : Integrate the knowledge of cloud application programming interface					

CO5 : Access the security issues of google cloud computing with virtual private networks.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3						2	3			3	
CO2	3	3	2						3	3			2	2
CO3	3	2	3						2	2			3	3
CO4	2	3	2						3	2				2
CO5	3	2	2						2	3			3	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Prof.Soumya Kanti Ghosh, “Google Cloud Computing Foundations” IIT Kharagpur,2020.

2.Praveen Kukreti , “Google Cloud Platform – All-In-One-Guide”,bpb Publisher,2023.

3.Patrick Haggerty , “The Ultimate Guide to Building a Google Cloud Foundation”,Packt Publishing,2022.

REFERENCE BOOKS:

1.Alasdair Gilchrist , “Google Cloud Platform an Architect’s Guide”

2.Adney Ainsley , “Google Cloud Platform” – The Ultimate Guide for Beginners,2020.

3.Valarie Lestourgeon , “A Beginner’s Guide To Google Cloud Computing”2021.

WEB RESOURCES:

1.https://www.cloudskillsboost.google/course_templates/153

2.<https://alison.com/courses/google-cloud-computing-foundation/resources>

VERTICAL III CYBER SECURITY

CS606301-Ethical Hacking (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To gain an idea about how to analyse remote device. • To compare and contrast various Wireless Access Point attacks • To understand password cracking using different tools • To apply ethical theories to a cyber-related issue • To learn some techniques for launching server attacks 					

Week 1 Module 1: Introduction to ethical hacking Module 2: Fundamentals of computer networking Module 3: TCP/IP protocol stack.																																																																																										
Week 2 Module 1: IP addressing and routing Module 2: Routing protocols																																																																																										
Week 3 Module 1: Introduction to network security Module 2: Information gathering: reconnaissance, scanning, etc																																																																																										
Week 4 Module 1: Vulnerability assessment: OpenVAS, Nessus, etc Module 2: System hacking: password cracking, penetration testing, etc.																																																																																										
Week 5 Module 1: Social engineering attacks Module 2: Malware threats Module 3: penetration testing by creating backdoors																																																																																										
Week 6 Module 1: Introduction to cryptography Module 2: private-key encryption Module 3: public-key encryption																																																																																										
Week 7 Module 1: Key exchange protocols Module 2: cryptographic hash functions Module 3: applications																																																																																										
Week 8 Module 1: Steganography, biometric authentication Module 2: lightweight cryptographic algorithms																																																																																										
Week 9 Module 1: Sniffing: Wire shark, Module 2: ARP poisoning Module 3: DNS poisoning Module 4: Hacking wireless networks Module 5: Denial of service attacks																																																																																										
Week 10 Module 1: Elements of hardware security: side-channel attacks, Module 2: physical unclonable functions																																																																																										
Week 11 Module 1: Hacking web applications: vulnerability assessment, Module 2: SQL injection, cross-site scripting.																																																																																										
TOTAL: 45 PERIODS																																																																																										
COURSE OUTCOMES: At the end of the course, the student will be able to																																																																																										
CO1: Idea about how to analyse remote device																																																																																										
CO2: Compare and contrast various Wireless Access Point attacks																																																																																										
CO3: Understand password cracking using different tools																																																																																										
CO4: Apply ethical theories to a cyber-related issue																																																																																										
CO5: learn some techniques for launching server attacks																																																																																										
CO-PO MAPPING																																																																																										
<table border="1"> <thead> <tr> <th></th> <th>PO1</th> <th>PO2</th> <th>PO3</th> <th>PO4</th> <th>PO5</th> <th>PO6</th> <th>PO7</th> <th>PO8</th> <th>PO9</th> <th>PO10</th> <th>PO11</th> <th>PO12</th> <th>PSO1</th> <th>PSO2</th> </tr> </thead> <tbody> <tr> <td>CO1</td> <td>3</td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> </tr> <tr> <td>CO2</td> <td>3</td> <td>3</td> <td></td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td>1</td> <td>1</td> </tr> <tr> <td>CO3</td> <td>3</td> <td>3</td> <td>2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td></td> </tr> <tr> <td>CO4</td> <td>3</td> <td>3</td> <td>3</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td>1</td> <td></td> </tr> <tr> <td>CO5</td> <td>3</td> <td>3</td> <td>3</td> <td>3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>2</td> <td></td> <td>2</td> <td></td> <td>1</td> </tr> </tbody> </table> <p style="text-align: center;">1- low, 2 - medium, 3 - high, '-' no correlation</p>		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	CO1	3	2		2						2		2			CO2	3	3		3						2		2	1	1	CO3	3	3	2							2		2			CO4	3	3	3	3						2		2	1		CO5	3	3	3	3						2		2		1
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2																																																																												
CO1	3	2		2						2		2																																																																														
CO2	3	3		3						2		2	1	1																																																																												
CO3	3	3	2							2		2																																																																														
CO4	3	3	3	3						2		2	1																																																																													
CO5	3	3	3	3						2		2		1																																																																												
TEXT BOOKS:																																																																																										
1. Hacking: The Art of Exploitation ,“ Jon Erickson”, Second Edition, Pearson Education																																																																																										
2. The Basics of Hacking and Penetration Testing by Patrick Engebretson, Second Edition, Pearson Education																																																																																										

3. The Web Application Hacker's Handbook By Dafydd Stuttard
REFERENCE BOOKS:
1. <u>The Hacker Playbook 2</u> by Peter Kim, 1st Edition
2. Georgia Weidman, "Penetration Testing", First Edition, PHI Learning Private Limited, 2012.
WEB RESOURCES:
https://www.synopsys.com/glossary/what-is-ethical-hacking.html#:~:text=Definition,and%20actions%20of%20malicious%20attackers.
https://www.eccouncil.org/cybersecurity/what-is-ethical-hacking/

CS606302-Digital and Mobile Forensics						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To understand the role of investigator and lab requirements in Digital Forensics. • To analyse the Data Acquisition methods, tools and storage formats of digital evidence. • To classify the Collecting, Preserving and Seizing of various digital evidences • To apply the Validating and Testing of evidences using various methods. • To understand the techniques in developing standard methods of network forensics 						
UNIT 1: COMPUTER FORENSICS AND INVESTIGATIONS						9
Understanding Computer Forensics, Preparing for Computer Investigations, Taking A Systematic Approach, Procedure for Corporate High- Tech Investigations, Understanding Data Recovery Workstations and Software Office and Laboratory: Understanding Forensics Lab Certification Requirements Determining the Physical Requirements for a Computer, Forensics Lab Selecting a Basic Forensic Workstation						
UNIT 2: INTENTS AND SERVICES						9
Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisition, Performing RAID Data Acquisition, Using Remote Network Acquisition Tools, Using Other Forensics Acquisition Tools						
UNIT 3: WEB COMMUNICATION AND TELEPHONY						9
Identifying Digital Evidence, Collecting the Evidence in Private-Sector Incident Scenes, Processing law Enforcement Crime Scenes, preparing for a Search, Securing a Computer Incident or Crime Scene, Seizing Digital evidence at the crime Scene, Storing Digital evidence, Obtaining a Digital Hash, Current Computer Forensics Tools, Evaluating Computer Forensics Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools						
UNIT 4: GRAPHICS AND MULTIMEDIA						9
Forensics Software Computer Forensics Analysis and Validation, Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisition, data carving, Recovering Graphics and Network Forensics, Recognizing a Graphics File, Understanding Data Compression, Locating and Recovering Graphics Files, live Memory forensics (RAM), Understanding Copyright Issues with Graphics, Network Forensic, social media forensics.						
UNIT 5: SECURITY AND HACKING						9
Developing Standard Procedure for Network Forensics, Using Network Tools, Examining Honey net Project, E-mail Investigations, Cell Phone and Mobile Device Forensics, Exploring the Role of E- mail in Investigations, Exploring the Role of Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools, Understanding Mobile Device Forensics, Understanding Acquisition Procedure for Cell Phones and Mobile Devices						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Understand the role of investigator and lab requirements in Digital Forensics.						
CO2 : Analyze the Data Acquisition methods, tools and storage formats of digital evidence						
CO3 : Classify the Collecting, Preserving and Seizing of various digital evidences						

CO4 : Apply the Validating and Testing of evidences using various methods

CO5 : Understand the techniques in developing standard methods of network forensics

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		1		2	1			2			1	
CO2	2	1			3	1	1			2				1
CO3	2		3	1	2	1		1		2				
CO4	1	1	2	2	1	1	1			2				
CO5	1	2	1	2	2	1		1		2				1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Guide to computer forensics and investigation 3rd or 4th edition by Amelia Philips, Bill Nelson and Christopher Steuart.

REFERENCE BOOKS:

1. <https://www.coursehero.com/file/p3ip151/Understanding-Data-Recovery-Workstations-and-Software-Investigations-are/>

2. <https://www.intaforensics.com/2012/01/20/understanding-the-computer-forensics-process/>

WEB RESOURCES:

<https://www.geeksforgeeks.org/mobile-forensics-definition-uses-and-principles/>

<https://securityscorecard.com/blog/what-is-mobile-forensics-a-real-example-from-the-securityscorecard-forensics-lab/>

CS606303-Systems and Usable Security (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To learn how to design and analyse usability studies • To overview of the definitions of privacy as well as some of the legal and social aspects of it. • To analyse of common privacy issues and how they are expressed through user interaction with systems. • To discuss of ethics, particularly around research in topics in security and privacy where participants can be particularly vulnerable. • To test and work with a system security 					
WEEK 1					
Introduction: Computer security concepts, threats, attacks Malicious Software: Types of Malicious Software (Malware), Vulnerability, Exploits, Social Engineering–SPAM E-mail, Zombie, Bots, Keyloggers, Phishing, Spyware.					
WEEK 2					
Operating System Security: System Security Planning, Application Security, Linux/Unix Security, Windows Security, Virtualization Security					
WEEK 3					
Web Security: Secure E-mail and S/MIME, Domain Keys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, Public-Key Infrastructure and Federated Identity Management.					
WEEK 4					
Usable Security: Introduction to Privacy, Trust and Semantic Security, Visualizing Privacy, Web Browser Security and Privacy, Authentication and Text Passwords, Biometrics and Graphical Passwords.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Learn how to design and analyse usability studies					
CO2: Overview of the definitions of privacy as well as some of the legal and social aspects of it.					
CO3: Analyse of common privacy issues and how they are expressed through user interaction with systems					
CO4: Discuss of ethics, particularly around research in topics in security and privacy where participants can be particularly vulnerable.					
CO5: Test and work with a system security					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1		1		1	1							
CO2	2	2		1		2	1	1						
CO3	3	1	2	2	1	1		1						
CO4	1		3	2	2	1		1						
CO5	2	1		2	2	1	1						1	1

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. John Slavio, "Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing", O'Reilly Media, 3rd Edition, 2013

2. Raef Meeuwisse, "Cybersecurity for Beginners", May 14, 2015 by Lulu Publishing Services.

REFERENCE BOOKS:

1. Hacking for Beginners: A Step By Step Guide For You To Learn the Basics of Cyber security And Hacking - Ramon Nastase, August 6, 2018 by Independently Published

2. The Code Book: The Science of Secrecy from Ancient Egypt to Quantum Cryptography - Simon Singh, August 15, 2011 by Little, Brown and Company

WEB RESOURCES:

1. <https://www.knowledgehut.com/blog/security/best-book-on-cyber-security>

2. <https://www.simplilearn.com/tutorials/cyber-security-tutorial/cyber-security-books>

CS606304-Modern Cryptography					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand basics of Cryptography and Network Security. • To be able to secure a message over insecure channel by various means. • To learn about how to maintain the Confidentiality, Integrity and Availability of a data. • To understand various protocols for network security to protect against the threats in the networks. • To learn the IP Security 					
UNIT 1: Introduction to Cryptography and Block Ciphers				9	
Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon’s theory of confusion and diffusion - feistel structure - data encryption standard(DES) - strength of DES - differential and linear crypt analysis of DES - block cipher modes of operations - triple DES – AES.					
UNIT 2: Confidentiality and Modular Arithmetic				9	
Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to group - ring and field - prime and relative prime numbers - modular arithmetic - Fermat’s and Euler’s theorem - primality testing - Euclid’s Algorithm - Chinese Remainder theorem - discrete algorithms.					
UNIT 3: Public key cryptography and Authentication requirements)				9	
Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffie-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamal encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.					
UNIT 4: (Integrity checks and Authentication algorithms)				9	
MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.					
UNIT 5: IP Security and Key Management				9	
IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Understand basics of Cryptography and Network Security.					
CO2: Understand the secure a message over insecure channel by various means.					
CO3: Classify how to maintain the Confidentiality, Integrity and Availability of a data.					
CO4: understand various protocols for network security to protect against the threats in the networks.					

CO5:Apply IP Security methods														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									1		1		
CO2	1									1		1		
CO3	1	1	1							1		1		
CO4	1	1	1							1		1		1
CO5	1	1	1							1		1	1	1
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.William Stallings, “Cryptography and Network security Principles and Practices”, Pearson/PHI. 2. Wade Trappe, Lawrence C Washington, “ Introduction to Cryptography with coding theory”, Pearson.														
REFERENCE BOOKS:														
1.W.Mao, “Modern Cryptography – Theory and Practice”, Pearson Education. 2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.														
WEB RESOURCES:														
1. https://www.tutorialspoint.com/cryptography/modern_cryptography.htm														
2. http://staff.ustc.edu.cn/~mfy/moderncrypto/reading%20materials/Introduction_to_Modern_Cryptography.pdf														

CS606305-Engineering Secure software systems															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> • Demonstrate knowledge of the distinction between critical and non-critical systems. • Demonstrate the ability to manage a project including planning, scheduling and risk assessment/management. • Remember a software requirements document. • Demonstrate an understanding of the proper contents of a software requirements document. • Remember a formal specification for a software system. 															
UNIT 1: Security a software Issue													9		
Introduction, the problem, Software Assurance and Software Security, Threats to software security, Sources of software insecurity, Benefits of Detecting Software Security What Makes Software Secure: Properties of Secure Software, Influencing the security properties of software, Asserting and specifying the desired security properties?															
UNIT 2:Requirements Engineering for secure software													9		
Introduction, the SQUARE process Model, Requirements elicitation and prioritization															
UNIT 3: Secure Software Architecture and Design													9		
Introduction, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles, security guidelines and attack patterns Secure coding and Testing: Code analysis, Software Security testing, Security testing considerations throughout the SDLC															
UNIT 4: Security and Complexity													9		
System Assembly Challenges: introduction, security failures, functional and attacker perspectives for security analysis, system complexity drivers and security															
UNIT 5: Governance and Managing for More Secure Software													9		
Governance and security, Adopting an enterprise software security framework, How much security is enough, Security and project management, Maturity of Practice															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1:Apply contemporary techniques to model and analyze the security of a software system															
CO2: Identify project security risks & selecting risk management strategies.															
CO3: Use statistical methods to collect and analyze metrics for assessing and improving the security of a product, process, and project objectives.															
CO4:Describe and discuss security concerns designs at multiple levels of abstraction															
CO5: Comply with data privacy and security requirements when designing a software system.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2								2		2			
CO2	2	2								2		2			

CO3	2	2						1		2		2		
CO4	2	2						1		2		2		
CO5	2	2								2		2		
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Software Security Engineering: Julia H. Allen, Pearson Education														
REFERENCE BOOKS:														
1. Developing Secure Software: Jason Grembi, Cengage Learning														
2. Software Security : Richard Sinn, Cengage Learning														
WEB RESOURCES:														
1. https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=513522														
2. https://www.coursera.org/lecture/software-security/designing-and-building-secure-software-introduction-kUWem														

CS606306-Crypto currency and Block chain Technologies					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To understand the basic concepts and technology used for blockchain. To learn the primitives of the distributed computing and cryptography related to blockchain. To Illustrate the concepts of Bitcoin and their usage To Implement Ethereum block chain contract To Apply security features in blockchain technologies 					
UNIT 1: INTRODUCTION					9
Need for Distributed Record Keeping, Modeling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Nakamoto's concept with Blockchain based cryptocurrency, Technologies Borrowed in Blockchain – hash pointers, consensus, byzantine fault-tolerant distributed computing, digital cash etc					
UNIT 2 : BASIC DISTRIBUTED COMPUTING & CRYPTO PRIMITIVES					9
Atomic Broadcast, Consensus, Byzantine Models of fault tolerance, Hash functions, Puzzle friendly Hash, Collision resistant hash, digital signatures, public key crypto, verifiable random functions, Zero-knowledge systems					
UNIT 3: ETHEREUM BASICS					9
Ethereum and Smart Contracts, The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts, Writing smart contracts using Solidity & JavaScript					
UNIT 4: PRIVACY, SECURITY ISSUES IN BLOCKCHAIN					9
Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains: Sybil attacks, selfish mining, 51% attacks advent of algorand; Sharding based consensus algorithms to prevent these attacks					
UNIT 5: CASE STUDIES					9
Block chain in Financial Service, Supply Chain Management and Government Services					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Describe the basic concepts and technology used for block chain.					
CO2: Describe the primitives of the distributed computing and cryptography related to block chain.					
CO3: Illustrate the concepts of Bitcoin and their usage. 4. Implement Ethereum block chain contract.					
CO4: Implement Ethereum block chain contract					
CO5: Apply security features in block chain technologies.					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2	1		1		2	2	1		1			
CO2	2	3	2	3	1		1	1			2			
CO3	1	2	3	3	2		2	1	2		2			
CO4	2	1	2	2	2		2	1			1		1	
CO5	1		2	2	2		3	1	2		2		1	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Ramayana, Bonneau, Felten, Miller and Goldfeder, “Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction”, Princeton University Press.

2.Josh Thompson, ‘Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming’, Create Space Independent Publishing Platform, 2017.

3.Imran Bashir, “Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained”, Packt Publishing.

REFERENCE BOOKS:

1.MerunasGrincalaitis, “Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols”, Packt Publishing.

2.Prof.SandipChakraborty, Dr. Praveen Jayachandran, “Blockchain Architecture Design And Use Cases”[MOOC], NPTEL: <https://nptel.ac.in/courses/106/105/106105184/>

WEB RESOURCES:

1.<https://www.pwc.com/us/en/industries/financial-services/fintech/bitcoin-blockchain-cryptocurrency.html>

2.<https://online.stanford.edu/courses/xcs251-cryptocurrencies-and-blockchain-technologies>

CS606307-Cryptography And Network Security (NPTEL)														
Course Category: Programme Elective	Course Type: Theory					L	T	P	C					
						3	0	0	3					
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To understand the most common type of cryptographic algorithm . To understand the Public-Key Infrastructure . To understand security protocols for protecting data on networks . To be able to digitally sign emails and files . To understand vulnerability assessments and the weakness of using passwords for authentication 														
WEEK1: Introduction to cryptography, Classical Cryptosystem, Block Cipher.														
WEEK2: Data Encryption Standard (DES), Triple DES, Modes of Operation, Stream Cipher.														
WEEK3: LFSR based Stream Cipher, Mathematical background, Abstract algebra, Number Theory.														
WEEK4: Modular Inverse, Extended Euclid Algorithm, Fermats Little Theorem, Euler Phi-Function														
WEEK5: Advanced Encryption Standard (AES), Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange														
WEEK6: Primarily Testing, ElGamal Cryptosystem, Elliptic Curve over the Reals,														
WEEK7: Generalized ElGamal Public Key Cryptosystem, Rabin Cryptosystem.														
WEEK8: Cryptographic Hash Function, Secure Hash Algorithm (SHA), Digital Signature Standard (DSS).														
WEEK9: Cryptanalysis, Time-Memory Trade-off Attack, Differential and Linear Cryptanalysis														
WEEK 10: Cryptanalysis on Stream Cipher, Modern Stream Ciphers, Shamirs secret sharing and BE, Identity-based Encryption (IBE)														
WEEK 11: Side-channel attack, The Secure Sockets Layer (SSL), Pretty Good Privacy (PGP), Introduction to Quantum Cryptography														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1:Understand the most common type of cryptographic algorithm .														
CO2:Understand the Public-Key Infrastructure .														
CO3:Understand security protocols for protecting data on networks .														
CO4:Be able to digitally sign emails and files .														
CO5:Understand vulnerability assessments and the weakness of using passwords for authentication														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3							2				
CO2	2	3	3							2				
CO3	2		2	3	3					2				
CO4		2	3		2					2				
CO5		2	2		3					2				
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														

1. William Stallings , “Cryptography and Network security”, Pearson Education, 4th ed.,
REFERENCE BOOKS:
1. William Stallings, “Network Security Essentials Applications and Standards”, 2nd ed., Pearson Education, 2003.
2. Charlie Kaufman, Radis Perlman and Mike Speciner, “Network Security – Private Communication in a Public World” 2nd ed., Pearson Education, 2003
WEB RESOURCES:
1. https://rguktrkv.ac.in/curriculumpdf/CS3505.pdf
2. https://www.gvpce.ac.in/syllabi/Cryptography%20and%20Network%20Security.pdf

CS606308-Network Management						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To understand the basic concepts in networking • To understand the various network protocols and effective representation of multimedia data. • To learn the congestion control and avoidance techniques and how to secure the data transmission. • To learn the network management technologies and tools. • To understand the network management applications 						
Unit 1 FOUNDATION FOR NETWORKS						9
Introduction - Architecture - Framing - Error Detection - Ethernet and Multiple Access Networks - Wireless Networks - Internetworking: Switching and Bridging, Basic Internetworking (IP), Routing – Advanced Internetworking: Global Internet, Multicast, Routing Among Mobile Devices						
Unit 2 PROTOCOLS AND DATA REPRESENTATION						9
End-to-End Protocols: UDP, TCP, RPC, Transport for Real Time Applications - End-to-End Data: Presentation Formatting: Taxonomy, Markup Languages - Multimedia Data Lossless Compression Techniques - Image Representation and Compression - Video Compression - Audio Compression						
Unit 3 CONGESTION CONTROL AND NETWORK SECURITY						9
Congestion Control: Effects of Congestion - Congestion and Control - TCP Congestion Control - Congestion Avoidance Schemes Issues in Resource Allocation - Traffic Management - TCP Traffic Control -TCP Flow Control - Network Security: Cryptographic Building Blocks - Key Pre Distribution -Authentication Protocols						
Unit 4 DATA COMMUNICATION AND NETWORK MANAGEMENT						9
Data and Tele communication Network-Distributed Computing Environment -TCP/IP-Based Networks: Internet and Intranet-Communication Protocols and Standards-Networks, Systems, and Services-System and Service Management-Challenges of IT Managers-Network Management: Goals, Organization, and Functions-Network Management Architecture and Organization-Network Management Perspectives Section-NMS Platform Section-Current Status and Future of Network Management.						
Unit 5 NETWORK MANAGEMENT APPLICATIONS						9
Configuration Management - Fault Management-Performance Management-Event Correlation Techniques-Security Management-Accounting Management- Report Management-Policy-Based Management -service Level Management.						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Acquire knowledge about the developments in the area of Networking						
CO2: understand the different network management tools and techniques						

CO3: apply the networking principles to design a network														
CO4: Develop network applications in various platforms														
CO5: understand the network management applications														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3							2				
CO2	2	3	3							2				
CO3	2		2							2				
CO4		2	3							2				
CO5		2	2							2			1	
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Larry L. Peterson and Bruce S. Davie, “Computer Networks - A systems Approach”, Morgan Kaufmann publications, Fifth Edition, 2011. (UNIT I, II, III)														
2.Mani Subramanian, “Network Management - Principles and Practice”, Pearson Education, Second Edition, 2010. (UNIT IV,V)														
REFERENCE BOOKS:														
1.Stallings. W, “High Speed Networks and Internets: Performance and Quality of service”, Prentice Hall, Second Edition, Seventh Impression, 2008														
2.Behrouz A. Forouzan, “Data communication and Networking”, Tata McGraw-Hill Second Edition, 2006														
WEB RESOURCES:														
1. https://www.cisco.com/c/en/us/solutions/enterprise-networks/what-is-network-management.html														
2. https://www.spiceworks.com/tech/networking/articles/what-is-network-management/														

CS606309-Cyber Crime And Laws					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand Cyber Crime Attacks • To learn Denial-of-service (DOS) attack • To know about Phases of cyber attack • To learn Different types of tools used in cybercrime • To learn Prevention of Cyber Crime 					
Unit 1 Introduction					9
Cyber Crime- Overview, Internal and External Attacks, Attack Vectors. Cybercrimes against Individuals – E-mail spoofing and online frauds, Phishing and its forms, Spamming, Cyber-defamation, Cyberstalking, Cyber Bullying and harassment, Computer Sabotage, Pornographic offenses, Password Sniffing. Keyloggers and Screenloggers. Cyber Crimes against Women and Children.					
Unit 2 Cybercrime					9
Cybercrime against organization – Unauthorized access of computer, Password Sniffing, Denial-of-service (DOS) attack, Backdoors and Malwares and its types, E-mail Bombing, Salami Attack, Software Piracy, Industrial Espionage, Intruder attacks. Security policies violations, Crimes related to Social Media, ATM, Online and Banking Frauds. Intellectual Property Frauds. Cyber Crimes against Women and Children.					
Unit 3 Phases of cyber attack					9
A global perspective on cybercrimes, Phases of cyber attack – Reconnaissance, Passive Attacks, Active Attacks, Scanning, Gaining Access, Maintaining Access, Lateral movement and Covering Tracks. Detection Avoidance, Types of Attack vectors, Zero-day attack, Overview of Network based attacks.					
Unit 4 Attacks					9
Cybercrime and cloud computing, Different types of tools used in cybercrime, Password Cracking – Online attacks, Offline attacks, Remote attacks, Random Passwords, Strong and weak passwords. Viruses and its types. Ransomware and Cryptocurrencies. DoS and DDoS attacks and their types. Cybercriminal syndicates and nation state groups.					
Unit 5 Prevention of Cyber Crimes					9
Prevention of Cyber Crimes -Critical analysis of the IT Act, 2000 3. International position on Free Speech on Internet- Cyber Crimes: Obscenity, Stalking, Hate Speech 2. Data Theft Hacking, Phishing - Sedition, Privacy, Cyber-terrorism TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
<ul style="list-style-type: none"> • Understand Cyber CrimeAttacks • Learn Denial-of-service (DOS) attack • Classify about Phases of cyber attack • Design Different types of tools used in cybercrime • Learn Prevention of Cyber Crime 					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3							2				
CO2	2	3	2					2		2				
CO3	2					1				2				
CO4		2	3							2				
CO5		2	2							2				
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.NinaGodbole and SunitBelapore; “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley Publications, 2011.														
2. Shon Harris, “All in One CISSP, Exam Guide Sixth Edition”, McGraw Hill, 2013. 3. Bill Nelson, Amelia Phillips and Christopher Steuart; “Guide to Computer Forensics and Investigations” – 3 rd Edition, Cengage, 2010 BBS.														
3. William Stallings; “Cryptography and Network Security: Principles and Practices”, Fifth Edition, Prentice Hall Publication Inc., 2007.														
REFERENCE BOOKS:														
1.Atul Jain; “Cyber Crime: Issues, Threats and Management”, 2004. 6. Majid Yar; “Cybercrime and Society Sage Publications, 2006.														
2.Michael E Whiteman and Herbert J Mattord; “Principles of Information Security”, Vikas Publishing House, New Delhi, 2003. 8. Matt Bishop, “Computer Security Art and Science”, Pearson/PHI, 2002														
WEB RESOURCES:														
1. https://blog.ipleaders.in/cyber-crime-laws-in-india/														
2. https://legalserviceindia.com/legal/article-9498-an-overview-of-cyber-crimes-and-cyber-laws-in-india.html														

CS606310-Design of Network Router						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To recognize the principles of the big picture of computer networks. • To understand the networking environment. • To know the importance of VPNs. • To convey the availability of tools and techniques for networking. • To discuss about evolving technologies in networks. 						
Unit 1 FUNDAMENTALS OF NETWORK DESIGN						9
Design Principles - Determining Requirements - Analyzing the Existing Network - Preparing the Preliminary Design - Completing the Final Design Development - Deploying the Network - Monitoring and Redesigning – Maintaining - Design Documentation - Modular Network Design - Hierarchical Network Design						
Unit 2 UNDERLYING LAN CONCEPTS						9
LAN connectivity for small businesses – Integration – Token-Ring – Ethernet – ATM LAN emulation – InterLAN Switching – LAN to Mainframe – Building networks.						
Unit 3 VPNS, INTRANETS AND EXTRANETS						9
Virtual Network management and planning – VPNs for small businesses – Secure remote access in VPNs – IPsec VPNs – Integrating data centers with Intranets – Implementing and supporting Extranets.						
Unit 4 NETWORKING TOOLS AND TECHNIQUES						9
Trends in data communications – Merits of xDSL technology – Preparing for cable modems - Voice and video on the LAN – Internet voice applications – Building IP PBX telephony network – Fax over IP – Videoconferencing over IP networks						
Unit 5 EVOLVING TECHNOLOGIES						9
Prevention of Cyber Crimes -Critical analysis of the IT Act, 2000 3. International position on Free Speech on Internet- Cyber Crimes: Obscenity, Stalking, Hate Speech 2. Data Theft Hacking, Phishing - Sedition, Privacy, Cyber-terrorism						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Understand the principles of networks.						
CO2: Interpret LAN concepts and design						
CO3: Gain knowledge in evolving technologies.						
CO4:Clearly outline the logic behind VPNs.						
CO5: Know the importance of tools and techniques in building a network.						
CO-PO MAPPING						

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3											1
CO2			2					2						
CO3	2					1								1
CO4										2			1	
CO5		2	2							2			1	

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Gil Held, “Network Design: Principles and Applications (Best Practices)”, Auerbach Publications, 1st edition, 2000.

2.Diane Tiare and Catherine Paquet, “Campus Network Design Fundamentals”, Pearson Education, 1st edition, 2006.

3.Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Morgan Kaufmann Publishers Inc., 5th edition, 2012.

REFERENCE BOOKS:

1.William Stallings, “Data and Computer Communications”, Pearson Education, 8th edition, 2016.

2.James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Pearson Education, 6th edition, 2012

WEB RESOURCES:

1.<https://www.networkcomputing.com/networking/network-design-router-vs-switch>

2.<https://www.sciencedirect.com/topics/computer-science/router-architecture>

VERTICAL IV INTERNET OF THINGS

CS606401 - INTRODUCTION TO INTERNET OF THINGS (NPTEL)						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To describe the Basics of IoT and Networking. To Implement the Connectivity of Sensor Networks. To Know the Knowledge of Arduino. To Implement IoT with Raspberry Pi. To determine the data analytics of Cloud Computing. 						
UNIT 1: INTRODUCTION TO IOT						9
Introduction to IoT- part-I ,Introduction to IoT-Part- II ,Sensing , Actuation ,Basics of IoT Networking-Part-I , Basics of IoT Networking-Part-II , Basics of IoT Networking- Part-III ,Basics of IoT Networking- Part- IV ,Connectivity Technologies- Part-1 ,Connectivity Technologies- Part-2 .						
UNIT-2 : SENSOR NETWORKS						9
Connectivity Technologies- Part-3 ,Connectivity Technologies- Part- 4 , Connectivity Technologies- Part- 5 ,Sensor Networks – I ,Sensor Networks – II , Sensor Networks – III Sensor Networks – IV , Sensor Networks – V , UAV Networks , Machine to Machine Communication .						
UNIT-3 : INTRODUCTION TO ARDUINO						9
Interoperability in Internet of Things ,Introduction to Arduino- I , Introduction to Arduino- II , Integration of Sensors and Actuators with Arduino- I ,Integration of Sensors and Actuators with Arduino- II Introduction to Python Programming – I , Introduction to Python Programming – II , Introduction to Raspberry Pi– 1 , Introduction to Raspberry Pi– 2 , Implementation of IoT with Raspberry Pi- I .						
UNIT-4 : IMPLEMENTATION OF IoT						9
Implementation of IoT with Raspberry Pi- II,Implementation of IoT with Raspberry Pi- II Software – Defined Networking – Part – I Software – Defined Networking – Part – II,Software-Defined IoT Networking - Part- 1 ,Software-Defined IoT Networking - Part- 2 Cloud Computing- Fundamentals , Cloud Computing - Service Models , Cloud Computing - Service Management and Security ,Cloud Computing- Case Studies .						
UNIT-5 : CLOUD COMPUTING						9
Cloud Computing: Practical Sensor - Cloud – I Sensor - Cloud – II Fog Computing – I Fog Computing – II Smart Cities and Smart Homes, Smart Cities and Smart Homes– II ,Smart Cities and Smart Homes– III , Connected Vehicles-I , Connected Vehicles– II ,Smart Grid-Part-I Smart Grid – Part – II , Industrial Internet of Things– Part-I ,Industrial Internet of Things– Part– II Data Handling and Analytics– Part-I ,Data Handling and Analytics- Part- II .Case Study: Agriculture , Case Study: Healthcare , Activity Monitoring (Case Study) –I Activity Monitoring (Case Study)– II .						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Determine the supporting technologies for design of IoT applications.						
CO2: Apply the architecture and core modules for IoT applications.						
CO3: Develop IoT applications using embedded systems.						

CO4: Learn the necessary of framework required for IoT application.
 CO5: Apply data analytics for IoT applications.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2							2		2	2	3
CO2	2	3	2							3	2	2	3	2
CO3	2	2	2							2		3	2	2
CO4	2	3	3							2		2	2	2
CO5	3	2	2							2	3	3	3	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Introduction of IoT- Prof.SudipMisra ,Department of Computer Science and Engineering,kharagpur,Published 2021,in India.

2.**CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

3.**Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition,Standards Information Network; 1st edition.

REFERENCE BOOKS:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. *Introduction to IoT*. Cambridge University Press.

2. S. Misra, C. Roy, and A. Mukherjee, 2020. *Introduction to Industrial Internet of Things AndIndustry 4.0*. CRC Press.

3. DimitriosSerpanos, MarilynWolf, “Internet-of-things (IoT) systems: architectures, algorithms, methodologies”, 1stEdition, Springer,UK,2017.

WEB RESOURCES:

1.IntroductionTo Internet Of Things (Nptel)- <https://archive.nptel.ac.in/courses/106/105/106105166/>

2.https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

CS606402 - IOT ARCHITECTURE AND FRAMEWORK														
Course Category: Programme Elective				Course Type: Theory				L	T	P	C			
								3	0	0	3			
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To describe the concept and enabling IoT Technologies. To apply the knowledge on IoT architecture and modules To design Internet of Things with Embedded systems using data analytics To Analysis and evaluate the data received through sensors in IOT. To Determine the data analytics of IoT system. 														
UNIT 1: IOT CONCEPTS AND ENABLING TECHNOLOGIES												9		
Introduction – Definition and Characteristics of IoT – Benefits of IoT –Physical design of IoT Logical design of IoT –IoT Enabling Technologies–Resource Management – Resource Partitioning – Computation Offloading – Identification and Resource/Service Discovery–IoT Levels.														
UNIT 2: IOT ARCHITECTURE AND ITS CORE MODULES												9		
Reference architecture for IoT – SOA based & API oriented architecture – Four layer architecture – Seven Layer architecture – fog computing – Open stack cloud architecture – Gateways, Edge Devices, Data acquisition systems, Cloud services.														
UNIT 3: EMBEDDED PROTOTYPING OF IOT												9		
Overview of Raspberry Pi – General-Purpose Input/Outputs – Sensors with Raspberry Pi – Actuators with Raspberry –Web Server with Raspberry Pi – Raspberry Pi as a Database Server ESP8266 Wi-Fi Module – Block Diagram, Features, applications.														
UNIT 4: IOT FRAME WORK & INDUSTRIAL IOT												9		
IoT Value Chain – IoT Platforms – Cisco, Salesforce, Azure IoT, Eclipse IoT, Thingworx, GEPredix, AWSIoT, WatsonIoT, KaaIntroductiontoIndustrialInternetofThings&Industry4.0–IIoTArchitecture–ApplicationsandChallenges.														
UNIT 5: DATA ANALYTICS & IOT CASE STUDIES												9		
IoT Data Management–Analytics–Apache Hadoop Programming Model, JobExecution, Hadoop Cluster–Case Studies Smart Parking, Smart Irrigation Control, Air Pollution Monitoring, Forest Fire Detection, Weather Forecasting.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Determine the supporting technologies for design of IoT applications.														
CO2: Apply the architecture and core modules for IoT applications.														
CO3: Develop IoT applications using embedded systems.														
CO4: Learn the necessary of framework required for IoT application.														
CO5: Apply data analytics for IoT applications.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2							2	2	2	2	3

CO2	2	3	2							3	2	3	3	2
CO3	2	2	2							2	3	2	2	2
CO4	2	3	3							2	2	3	2	2
CO5	3	2	2							2	3	2	3	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.ArshdeepBahga, VijayMadiseti, “InternetofThings, A Hands-on-Approach”, 1stEdition,Universitiespress Pvt.Ltd.,India,2015.														
2.MayurRamgir, “Internet of Things-Architecture, Implementation, and Security”, 1stEdition, Pearson Education,India,2019														
3.Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons, 2018.														
REFERENCE BOOKS:														
1.Raj KumarBuyya, Amir VahidDastjerdi, “Internet of Things: Principles and Paradigms”,1st Edition,Elsevier,USA,2016														
2.DimitriosSerpanos, MarilynWolf, “Internet-of-things (IoT) systems: architectures, algorithms, methodologies”, 1stEdition, Springer,UK,2017.														
3.CharlesBell, “Beginning Sensor Networks with Arduino and RaspberryPi”,1stEdition, Apress Publishers,USA,2013														
WEB RESOURCES:														
Architecture of Internet of Things- https://www.geeksforgeeks.org/architecture-of-internet-of-things-iot/														
https://www.amazon.in/Introduction-IoT-Sudip Misra/dp/1108959741/ref=sr_1_1?dchild=1&keywords=sudip+misra&qid=1627359928&sr=8-1														

CS606403 - COMMUNICATION PROTOCOLS FOR IOT														
Course Category: Programme Elective				Course Type: Theory				L	T	P	C			
								3	0	0	3			
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To discuss the fundamental concepts of internet protocols and standards To examine the protocol standards in data link and networking layers To simulate the different Network protocols through IoT open source tools. To get the knowledge of Iot based Edge Computing. To describe the security issues of protocols in IoT. 														
UNIT 1: EVOLVING IOT STANDARDS											9			
Overview and Approaches –IoT Ecosystem–Protocols for IoT-Structural Aspects-KeyTechnologies-Sensor Technology- RFID technology–Satellite Technology–CoAP–REST–ETSIM2M.														
UNIT 2: DATA LINK PROTOCOLS											9			
IEEE802.15.4e-IEEE802.11ah–WirelessHART-Z-Wave-BluetoothLowEnergy-ZigbeeSmartEnergy-DASH7–HomePlug-G.9959-LTE-A –LoRaWAN–Weightless - DECT/ULE.														
UNIT 3: NETWORK LAYER PROTOCOLS											9			
RoutingProtocols–RPL–CORPL–CARP-EncapsulationProtocols-6LoWPAN-6TiSCH-6Lo-IPv6overG.9959-IPv6overBluetooth Low Energy- Session Layer Protocols–MQTT–SMQTT–XMPP–DDS.														
UNIT 4: IOT EDGE COMPUTING											9			
Edge Computing– Purpose and Definition – Edge Hardware Architectures – Operating System–Edge Platforms, Virtualisation – Containers –Use Cases – Ambient Computing– Synthetic Sensing.														
UNIT 5: SECURITY AND PRIVACY											9			
Security Issues in the IoT - Security Mechanisms- Key Agreement, Distribution, and Security Bootstrapping -Key Agreement Protocols. Privacy Issues in the IoT - Role of Authorization - IoT-OAS: Delegation-based Authorization for the Internet of Things- IoT-OASApplication Scenarios.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Describe the evolving IoT Standards														
CO2: Demonstrate and visualize the data link protocols for IoT.														
CO3:Evaluate the network protocols and standards for IoT.														
CO4: Analyse the importance of IoT Edge devices.														
CO5: Apply security mechanisms for protocol security.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							3		3	2	3
CO2	2	3	3							2		3	3	2
CO3	3	2	2							2		2	3	2
CO4	2	3	3							2		2	2	3
CO5	3	2	3							2		2	3	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														

1.Geng,Hwaiyu."Internet of Things and Data Analytics in the Cloud with Innovation and Sustainability. "The Internet of Things &Data AnalyticsHandbook,2017.
2.SimoneCirani,GianluigiFerrari,MarcoPicone,LucaVeltri InternetofThings_Architectures,ProtocolsandStandards-Wiley,2018.
3.PerryLea,“IoTandEdge Computing for Architects_ Implementing edge and IoTsystems from sensors to clouds with communication systems, analytics, and security, 2ndEdition”, PacktPublishing,2020.
REFERENCE BOOKS:
1.JanHoller, VlasiosTsiatsis, CatherineMulligan, StefanAves and, Stamatis Karnouskos, DavidBoyle, “From Machine-to-Machine to the Internet of Things :Introduction to a New Age of Intelligence”, 1stEdition,AcademicPress, 2014.
2.Vijay Madiseti, ArshdeepBahga, “Internet of Things (AHands-on Approach)”, 1stEdition, VPT,2014.
3.PerryLea, “Internet of Things for Architects_ArchitectingIoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security”, Packt Publishing, 2018.
WEB RESOURCES:
<u>Internet of Things (IoT)-</u> https://www.gsma.com/iot/gsma-vision-of-smart-home-report/
Communication Protocols in IoT- https://www.geeksforgeeks.org/data-link-layer-communication-protocols-in-iot/

CS606404 - CLOUD SERVICES FOR IOT														
Course Category: Programme Elective							Course Type: Theory			L	T	P	C	
										3	0	0	3	
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To comprehend the cloud architecture and its services To illustrate the various sensors and their cloud interfaces To learn the cloud platforms of IoT To identify various cloud services for IoT To familiarize the applications security issues 														
UNIT 1: CLOUDPLATFORMARCHITECTUREANDSERVICES													9	
Cloud computing and service models: Public, Private and Hybrid clouds-Infrastructure as a service (IaaS)-Platformasa service(PaaS)- Software as a service(SaaS)- Architectural design of compute and storage clouds: Layered cloud architectural development- Architectural design challenges Public cloud platforms:GAE,AWSandAzure.														
UNIT 2: PROGRAMMING IOTDEVICES FOR CLOUDINTERFACE													9	
Basics of Sensors and actuators – examples and working principles of sensors and actuators Cloud computing andIOT – Arduino/Equivalent Microcontroller platform. IoT Communication Technologies – RFID – Bluetooth – Zigbee –Wifi–Wired Communication														
UNIT 3: CLOUDPLATFORMSFOR IOT													9	
Think speak IoT Cloud Platform, Kaa Open Source IoT Cloud Platform, AWS IoT Cloud Platform –AWS IoT Device SDK.Arduino AWS IoT development. Raspberry Pi3-AWSIoTdevelopment.														
UNIT 4: CLOUDSERVICESFOR IOT													9	
Service Management in Cloud Computing - Service Level Agreements (SLAs), Managing IoT Data – Looking at Data, Scalability & Cloud Services, Database& Data Storesin Cloud, LargeScaleData Processing.														
UNIT 5: SECURITYANDAPPLICATIONS													9	
Application Safety and Service Vulnerability in Cloud Network- IoT Security and Privacy Preservation- Security and Challenges in Mobile Cloud Computing-The vital role of Fog computing in Internet of Things.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Build an appropriate cloud architecture and identify the cloud services														
CO2: Handle various sensors and the technologies.														
CO3:Develop IoT applications using cloud platforms.														
CO4: Integrate the IoT applications into the cloud services.														
CO5: Access the security issues in applications and networks.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							2			3	2
CO2	2	2	3							3			3	2
CO3	3	2	3							2			2	2
CO4	2	2	3							3			2	3
CO5	3	2	3							2			3	2
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														

1.KaiHwang, Geoffrey CFox, JackGDongarra, “Distributed and Cloud Computing, From parallel processing totheInternetofThings”,MorganKaufmannPublishers,2012.
2.RajKamal,“InternetofThings:ArchitectureandDesignPrinciples”,McGraw-HillEducationPvt.Ltd.,2018.
3.CharalamposDoukas,“BuildingInternetofThingswiththeArduino”,CreateSpace, April2002.
REFERENCE BOOKS:
1.Dac-Nhuong Le, Chintan Bhatt, ManiMadhukar “Security Designs for the Cloud, IoT, and Social Networking” JohnWiley& Sons (11October2019)
2.HonboZhou,“TheInternetofThingsintheCloud:AMiddlewarePerspective”, CRCPress,2013.
3.RajkumarBuyya,ChristianVecchiola.S.ThamaraiSelvi,“MasteringCloudComputing”,McGrawHillEducation,2013.
WEB RESOURCES:
IoT Cloud Platforms- https://devopedia.org/iot-cloud-platforms
Connecting IoT Devices to Cloud Service https://embeddedcomputing.com/application/networking-5g/connecting-iot-devices-to-cloud-services .

CS606405 - COMPUTER NETWORKS AND INTERNET PROTOCOL (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To comprehend the Computer Networks architecture and its services To illustrate the various sensors and their cloud interfaces To learn the cloud platforms of IoT To understand the various cloud services for IoT To familiarize the applications security issues 					
UNIT 1: INTRODUCTION TO COMPUTER NETWORKS					9
Introduction to computer networks and TCP/IP Protocols, The TCP/IP protocol suit and the TCP/IP model The concept of layering, The job of each layer, Connectionless vs. Connection oriented communication and services. TCP as CO service over CL connection and UDP as CL service over CL connection.					
UNIT 2: CONVENTIONAL NETWORK MODEL					9
Computer Networks and its fundamentals, definition of the network, its characteristics, network components and network connections. Modern network demands, packet classification, services using packet classification process, Conventional network model and modern network model based on service based on packet classification.					
UNIT 3: DATA COMMUNICATION PROCESS					9
Relation between the Bandwidth and the data rate of a channel, Data communication process and its ingredients, maximum data rate of a channel based on bandwidth of the channel and other parameters T.					
UNIT 4: WIRELESS NETWORKS					9
The EM spectrum, Radio, microwave and other types of waves. The frequencies used by different portions of the spectrum; frequency bands, characteristics of each of the portions and consequences. The relation between data communication and the frequency bands. Wired and wireless physical layers, UTP, FO cables and their use in data communication, total internal reflection principle and difference between UTP and FO cables Hidden and exposed stations problem for wireless data communication and their solution. 802.11,16 and xDSL physical layers, Wireless LAN 802.11, multiple standards and versions of 802.11, 802.11a,802.11b,802.11g,802.11n, 802.11ac, OFDM, OFDMA and Discrete multitone					
UNIT 5:DATA LINK LAYER SERVICE PRIMITIVES					9
The Data link layer duties, error handling process, introduction to CRC Error correction and other jobs of Data Link Layer, Hamming distance, hamming code, error correction vs. error detection, Convolution, Reed-Solomon, LDPC and Turbo codes Communication at data link and transport layers, need for protocols, sliding windows, Go back n and Selective repeat strategies for communication					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Describe the functions of the architecture and principles of today's computer networks					
CO2: Know the concept of Fundamentals of Computer Networks.					
CO3: Apply channel allocation, framing, error and flow control techniques					
CO4: Implement the protocols and their functionalities,					

CO5: Analyse the requirements for the future Internet and its impact on the computer network architecture.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							2		2		
CO2	2	3	2							2		3		
CO3	3	3	2							3		2		
CO4	2	2	3							3		3		
CO5	3	2	3							2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

- 1.Computer Networks by Bhushan Trivedi, Oxford University Press.
- 2.Data Communication and Networking by Bhushan Trivedi, Oxford University Press
- 3.Prof.SoumvaKanti Ghosh & Prof Sandip-Computer Networks and internet protocol, Department Computer Science Engineering,Kharagpur.

REFERENCE BOOKS:

- 1.Behrouz Forouzan, “Data Communication and Networking”, McGraw Hill
- 2.Kurose and Ross, “Computer Networking- A Top-Down Approach”,Pearson
- 3.W. A. Shay, “Understanding Communications and Networks”,Cengage Learning.

WEB RESOURCES:

TCP/IP Tutorial and Technical Overview, (IBM Redbook) - Download
From <http://www.redbooks.ibm.com/abstracts/gg243376.html>

TCP/IP Guide, Charles M. Kozierok, Available Online -<http://www.tcpip guide .com> Request for Comments (RFC) - IETF - <http://www.ietf.org/rfc.html>

CS606406 - PRIVACY AND SECURITY IN IOT															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To analyse the security requirements in IoT. To learn the cryptographic fundamentals in IoT. To know the working of authentication credentials and access control. To familiarize with privacy protection and trust models. To familiarize with the various IoT Attacks. 															
UNIT 1: INTRODUCTION: SECURING THE IOT													9		
Security Requirements in IoT Architecture - Security in Enabling Technologies -Security Concerns in IoT Applications.SecurityArchitectureintheInternetofThings-SecurityRequirementsinIoT-Insufficient Authentication / Authorization– Insecure Access Control-Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity -Authentication/Authorization for SmartDevices -Transport Encryption–Attack & Fault trees.															
UNIT 2: CRYPTOGRAPHIC FUNDAMENTALS FOR IOT													9		
Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random Number Generation – Cipher Suites – Key Management Fundamentals– Cryptographic Controls Built into IoT Messaging and Communication Protocols–IoTNodeAuthentication															
UNIT 3: IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT													9		
Identity Lifecycle – Authentication Credentials – IoT IAM infrastructure – Authorization with Publish / SubscribeSchemes–Access Control															
UNIT 4: PRIVACY PRESERVATION AND TRUST MODELS FOR IOT													9		
Concerns in Data Dissemination – Light weight and Robust Schemes for Privacy Protection – Trust and Trust Models for IoT–Self-organizing Things-Preventing Unauthorized Access															
UNIT 5: IOT ATTACKS-CASE STUDIES													9		
MIRAI Botnet Attack-Iran's Nuclear Facility Stuxnet Attack–Tesla Cryptojacking Attack-The TRENDnet Webcam Attack- TheJeepSUVAttack- The Owllet Wi-Fi Baby Heart Monitor Vulnerabilities- St.Jude_Hackable Cardiac Devices															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1:Identify the security requirements in IoT Architecture															
CO2: Apply different cryptographic techniques in IoT Security.															
CO3:Apply different solutions in Identity and Access Management.															
CO4: Familiarize the privacy preservation and trust models in IoT.															
CO5: Develop solutions for different types of IoT attacks.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2							3			2	2	
CO2	2	2	2							2			3	3	

CO3	2	3	2							3			2	2
CO4	2	3	3							3			2	3
CO5	3	2	3							2			3	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing Limited, 2nd Edition, 2018.

2. ShancangLiandLiDaXu, "Securing the Internet of Things", Elsevier, 2017.

3. **CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

REFERENCE BOOKS:

1. Raj Kumar Buyya, Amir VahidDastjerdi, "Internet of Things: Principles and Paradigms", 1st Edition, Elsevier, USA, 2016

2. ImitriosSerpanos, Marilyn Wolf, "Internet-of-things (IoT) systems: architectures, algorithms, methodologies", 1st Edition, Springer, UK, 2017.

3. Charles Bell, "Beginning Sensor Networks with Arduino and RaspberryPi", 1st Edition, Apress Publishers, USA, 2013

WEB RESOURCES:

IoT Cloud Platforms- <https://devopedia.org/iot-cloud-platforms>

Connecting IoT Devices to Cloud Services

<https://embeddedcomputing.com/application/networking-5g/connecting-iot-devices-to-cloud-services>.

CS606407 - IOT PLATFORM FOR SMART CITY PLANNING						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> • To confidence in working along with Planning and civic agencies • To work on different software/s (tools) to Simulate, analyze and authenticate the output to interpret and conclude. • To identify the various stakeholders – both public and private. • To involve in case studies and field visits/ field work. • To accustom with the use of various acts and legal provisions in preparation of master plan etc. 						
UNIT 1:INTRODUCTION TO SMART CITIES						9
Understanding Smart Cities Introduction to smart cities- Definition, dimensions, scope Smart Cities –Global Standards and Performance Benchmarks, Practice Code. India “100 Smart Cities” Policy and Mission. Planning for Urban Infrastructure Urban Infrastructure, Role of Planner in the provision of urban networks and services, feasibility studies for infrastructure projects, planning for major infrastructure projects, Various Infrastructure Programmes and policies by MOUD, PPP (DBOOT, BOOT, etc.) in infrastructure projects.						
UNIT 2: WATER SUPPLY						9
Water– sources of water, treatment and storage, transportation and distribution, quality, networks, distribution losses, water harvesting, recycling and reuse, norms and standards of provision, institutional arrangements, planning provisions, and management issues. Network design, Economics, distribution networks, Computer applications – Appurtenances –sensor-based Leak detection. Principles of design of water supply in buildings – House service connection.						
UNIT 3: SANITATION AND SOLID WASTE						9
Sanitation – points of generation, collection, treatment, disposal, norms and standards, grey water disposal, DEWATS, institutional arrangements, planning provisions, and management issues. storm water collection and disposal, norms and standards, institutional arrangements, planning provisions, and management issues. Municipal and other wastes –generation, typology, quantity, collection, storage, transportation, treatment, disposal, recycling and reuse, wealth from waste, norms, and standards, institutional arrangements, planning provisions, and management issues. management.						
UNIT 4: ELECTRICITY & FIRE SERVICES AND RENEWABLE ENERGY						9
Electricity – Sources of electricity, distribution networks, demand assessment, norms and standards, planning provisions, and management issues. Fire –fire hazards, vulnerable locations, methods of firefighting, norms, and standards, planning provisions, and management issues. Energy Management, energy requirement, non-conventional energy systems, management of solar energy, wind energy, tidal energy, biomass energy, energy from waste.						
UNIT 5: SOCIAL INFRASTRUCTURE - EDUCATION, HEALTH, CIVIC						9
Social Infrastructure – Education, Health, Civic Types, hierarchical distribution of facilities, Access to facilities, provision and location criteria, Norms and standards, etc. provisions for education, Tele- Health.						

TOTAL: 45 PERIODS

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

CO1: Confidence in working along with Planning and civic agencies

CO2: Work on different software/s (tools) to Simulate, analyze and authenticate the output to interpret and conclude

CO3 :Know the knowledge of various stakeholders – both public and private.

CO4: Involve in case studies and field visits/ field work.

CO5: Accustom with the use of various acts and legal provisions in preparation of master plan etc

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							2		3	2	2
CO2	2	2	2							3		2	2	3
CO3	3	3	3							2		3	3	2
CO4	2	2	2							3		2	2	3
CO5	2	3	2							2		2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Ben Green, 2019, The Smart Enough City: Putting Technology in Its Place to Reclaim Our Urban Future, MIT Press.

2. **Cuno Pfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

3. **Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition, Standards Information Network; 1st edition.

REFERENCE BOOKS:

1. Rashid Mehmood, et.al., 2020, Smart Infrastructure and Applications: Foundations for Smarter Cities and Societies, Springer, Switzerland.

2. Sameer Kochhar, et.al., 2008, Infrastructure and Governance, Academic Foundation, New Delhi.

3. Gathe Donald E Billings, et.al., 2009, Managing urban water supply, Dordrecht, Kulwer, Academic Press.

WEB RESOURCES:

Connecting IoT Devices to Cloud Services

<https://embeddedcomputing.com/application/networking-5g/connecting-iot-devices-to-cloud-services>.

IoT Cloud Platforms- <https://devopedia.org/iot-cloud-platforms>

CS606408 - IOT FOR SMART GRIDS						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To impart knowledge on Smart Cities To Identify the emerging area of Internet of Things and Smart Grid. To learn the Internet of Things and Smart Grid Applications To Familiar with application of HAN and WAN. To study the prototype process of IoT 						
UNIT 1: IOT AND SMART GRID						9
Internet of Things - Smart Grid- Importance of Smart Grid in Smart Cities-Integration of the Internet of Things into a Smart Grid						
UNIT 2: IOT TECHNOLOGIES						9
IoT Technologies – Communication Technologies: Home Area Network (HAN) - Neighbourhood Area Network (NAN)- Wide Area Network (WAN) - Standardization:Activities in IoT, Smart Grid and IoT aided Smart grid systems .						
UNIT 3: EXISTING APPLICATIONS						9
HAN applications: Smart Home – Electric vehicle – AMI – Integration of DERs – Power demand management- NAN applications: Smart Distribution – smart patrol – WAN applications: Transmission tower protection – monitoring of power transmission lines						
UNIT 4: ARCHITECTURES FOR IOT						9
Smart Grid Architecture Model – Three layered architecture – Four layered architecture – Cloud based architecture – Web enabled smart grid architecture – Last meter smart grid architecture						
UNIT 5: PROTOTYPES FOR IOT AIDED SMART GRID SYSTEMS						9
A Simple Prototype for Energy Efficiency- Integration of Renewable and Non Renewable energy Sources at Home- In Home Appliance Monitoring Implementation- Real time Monitoring of Medium Voltage Grid – Open issues & challenges.						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Describe the concepts of Internet of Things and Smart Grid						
CO2: Work on different IoT technologies and communication technologies.						
CO3 : Explicate the applications of HAN, NAN and WAN						
CO4: Spell out the suitable architectures for IoT aided Smart grid systems						
CO5: Enumerate the suitable architecture, possible applications and existing prototypes of IoT aided smart grid system						
CO-PO MAPPING						

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							2		3	2	2
CO2	3	3	2							3		2	2	3
CO3	3	2	3							2		3	3	2
CO4	2	3	2							3		2	2	3
CO5	2	2	2							2		2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.P. Waher, Learning Internet of Things. Packt Publishing, 2015.

2.N. Ramesh Babu, Smart Grid Systems: Modeling and Control, CRC Press,2018.

3.F. P. Sioshansi, Smart Grid: Integrating Renewable, Distributed and Efficient Energy, Academic Press, 2011.

REFERENCE BOOKS:

1.A. McEwen and H. Cassimally, Designing the Internet of Things. John Wiley & Sons, 2013.

2.D. Kellmerit, The Silent Intelligence: The Internet of Things. DnD Ventures, 2013.

3.S. Borlase, Smart Grids: Advanced Technologies and Solutions, Second Edition. CRC Press, 2017.

WEB RESOURCES:

IntroductionTo Internet Of Things (Nptel)- <https://archive.nptel.ac.in/courses/106/105/106105166/>

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

CS606409 - IOT AND ITS APPLICATIONS						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To study the Fundamental concepts of IoT and its necessary towards society To Use of different protocols in IoT To Familiarize with IoT architectures To learn Sensors, actuators, development boards and Arduino programming To Identify the concepts of web of things and applications 						
UNIT 1: INTRODUCTION TO IOT						9
Introduction– Elements of an IoT ecosystem –Technology drivers– Business drivers–Trends and implications– Overview of Governance– Privacy and Security Issues						
UNIT 2: IOT PROTOCOLS						9
Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee–Networklayer –APSlayer – Security.						
UNIT 3: IOTARCHITECTURE						9
IoT Open source architecture (OIC) – OIC Architecture & Design principles– IoT Devices and deployment models–IoTivity: An OpensourceIoTstack-Overview–IoTivitystackarchitecture–Resource model and Abstraction						
UNIT 4: IOT HARDWARE ANDPROGRAMMING						9
Basics of sensors and actuators – Examples and working principles of sensors and actuators – Arduino Programming for IOT– Raspberry Pi–Reading from Sensors. Communication: Connecting microcontroller with Bluetooth and USB Connection with the Internet using Ethernet.						
UNIT 5: APPLCIATIONS AND CASE STUDY						9
Connected vehicles– Traffic management- Smart grids–Environmental monitoring–Smart buildings / smart homes Smart cities –Supply chain management–Industrial, agricultural and commercial management.						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Identify the fundamentals of IoT						
CO2: Illustrate various IoT Protocols for establishing communication between things.						
CO3 :Design and Develop IoT application using IoT architecture.						
CO4: Build simple IoT Systems using Arduino and Raspberry Pi.						
CO5: Create IoT solutions using sensors, actuators and Devices						
CO-PO MAPPING						

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3							2		2	3	2
CO2	2	2	2							2		3	2	3
CO3	2	3	3							2		2	3	2
CO4	2	3	2							3		2	2	3
CO5	2	2	2							2		2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Introduction of IoT- Prof.SudipMisra ,Department of Computer Science and Engineering,kharagpur,Published 2021,in India.

2.**CunoPfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

3.**Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition,Standards Information Network; 1st edition.

REFERENCE BOOKS:

1.ArshdeepBahga, Vijay Madiseti, “Internet of Things–A hands-on approach”, Universities Press, 2015.

2.David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”, Cambridge University Press, 2010.

3.Dieter Uckelmann, Mark Harrison, Michahelles, Florian(Eds), “Architecting the Internet of Things”, Springer,2011.

WEB RESOURCES:

IntroductionTo Internet Of Things (Nptel)- <https://archive.nptel.ac.in/courses/106/105/106105166/>

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

CS606410 - INTRODUCTION TO INDUSTRY 4.0 AND INDUSTRIAL INTERNET OF THINGS (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To study the Fundamental concepts of IoT and its necessary towards society To Use of different protocols in IoT To Familiarize with IoT architectures To learn Sensors, actuators, development boards and Arduino programming To Identify the concepts of web of things and applications 					
UNIT 1: INTRODUCTION OF COMMUNICATION AND NETWORK				9	
Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II , Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories.					
UNIT 2: BIG DATA ANALYSIS				9	
Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.Cyber security in Industry 4.0, Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems.					
UNIT 3: INDUSTRIAL IOT				9	
IoT-Introduction, Industrial IoT: Business Model and Reference Architecture : IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II.IndustrialIoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-PartIndustrial IoT-Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III.IndustrialIoT: Big Data Analytics and Software Defined Networks: IIoT Analytics					
UNIT 4: INTRODUCTION, MACHINE LEARNING AND DATA SCIENCE				9	
Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.IndustrialIoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II.					
UNIT 5: IoT- APPLICATION DOMAINS				9	
Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food industry. Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Apply the network concepts of communication					
CO2: Identify the Big Data Analysis and basics of IoT in Industries .					
CO3 :Implement the IoT Application in Industries.					

CO4: Analyse the Machine learning and data science.

CO5: Design and Develop IoT application using IoT architecture.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							3		3	2	2
CO2	3	2	3							2		2	3	2
CO3	2	2	3							2		2	3	2
CO4	2	3	2							3		2	2	3
CO5	2	2	2							2		2	1	2

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. **Daniel Chew** -The Wireless Internet of Things: A Guide to the Lower Layers 1st Edition, Kindle Edition, Standards Information Network; 1st edition.

2. Introduction of IoT- Prof. Sudip Misra, Department of Computer Science and Engineering, Kharagpur, Published 2021, in India.

3. **Cuno Pfister** -Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) 1st Edition, Kindle Edition.

REFERENCE BOOKS:

1. S. Misra, A. Mukherjee, and A. Roy, 2020. Introduction to IoT. Cambridge University Press.

2. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

3. Dimitrios Serpanos, Marilyn Wolf, "Internet-of-things (IoT) systems: architectures, algorithms, methodologies", 1st Edition, Springer, UK, 2017.

WEB RESOURCES:

Introduction To Internet Of Things (Nptel)-<https://archive.nptel.ac.in/courses/106/105/106105166/>

https://www.amazon.in/dp/1032146753/ref=sr_1_3?dchild=1&keywords=sudip+misra&qid=1627359971&sr=8-3

VERTICAL V BLOCK CHAIN

CS606501 - FOUNDATIONS OF CRYPTOGRAPHY (NPTEL)						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:		<ul style="list-style-type: none"> To gain the knowledge about Symmetric-key Encryption To develop the knowledge in Theoretical & Practical Constructions of Block Ciphers. To learn about MAC & Generic Attacks on Hash Functions, To Compose CPA-secure Cipher with a Secure MAC & Cyclic Groups To analyse Public-key Encryption & Zero-Knowledge Protocols 				
UNIT 1: SYMMETRIC-KEY ENCRYPTION & STREAM CIPHERS				9		
Introduction - Symmetric-key Encryption - Historical Ciphers and their Cryptanalysis - Perfect Security - Limitations of Perfect Security – Introduction to Computational Security - Semantic Security - Pseudo-random Generators (PRGs) - Operations on Pseudorandom Generators - Stream Ciphers - Provably-secure Instantiation of PRG - Practical Instantiations of PRG - CPA-security - Pseudo-random Functions (PRFs) - CPA-secure Encryption from PRF						
UNIT 2: BLOCK CIPHERS & MESSAGE AUTHENTICATION				9		
Modes of Operations of Block Ciphers Part I - Modes of Operations of Block Ciphers Part II - Theoretical Constructions of Block Ciphers - Practical Constructions of Block Ciphers: Part I - Practical Constructions of Block Ciphers: Part II - From Passive to Active Adversary - Message Integrity and Authentication - Message Authentication for Long Messages : Part I - Message Authentication for Long Messages : Part II						
UNIT 3: INFORMATION-THEORETIC MACS & HASH FUNCTIONS				9		
Information-theoretic MACs : Part I - Information-theoretic MACs : Part II - Cryptographic Hash Functions: Part I - Cryptographic Hash Functions: Part II - Message Authentication Using Hash Functions - Generic Attacks on Hash Functions and Additional Applications of Hash Functions - Random Oracle Model: Part I - Random Oracle Model: Part II - Authenticated Encryption						
UNIT 4: COMPOSING CPA, CYCLIC GROUPS				9		
Composing CPA-secure Cipher with a Secure MAC: Part I - Composing CPA-secure Cipher with a Secure MAC: Part II - Key-Exchange Protocols: Part I - Key-Exchange Protocols: Part II - Cyclic groups - Cryptographic Hardness Assumptions in the Cyclic Groups - Candidate Cyclic Groups for Cryptographic Purposes: Part I - Candidate Cyclic Groups for Cryptographic Purposes: Part II - Cryptographic Applications of the Discrete Log Assumption						
UNIT 5: PUBLIC-KEY ENCRYPTION & ZERO-KNOWLEDGE PROTOCOLS				9		
Public-key Encryption - El Gamal Public-key Encryption Scheme - RSA Assumption - RSA Public-key Cryptosystem - Hybrid Public-key Cryptosystem - CCA-Secure Public-key Ciphers - CCA-Secure Public-key Ciphers Based on Diffie-Hellman Problems - CCA-Secure Public-key Ciphers Based on RSA Assumption - Digital Signatures - RSA Signatures - Identification Schemes - Schnorr Signature Scheme and TLS/SSL - Number Theory - Secret Sharing - Zero-Knowledge Protocols: Part I - Zero-Knowledge Protocols: Part II						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Gain the knowledge about Symmetric-key Encryption						

CO2:Develop the knowledge in Theoretical & Practical Constructions of Block Ciphers														
CO3: Analyze security properties MAC &Generic Attacks on Hash Functions														
CO4:Compose CPA-secure Cipher with a Secure MAC & Cyclic Groups														
CO5: Analyse Public-key Encryption &Zero-Knowledge Protocols														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							2		2		
CO2	2	3	2							2		2		
CO3	2	3	2							2		2		
CO4	2	2	3							2		2		
CO5	3	2	2							2		2		
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. Foundations of Cryptography – Prof. Ashish Choudhury, CSE, IIT - Bangalore														
2. Understanding Cryptography - A Textbook for Students and Practitioners By Christof Paar, Jan Pelzl - 2014														
3. Applied Cryptography - Protocols, Algorithms and Source Code in C By Bruce Schneier · 2017														
REFERENCE BOOKS:														
1. Break the Code - Cryptography for Beginners By Bud Johnson · 2013														
2. Practical Cryptography By Niels Ferguson, Bruce Schneier · 2003														
3. Serious Cryptography - A Practical Introduction to Modern Encryption By Jean-Philippe Aumasson · 2017														
WEB RESOURCES:														
1. https://archive.nptel.ac.in/courses/106/106/106106221/														
2. https://inst.eecs.berkeley.edu/~cs161/sp11/														

CS606502 - BLOCK CHAIN AND ITS APPLICATIONS (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To provide conceptual understanding of how Blockchain technology can be used to innovate and improve business processes & deploy Decentralized Application To gain the knowledge about the various Blockchain elements & Permissionless Model To learn Ethereum & Distributed Consensus To describe Hyperledger Fabric To develop Blockchain Interoperability & Blockchain Security 					
UNIT 1: BLOCKCHAIN TECHNOLOGY & CRYPTOGRAPHIC PRIMITIVES					9
The Model of Decentralization - What is Blockchain- Basic Cryptographic Primitives I - II - III - IV - V, Distributed Systems for Decentralization - The Evolution of Cryptocurrencies - Open Consensus and Bitcoin.					
UNIT 2: BLOCKCHAIN ELEMENTS					9
Bitcoin Mining and Beyond - Smart Contracts and the Permissioned Models of Blockchain - Blockchain Elements - I - II - III - IV - V, Permissionless Model and Open Consensus - Nakamoto Consensus (Proof of Work) - Limitations of PoW: Forking and Security					
UNIT 3: ETHEREUM & DISTRIBUTED CONSENSUS					9
Beyond PoW - Ethereum 1-2-3-4 - Consensus for Permissioned Models - State Machine Replication as Distributed Consensus - Paxos - Byzantine Faults - Byzantine Agreement Protocols					
UNIT 4: HYPERLEDGER FABRIC					9
Safety and Liveness of PBFT - Enterprise Blockchains - Hyperledger Fabric 1-2-3-4 - Consensus Scalability - Bitcoin-NG - Collective Signing					
UNIT 5: BLOCKCHAIN INTEROPERABILITY & SECURITY					9
Blockchain Interoperability - I - II - III - Hyperledger Indy I - II - Hyperledger Aries - Blockchain Security - I - II - III - Use Cases - A Potential Use Case From a Critics Perspective - Blockchain in Financial Services - Public Sector Use Cases - Blockchain for Decentralized Marketplace					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: implement Block chain technology & deploy Decentralized Application					
CO2: knowledge about the various Blockchain elements & Permissionless Model					
CO3: analyze block chain based solutions and write smart contract using Ethereum Framework					
CO4: describe the knowledge about Hyperledger Fabric					
CO5: develop Blockchain Interoperability & implement Blockchain Security					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2							2		2		
CO2	2	2	2							2		2		
CO3	3	2	2							2		2		
CO4	3	2	2							3		3		
CO5	2	2	3							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Imran Bashir, Packt Publishing, 2020,

2.Bloomsbury A Practical Guide to Blockchain and Its Applications by PARIKSHIT JAIN Edition 2019

3.Blockchain Technology and Applications : A systematic and Practical approach Kindle Edition by Amit Dua (Author)

REFERENCE BOOKS:

1.Blockchain and its applications by PROF. SANDIP CHAKRABORTY Department of Computer Science and Engineering IIT Kharagpur PROF. SHAMIK SURAL Department of Computer Science and Engineering IIT Kharagpur

2.Advanced Applications of Blockchain Technology (Studies in Big Data Book 60) 1st ed. 2020 Edition, Kindle Edition by Shiho Kim (Editor), Ganesh Chandra Deka (Editor)

3.Mastering Blockchain: Unlocking the Power of Cryptocurrencies, Smart Contracts, and Decentralized Applications (Grayscale Indian Edition) (Paperback, Lorne Lantz, Daniel Cawrey)

WEB RESOURCES:

1.<https://www.packtpub.com/product/mastering-blockchain-third-edition/9781839213199>

2.<https://archive.nptel.ac.in/courses/106/105/106105235/>

3.<https://www.hyperledger.org/use/tutorials>

4.<https://ethereum.org/en/developers>

CS606503 - BLOCK CHAIN TECHNOLOGIES					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To learn the various cryptography primitives used in block chain. To study the design principles of block chain. To describe the various consensus algorithms. To implement the block chain in networking. To learn the enhancements of block chain technologies 					
UNIT 1: CRYPTOGRAPHY IN BLOCKCHAIN				9	
Block chain Definitions – Block chain versus Databases – History – Motivation – Characteristics – Types – Overview -Hashing in Block chain – Linking blocks in block chain – Linking blocks using SHA256 – Block structure – Block chain functionality – Creating Block chain – Byzantine failure problem in block chain – Digital signatures in block chain –Block chain wallets					
UNIT 2: BLOCKCHAIN DESIGN PRINCIPLES				9	
Networked Integrity – Distributed Power-Value as Incentive – Security – Privacy – Rights Preserved – Inclusion –Centralized Registries versus Distributed Ledgers – Public versus Private Ledgers – Transparency as a Strategic Risk –Transparency as a Strategic Asset-Zero Knowledge Proofs					
UNIT 3: CONSENSUS ALGORITHMS				9	
Proof of Work – Pure Stake Based Consensus – Proof of Stake - Leased Proof of Stake – Delegated Proof of Stake –Hybrid Form of PoS and PoW – Practical Byzantine Fault Tolerance – Ripple –Tendermint – Proof of Elapsed Time –ProofofActivity–ProofofBurn–Hyperledger Fabric					
UNIT 4: NETWORKING IN BLOCKCHAIN				9	
Peer – to –peer Networking – Network Discovery – Block Synchronization – Building a simple Blockchain in P2PNetwork – Validating new Block – Selecting Longest chain – Block Exchange between Peers – Application Interfaces-Blockchain Networks–Testnet–Regtest –Blockchain in 5G–Blockchain in Social Networking–Blockchain for IoT					
UNIT 5: BLOCKCHAIN OPTIMIZATIONS AND ENHANCEMENTS				9	
Blockchain Optimizations – Transaction Exchange – Off-chain Transactions – Block size improvements – Blockchain enhancements – Sharding – Evolution of consensus algorithm – Proof of Stake – Proof of Activity – Byzantine Fault Tolerance Consensus Models – Proof of Elapsed Time – Cross-chain Protocol – Privacy Enhancement – Blockchain Security – Transaction Security Model–Decentralized Security Model–Attacks on Blockchain					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1:Implement the required cryptography primitives for block chain systems.					
CO2: Work with various block chain design principles.					
CO3: Implement with various consensus algorithms.					
CO4: Equip networks with the various block chain techniques.					

CO5: Work with block chain optimization techniques.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							2		2		
CO2	2	2	2							2		2		
CO3	3	2	2							3		2		
CO4	2	2	2							2		3		
CO5	3	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.KoshikRaj, “Foundations of Blockchain”, Packt Publishers, 2019

2.S.Shukla, M.Dhawan, S.Sharma and S.Venkatesan, “Blockchain Technology: Cryptocurrency and Applications”, Oxford UniversityPress, 2019.

3.Josh Thompson, “Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming”, Create Space Independent Publishing Platform, 2017

REFERENCE BOOKS:

1.AndreasM.Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, OreillyMedia, 1stEdition, 2014.

2.Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller,and Steven Goldfeder. “Bitcoin and cryptocurrency technologies: a comprehensive introduction”, Princeton University Press, 2016.

3.Blockchain Technology: Exploring Opportunities, Challenges, and Applications

Publisher: CRC Press ,Authors: Sonali Vyas, Vinod Kumar Shukla, Shaurya Gupta, Ajay Prasad

4.Blockchain and Web3: Building the Cryptocurrency, Privacy, and Security Foundations of the Metaverse , Publisher: Wiley , Author: Winston Ma and Ken Huang

WEB RESOURCES:

1.[https://www.ibm.com/topics/blockchain#:~:text=first%20blockchain%20application-.Blockchain%20overview,patents%2C%20copyrights%2C%20branding\).](https://www.ibm.com/topics/blockchain#:~:text=first%20blockchain%20application-.Blockchain%20overview,patents%2C%20copyrights%2C%20branding).)

2.<https://www.edx.org/course/introduction-to-hyperledger-blockchain-technologie>

CS606504 - BLOCKCHAIN ARCHITECTURE DESIGN AND USE CASES (NPTEL)					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To learn the various cryptography primitives used in Blockchain. To study the Hyperledger Fabric of Blockchain. To describe the various use cases of Blockchain. To study the Blockchain security . To learn the research aspects of block chain in AI and Bigdata 					
UNIT 1:BLOCKCHAIN AND CRYPTO PRIMITIVES				9	
Introduction to Blockchain - Crypto Primitives - Distributed Consensus - Consensus in Bitcoin – I (The Basics, PoW and Beyond, The Miners) - Permissioned Blockchain : Basics, Consensus , RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance					
UNIT 2: HYPERLEDGER FABRIC				9	
Hyperledger Fabric - Blockchain for Enterprise – Overview -Blockchain Components and Concepts - Hyperledger Fabric – Transaction Flow - Hyperledger Fabric Details - Fabric – Membership and Identity Management - Hyperledger Fabric Network Setup - Fabric Demo: Fabric Dmoon IBM Blockchain Cloud Fabric Demo, deploy from scratch , Hyperledger Composer – Application Development , Hyperledger Composer – Network Administration					
UNIT 3: USE CASES				9	
Block chain Use Cases - Financial Service - Payments and Secure Trading, Compliance and Mortgage, Financial Trade ; Revolutionizing Global Trade , Blockchain in Supply Chain - Blockchain in Other Industries					
UNIT 4: BLOCK CHAIN SECURITY				9	
Blockchain in Government : Advantages, Use Cases, Digital Identity - Hyperledger Indy, Tax Payments and Land Registry Records -Blockchain Security : Overview, Membership and Access control in Fabric,Privacy in Fabric - Blockchain Security: Fabric SideDB					
UNIT 5: RESEARCH ASPECTS				9	
Research Aspects : Consensus Scalability, Bitcoin-NG, Collective Signing, Byzcoin ; Research Aspects : Algorand,Cross Fault Tolerance, Secured Multi-Party Computation ; Blockchain for Science : Blockchain for Big Data,Blockchain and AI ; Comparing Ecosystems – Ethereum– Ethereum development tools and Quorum – Corda Part 1 – Corda Part 2					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Identify the various cryptography primitives used in Blockchain.					
CO2: Summarize the Hyperledger Fabric of Blockchain.					
CO3: Implement the various use cases of Blockchain..					
CO4: Analyze the Blockchain security .					
CO5: Describe research aspects of Blockchain in AI and Bigdata					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2							2		2		
CO2	2	2	2							2		2		
CO3	3	2	2							3		2		
CO4	2	2	2							2		3		
CO5	3	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos - Blockchain by Melanie Swa, O'Reilly

2.Blockchain state-of-the-art: architecture, use cases, consensus, challenges and opportunities, Author:Bela Shrimali · Hiren B. Patel

3.Hyperledger Fabric - Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits

REFERENCE BOOKS:

1.The Basics of Bitcoin and Blockchain 2021: Basics of Cryptocurrency for the Beginners by **Spazi Liberi** (Author)

2.Architecture for Blockchain Applications ByXiwei Xu, Ingo Weber, Mark Staples · 2019

3.The Blockchain and the New Architecture of Trust by Kevin Werbach

WEB RESOURCES:

1.<https://www.udemy.com/course/understanding-blockchain-technology/>

2.https://onlinecourses.nptel.ac.in/noc19_cs63/preview

CS606505 - BLOCK CHAIN PLATFORMS						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To describe the various primitives used in block chain. To implement using Ethereum Platform. To analysis the various modules in Hyper ledger framework. To develop using Hyper ledger Platform To learn about different Block chain Platforms. 						
UNIT 1:INTRODUCTION						9
Decentralized applications-Dapp-Good and bad Dapps-Understanding the blockchain-A deeper look at decentralized applications-Ethereum’s history and governance-Connecting to Ethereum through the wallet-Smart contracts: The brain of Dapps-Connecting to Ethereum with geth-Managing accounts with geth						
UNIT 2: ETHEREUM						9
Managing smart contracts with Web3.js-Revisiting deployment through geth’s interactive console- Interacting with SimpleCoin through geth’s console-Simplifying command-based deployment with Node.js-Deploying on a private network-Making development more efficient by deploying on mock networks-Smoother interaction with SimpleCoin through a web UI-The Ethereum ecosystem-The core components -Decentralized address resolution with ENSDecentralized content storage-Accessing external data through oracles-Dapp frameworks and IDEs						
UNIT 3: HYPER LEDGER FABRIC FRAMEWORK						9
Exploring Hyperledger Fabric- Hyperledger frameworks, tools, and building blocks-Hyperledger frameworks Hyperledger tools-The building blocks of blockchain solutions-Hyperledger Fabric component design-the Journey of a sample transaction-Hyperledger Fabric explored-Understanding governance in business networks powered by blockchain						
UNIT 4: IMPLEMENTATION IN HYPERLEDGER						9
The Hyperledger Family-Prerequisites and Setting up a Development Environment – Developing First Business Network and Deploying it -Define your Business Network - Secure your API using Passport and Enable Multi-Use Case Study and Implementation						
UNIT 5: DIFFERENT BLOCK CHAIN PLATFORMS						9
Multichain-Features-Mechanisms-Deployment-R3 Corda-Features-Model-Consensus Mechanism –Use cases- Ripple Technology- Transaction- IOTA-Consensus Mechanism-Implementation-Setup-Real World Implementation						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Implement the required cryptography primitives for block chain systems						
CO2: Develop and Deploy using Ethereum Platform.						
CO3: Work with various techniques in Hyper ledger framework.						
CO4: Develop and Deploy using Hyper ledger Platform						
CO5: Work with alternate Block chain Platforms						
CO-PO MAPPING						

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3							2		2		
CO2	1	2	2							3		2		
CO3	2	2	3							2		2		
CO4	2	3	2							3		2		
CO5	2	2	3							2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.RobertoInfante, “ Building EthereumDapps “, Manning Publications, March 2019, ISBN: 9781617295157

2.Petr Novotny, Nitin Gaur, Luc Desrosiers, Salman A. Baset ,”Blockchain Development with Hyperledger”, Packt Publishing, March 2019

3.NiazChowdhury, ”Inside Blockchain, Bitcoin, and Cryptocurrencies”, CRC press, Taylor & Francis,2020.

4.Ernesto Lee, Sudip Ghosh, ”Enterprise Blockchain Development: With Hyperledger Fabric and Composer” , ConsultantsNetwork,2018

REFERENCE BOOKS:

1.Josh Thompson, “Blockchain: The Blockchain for Beginnings Guide to Blockchain Technology and Leveraging Blockchain Programming”, Create Space Independent Publishing Platform, 2017.

2.Andreas M. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, Oreilly Media, 1st Edition, 2014.

3.Austin Grice, Eric Everson Mendes Marins, Garrett Lee Woodworth, Juliana Medeiros Destro, Rahul Gupta, VasfiGucer , “Implementation Guide for IBM Blockchain Platform for Multicloud”, IBM Redbooks,2019.

WEB RESOURCES:

1.<https://www.youtube.com/watch?v=Xm5qx2ZG7Z4>

2.<https://ethereum.org/en/what-is-ethereum/>

CS606506 - BLOCK CHAIN FORENSICS															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To learn about security and privacy in Bitcoin and Block chain To propose Block chain based security mechanism for different applications To understand the importance of bitcoin forensics To build Block chain-based apps and PKI solutions To understand challenges and the future of cyber security and Blockchain 															
UNIT 1:BLOCKCHAIN ON THE CIA SECURITY TRIAD													9		
CIA security triad- Blockchain on confidentiality-Blockchain on integrity-Blockchain on availability-Deploying PKI-Based Identity with Blockchain-Two-FactorAuthenticationwithBlockchain.															
UNIT 2: BLOCKCHAIN BASED SECURITY MECHANISMS													9		
Domain Name System- Understanding DNS components- DNS structure and hierarchy- DNS topology for large enterprise-Blockchain-based DNS solution- Blockchain-Based DDoS Protection.															
UNIT 3: BITCOIN FORENSICS													9		
Crypto currency artifacts and investigation–Bitcoin crimes–Crypto currency investigation challenges-CasestudiesTracking bitcoin transactions-Numisight bitcoin explorer															
UNIT 4: SECURITYAND PRIVACY IN BITCOIN													9		
Securityofconfirmedtransactions–SecurityofZero-confirmationTransactions–BitcoinForks-Userprivacy-Networklayer attacks-Enhancing privacy in bitcoin															
UNIT 5:BLOCKCHAIN AND CYBER SECURITY- CHALLENGES AND FUTURE													9		
Decision path for Blockchain – Checklist–Challenges- Future of cyber security with Blockchain.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Understand the security and privacy in Bitcoin and Blockchain															
CO2: Develop Block chain-based security mechanism for different applications															
CO3: Comprehend the need for bitcoin forensics															
CO4:Summarize the security and privacy issues in bit coin															
CO5: Realize the challenges and the potential of block chain in the field of cyber security.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	3							2		2			
CO2	2	2	2							3		2			
CO3	2	2	2							2		2			
CO4	2	2	1							3		2			
CO5	2	2	2							2		2			
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1.Rajneesh Gupta, Hands-On Cyber security with Blockchain", PacktPublishing,2018															

2.Niranjan Reddy, "Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations", Apress,2019
3.TianaLaurence, "Blockchain For Dummies", Dummies,2017.
REFERENCE BOOKS:
1.GhassanKarame, Elli And roulaki, "Bitcoin and Blockchain Security", Artech,2017
2.HarishGarg, "Hands-On Bitcoin Programming with Python", Packt Publishing, 2018
3.MakotoYano, ChrisDai, Kenichi Masuda, Yoshio Kishimoto, "Block chain And CryptCurrency: Building A High Quality Market place For Crypt Data", Springer2020.
WEB RESOURCES:
1. https://www.youtube.com/watch?v=mBW7djo_fg8
2. https://www.youtube.com/watch?v=Ylp4qexTwi4

CS606507 - ROBOT MANIPULATOR CONTROL					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • State space modelling of robot manipulator arm. • Robot manipulator dynamics. • Computed torque control. • Robust control of robot manipulator • Adaptive robust control of robot manipulator 					
UNIT 1:INTRODUCTION				9	
Introduction – structure of robot manipulator - transfer function approach - State variable representation – Linear state variable system – double integrator system, Non-linear state variable representation of robot manipulator, Equilibrium points and Lyapunov stability theorem.					
UNIT 2: ROBOT MANIPULATOR DYNAMICS AND STABILITY				9	
Lagrange-Euler Dynamics – Force, Inertia, and Energy - Lagrange’s Equations of Motion, Manipulator Dynamics -Dynamics of two-link planar and planar elbow arm – manipulator arm kinematic energy – manipulator arm potential energy –Structure and properties of robot equation					
UNIT 3: COMPUTED-TORQUE CONTROL OF ROBOT MANIPULATOR				9	
Path Generation – Converting Cartesian trajectories to Joint space trajectories – polynomial path interpolation –Linear function with parabolic blends – minimum time trajectories, Independent Joint Control – feedback control –decentralised feedback compensation, Computed Torque Control – PD Outer Loop Design- PID Outer Loop Design -PD-Plus-Gravity Controller.					
UNIT 4: ROBUST CONTROL OF ROBOT MANIPULATOR				9	
Introduction, Feedback- Linearization Controllers– Lyapunov design–Input Output design, Dynamic Controllers– Non-linear Controllers- Direct passive controllers– variable structure controllers–saturation type controllers.					
UNIT 5: ADAPTIVE CONTROL				9	
Introduction to Adaptive Control, Computed Torque approach Approximate computed torque controller- Adaptive computed torque controller, Adaptive Control by an Inertia-Related Approach - Adaptive Inertia- Related Controller, Robot Controllers with Reduced on-line Computation-Desired Compensation Adaptation Law- Repetitive Control Law– Adaptive Robust Control–Compensation for Actuator Dynamics.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Analyze the state space representation of the robot manipulator					
CO2: Identify the Derive the Robot Dynamical Equations					
CO3: Describe computed torque control of Robotic Systems					
CO4: Designate and Compare robust and adaptive control of robot manipulator arm.					
CO5: Describe adaptive robust control of robot manipulator arm.					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3							2		2		
CO2	2	3	2							2		3		
CO3	3	2	2							3		2		
CO4	2	2	3							2		2		
CO5	2	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Frank L Lewis, Darren M. Dawson, Chaouki T. Abdallah, "Robot Manipulator Control–Theory and Practice", Marcel Dekker Inc., 2004

2. Lorenzo Sciavicco and Bruno Siciliano, "Modelling and Control of Robot Manipulators" Springer, Second edition, 2012

3. Moshe Shoham "A Textbook of Robotics–Structure Control and Operation" Eshed Robotec, 1984

REFERENCE BOOKS:

1. Reza N. Jazar, "Theory of Applied Robotics–Kinematics, Dynamics, and Control", Springer International, 2007

2. Model-Based Control of a Robot Manipulator (Artificial Intelligence) by Chae H. An, Christopher G. Atkeson, et al. | Apr 7, 1988

3. Fundamentals for Control of Robotic Manipulators by Antti J. Koivo | Jun 14, 1989

WEB RESOURCES:

1. <https://www.youtube.com/watch?v=5DnKot3mMSc>

2. <https://www.youtube.com/watch?v=zf223NAOfcA>

3. <https://www.youtube.com/watch?v=4hQfnBtQJEA>

CS606508 - COMPUTER VISION WITH OPEN CV					
Course Category: Program Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To gain the knowledge of the Open CV methods to apply the basic operations on images • To learn about histogram and binary vision • To study about geometric transformations and edge detection • To analyze various features and recognition techniques • To implement the video tracking and panoramas 					
UNIT 1:OPENCV AND BASIC OPERATIONS ON IMAGES				9	
History of OpenCV - Built-in Modules - Setting up OpenCV on Your Computer - Stereo Matching - Homography Estimation in Video - Circle and Line Detection - Image Segmentation - Bounding Box and Circle - Image Inpainting -Displaying Images from Disk in a Window - The cv::Mat Structure - Converting Between Color-spaces - GUI Track-Bars and Callback Functions- ROIs: Cropping a Rectangular Portion out of an Image- Accessing Individual Pixels of an Image -Videos					
UNIT 2: IMAGES, HISTOGRAMS, BINARY VISION				9	
Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing –1D and 3D histograms- Histogram / Image Equalisation - Histogram Comparison- Back- projection-k-means Clustering – Thresholding- Threshold Detection Methods- Variations on Thresholding-Mathematical Morphology- Connectivity					
UNIT 3: EDGES AND GEOMETRIC TRANSFORMATIONS				9	
Problem Specification and Algorithm - Affine Transformations - Perspective Transformations - Specification of MoreComplex Transformations – Interpolation - Modelling and Removing Distortion from Cameras - Edge Detection -ContourSegmentation-Hough Transform					
UNIT 4: FEATURES AND RECOGNITION				9	
Moravec Corner Detection - Harris Corner Detection - FAST Corner Detection – SIFT - Other Detectors - Template Matching - Chamfer Matching - Statistical Pattern Recognition - Cascade of Haar Classifiers - Other Recognition Techniques–Performance					
UNIT 5: VIDEO AND PANORAMAS				9	
Moving Object Detection– Tracking- Video Datasets and Formats-Metrics for Assessing Video Tracking Performance– Affine Transformations- Perspective Transformations- Image panorama					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Apply Open CV image processing basic operations					
CO2: Find the histogram and apply thresholding					
CO3: Do edge detection and apply geometric transformations in images					
CO4: Extract various features from images					
CO5: Create image panorama and track videos					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3							2		3		
CO2	2	2	2							2		2		
CO3	2	2	2							2		3		
CO4	2	2	3							2		2		
CO5	2	2	2							2		3		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Kenneth Dawson-Howe, "A Practical Introduction to Computer Vision with OpenCV", Wiley, 2014
2. Samarth Brahmhatt, "Practical OpenCV", Apress, 2013
3. Adrian Kaehler, Gary Bradski, "Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library", First Edition, O'Reilly Media, 2017

REFERENCE BOOKS:

1. Prateek Joshi, David Millán Escrivá, Vinicius Godoy, "OpenCV by Example", Packt Publishing, 2016. Adrian Rosebrock, "Practical Python and OpenCV", Second Edition, PyImage Search, 2016.

2. Mastering OpenCV with Practical Computer Vision Projects Paperback

by Shervin Emami (Author), Khvedchenia Levgen (Author), Naureen Mahmood (Author)

3. Mastering OpenCV 4: A comprehensive guide to building computer vision and image processing applications with C++, 3rd Edition by Roy Shilkrot (Author), David Millán Escrivá (Author)

WEB RESOURCES:

1. https://www.youtube.com/watch?v=1_Mhv0rxbQk&list=PLaHodugB5x-Ddy_H951h0VHjOjfzZNCBh
2. <https://www.youtube.com/watch?v=oXlwWbU8I2o>

CS606509 - INTERNET SECURITY						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To study the fundamental concepts of classical encryption techniques and Crypt Analysis. To gain the knowledge of the principles of secret keys management. To acquire the concepts of IP Security and its applications To study the concepts of Transport layer security and its applications To learn the working principle of Email and public key distribution 						
UNIT 1:INTRODUCTION AND BASIC ENCRYPTION						9
IntroductionEssentialsofCryptography,EssentialsofNetworkingandInternet,SecurityObjectives,C ommunication Security, Legal restrictions, Basics of Encryption – Building Blocks of Encryption, Cryptanalysis and Modern Codes, Brute Force cracking of Secret Keys, Choosing Cryptography Algorithms						
UNIT 2: LINK ENCRYPTION AND SECURE KEY MANAGEMENT						9
Link Encryption – Inline Encryption, Point to Point Encryption, IP Routed Configuration, Managing Secret Keys –Issues in Secret Key Management, Technology - Random Key Generation, Random Seeding, Pseudorandom Number Generators, Manual Key Distribution, Automatic Rekeying, Key Distribution Centres, Maintaining Keys and SystemSecurity						
UNIT 3: IPLAYER SECURITYAND APPLICATIONS						9
Basic Issues in IP Security (IPSEC), Cryptographic Checksums, IP Security Protocol, IPSEC key management, TCP/IP Network Security Protocols, Virtual Private Network(VPN)–Issues in VPN, IPSEC proxy cryptography, IPSECencrypting Router, Site to Site Encryption, Remote Access with IPSEC – problems in IPSEC clients, IPSEC Client, ClienttoServer site access						
UNIT 4: SECURE SOCKET LAYER						9
Public Key Cryptography, RSA Encryption, Key Exchange with RSA, Secure Socket Layer (SSL), World Wide Web Transaction Security–Issues in Internet Transaction Security, Transactions on World Wide Web, Security Alternatives for Web Forms, Web Browser with SSL, Web Server with SSL						
UNIT 5: SECURE E-MAIL AND PUBLIC KEY CERTIFICATES						9
Secure Email- Email Security Issues, Basics of Internet E-Mail, Offline Message Keying, Digital Signature, Secure Email Client, Public Key Certificates–Distributing Public Keys, Public Key Certificates, Certificate Distribution, Centralized Certification Authority, Hierarchical Certification Authority, Pretty Good Privacy(PGP)						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Interpret basic building blocks of encryption for crypt analysis						
CO2: Identify suitable key generation technique for secret key management						
CO3: Apply IP security in VPN and Remote Access						
CO4: Apply SSL in Worldwide web transactions						

CO5: Explore various public key and certificate distribution strategies and its using PGP

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2							2		2		
CO2	2	2	2							2		2		
CO3	2	3	2							2		2		
CO4	2	2	3							2		3		
CO5	3	2	2							2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Richard E. Smith, Internet Cryptography, 6th Edition, Pearson, 2011

2. Uyless Black, "Internet Security Protocols – Protecting IP Traffic", Pearson Education, 2001

3. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013

REFERENCE BOOKS:

1. Bruce Schneier and Neils Ferguson, Practical Cryptography, First Edition, Wiley Dream tech India Pvt Ltd, 2003

2. Tim Speed, Juanita Ellis, "Internet Security", Elsevier, 2006

3. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd edition, Pearson, 2000

WEB RESOURCES:

<https://www.youtube.com/watch?v=zd0U1zNBYNk>

<https://www.youtube.com/watch?v=SaZGjQBItBc>

CS606510 - INTELLIGENT TRANSPORT SYSTEMS															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To describe Fundamentals of intelligent transport systems. To learn Concepts of ATIS and its operations. To implement Basics of predictive route guidance system. To study Concepts of APTS and its operations. To analyze General issues related to ITS and environment 															
UNIT 1:ITS FUNDAMENTALS													9		
Introduction to Intelligent Transportation Systems (ITS) –Definition of ITS and Identification of ITS Objectives-Historical Background - Benefits of ITS - ITS Data collection techniques –Detectors - Automatic Vehicle Location (AVL)-Automatic Vehicle Identification(AVI).															
UNIT 2: ADVANCED TRAVELLER INFORMATION SYSTEMS													9		
Basic concepts - Models - Simulation - LOS of transportation systems - Static, real time and dynamic information -Value of information - Topology - Where and When to receive data - Information flows - Travel support - Dynamic routing.															
UNIT 3: PREDICTIVE ROUTE GUIDANCE													9		
ITS - Applications - Issues - Information types- Impact on route guidance - Case studies.															
UNIT 4: ADVANCED PUBLIC TRANSPORTATION SYSTEMS(APTS)													9		
Scope-Components of APTS-Advantages- Limitations ofAPTS-Casestudies -Issues															
UNIT 5: ITS AND ENVIRONMENT													9		
ITS and Flexibility- ITS and Customer - centricity - ITS and the Environment-General issues and Case studies - Overview of ITS implementations in developed countries.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Analyze the various types of traffic and suggesting ITS.															
CO2: Plan and design the ATIS															
CO3: Plan the predictive route guidance system.															
CO4: Analyze the traffic data and able to suggest suitable APTS															
CO5: Manage the issues arising out of introduction of ITS.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	3							2		2			
CO2	1	2	2							3		2			
CO3	2	2	3							2		2			
CO4	2	3	2							3		2			
CO5	2	2	3							2		2			
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1.PradipKumarSarkar, AmitKumarJain, “Intelligent Transport Systems”, Paperback, PHILearning,2018															
2.Intelligent Transportation Systems: Theory and Practice ; Authors: <u>Amit Kumar Tyagi</u> , <u>Niladhuri Sreenath</u>															

3.Sussman,J.M., Perspective on ITS, Artech House Publishers, 2005.
REFERENCE BOOKS:
1.Paolo Baggano,“Intelligent transport Systems Good practices to standards”, CRC press,2016.
2.ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by KanPaulChen, John Miles
3. Intelligent Transportation Systems by Teodor Piatek, Scitus Academics ; Author: <u>Teodor Piatek</u> ; Publisher: <u>Scitus Academics</u>
WEB RESOURCES:
https://www.youtube.com/watch?v=YDM0Xh3S6JI
https://www.youtube.com/watch?v=aNhI2Jstouw

VERTICALVI DIVERSIFIED COURSES

CS606601 - DATA ANALYTICS WITH PYTHON (NPTEL)														
Course Category: Programme Elective				Course Type: Theory				L	T	P	C			
								3	0	0	3			
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To study about probability and sampling distributions. To study about Hypothetical tests and ANOVA. To study about different regression. To study about cluster analysis. To study about Classifications and Regression Trees. 														
PRE-REQUISITES: Cryptography														
SYLLABUS												46		
Week 1 : Introduction to data analytics and Python fundamentals Week 2 : Introduction to probability Week 3 : Sampling and sampling distributions Week 4 : Hypothesis testing Week 5 : Two sample testing and introduction to ANOVA Week 6 : Two way ANOVA and linear regression Week 7 : Linear regression and multiple regression Week 8 : Concepts of MLE and Logistic regression Week 9 : ROC and Regression Analysis Model Building Week 10 : c² Test and introduction to cluster analysis Week 11 : Clustering analysis Week 12 : Classification and Regression Trees (CART).														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Solve problems in probability and probability distributions.														
CO2: use ANOVA.														
CO3: use different regression models to do predictions.														
CO4: use clustering algorithms.														
CO5: use classification and regression trees.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc."														
2.Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.														
3.Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc".														
REFERENCE BOOKS:														

1. Jiawei Han and MichelineKamber (2006). Data Mining: Concepts and Techniques. “
 2. David W. Hosmer, Stanley Lemeshow (2000). Applied logistic regression (Wiley Series in probability and statistics). “Wiley-Interscience Publication”.

CS606602 - PROBLEM SOLVING USING PYTHON					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:		<ul style="list-style-type: none"> To understand the basics of algorithmic problem solving. To learn to solve problems using Python conditionals and loops. To define Python functions and use function calls to solve problems. To use Python data structures – lists, tuples, dictionaries to represent complex data. To do input/output with files in Python. 			
UNIT 1: COMPUTATIONAL THINKING AND PROBLEM SOLVING				9	
Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sortedcards, guess an integer number in a range, Towers of Hanoi.					
UNIT 2: DATA TYPES, EXPRESSIONS, STATEMENTS				9	
Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.					
UNIT 3: CONTROL FLOW, FUNCTIONS, STRINGS				9	
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search					
UNIT 4: LISTS, TUPLES, DICTIONARIES				9	
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.					
UNIT 5: FILES, MODULES, PACKAGES				9	
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word countcopy file, Voter’s age validation, Marks range validation (0-100).					

TOTAL: 45 PERIODS

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

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Write simple Python programs using conditionals and looping for solving problems.

CO4: Decompose a Python program into functions.

CO5: Represent compound data using Python lists, tuples, dictionaries etc.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	2	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	2	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.

2.Karl Beecher, “Computational Thinking: A Beginner’s Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOKS:

1.Paul Deitel and Harvey Deitel, “Python for Prammers”, Pearson Education, 1st Edition, 2021.

2.G Venkatesh and MadhavanMukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.

3.John V Guttag, “Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data“, Third Edition, MIT Press

CS606603 - DATA SCIENCE FOR ENGINEERS (NPTEL)														
Course Category: Programme Elective	Course Type: Theory			L	T	P	C							
				3	0	0	3							
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> • Introduce R as a programming language • Introduce the mathematical foundations required for data science • Introduce the first level data science algorithms • Introduce a data analytics problem solving framework • Introduce a practical capstone case study 														
Week 1: Course philosophy and introduction to R														
Week 2: Linear algebra for data science -Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse)- Geometric view - vectors, distance, projections, eigenvalue decomposition														
Week 3: Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates)														
Week 4: Optimization														
Week 5: Typology of data science problems and a solution framework														
Week 6: Simple linear regression and verifying assumptions used in linear regression Multivariate linear regression, model assessment, assessing importance of different variables, subset selection														
Week 7: Classification using logistic regression														
Week 8: Classification using KNN and k-means clustering														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Describe a flow process for data science problems														
CO2: Classify data science problems into standard typology														
CO3: Develop R codes for data science solutions														
CO4: Correlate results to the solution approach followed														
CO5: Assess the solution approach														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.RaghunathanRengaswamy, Resmi Suresh, “Data Science for Engineers”, 1st edition, CRC Press.														

REFERENCE BOOKS:

1. <https://rpubs.com/uwaterloodatateam/r-programming-reference>

CS606604 - DATABASE DESIGN (NPTEL)

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn ER models with applying ER modelling.
- To learn Relational model.
- To learn Functional dependencies and Normal Form.
- To learn File handling, applying Hashing and understanding B+ Trees.
- To learn Transactions.

MODULE 1:

Introductory Concepts (1 session) Databases and Information Systems, An example usage context, Database system concepts and architecture.

MODULE 2:

Semantic Database Design (3 sessions) High-level conceptual modeling, ER Modeling concepts, ER Diagrams, Cardinality constraints, Higher-order relationships, Enhanced ER Model (EER), Weak-entity types, Subclasses and inheritance, Specialization and Generalization, Modeling of UNION types using categories

MODULE 3:

Relational Model, Languages and Systems (7 sessions) Relational algebra (2 sessions): Relational model concepts, Relational integrity constraints, Update operations on relations, Relational algebra model, ER to relational mapping SQL (2 sessions): Data definition in SQL, Queries and update statements, Views, Integrity constraints, Specifying indexes, Embedded SQL. IBM DB2 case study (2 sessions): Architecture of DB2, Data definition and manipulation in DB2. EER to Relational mapping (1 session).

MODULE 4:

Database design using the relational model (4 sessions) Functional dependencies (2 sessions): Keys in a relational model, Concept of functional dependencies, Normal forms based on primary keys, Boyce-Codd Normal Forms Further Dependencies (2 sessions): Multi-values dependencies and fourth normal form, Join dependencies and fifth normal form, Inclusion dependencies, Other dependencies and normal forms

MODULE 5:

Storage and Indexing Structures (6 sessions) Storage structures (3 sessions): Secondary storage devices, Buffering of blocks, File Organization, Heaps, Sorted Files, Hashing and overflow handling techniques, Dynamic hashing, Extensible hashing, Other file organizations Indexing methods (3 sessions): Basic terminology, Primary indexes, Clustering index, Secondary index, Multilevel indexes, ISAM, B-trees, B+ trees, inserting and searching algorithms for B+ trees, Other indexing methods

MODULES 6:

Transaction Processing and Concurrency Control (6 sessions) Transaction Fundamentals (3 sessions): OLTP environments, Concurrency issues, need for transactions, Necessary properties of transactions (ACID properties), Transaction states, serializability, Serial schedules, Conflict serializability, View serializability, Recoverable and non-recoverable

schedules, Cascading rollbacks, Cascadeless schedules Concurrency control

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

CO1: Design ER models.

CO2: Identify relational models.

CO3: Apply normal forms in splitting tables.

CO4: Identify the file forms and handle them and use hashing.

CO5: use transactions in DBMS.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, "Database Design", McGraw Hill Education; Sixth edition (1 December 2013).

REFERENCE BOOKS:

1. C. J. Date, "Database Design and Relational Theory: Normal Forms and All That Jazz", Apress, December 2019.

2. Michael J. Hernandez, "Database Design for Mere Mortals: A guide to relational database design".

CS606605 - MATLAB PROGRAMMING FOR ENGINEERS															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To Understand basic MATLAB concepts To learn Vectors and variables To know about the command statements To develop codes To understand Segmentation concepts 															
UNIT 1: INTRODUCTION														9	
Create, edit, and open scripts- Write Comments in Lines and Blocks- Using MATLAB for a Personal Budget- Personalize MATLAB Colors- Start MATLAB with an Encouraging Note															
UNIT 2: VECTORS AND VARIABLES														9	
Create Vectors and Matrices-Unsolved: Valid and Invalid Matrices- Working with Text (Characters and Strings)- HTML Table from MATLAB Code- Round pi to N significant Digits- File/folder Information Using Structures															
UNIT 3: COMMANDS STATEMENTS														9	
Create a Hilbert Matrix Using for-loops- Unsolved: Compare two while Loops- Save and Load Multiple Files- Import Formatted Text Data- Import Excel-format Data															
UNIT 4: TRANSLATE FORMULAS INTO CODE														9	
Trig Functions and Gaussians- Laplace and log-normal Distributions- Complex Numbers and Euler's Formula- Piecewise Functions- Piecewise Function in one line of Code.															
UNIT 5: SEGMENTATION														9	
Threshold-based Time Series Segmentation- Derivative-based Time Series Segmentation- Intensity-based Image Segmentation- Identify Neurons in a Mouse Brain Slice															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Understand basic MATLAB concepts.															
CO2: learn Vectors and variables.															
CO3: Understand to know about the command statements.															
CO4: Develop the codes.															
CO5: Understand Segmentation concepts															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO4	2	2	2	2	2	-	-	-	-	-	-	-	-	-	
CO5	2	2	2	2	2	-	-	-	-	-	-	-	-	-	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1.MATLAB Programming for Engineers, 6th edition, Stephen J. Chapman, BAE Systems 2020.															
2.MATLAB Programming for Engineers Perfect Paperback – by Stephen J. Chapman 2012.															

REFERENCE BOOKS:

1. MATLAB and its Applications in Engineering, 2e Paperback – 2016, by Bansal ,Goel, Sharma.

2. Programming and Engineering Computing with MATLAB 2017, Huei-Huang Lee :Sdc Publications.

CS606606 - ROBOTICS AND ITS APPLICATIONS															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> Identify robots and its peripherals for satisfactory operation and control of robots for industrial and non-industrial applications. 															
UNIT 1: ROBOT BASICS													9		
Robot-Basic concepts, Need, Law, History, Anatomy, specifications. Robot configurations- cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.															
UNIT 2: ROBOT ELEMENTS													9		
End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.															
UNIT 3: ROBOT KINEMATICS AND CONTROL													9		
Robot kinematics – Basics of direct and inverse kinematics, Robot trajectories, 2D and 3D Transformation-Scaling, Rotation, Translation Homogeneous transformation. Control of robot manipulators – Point to point, Continuous Path Control, Robot programming															
UNIT 4: ROBOT SENSORS													9		
Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors. Force sensor-Light sensors, Pressure sensors, Introduction to Machine Vision and Artificial Intelligence.															
UNIT 5: ROBOT APPLICATIONS													9		
Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defense, Disaster management. Applications, Micro and Nanorobots, Future Applications.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: list and explain the basic elements of industrial robots.															
CO2: analyze robot kinematics and its control methods.															
CO3: Classify the various sensors used in robots for better performance.															
CO4: summarize various industrial and non-industrial robots.															
CO5: Implement the real time applications.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO2	2	2	2	-	2	-	-	-	-	-	-	-	-	-	
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO5	2	2	2	-	-	-	-	-	-	-	-	2	1	1	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1.Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics Technology, Programming and Applications”, Tata –McGraw Hill Pub. Co., 2008.															
2.Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata															

McGraw Hill Publishing Company Limited, 2010.

3.Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering: An Integrated Approach", Prentice Hall of India Pvt. Ltd., 1994.

REFERENCE BOOKS:

1.Fu.K.S, Gonzalez.R.C&Lee.C.S.G, "Robotics control, sensing, vision and intelligence", Tata- McGraw Hill Pub. Co., 2008 5. Yu. "Industrial Robotics", MIR Publishers Moscow, 1985.

CS606607 - ADHOC NETWORKS					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • Learn Ad hoc network and Sensor Network fundamentals. • Understand the different routing protocols. • Have an in-depth knowledge on sensor network architecture and design issues. • Understand the transport layer and security issues possible in Ad hoc and Sensor networks. • Have an exposure to mote programming platforms and tools 					
UNIT 1: INTRODUCTION AND ROUTING PROTOCOLS				9	
Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV).					
UNIT 2: SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES				9	
Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.					
UNIT 3: WSN NETWORKING CONCEPTS AND PROTOCOLS				9	
MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols Energy Efficient Routing, Challenges and Issues in Transport layer protocol.					
UNIT 4: SENSOR NETWORK SECURITY				9	
Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.					
UNIT 5: SENSOR NETWORK PLATFORMS AND TOOLS				9	
Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Know the basics of Ad hoc networks and Wireless Sensor Networks.					
CO2: Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement.					

CO3: Apply the knowledge to identify appropriate physical and MAC layer protocols.

CO4: Understand the transport layer and security issues possible in Ad hoc and sensor networks.

CO5: Be familiar with the OS used in Wireless Sensor Networks and build basic modules.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	2	-	-	-	-	-	-	-	1	1
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	-	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.C.Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007. 2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

REFERENCE BOOKS:

1.Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, “Mobile ad-hoc networking”, Wiley-IEEE press, 2004.

2.Mohammad Ilyas, “The handbook of ad-hoc wireless networks”, CRC press, 2002.

3.T. Camp, J. Boleng, and V. Davies “A Survey of Mobility Models for Ad-hoc Network”

4.Research, “Wireless Communication, and Mobile Computing”. Special Issue on Mobile Ad-hoc Networking Research, Trends and Applications, Vol. 2, no. 5, 2002, pp. 483 – 502.

CS606608 - PRINCIPLES OF DISTRIBUTED SYSTEMS

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To understand Transactions and Concurrency control. • To understand Security issues. • To Understanding Distributed shared memory. • To design distributed systems for basic level applications. • To learn about distributed shared memory. 					
UNIT 1: INTRODUCTION					9
Characterization of Distributed Systems-Introduction, Examples of Distributed systems, Resource sharing and web, challenges, System models -Introduction, Architectural and Fundamental models, Networking and Internetworking, Interprocess Communication, Distributed objects and Remote Invocation-Introduction, Communication between distributed objects, RPC, Events and notifications, Case study-Java RMI.					
UNIT 2: OPERATING SYSTEM					9
Operating System Support- Introduction, OS layer, Protection, Processes and Threads, Communication and Invocation, Operating system architecture, Distributed File Systems-Introduction, File Service architecture.					
UNIT 3: PEER TO PEER SYSTEMS					9
Peer to Peer Systems-Introduction, Napster and its legacy, Peer to Peer middleware, Routing overlays, Overlay case studies-Pastry, Tapestry, Application case studies-Squirrel, OceanStore. Time and Global States-Introduction, Clocks, events and Process states, Synchronizing physical clocks, logical time and logical clocks, global states, distributed debugging. Coordination and Agreement-Introduction, Distributed mutual exclusion, Elections, Multicast communication, consensus and related problems.					
UNIT 4: TRANSACTIONS AND CONCURRENCY					9
Transactions and Concurrency Control-Introduction, Transactions, Nested Transactions, Locks, Optimistic concurrency control, Timestamp ordering. Distributed Transactions-Introduction, Flat and Nested Distributed Transactions, Atomic commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery.					
UNIT 5: REPLICATION					9
Replication-Introduction, System model and group communication, Fault tolerant services, Transactions with replicated data. Distributed shared memory, Design and Implementation issues, Consistency models.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Understand Transactions and Concurrency control.					

CO2: Understand Security issues.														
CO3: Design distributed systems for basic level applications.														
CO4: Understanding Distributed shared memory.														
CO5: Implementation of the models.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	2	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Cormen, C. Leiserson, R. Rivest and C. Stein, "Introduction to Algorithms", Third Edition, McGraw-Hill, 2009.														
2.R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995. J. J. McConnell, "Analysis of Algorithms: An Active Learning Approach", Jones & Bartlett Publishers, 2001.														
3.D. E. Knuth, Art of Computer Programming, Volume 3, "Sorting and Searching", Second Edition, Addison-Wesley Professional, 1998.														
4.S. Dasgupta, C. H. Papadimitriou and U. V. Vazirani, "Algorithms", McGraw-Hill, 2008.														
REFERENCE BOOKS:														
1."Distributed Systems – Principles and Paradigms", A.S. Tanenbaum and M.V. Steen, Pearson Education.														
2.Distributed Computing, Principles, Algorithms and Systems, Ajay D. Kshemakalyani and MukeshSinghal, Cambridge, rp 2010.														

CS606609 - PYTHON SCRIPTING															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To Learn Fundamentals of Python To understand Control Flow Structures To know about Lists, Tuples, Sets and Dictionaries To create Functions and Modules To understand String Processing and File Handling 															
UNIT 1: FUNDAMENTALS OF PYTHON													9		
Introduction to Python- History of Python- Python Features- Python Applications- Python Applications- Elements of Python- Keywords and Identifiers- Assigning Values to Variables- Data types- Type Casting- Input-Output functions: input, print- Operators.															
UNIT 2: CONTROL FLOW STRUCTURES													9		
Introduction to Control Structures- if Statement- if else Statement- Nested if-else- if-elif-else statements- Switch Statement- loop- while loop- for loop- Nested loops- break statement- continue statement- Pass Statement.															
UNIT 3: LISTS, TUPLES, SETS AND DICTIONARIES													9		
Lists and operations on Lists- Create Python Lists- List operations- List Slicing- Add/Change List Elements- Insert()- Delete- Remove() and pop()- Tuples and operations on Tuples- Characteristics of Tuple- Concatenation - Sets and operations on Sets.															
UNIT 4: FUNCTIONS AND MODULES													9		
Introduction to Python User defined Function- Passing parameters to a function and returning values from a function- Python Default Arguments- Recursion- Modules and Packages- rand module - Random numbers generators.															
UNIT 5: STRING PROCESSING AND FILE HANDLING													9		
Introduction to String- String Operation- Add strings to list- Concatenate lists of strings- Access String elements using index operator- String functions- String functions- File Handling functions.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Understand the Fundamentals of Python															
CO2: Understand the Control Flow Structures															
CO3: know about Lists, Tuples, Sets and Dictionaries															
CO4: create Functions and Modules															
CO5: understand String Processing and File Handling															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO2	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
CO4	2	2	2	2	2	-	-	-	-	-	-	-	-	-	
CO5	2	2	2	-	-	-	-	-	-	-	-	-	-	-	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1.Jones, M. (2013), "Python for Biologists: A complete programming course for beginners" Create Space Independent Publishing Platform 1st edition. ISBN: 978-1492346135															

REFERENCE BOOKS:

1. Pilgrim M, (2009), "Dive into Python 3" Apress ISBN: 978-1430224150.

CS606610 - IMPLEMENT RUST

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the Rust language basics
- To learn advanced Rust
- To Implement the small programs
- To understand the practical engineering skills
- To design the APIs concepts.

UNIT 1: RUST LANGUAGE BASICS	9
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Basic syntax-pointers, references, and (im)mutability-ownership, borrowing, and lifetimes-generic functions and types implementing and defining traits.

UNIT 2: ADVANCED RUST	9
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Concurrency-networking-Iterators-futures and async-lient-side web programming via Web Assembly-mixing Rust with C.

UNIT 3: IMPLEMENTATION	9
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How big are things, and where are they stored? Where does allocation happen?-monomorphization versus dynamic dispatch translating Rust to C

UNIT 4: PRACTICAL ENGINEERING SKILLS	9
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Unit and integration testing-benchmarking and optimization-source control and continuous integration-writing API documentation

UNIT 5: DESIGN SKILLS	9
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Factoring components into minimum viable concepts-designing APIs for safety and efficiency-improving code clarity

TOTAL: 45 PERIODS

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

CO1: Understand the Rust language basics

CO2: Learn advanced Rust

CO3: Implement the small programs

CO4: Understand the practical engineering skills

CO5: Design the APIs concepts

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	2	2	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	2	2	2	2	-	-	-	-	-	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Programming Rust, 2nd Edition by Jim Blandy, Jason Orendorff, Leonora F . S. Tindall Released June 2021 Publisher(s): O'Reilly Media, Inc. ISBN:

9781492052548.

REFERENCE BOOKS:

<https://doc.rust-lang.org/book/ch00-00-introduction.html>

VERTICALVII ARTIFICIAL INTELLIGENCE

CS606701 - ARTIFICIAL INTELLIGENCE IN FINANCE															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To explore the concepts of machine intelligence To understand the types of Finance, and Concepts of AI in Finance To discuss the neural networks and reinforcement learning To learn algorithmic trading and test it in python environment To know the role of AI in finance and its applications 															
UNIT 1:MACHINE INTELLIGENCE													9		
Artificial Intelligence: Algorithms, Neural Networks— Importance of Data. Super Intelligence: Forms of Intelligence – Paths to Superintelligence – Intelligence Explosion.															
UNIT-2 : FINANCE AND MACHINE LEARNING													9		
Normative Finance: Uncertainty and Risk – Expected Utility Theory – Mean – Variance Portfolio Theory – Capital Asset Pricing Model – Arbitrage Pricing Theory. Data-Driven Finance: Scientific Method – Financial Econometrics and Regression – Data Availability, Normative Theories Revisited – Debunking Central Assumptions. Machine Learning. AI–First Finance															
UNIT-3 : STATISTICAL INEFFICIENCIES													9		
Dense Neural Networks: Baseline prediction – Normalization – Dropout – Regularization – Bagging – Optimizers .Recurrent Neural Networks: Second Example – Financial Price Series – Financial Return Series – Financial Features. Reinforcement Learning : Fundamental Notations – OpenAI Gym - Monte Carlo Agent – Neural Network Agent – DQL Agent – Simple Finance Gym - Better Finance Gym – FQL Agent															
UNIT-4 : ALGORITHMIC TRADING													9		
Vectorized Backtesting : Backtesting an SMA-Based Strategy - Backtesting a Daily DNN-Based Strategy – Backtesting an Intraday DNN-Based Strategy. Risk Management: Trading Bot, Vectorized Backtesting Event-Based Backtesting – Assessing Risk – Backtesting Risk Measures. Execution and Deployment : Oando Account – Data Retrieval – Order Execution Trading Bot.															
UNIT-5 : OUTLOOK													9		
AI-Based Competition: AI and Finance – Lack of Standardization – Education and Training Fight for Resources – Market Impact – Competitive Scenarios – Risks – Regulation and Oversight. Financial Singularity.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Explore the main concepts of AI and machine learning															
CO2: Use financial types, metrics and machine learning techniques in AI															
CO3: Apply neural networks in Finance															
CO4: Explore algorithmic trading that AI and machine learning techniques can add to various portfolio and risk management strategies															
CO5: Apply the concepts of AI in financial applications															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	-	-	-	2	-	-	--		2		2	-	-	
CO2	-	2	-	-	2	-	-	-	-	2	-	-	-	-	

CO3	2	-	-	-	2	-	-	-	-	2	-	2	-	-
CO4	-	-	-	-	2	-	-	-	-	2	-	2	-	-
CO5	-	2	-	-	2	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Yves Hilpisch,“Artificial Intelligence in Finance – A Python-Based Guide”, O’Reilly Media, Inc. First Edition, 2020

REFERENCE BOOKS:

1.Oliver Wyman,"Artificial Intelligence Applications in Financial Services”,Marsh & McLennan, First Edition, 2019

WEB RESOURCES:

1.<https://www.mdpi.com/2227-7072/8/3/45>

2.<https://community.ibm.com/community/user/ai-datascience/blogs/stephen-crenshaw/2021/11/14/artificial-intelligence-in-finance-opportunities-a>

**CS606702 - OPTIMIZATION FOR MACHINE LEARNING
(NPTEL)**

Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Know The Basics of Linear Algebra and Calculus
- To learn the Gradient Descent Concepts
- To Analyse the Convex and Non Convex Optimization problems
- To get the knowledge of Variants of Gradient Descent
- To Learn the Newton's Method

Week 1: 9

Basics of Linear Algebra and Calculus: Subspaces, EigenValue Decomposition, Singular Value Decomposition - Algorithms and Methods, PSD Matrices and Kernel Functions, Vector Calculus

Week 2: 9

Gradient Descent: math, programming basic optimisation problems and their solutions

Week 3: 9

Convex Functions, First and Second Order Conditions for Optimizations, Convex and Non Convex Optimization problems in Machine Learning.

Week-4 : 9

Variants of Gradient Descent: Projected, Stochastic, Proximal, Accelerated, Coordinate Descent, Training a Neural Network: Theory

Week-5 : 9

Newton's Method, Optimization for ML in practice: Pytorch/Tensor Flow. Training a Neural Network, Implementation

TOTAL:45 PERIODS

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

CO1: Know The Basics of Linear Algebra and Calculus

CO2: learn the Gradient Descent Concepts

CO3: Analyze the Convex and Non Convex Optimization problems

CO4: Get the knowledge of Variants of Gradient Descent

CO5: Learn the Newton's Method

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	2	-	-	-	-	2	-	2	-	-
CO2	2	1	-	2	-	-	-	-	-	2	-	2	-	-
CO3	-	2	2	-	-	-	-	-	-	2	-	1	-	-
CO4	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO5	1	2	-	2	2	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. Foundations of Data Science, Avrim Blum and Ravi Kannan, Hindustan Book Agency/Cambridge University Press
2. Linear Algebra and Learning from Data, Gilbert Strang
REFERENCE BOOKS:
1. Convex Optimisation by Stephen Boyd
2. Optimisation for Machine Learning by Suvrit Sra, MIT Press.
WEB RESOURCES:
1. https://onlinecourses.nptel.ac.in/noc23_cs64/preview
2. https://www.tensorflow.org/

CS606703 - DESIGN THINKING IN ARTIFICIAL INTELLIGENCE					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To learn the different views of learning • To study the various search strategies • To study the knowledge representation framework • To understand the transition from micro world to knowledge representation • To learn the brain architecture 					
UNIT 1:INTRODUCTION					9
Mind Design – Perspectives and Things – Turing Test – Intentionality –Formal systems – Automatic Formal systems – Computers and Intelligence – GOF AI – Interpreted Formal systems – New Fangled AI – Connectionist Networks – Embodied and Embedded AI – Imitation Game– Critique of the new problem – Machines Concerned – Digital Computers – Universality – Contrary Views – Learning Machines.					
UNIT-2 : SEARCH STRATEGIES					9
Intentional Strategy –Working – True Believers – Computer Science as Empirical Inquiry: Symbols and Search – Symbols and physical symbol systems – Laws of Qualitative Structure – Development of the symbol–system hypothesis – Evidence –Heuristic Search – Problem Solving – Search Trees – Forms of Intelligence – Intelligence without much Search.					
UNIT-3 : FRAMEWORK FOR REPRESENTING KNOWLEDGE					9
Frames – Artificial intelligence and human problem solving – Language, understanding, and scenarios – Words, sentences, and meanings – Scenarios and questions – Questions, systems, and cases – Learning, memory, and paradigms – Requests to memory – Clusters, classes, and a geographic analogy – Analogies and alternative descriptions – Frames and paradigms.					
UNIT-4 : KNOWLEDGE REPRESENTATION: AI AT AN IMPASSE					9
Micro–worlds – SHRDLU: Understanding Natural Language – Scene Parsing And Computer Vision – Learning New Concepts or Categories – Knowledge Representation –Scripts and Primitive Actions – KRL: A Knowledge – Representation Language – Minds, Brains, and Programs					
UNIT-5 : THE ARCHITECTURE OF MIND: A CONNECTIONIST APPROACH					9
Brain–Style Computation –The Connectionist Framework – Computational Features Of Connectionist Models – State Of The Art –Architectures – Scaling Problem – Generalization Problem – Connectionist Modeling: Neural Computation / Mental Connections – Levels Of Analysis: Neural And Mental Structures – Symbolic Paradigm – Subsymbolic Paradigm – Semantic Interpretation – The Subsymbolic Level – Subsymbolic Computation – Subsymbolic Inference And The Statistical Connection – Higher–Level Descriptions.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Learn the different views of learning					

CO2: Study the various search strategies														
CO3: Study the knowledge representation framework														
CO4: Analyze the transition from micro world to knowledge representation														
CO5: Design the brain architecture														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO2	2	-	2	-	2	-	-	-	-	2	-	2	-	-
CO3	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO4	2	-	2	-	2	-	-	-	-	2	-	2	-	-
CO5	2	2	-	-	2	-	-	-	-	2	-	2	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1. John Haugeland, "Mind Design II – Philosophy Psychology Artificial Intelligence", The MIT Press, Second Edition, 1997														
REFERENCE BOOKS:														
1. Denis Rithman, "Artificial Intelligence By Example", Packt Publishers, First Edition, 2018														
2. Melanie Mitchell, "Artificial Intelligence: A Guide for Thinking Humans", Penguin Publishers, First Edition, 2019														
3. Michael Lewrick, Patrick Link and Larry Leifer, "The Design Thinking Playbook", Wiley Publishers, First Edition, 2019														
WEB RESOURCES:														
1. https://nexocode.com/blog/posts/applying-design-thinking-to-ai/														
2. https://bootcamp.uxdesign.cc/about-ai-and-the-design-thinking-process-in-ux-design-e21b3ba1ed9c?gi=9b9a2e4cd85b														

CS606704 - ARTIFICIAL INTELLIGENCE AND REINFORCEMENT LEARNING														
Course Category: Programme Elective		Course Type: Theory				L	T	P	C					
						3	0	0	3					
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> • Importance of AI in problem solving. • Basics of AI logics and develop plan using AI. • Probability in AI for decision making. • Basics of Reinforcement Learning and use it for untrained learning. • The applications using AI and RL. 														
UNIT 1: ARTIFICIAL INTELLIGENCE BASED PROBLEM SOLVING												9		
Intelligent Agents, Problem Formulation, Uninformed Search Strategies, Heuristics Search Strategies (A*), Local Search Algorithms and optimization problems, Problem Decomposition (AO*) and Rule Based Systems.														
UNIT-2 : KNOWLEDGE AND PLANNING												9		
Logic and inferences: Logic Agents, First Order Logic, Forward and Backward chaining. Planning: Forward and Backward Search, Goal Stack Planning.														
UNIT-3 : REASONING AND DECISION MAKING												9		
Reasoning: Quantifying Uncertainty and Probabilistic Reasoning–Semantics and Inference in Bayesian Networks, Probabilistic Reasoning over time – Hidden Markov Models, Kalman filters. Decision Making: Sequential Decision Problems, Value Iteration, Policy Iteration, Markov Decision Process (MDP).														
UNIT-4 : REINFORCEMENT LEARNING												9		
Forms of Learning, Elements of Reinforcement Learning (RL), Agent - Environment Interface, Passive RL, Active RL, Multi- armed Bandit, Monte Carlo Method, Temporal Difference Learning, Eligibility Traces, DQN & Policy Gradient Approaches.														
UNIT-5 : AI AND RL APPLICATION												9		
Future of AI, RL applications and Case study: Alpha Go, Universal Robots - cobots, Mars Curiosity Rover and Sophia.														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Learn the problem using AI.														
CO2: Develop AI logics and plan.														
CO3: Develop AI based Decision Making.														
CO4: Analyse various RL algorithms.														
CO5: Develop AI and RL based System.														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO2	2	-	-	2	2	-	-	-	-	2	-	2	-	-
CO3	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO4	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO5	2	-	2	-	2	-	-	-	-	2	-	2	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														

1.Russell, S.J. and Norvig, P., “Artificial intelligence – A modern approach”, 3rd edition, Pearson, 2015.

2.Richard S. Sutton, Andrew G Barto, “Reinforcement Learning – An Introduction”, MIT Press, 2018.

REFERENCE BOOKS:

1.M. Nagenevtsky, “Artificial Intelligence – a guide to intelligent systems” Addison Wesley, 3rd Edition, 2011.

2.Sebastian Thrun, Wolfram Burgard, & Dieter Fox, “Probabilistic Robotics” MIT Press. 2005.

3.Deepak Khemani, “A First Course in Artificial Intelligence”,McGraw Hill Education; 1st edition (1 July 2017).

4.Csaba Szepesvari, “Algorithms for Reinforcement Learning”, Morgan and Claypool Publishers; 1st edition, 2010

WEB RESOURCES:

1.<https://analyticsindiamag.com/top-resources-to-learn-reinforcement-learning-in-2022/>

2.<https://aws.amazon.com/machine-learning/ai-services/>

**CS606705 - MACHINE LEARNING FOR SOIL AND CROP
MANAGEMENT (NPTEL)**

Course Category: Programme Elective	Course Type: Theory	L	T	P	C									
		3	0	0	3									
COURSE OBJECTIVES:														
<ul style="list-style-type: none"> To Learn the Overview Of ML And DL Applications To get the knowledge of Classification And Clustering Methods In Agriculture To know the ML And DL For Soil And Crop Image Processing To Analyse the : Hyper spectral Remote Sensing To apply the Digital Soil Mapping With Continuous Variables 														
Week 1: General Overview Of ML And DL Applications In Agriculture Week 2: Basics Of Multivariate Data Analytics Week 3: Principal Component Analysis And Regression Applications In Agriculture Week 4: Applications Of Classification And Clustering Methods In Agriculture Week 5: Diffuse Reflectance Spectroscopy: Basics And Applications For Crop And Soil Week 6: Use Of ML For Portable Proximal Soil And Crop Sensors Week 7: ML And DL For Soil And Crop Image Processing Week 8: Ova And ML Applications In Agriculture Week 9: Hyper spectral Remote Sensing And ML Applications In Agriculture Week 10: Digital Soil Mapping – General Overview Week 11: Digital Soil Mapping With Continuous Variables Week 12: Digital Soil Mapping With Categorical Variables														
TOTAL: 45 PERIODS														
COURSE OUTCOMES: At the end of the course, the student will be able to														
CO1: Learn the Overview Of ML And DL Applications														
CO2: Get the knowledge of Classification And Clustering Methods In Agriculture														
CO3: Know the ML And DL For Soil And Crop Image Processing														
CO4: Analyze the : Hyper spectral Remote Sensing														
CO5: Apply the Digital Soil Mapping With Continuous Variables														
CO-PO MAPPING														
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO2	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO3	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO4	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO5	2	2	-	-	2	-	-	-	-	2	-	2	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Introduction to Multivariate Statistical Analysis in Chemometrics by Kurt Varmuza and Peter Filzmoser														
REFERENCE BOOKS:														
2.Using R for Digital Soil Mapping by Malone, Minasny, and McBratney														
WEB RESOURCES:														
1. https://onlinecourses.nptel.ac.in/noc23_ag04/preview														

CS606706 - COMPUTATIONAL INTELLIGENCE															
Course Category: Programme Elective			Course Type: Theory			L	T	P	C						
						3	0	0	3						
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To learn the basic concepts of computational intelligence To understand the problem solving search algorithms To study the representation of knowledge and the reasoning process To explore models used to solve uncertainty problems To introduce models that learn from samples of data 															
UNIT 1:INTRODUCTION													9		
Introduction –Foundations of AI- History of AI- Intelligent agents – Agents and Environments-Concepts of Rationality - Nature of Environments- Structure of Agents.															
UNIT-2 : PROBLEM SOLVING													9		
Solving problems by searching - Problem solving Agents - Example Problems - Searching for solutions - Uninformed search strategies - Informed search strategies: Greedy best first search, A* search - Memory bounded Heuristic search - Heuristic functions-Local search algorithms and optimization problems-Local search in continuous spaces.															
UNIT-3 : KNOWLEDGE AND REASONING													9		
Logic Agents: Knowledge based agents - Wumpus world - Logic - Propositional logic - Syntax and Semantic of FOL - Using FOL - Propositional vs First order inference - Unification and Lifting - Forward chaining - Backward chaining – Resolution.															
UNIT-4 : UNCERTAIN KNOWLEDGE AND REASONING													9		
Quantifying Uncertainty - Acting under Uncertainty - Basic probability notation – Axioms of Probability- Inference using Full joint distribution - Independence - Bayes rule - Probabilistic Reasoning - Semantics of Bayesian networks - Bayesian nets with continuous variable – Inference by enumeration- Variable elimination algorithm-Approximate Inference in Bayesian networks.															
UNIT-5 : LEARNING													9		
Forms of learning - Supervised learning - Learning decision trees – Theory of learning-Regression and Classification with Linear models-Artificial Neural networks-Nonparametric models-Support Vector Machines-Ensemble learning.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Exploit the structure of agents															
CO2: Apply searching and optimization algorithms for real world problems															
CO3: Represent knowledge in propositional logic and FOL															
CO4: Construct network models to represent knowledge in uncertain domain															
CO5: Apply learning algorithms to solve real world problems															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	-	-	2	-	-	-	-	2	-	2	-	-	
CO2	2	2	-	2	-	-	-	-	-	2	-	2	-	-	
CO3	2	2	2	2	2	-	-	-	-	2	-	2	-	-	

CO4	2	2	-	-	-	-	-	-	-	2	-	2	-	-
CO5	2	2	2	2	-	-	-	-	-	2	-	2	-	-
1- low, 2 - medium, 3 - high, '-' no correlation														
TEXT BOOKS:														
1.Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson education, Third edition, 2014														
REFERENCE BOOKS:														
1.Nils.J.Nilsson, "Artificial Intelligence: A new synthesis", Elsevier, July 2003														
2.Andries P.Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, 2nd edition, 2007														
3.John Fulcher, L.C. Jain, "Computational Intelligence: A Compendium, Studies in Computational Intelligence", Vol.115, Springer,2008														
WEB RESOURCES:														
1. https://cis.ieee.org/														
2. https://www.hindawi.com/journals/cin/														

CS606707 - DEEP LEARNING FOR VISUAL COMPUTING (NPTEL)															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To Learn the Visual Computing and Neural Networks To get the knowledge of Convolutional Neural Networks To Analyse the Very Deep Cnn For Classification To know the Generative Models With Adversarial Learning To apply the Neural Networks (Rnn) For Video Classification 															
SYLLABUS															
Week 1: Introduction To Visual Computing And Neural Networks Week 2: Multilayer Perceptron To Deep Neural Networks With Autoencoders Week 3: Autoencoders For Representation Learning And Mlp Initialization Week 4: Stacked, Sparse, Denoising Autoencoders And Ladder Training Week 5: Cost Functions, Learning Rate Dynamics And Optimization Week 6: Introduction To Convolutional Neural Networks (Cnn) And Lenet Week 7: Convolutional Autoencoders And Deep Cnn (Alexnet, Vggnet) Week 8: Very Deep Cnn For Classification (Googlenet, Resnet, Densenet) Week 9: Computational Complexity And Transfer Learning Of A Network Week 10: Object Localization (Rcnn) And Semantic Segmentation Week 11: Generative Models With Adversarial Learning Week 12: Recurrent Neural Networks (Rnn) For Video Classification															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Learn the Visual Computing and Neural Networks															
CO2: Get the knowledge of Convolutional Neural Networks															
CO3: Analyze the Very Deep Cnn For Classification															
CO4: Know the Generative Models With Adversarial Learning															
CO5: Apply the Neural Networks (Rnn) For Video Classification															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	-	-	-	-	-	-	-	2	-	2	-	-	
CO2	2	2	2	-	2	-	-	-	-	2	-	2	-	-	
CO3	2	2	-	3	-	-	-	-	-	2	-	2	-	-	
CO4	2	2	-	-	-	-	-	-	-	2	-	2	-	-	
CO5	2	2	2	-	2	-	-	-	-	2	-	2	-	-	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1. Goodfellow, Y, Bengio, A. Courville, "Deep Learning", MIT Press, 2016															
REFERENCE BOOKS:															
1. S. Haykin, "Neural Networks and Learning Machines", 3e, Pearson, 2008.															
WEB RESOURCES:															
1. https://onlinecourses.nptel.ac.in/noc23_ee53/preview															

2.<https://archive.nptel.ac.in/courses/108/105/108105103/>

CS606708 - SOFT COMPUTING					
Course Category: Programme Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To learn the basic concepts of Soft Computing To become familiar with various techniques like neural networks, genetic algorithms To apply soft computing techniques to solve problems. To Learn the Genetic Algorithm To Create Hybrid Systems using soft computing tools 					
UNIT 1:INTRODUCTION TO SOFT COMPUTING					9
Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.					
UNIT-2 : ARTIFICIAL NEURAL NETWORKS					9
Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory - Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.					
UNIT-3 : FUZZY SYSTEMS					9
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.					
UNIT-4 : GENETIC ALGORITHMS					9
Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators - Convergence of Genetic Algorithm.					
UNIT-5 : HYBRID SYSTEMS					9
Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Apply suitable soft computing techniques for various applications.					
CO2: Integrate various soft computing techniques for complex problems.					
CO3: Apply soft computing techniques to solve problems					
CO4: Learn the Genetic Algorithm					
CO5: Create Hybrid Systems using soft computing tools					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO2	2	2	2	-	-	-	-	-	-	2	-	2	-	-
CO3	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO4	2	2	-	-		-	-	-	-	2	-	2	-	-
CO5	2	2	2	-	2	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.

2.S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.

3.S.Rajasekaran, G.A.VijayalakshmiPai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt.Ltd., 2017.

REFERENCE BOOKS:

1.Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, —Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2002.

2.KwangH.Lee, —First course on Fuzzy Theory and Applications, Springer, 2005.

3.George J. Klir and Bo Yuan, —Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1996.

WEB RESOURCES:

1.<https://link.springer.com/journal/500/online-first>

2.<https://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html>

CS606709 - TEXT AND SPEECH ANALYSIS															
Course Category: Programme Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To Understand Speech production mechanisms To learn Front-end analysis To know the language models To understand parameter tying To classify Phrase-based translation systems 															
UNIT 1:Introduction													9		
Introduction & Applications. Speech production mechanisms, types of speech sound, source-filter model, applications of speech and text processing															
UNIT-2 : Analysis													9		
FFT based methods. All-pole filter models, calculation of LP coefficients. LP Spectrum. Cepstral analysis. Front-end analysis for speech recognition (MFCCs).															
UNIT-3 : Language Models													9		
Perplexity, N-gram language models, discounting, interpolation. Continuous speech recognition. Pruning. Integrating context dependent HMMs and N-gram language models.															
UNIT-4 : Sub-word Acoustic Models													9		
Large vocabulary speech recognition, continuous speech training, limitations of word models, context dependent phones, parameter tying, WSJ performance.															
UNIT-5 : SMT - Translation													9		
Parallel text as training data. Models of word and phrase alignment in translation. Model estimation procedures. Phrase-based translation systems. Implementation via WFSTs															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Learn the Speech production mechanisms															
CO2: Identify Front-end analysis															
CO3: Gain the knowledge of language models															
CO4: Apply the parameter tying															
CO5: classify Phrase-based translation systems															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	-	-	2	2	-	-	-	-	2	-	2	-	-	
CO2	2	-	2	-	-	-	-	-	-	2	-	2	-	-	
CO3	2	-	2	2	2	-	-	-	-	2	-	2	-	-	
CO4	2	2	-	-	-	-	-	-	-	2	-	2	-	-	
CO5	2	-	-	2	2	-	-	-	-	2	-	2	-	-	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1. Daniel Jurafsky and James Martin. Speech and Language Processing (Second Edition) , Prentice Hall, 2008															

2.Xuedong Huang, Alex Acero and Hsiao-Wuen Hon, Spoken Language Processing, Prentice Hall, 2001

REFERENCE BOOKS:

1.Paul Taylor. Test-to_speech Synthesis, Cambridge University Press, 2009

WEB RESOURCES:

1.<https://azure.microsoft.com/en-us/products/cognitive-services/speech-services>

2.<https://cloud.google.com/natural-language>

CS606710-MACHINE LEARNING TECHNIQUES						
Course Category: Programme Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To understand the need for machine learning for various problem solving To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning To understand the latest trends in machine learning To design appropriate machine learning algorithms for problem solving To Analyze and suggest appropriate machine learning approaches for various types of problems 						
UNIT 1:INTRODUCTION						9
Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.						
UNIT-2 : NEURAL NETWORKS AND GENETIC ALGORITHMS						9
Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.						
UNIT-3 : BAYESIAN AND COMPUTATIONAL LEARNING						9
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.						
UNIT-4 : INSTANT BASED LEARNING						9
K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.						
UNIT-5 : ADVANCED LEARNING						9
Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1:Differentiate between supervised, unsupervised, semi-supervised machine learning approaches						
CO2:Discuss the decision tree algorithm and identity and overcome the problem of overfitting						
CO3:Discuss and apply the back propagation algorithm and genetic algorithms to various problems						
CO4:Apply the Bayesian concepts to machine learning						

CO5:Analyse and suggest appropriate machine learning approaches for various types of problems

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO2	2	2	-	2	-	-	-	-	-	2	-	2	-	-
CO3	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO4	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO5	2	2	2	-	-	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

REFERENCE BOOKS:

1.Ethem Alpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004

2. Stephen Marsland, —Machine Learning: An Algorithmic Perspective, CRC Press, 2009

WEB RESOURCES:

1.<https://www.analyticsvidhya.com/resources-machine-learning-deep-learning-neural-networks/>

2.<https://www.kdnuggets.com/2018/12/finlayson-machine-learning-resources.html>

INSTITUTE ELECTIVE

CS607106 - Augmented Reality / Virtual Reality					
Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none">• Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR• Review the Geometric Modeling Techniques					

<ul style="list-style-type: none"> • Review the Virtual Environment • Discuss and Examine VR/AR Technologies • Use of various types of Hardware and Software in Virtual Reality systems 	
UNIT 1: Introduction to Virtual Reality(VR)	9
Virtual Reality and Virtual Environment, Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark.	
UNIT 2: Computer Graphics and Geometric Modelling	9
Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection.	
UNIT 3: Virtual Environment	9
Input / Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Video-based Input, 3DMenus & 3DScanner,etc.), Output (Visual/ Auditory/ Haptic Devices)	
Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system.	
UNIT 4: Augmented Reality(AR)	9
Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with R, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating AR systems.	
UNIT 5: Development Tools and Frameworks	9
Human factors: Introduction, the eye, the ear, the somatic senses Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.	
TOTAL: 45 PERIODS	
COURSE OUTCOMES: At the end of the course, the student will be able to	
CO1: Learn about the fundamental computer vision, Computer graphics and human-Computer interaction techniques .	
CO2: Study about the geometric modeling techniques.	
CO3: Learn the importance of Virtual Environment.	
CO4: Analyze And evaluate VR/AR technologies.	
CO5: Apply various types of Hardware and software in virtual reality systems.	
CO-PO MAPPING	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									2				
CO2			2											
CO3		3												
CO4				2						2				
CO5					3							2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1 Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press

2.Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice,"

3.Norman, K., Kirakowski, J.,(2018), "Wiley Handbook of Human Computer Interaction,"Wiley-Blackwell..

4.LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D UserInterfaces:Theoryand Practice,"Pearson

REFERENCE BOOKS:

1.Fowler, A., (2019), "Beginning iOS AR Game Development: Developing Augmented Reality Apps with Unity and C#," Apress

2.Hassanien, A. E., Gupta, D., Khanna, A., Slowik, A., (2022), "Virtual and Augmented Reality for Automobile Industry: Innovation Vision and Applications,"Springer

3.Paul Mealy, "Virtual & Augmented Reality for Dummies", 2018 edition.

WEB RESOURCES:

1.<https://www.vntana.com/blog/web-ar/>

2.<https://webflow.com/made-in-webflow/augmented-reality>

CS607107 - ROBOTIC PROCESS AUTOMATION						
Course Category: Institute Elective	Course Type: Theory	L	T	P	C	
		3	0	0	3	
COURSE OBJECTIVES:						
<ul style="list-style-type: none"> To develop a knowledge in basics of robotics. To understand the basic homogeneous transformation matrices To study the forward and inverse kinematics. To know the various sensors and actuators To know the velocity and force feedback 						
UNIT 1:ROBOT FUNDAMENTALS						9
Classification of Robots - History of Robotics - Robot Components - Robot Joints and Degrees of Freedom –Coordinates and Reference Frames - Robot Workspace – Applications - Social Issues.						
UNIT-2 : RIGID MOTIONS AND HOMOGENEOUS TRANSFORMATIONS						9
Representation of Positions and rotations in matrix form - Rotational Transformations - Rotation with respect to thecurrent coordinate frame - Rotation with respect to a fixed frame - Parameterizations of Rotations - Euler Angles -Roll, Pitch, Yaw Angles - Axis/Angle Representation - Homogeneous Transformations.						
UNIT-3 : FORWARD AND INVERSE KINEMATICS						9
Forward Kinematics - Kinematic Chains - Denavit Hartenberg Representation - Existence and uniqueness issues -Assigning the coordinate frames -Inverse Kinematics - Kinematic Decoupling - Inverse Position - Inverse Orientation -Degeneracy and Dexterity.						
UNIT-4 : ROBOTIC SENSORS AND ACTUATORS						9
Sensor Characteristics – Position, Velocity, Acceleration Sensors - Force and Pressure Sensors - Torque Sensors -isible Light and Infrared Sensors - Touch and Tactile Sensors - Proximity Sensors - Range Finders – other sensorsCharacteristics of Actuating Systems - Comparison of Actuating Systems - Hydraulic Actuators - Pneumatic Devices -Electric Motors and their types.						
UNIT-5 : MOTIONS AND VELOCITIES						9
Differential Motions and Velocities - Differential Relationships – Jacobian - Differential Motions of a Frame -Calculation of the Jacobian - Inverse Jacobian – Force feedback (elementary) – end effector systems – case study with egg picker.						
TOTAL: 45 PERIODS						
COURSE OUTCOMES: At the end of the course, the student will be able to						
CO1: Understand the fundamentals of robotics.						
CO2: Explain about rigid body transformations.						

CO3: Describe the forward and inverse kinematics.

CO4: Explain about various robotic sensors and actuators.

CO5: Illustrate end effector motion with an example.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	-	2	2	-	-	-	-	2	-	2	-	-
CO2	2	2	2	-	2	-	-	-	-	2	-	2	-	-
CO3	2	2	2	2	2	-	-	-	-	2	-	2	-	-
CO4	2	2	-	-	2	-	-	-	-	2	-	2	-	-
CO5	2	2	2	2	2	-	-	-	-	2	-	2	-	-

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Saeed Benjamin Niku," Introduction To Robotics: Analysis, Control, Applications", John Wiley & sons, 2011

2.Mark W. Spong," Robot Dynamics and Control", Wiley,2005

REFERENCE BOOKS:

1.Paul Sandin ,"Robot mechanisms and mechanical devices illustrated", McGraw-Hill, 2003

2.Jorge Angeles, "Fundamentals of Robotic Mechanical Systems: Theory, Methods, and Algorithms", SpringerInternational, 2014

WEB RESOURCES:

1.<https://www.uipath.com/rpa/robotic-process-automation>

2.<https://techbeacon.com/enterprise-it/15-essential-resources-robotic-process-automation-teams>

CS607205 - NEURAL NETWORKS AND DEEP LEARNING															
Course Category: Institute Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To learn basic concepts of machine learning To understand descriptive statistics To explore regression and classification models To learn unsupervised learning techniques To study concepts of artificial neural networks 															
UNIT 1:INTRODUCTION TO MACHINE LEARNING													9		
Concept of learning-Types of machine learning-Industrial applications-Introduction to R-Object, Vector, List, Factor,Matrix, Array, Data Frame, Manipulating objects, Input/output.															
UNIT-2 : DESCRIPTIVE STATISTIC													9		
Central tendency- Dispersion of data-Variance and standard deviation-Shape-skewness, kurtosis, percentiles, fivenumber summary, boxplots, histograms, barplot, pie chart, scatter plot , covariance, correlation, Chi-square test fortwo way tables.															
UNIT-3 : REGRESSION AND CLASSIFICATION													9		
Regression- Simple linear regression-Multiple linear regression-Logistic regression-Classification-Decision tree-knearestneighbours-Support vector machine.															
UNIT-4 : UNSUPERVISED LEARNING													9		
Clustering-Applications-Similarity measures-Partition based clustering techniques- K means clustering, k-mediodclustering- Hierarchical clustering-Density based clustering-Cluster validation															
UNIT-5 : NEURAL NETWORKS AND DEEP LEARNING													9		
Neural networks basics-Activation functions, learning rate, stochastic gradient descent- Deep Feed forwardnetworks- Convolutional Networks-Autoencoders- Undercomplete, Regularized and Denoising Autoencoders.															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Exploit the basics of machine learning															
CO2: Work with descriptive statistics															
CO3: Apply regression and classification for real world problems															
CO4: Work with unsupervised learning methods															
CO5: Construct neural network architecture for real world problem															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	2	2	-	2	2	-	-	-	-	2	-	2	-	-	
CO2	1	2	-	-	2	-	-	-	-	2	-	2	-	-	
CO3	1	2	2	2	2	-	-	-	-	2	-	2	-	-	
CO4	1	2	-	-	2	-	-	-	-	2	-	2	-	-	
CO5	2	2	2	2	2	-	-	-	-	2	-	2	-	-	
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															

1.Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014
2.Jiawei Han, Micheline Kamber, Jian Pei, “Data Mining : Concepts and Techniques”, Morgan Kaufmann Publishers, Third Edition,2014
REFERENCE BOOKS:
1.Gareth James, Daniela Witten, Trever Hastie and Robert Tibshirani, “An Introduction to Statistical Learning:with Applications in R”, Springer, 2015
2.P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge UniversityPress, 2012.
WEB RESOURCES:
1. https://www.coursera.org/learn/neural-networks-deep-learning
2. https://www.analyticsvidhya.com/blog/2015/11/free-resources-beginners-deep-learning-neural-network/

CS607206 - Cyber security					
Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To familiarize various types of cyber-attacks and cyber-crimes To give an overview of the cyber laws To study the defensive techniques against these attacks To study cyber security challenges and implications. To know about Cyber Security. 					
UNIT 1: Introduction					9
Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.					
UNIT 2: Cyber Security					9
Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing..					
UNIT 3: Cybercrime					9
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops					
UNIT 4: IPR in Cyber Security					9
Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations. Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.					
UNIT 5: Privacy Issues					9
Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc. Cybercrime: Examples and Mini-Cases Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances. Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain					

TOTAL: 45 PERIODS

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

CO1: Able to learn the basic concepts of Cyber Crimes.

CO2: Ability to identify the attacks in Cyber Crimes

CO3: Able to specify the suitable methods used in Cyber Crime

CO4: Ability to face cyber security challenges.

CO5: Able to study the Cyber laws.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2											1		
CO2		2										2		
CO3				2										
CO4				2										
CO5		1										2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley.

2.B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

3.Jon Errickson, "Hacking, The Art of Exploitation", 2008.

REFERENCE BOOKS:

1.Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press

2.Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

3. Kent Peterson, "Cyber Security, Cyberwar and Cyber Weapn", 2021.

WEB RESOURCES:

1.<https://www.cybersecurityeducation.org/resources/>

2.<https://www.w3schools.com/cybersecurity/>

CS607305 - Front End Development															
Course Category: Institute Elective					Course Type: Theory					L	T	P	C		
										3	0	0	3		
COURSE OBJECTIVES:															
<ul style="list-style-type: none"> To understand basic concept of html To Learn the Css properties To create the Css queries To understand the javascript functions To implement the real time projects. 															
UNIT 1: Introduction														9	
Introduction to Front-End Development- Code Editor Installation- Html 5 Introduction- Html 5 Basic Tags- Html 5 Tags- Html 5 Semantic Tags.															
UNIT 2: CSS														9	
Task Solving & Doubts Clearing on Html 5- Css Introduction- Css Basic Properties- Css Box Model Concepts- Css Properties															
UNIT 3: Animation														9	
Css Media Queries (Responsive Site)- Css Tasks- Css Animation- Javascript Introduction- Javascript Basics.															
UNIT 4: Java script														9	
Javascript Functions- Javascript DOM- Bootstrap Introduction- Bootstrap Exploration- Bootstrap Components- Bootstrap Real Time Implementation.															
UNIT 5:Project work														9	
Practical Portfolio Building- Wrapping Up Front-End Development															
TOTAL: 45 PERIODS															
COURSE OUTCOMES: At the end of the course, the student will be able to															
CO1: Learn the basic concept of html..															
CO2: Study about the CSS properties.															
CO3: Analyze about the CSS queries.															
CO4: Study about the javascript functions.															
CO5: Implement the real time projects.															
CO-PO MAPPING															
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1		2									1	2			
CO2			2					2			2				
CO3			2							1		2			
CO4		1													
CO5			2								3	2			
1- low, 2 - medium, 3 - high, '-' no correlation															
TEXT BOOKS:															
1Jon Duckett, “HTML & CSS, Design and Build Web”, 2011.															
2. Jon Duckett, “Java Script and JQuery: Front End Development”, 2018.															
3. Jennifer Robins, “Beginner’s guide to HTML, CSS, JavaScript, And Web Graphics”, Fifth Edition , 2018.															
REFERENCE BOOKS:															

1.Mariin, Haverbeke, “Eloquent Javascript”, 3 rd Edition, 2018.
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2.Mark Sapp, “Front-end Web Developer:Javascript,HTML5 and CSS3”, 2018.

3.Chris Aquino, Todd Gandee, “Front-end Development”, 2016.

WEB RESOURCES:

1. https://www.pluralsight.com/blog/software-development/tips-for-front-end-developers
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2. https://w3resource.com/
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CS607306 - Block Chain Architecture					
Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To introduce the concept of Blockchain . To study the Blockchain architecture To learn the process of Bitcoin mining and Ethereum platform for developing smart contracts. To identify applications of Blockchain in various sectors 					
UNIT 1: INTRODUCTION TO BLOCKCHAIN					9
Introduction to Block chain: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Block chain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hash chain to Block chain, Basic consensus mechanisms.					
UNIT 2: BLOCKCHAIN ARCHITECTURE					9
Structure of a Block–Block Header – Block Identifiers – The Genesis Block – Linking Blocks in the Blockchain – Merkle Trees – Properties of Blockchain Solutions – Blockchain Transactions – Permissionless Blockchain – Distributed Consensus Mechanisms: Proof of Work, Proof of Stake, Proof of Burn, Proof of Elapsed Time (PoET) – Permissioned Blockchain – Permissioned Consensus Mechanisms: Practical Byzantine Fault Tolerant Algorithm (PBFT).					
UNIT 3: HYPERLEDGER FABRIC & GAME THEORY					9
Hyperledger Fabric (A): Decomposing the consensus process, Hyperledger fabric components, Chain code Design and Implementation - Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool - Game Theory: Introduction to Game Theory, Nash Equilibrium, Prisoner’s Dilemma, Byzantine Generals’ Problem, Zero-Sum Games.					
UNIT 4: BITCOIN MINING AND ETHEREUM PLATFORM					9
Bitcoin Economics and Currency Creation – Independent Verification of Transactions – Mining Nodes – Aggregating Transactions into Blocks – Constructing the Block Header – Mining the Block – Validating a New Block – Assembling and Selecting Chains of Blocks – Mining and the Hashing Race Ethereum: Design Philosophy – Ethereum Blockchain – Ethereum Smart Contracts – Ethereum Virtual Machine and Code Execution – Introduction to Decentralized Apps (DApps).					
UNIT 5:BLOCKCHAIN APPLICATIONS					9
Blockchain for Government - Digital identity, land records and other kinds of record keeping between government entities - public distribution system social welfare systems - Blockchain Cryptography, Privacy and Security on Blockchain					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Identify the features of Blockchain.					
CO2: Design a Blockchain architecture for simple case.					
CO3: Hyperledger Fabric &Game theory algorithms.					

CO4: Mine bitcoin and develop smart contracts using Ethereum platform.
 CO5: Apply Blockchain technology to solve practical issues in various sectors.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1		2										2		
CO2			3					2						
CO3		2										2		
CO4				1										
CO5						2						2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

- 1.Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos.
- 2.Blockchain by Melanie Swa, O'Reilly.
- 3.Hyperledger Fabric – <https://www.hyperledger.org/projects/fabric>.
- 4.Zero to Blockchain – An IBM Redbooks course, by Bob Dill, David Smits.

REFERENCE BOOKS:

- 1.Andreas M. Antonopoulos, "The Internet of Money", O'Reilly Media, Inc., 2017.
- 2.Chris Dannen, "Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain.
- 3.Nicolas Dorier, "Blockchain Programming in C#", Open License, 2017

Web Resources:

- 1.<https://www.ibm.com/topics/blockchain>
- 2.<https://www.simplilearn.com/tutorials/blockchain-tutorial/blockchain-technology>

CS607307 - Optimization Techniques					
Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • Operation research models using optimization techniques based upon the fundamentals of engineering mathematics . • The problem formulation by using linear, dynamic programming, game theory and queuing models • The stochastic models for discrete and continuous variables to control inventory and simulation of manufacturing models for the production decision making. • Formulation of mathematical models for quantitative analysis of managerial problems in industry 					
UNIT 1: DEVELOPMENT OF O.R.ANDALLOCATION					9
Development, definition, characteristics and phases, types of operation research models, applications; Allocation: linear programming, problem formulation, graphical solution, simplex method, artificial variables techniques, two–phase method, big-M method.					
UNIT 2: TRANSPORTATION AND ASSIGNMENT PROBLEM					9
Transportation problem: Formulation, optimal solution, unbalanced transportation problem, Degeneracy; Assignment problem, formulation, optimal solution, variants of assignment problem, traveling salesman problem.					
UNIT 3: SEQUENCINGANDREPLACEMENT					9
Sequencing: Introduction, flow, shop sequencing, njobs through two machines, njobs through three machines, job shop sequencing, and two jobs through “m” machines. Replacement: Introduction: Replacement of items that deteriorate with time, when money value is not counted and counted, replacement of items that fail completely, group replacement.					
UNIT 4: THEORYOFGAMESANDINVENTORY					9
Theory Of Games: Introduction–Terminology, Solution of games with saddle points and without saddle points, 2×2 games, dominance principle, $m \times 2$ & $2 \times n$ games, Graphical method. Inventory: Introduction, Single item, Deterministic models, Purchase inventory models with one price break and multiple price breaks, Stochastic models, demand may be discrete variable or continuous variable, Single period model and no setupcost.					
UNIT 5:WAITINGLINES, DYNAMIC PROGRAMMING AND SIMULATION					9
Waiting Lines: Introduction, Terminology, Single Channel, Poisson arrivals and exponential service times with infinite population and finite population models, Multichannel, Poisson arrivals and exponential service times within finite population. Dynamic Programming: Introduction, Terminology, Bellman"s Principle of optimality, Applications of dynamic programming, shortest path problem, linear programming problem. Simulation: Introduction, Definition, types of simulation models, steps involved in the simulation process-Advantages and Disadvantages, Application of Simulation to queuing and inventory.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					

- CO1: Recall the theoretical foundations of various issues related to linear programming modeling to formulate real-world problems as a LP model
- CO2: To know the theoretical workings of the graphical, simplex and analytical methods for making effective decision on variables so as to optimize the objective function.
- CO3: Identify appropriate optimization method to solve complex problems involved in various industries..
- CO4: To learn about the theory of games and inventory.
- CO5: To study the appropriate algorithm for allocation of resources to optimize the process of assignment.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2								2		2		
CO2			2					2						
CO3		1										2		
CO4						3				2				
CO5			2									2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

- 1.J. K. Sharma, “Operations Research”, Macmillan, 5th Edition, 2012. .
- 2.R. Pannerselvan, “Operations Research.”, 2nd Edition, PHI Publications, 2006.
- 3.Fredrick S Hillier, Gerald J Lieberman, “”Introduction to operation Research”, 2005

REFERENCE BOOKS:

- 1.A. M. Natarajan, P. Balasubramani, A. Tamilarasi, “Operations Research”Pearson Education, 2013.
- 2.Maurice Saseini, Arhur Yaspan, Lawrence Friedman, “Operations Research: Methods & Problems”, 1 st Edition, 1959.
- 3.Pelin G Cambolat, “Introduction to operation Research”, 2015.

WEB RESOURCES:

1. <https://www.hotjar.com/website-optimization/techniques/>
2. <https://www.searchenginejournal.com/website-optimization-essentials/280641/>

CS607404 - Decision Making Methods					
Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To understand system view approach creation of various aspects of the structure, management and decision-making of the modern organization at all its levels; To acquire the skills of analytical and empirical research of existing organization and decision making processes, development and justification of organization's improvement; To develop decision-making process about the essence of strategies process for the modern organization as a whole and its individual units; To develop skills for quantitative and qualitative decision-making methods for organization of management at both micro and macro levels with the identification of short-term and long-term consequences of these decisions. 					
UNIT 1: Introduction					9
Problem Solving and Decision Making-Definition of the problem and potential causes for the problem-Identifying alternatives for approaches to resolve the problem-Selecting an approach to resolve the problem-Implementation of the best alternative-Action plan-Monitoring implementation of the plan-Rational Versus Organic Approach to Problem Solving-Discover Your Decision Making Style.					
UNIT 2: Decision Making Process					9
Decision Making Process-Disciplined decision-making process-Formal decision making method-Time decisions-Problem definition-Requirements identification-Goal establishment.-Evaluation criteria development-General Decision-Making Process (scheme)-Paired Comparison Analysis.					
UNIT 3: Analytic Hierarchy					9
Decision Making Process-General Decision-Making Process (description)-Define the Problem.-Determine Requirements-Establish Goals-Identify Alternatives-Define Criteria-Select a Decision-Making Tool: Pros and Cons Analysis, Kepner-Tregoe Decision Analysis (K-T), Analytic Hierarchy Process (AHP), Multi-Attribute Utility Theory Analysis (MAUT), Cost Benefit Analysis (CBA), Custom Tailored Tools etc-Evaluate Alternatives against Criteria-Validate Solution(s) against Problem Statement.					
UNIT 4: Analysis techniques					9
Decision Making Methods-Decision Analysis techniques-Pros and Cons Analysis-Pros and Cons Analysis (example)-Kepner-Tregoe (K-T) Decision Analysis-Kepner-Tregoe (K-T) Decision Analysis (example)-K-T Troubleshooting Methodology-Determining pros and cons of franchising by using SWOT-analysis.					
UNIT 5:Analytic Hierarchy Process					9
Decision Making Methods-Analytic Hierarchy Process (AHP)-Pair-wise comparisons-Analytic Hierarchy Process (AHP) (example)-Example of Pair-Wise Comparison of Criteria.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1:To study the system view approach creation of various aspects of the structure.					
CO2:Acquire the skills of analytical and empirical research of existing organization and decision making processes.					
CO3:Develop decision-making process about the essence of strategies process.					

CO4:Develop skills for quantitative and qualitative decision-making methods for organization of the management.

CO5:To learn the research and manage business processes, to prepare analytical materials based on the results of their application..

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1					2					2				
CO2				1				2				2		
CO3		1	2									2		
CO4			3							2				
CO5					2					1				

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Engineering Decision Making and Risk Management, Jeffrey W. Herrmann, ISBN: 978-1-118-91933-0 April 2015

2.Decision-Making in Engineering Design: Theory and Practice (Decision Engineering), by K. Iino (Translator), Yotaro Hatamura (Editor).

3.Malcom Gladwell, “Power of good thinking and bad thing”, 2009 edition

REFERENCE BOOKS:

1.Decision-making, by Shyama Prasad Mukherjee, 2022.

2.Thomas Richards, “Problem solving:Best strategies to Decision making”, 2015 edition.

3.Jhon C Maxwell, “How successful people thinking:Change thinking, change your life”, 2009.

WEB RESOURCES:

1.<https://www.mindtools.com/cyz4vzu/decision-making>

2.<https://www.smashingmagazine.com/2010/06/decision-making-models-in-web-development/>

CS607405 - Web Design And Development					
Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> To Learn the basic concepts in HTML, CSS, Java script To Understand the responsive design and development To learn the web project management and maintenance process To Design a Website with HTML, JS, CSS / CMS – Word press. 					
UNIT 1: INTRODUCTION : MARKUP WITH HTML					9
Introduction-Document background color and image – Text Structuring –Character Formatting – Lists – Ordered – Unordered – Definition Lists – Links to a web page – Tables – Borders and Rules – Rows and Cells – Formatting with Tables –Form handling-Building Forms-HTML5.					
UNIT 2: PHP INTRODUCTION					9
Incorporating PHP Within HTML-The Structure of PHP -Expressions and Control Flow in PHP-Operators-Conditionals.					
UNIT 3: PRESENTATION WITH CSS					9
Introduction to CSS- Importing a Style Sheet –CSS Rules-Style Types-CSS Selectors -The CSS Cascade - Measurements - Fonts and Typography -Managing Text Styles -CSS Colors - Positioning Elements –Pseudo-classes- The Box Model and Layout -Advanced CSS with CSS3- Attribute Selectors -CSS3 Backgrounds - CSS3 Borders –Text Effects Transformations.					
UNIT 4: JAVASCRIPT INTRODUCTION					9
Exploring JavaScript-Using Comments-Semicolons-Variables-Operators-Variable Typing-Functions - Global VariablesLocal Variables-The Document Object Model-Expressions and Control Flow in JavaScript-Expressions-Literals and Variables- Operators -The with Statement -Using try ... catch -Conditionals -Looping - JavaScript Arrays -JavaScript and PHP Validation and Error Handling-Validating User Input with JavaScript-Regular Expressions -Redisplaying a Form After PHP Validation.					
UNIT 5:MYSQL AND AJAX					9
Accessing MySQL Using PHP- Querying a MySQL Database with PHP -A Practical Example -Practical MySQL - Performing Additional Queries-Preventing SQL Injection - HTML Injection -Using Ajax- Using XML Http Request					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Study about the basics of website and html.					
CO2:Know about the architecture of web framework.					
CO3: Design interactive web pages using Scripting languages.					
CO4: Learn about the Python web frame work technologies.					
CO5: Design and develop a Web site using HTML, JS, CSS/ CMS- Wordpress.					
CO-PO MAPPING					

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2										2		
CO2			3					2						
CO3			2							2		2		
CO4		2												
CO5			2							2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1.Steven M.Schafer, “ HTML, XHTML and CSS”, Wiley Publishing, Inc., Fifth edition 2010.

2.Nixon Robin “Learning PHP, MySQL, JavaScript, CSS & HTML5 A step- by-step guide to creating Dynamic Websites” , O'Reilly Media, Inc, USA,June 2014..

3.Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006 4. Thomas Powell,”HTML & CSS: The Complete Reference”, McGraw Hill, Fifth Edition, Mar 2010

REFERENCE BOOKS:

1.Chuck Musciano Bill Kennedy, “HTML & XHTML: The Definitive Guide”, O’Reilly, 6th Edition, October 24, 2006.

2.Thomas A. Powell, “Web Design: The Complete Reference”, McGraw Hill, June 2000 .

3.Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006 4. Thomas Powell,”HTML & CSS: The Complete Reference”, McGraw Hill, Fifth Edition, Mar 2010.

WEB RESOURCES:

1.<https://homepages.cwi.nl/~steven/www/web-resources.html>

2.https://www.tutorialspoint.com/xhtml/xhtml_useful_resources.html

CS607406 - JAVA PROGRAMMING

Course Category: Institute Elective	Course Type: Theory	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES:					
<ul style="list-style-type: none"> • To learn about Java features • To understand Object Oriented Programming concepts and basic characteristics of Java. • To know the basic principles of inheritance and interfaces. • To develop Java applications with threads and package. • To define exceptions and use I/O streams 					
UNIT 1: INTRODUCTION					9
Fundamentals of Object-Oriented Programming - Java Features – Difference between Java and C-Java Environment- Overview of Java Language: Introduction-Simple Java Program - Java Program Structure – Java Tokens – Java statements – ImplementingaJavaprogram–JavaVirtualMachine–Commandlinearguments–Constants,variablesandDataTypes–OperatorsandExpressions–BranchingandLooping.					
UNIT 2: BASIC CONSTRUCTS					9
Class: Introduction – Defining a Class – Fields Declaration – Methods Declaration – Creating Objects – Accessing Class Members – Constructors – Method Overloading –Static Members–Nesting of Methods–Arrays, Strings and Vectors: Introduction–One- Dimensional Arrays– Creating an Array–Two-Dimensional Arrays –Strings..					
UNIT 3: INHERITANCE AND INTERFACES					9
Extending a class – Overriding methods – Final Variables and Methods –Final Classes – Finalizer Methods – Abstract Methods and Classes – Visibility Control - Interfaces:MultipleInheritance:Introduction–DefiningInterfaces–Extending Interfaces–Implementing Interfaces–Accessing Interface Variables.					
UNIT 4: PACKAGES AND MULTI THREADING					9
Packages: – Java API Packages – Using System Packages – Naming Conventions –Creating Packages – Accessing a Package – Using a Package – Adding a Class to a Package – Hiding Classes - Multithreaded Programming: Introduction – Life Cycle of a Thread—Creating Threads– Extending the Thread Class- Implementing the ‘Runnable’ Interface - Stopping and Blocking a Thread—Using Thread Methods.					
UNIT 5:EXCEPTIONANDI/OHANDLING					9
Exception Handling: Introduction – Types of Errors – Exceptions – Syntax of Exception Handling Code – Multiple Catch Statements – Using Finally Statement – Throwing Our Own Exceptions - Input/output: Introduction – Concept of Streams – Stream Classes –Byte Stream Classes–Character Stream Classes– Handling Primitive Data Types- Simple input and output.					
TOTAL: 45 PERIODS					
COURSE OUTCOMES: At the end of the course, the student will be able to					
CO1: Able to implement, compile,testandrunJavaprogram					

- CO2: Develop Java programs using OOP principles.
- CO3: Develop Java programs implementing the concepts of inheritance and interfaces.
- CO4: Develop multi-threaded and package Java applications.
- CO5: Build Java applications with exception handling and using I/O streams.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		2												
CO2			1									1		
CO3			2							2		2		
CO4				2										
CO5					2					2		2		

1- low, 2 - medium, 3 - high, '-' no correlation

TEXT BOOKS:

1. E.Balagurusamy, "Programming with Java: APrimer",FourthEdition, First reprint, TataMcGraw Hill,Reprint2011.
- 2.Herbet Schildt, " Java: A beginners guide", Eight Edition.
- 3.Bloch Jhosua, "Effective Java, A programming Language guide", 2nd Edition

REFERENCE BOOKS:

- 1.HerbertSchildt, "Java: A Beginner's Guide",4thEdition,TataMcGrawHill,2007.
- 2.C.Xavier,"Java Programming: A Practical Approach", TataMcGrawHill, 2011.
- 3.PaulDeitel&HarveyDeitel, "Java How to Program", Eleventh Edition, Pearson Education Ltd.2017.

WEB RESOURCES:

- 1.<https://www.iitk.ac.in/esc101/05Aug/tutorial/information/resources.html>
- 2.<https://www.simplilearn.com/resources-to-learn-java-programming-article>