K.L.N. COLLEGE OF ENGINEERING

Pottapalayam, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd:1994

THIRD YEAR

CURRICULUM AND SYLLABUS

REGULATIONS 2020

For Under Graduate Program

B.E. COMPUTER SCIENCE AND ENGINEERING

CHOICE BASED CREDIT SYSTEM

(For the students admitted in the academic year 2023-2024)

K.L.N. COLLEGE OF ENGINEERING, POTTAPALAYAM
(An Autonomous Institution, Affiliated to Anna University, Chennai

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry.

VISION OF THE DEPARTMENT

To evolve in the field of Computer Science & Engineering through sustainable technical education with innovative research and to foster competent professionals to serve and lead the society.

MISSION OF THE DEPARTMENT

- Imparting demand based proficient education through quality teaching – learning process in tune with the interdisciplinary needs of global work environment.
- Inculcating the attitude of continuous learning through industry institution interaction, consultancy and research activities.
- Cultivating professionalism, ethics and integrity of character for positive contributions to society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO I	Contribute effectively to the society by applying principles of Computer Science and Engineering for analyzing the real world problems to produce optimal and sustainable technical solutions.
PEO II	Sustain as good professionals by pursuing career / advanced studies and practice innovation in emerging technologies and current trends through lifelong learning.
PEO III	Build professionalism, team work, effective communication, ethical values and leadership qualities**.**

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Ability to apply good analytical, design and implementation skills to formulate and solve scientific and business applications pertaining to Algorithms, Computer Systems, Networks, Security, Data Analytics and Artificial Intelligence.
PSO2	Ability to update knowledge continuously in various domains like Virtualization, Mobile Application Development, Data Visualization, Machine Learning and Technologies like Storage, Computing, Communication to meet the industry requirements.

PROGRAM OUTCOMES (POs)

PO1: Engineering Knowledge

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Problem Analysis

Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/Development of Solutions

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Problems

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: 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.

PO8: Ethics

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: 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.

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REGULATIONS 2020

For Under Graduate Program

B.E. COMPUTER SCIENCE AND ENGINEERING

CHOICE BASED CREDIT SYSTEM

CATEGORY OF COURSES

i. **Humanities and Social Sciences (HS) Courses** include Technical English, Environmental Science and Engineering, Engineering Ethics and human values, Communication Skills and Management courses.

ii. **Basic Sciences (BS**) **Courses** include Mathematics, Physics, and Chemistry.

iii. **Engineering Sciences (ES) Courses** include Engineering Practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering / Instrumentation etc.

iv. **Professional Core (PC) Courses** include the core courses relevant to the chosen programme of study.

v. **Professional Elective (PE) Courses** include the elective courses relevant to the chosen programme of study.

vi. **Open Elective (OE) Courses** include courses from other departments which a student can choose from the list specified in the curriculum of the students B.E. / B.Tech. Programmes.

vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

viii. **Mandatory Courses (MC)** include Personality and Character development and the courses recommended by the regulatory bodies such as AICTE, UGC, etc

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B.E. COMPUTER SCIENCE AND ENGINEERING

SEMESTER V

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	20CS501	Computer Networks (Common to B.E. CSE & B.Tech IT programmes)	PC	3	3	0	0	3
2.	20CS503	Theory of Computation	PC	4	3	1	0	4
3.		Professional Elective I	PE	3	3	0	0	3
4.		Professional Elective II	PE	3	3	0	0	3
5.	20MC501	Constitution of India (Common to all B.E. / B.Tech programmes)	MC	1	1	0	0	-
THEORY CUM PRACTICAL								
6.	20CS504	Software Engineering	PC	5	3	0	2	4
7.	20EC512	Embedded System Design and IOT	PC	5	3	0	2	4
PRACTICAL								
8.	20CS5L1	Networks Laboratory (Common to B.E. CSE & B.Tech IT programmes)	PC	4	0	0	4	2
TOTAL				**28**	**19**	**1**	**8**	**23**

SEMESTER VI

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	20CS602	Cryptography and Network Security	PC	3	3	0	0	3
2	20CS603	Compiler Design	PC	3	3	0	0	3
3		Professional Elective III	PE	3	3	0	0	3
4		Professional Elective IV	PE	3	3	0	0	3
5		Open Elective I	OE	3	3	0	0	3
6	20MC801	Disaster Management	MC	2	2	0	0	-
THEORY CUM PRACTICAL								
7	20CS604	Machine Learning (Common to B.E. CSE & B.Tech IT programmes)	PC	5	3	0	2	4
8	20CS605	Web Technology	PC	5	3	0	2	4
PRACTICAL								
9	20CS6L1	Mobile Application Development Laboratory (Common to B.E. CSE, B.Tech IT & B.Tech AIDS programmes)	PC	4	0	0	4	2
TOTAL				**31**	**23**	**0**	**8**	**25**

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B.E. COMPUTER SCIENCE AND ENGINEERING

PROFESSIONAL ELECTIVE (PE) : VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V
Cloud Computing and Data Center Technologies	**Cyber Security and Data Privacy**	**Full Stack Development for IT**	**Innovative Computing Technologies**	**Artificial Intelligence and Machine Learning**
Cloud Computing Techniques	Social Network Analysis	Principles of Programming Languages	Data and Information Security	Business Intelligence System
Data Warehousing and Data Mining	Cyber Physical Systems	UI and UX Design	Quantum Computing	Data Communication and Computer Networks
Cloud Services Management	Digital and Mobile Forensics	Cloud Services Management	Neural Networks and Deep Learning	Neural Networks and Deep Learning
Software Defined Networks	Cryptocurrency and Blockchain Technologies	Software Testing and Automation	Cryptocurrency and Blockchain Technologies	Robotic Process Automation
Storage Technologies	Web Application Security	Web Application Security	Cyber Security	Text and Speech Analysis
Computer Vision	Engineering Secure Software Systems	Information Retrieval Techniques	3D Printing and Design	Fuzzy Logic and Applications
Security and Privacy in Cloud	Security and Privacy in Cloud	DevOps	Agile Methodologies	Ethics and AI
Reinforcement Learning Techniques	Malware Analysis	Reinforcement Learning Techniques	Virtual Reality and Augmented Reality	Health Care Analytics

Vertical I : Cloud Computing and Data Center Technologies

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CSV11	Cloud Computing Techniques	PE	4	2	0	2	3
2.	20CSV21	Data Warehousing and Data Mining	PE	3	3	0	0	3
3.	20CSV31	Cloud Services Management	PE	3	3	0	0	3
4.	20CSV41	Software Defined Networks	PE	3	3	0	0	3
5.	20ADV51	Storage Technologies	PE	3	3	0	0	3
6.	20CSV61	Computer Vision	PE	3	3	0	0	3
7.	20SCV71	Security and Privacy in Cloud	PE	3	3	0	0	3
8.	20ITV81	Reinforcement Learning Techniques	PE	3	3	0	0	3

Vertical II : Cyber Security and Data Privacy

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20CSV12	Social Network Analysis	PE	3	3	0	0	3
2.	20ITV22	Cyber Physical Systems	PE	3	3	0	0	3
3.	20SCV32	Digital and Mobile Forensics	PE	4	2	0	2	3
4.	20ITV42	Cryptocurrency and Blockchain Technologies	PE	3	3	0	0	3
5.	20SCV52	Web Application Security	PE	3	3	0	0	3
6.	20CSV62	Engineering Secure Software Systems	PE	3	3	0	0	3
7.	20SCV71	Security and Privacy in Cloud	PE	3	3	0	0	3
8.	20SCV82	Malware Analysis	PE	4	2	0	2	3

Vertical III : Full Stack Development for IT

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ITV13	Principles of Programming Languages	PE	3	3	0	0	3
2.	20CSV23	UI and UX Design	PE	4	2	0	2	3
3.	20CSV31	Cloud Services Management	PE	3	3	0	0	3
4.	20ITV43	Software Testing and Automation	PE	3	3	0	0	3
5.	20SCV52	Web Application Security	PE	3	3	0	0	3
6.	20ITV63	Information Retrieval Techniques	PE	3	3	0	0	3
7.	20ITV73	DevOps	PE	4	2	0	2	3
8.	20ITV81	Reinforcement Learning Techniques	PE	3	3	0	0	3

Vertical IV : Innovative Computing Technologies

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ADV14	Data and Information Security	PE	3	3	0	0	3
2.	20ITV24	Quantum Computing	PE	3	3	0	0	3
3.	20ADV34	Neural Networks and Deep Learning	PE	4	2	0	2	3
4.	20ITV42	Cryptocurrency and Blockchain Technologies	PE	3	3	0	0	3
5.	20SCV54	Cyber Security	PE	3	3	0	0	3
6.	20ITV64	3D Printing and Design	PE	3	3	0	0	3
7.	20CSV74	Agile Methodologies	PE	3	3	0	0	3
8.	20CSV84	Virtual Reality and Augmented Reality	PE	3	3	0	0	3

Vertical V: Artificial Intelligence and Machine Learning

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20ADV15	Business Intelligence System	PE	3	3	0	0	3
2.	20ADV25	Data Communication and Computer Networks	PE	3	3	0	0	3
3.	20ADV34	Neural Network and Deep Learning	PE	4	2	0	2	3
4.	20ADV45	Robotic Process Automation	PE	3	3	0	0	3
5.	20ADV55	Text and Speech Analysis	PE	3	3	0	0	3
6.	20ITV65	Fuzzy Logic and Applications	PE	3	3	0	0	3
7.	20ADV75	Ethics and AI	PE	3	3	0	0	3
8.	20ADV85	Health Care Analytics	PE	3	3	0	0	3

OPEN ELECTIVE I (OE I)

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20OE103	Refrigeration and Air Conditioning	OE	3	3	0	0	3
2.	20OE201	Fundamentals of Renewable Energy System	OE	3	3	0	0	3
3.	20OE202	Principles of Measurements and Instrumentation	OE	3	3	0	0	3
4.	20OE203	Introduction to Nano science	OE	3	3	0	0	3
5.	20OE303	Fundamentals of Wireless Communication	OE	3	3	0	0	3
6.	20OE601	Fundamentals of Electric Vehicles	OE	3	3	0	0	3
7.	20OE602	Supply Chain Management	OE	3	3	0	0	3
8.	20OE603	Automotive Safety Systems	OE	3	3	0	0	3
9.	20OE701	Biomedical Instrumentation and Measurements	OE	3	3	0	0	3
10.	20OE801	Linear Algebra and Number Theory	OE	3	3	0	0	3

OPEN ELECTIVE - I offered to other Departments

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE401	Fundamentals of Artificial Intelligence	OE	3	3	0	0	3
2.	20OE402	Introduction to Database Management Systems	OE	3	3	0	0	3
3.	20OE403	Computer Communication Networks	OE	3	3	0	0	3
4.	20OE404	Cloud Infrastructure and Technologies	OE	3	3	0	0	3

20CS501	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of layering and functions of each layers of the protocol suits
- To be familiar with the components required to build different types of networks
- To learn concepts related to network addressing and routing
- To familiarize the functions and protocols of the layer of Transport layer
- To understand the working of various application layer protocols

PRE-REQUISITE: NIL

UNIT – I INTRODUCTION TO NETWORKS 8

Network Introduction: Evolution of Computer Networks, Classification of computer Networks LAN, WAN, MAN, Software Defined Networks (SDN), Network Topology: BUS, STAR, RING, MESH, OSI Layered Architecture, TCP/IP Protocol Suite.

UNIT – II MEDIA ACCESS & INTER NETWORKING 12

Medium Access Control Techniques: Random, Round Robin, Reservation: ALOHA Pure and Slotted, CSMA/CD-CSMA/CA- Ethernet-Token Ring-Token Bus-ARQ 3 Types, Data Link Layer design issues: Error Detection Codes, Parity Check, Checksum Error Correction Codes, Hamming codes, IEEE Standards: Bluetooth (802.15), Basic Internetworking: IP -CIDR-ARP -DHCP -ICMP.

UNIT – III NETWORK DEVICES AND NETWORK LAYER 8

Network Devices: Router, Switch, HUB, Bridge, Routing: Static Routing, Introduction to dynamic Routing, Categories of Routing – RIP v1 and RIP v2-OSPF-DSDV,IPV6 Addressing-IPV6 Protocol.

UNIT – IV TRANSPORT LAYER 9

Overview of Transport layer: UDP - Reliable byte stream (TCP), Connection Management: Flow control – Retransmission – TCP Congestion control, Congestion avoidance: DECbit -RED.

UNIT – V APPLICATION LAYER 8

Traditional applications: SSH – HTTP – FTP –DNS – SNMP- Telnet

TOTAL: 45 PERIODS

TEXT BOOK:

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.

REFERENCES

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An OpenSource Approach, McGraw Hill Publisher, 2011.
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMPUTER NETWORKS										Course Code : 20CS501				
CO	**Course Outcomes**									**Unit**	**K-CO**	**POs**		**PSOs**
C301.1	Explain the organization of computer networks with the concept of layered approach									1	K2	1,2,12		1
C301.2	Classify various Media Access Control Protocols techniques									2	K3	1,2,3,8,9,12		1
C301.3	Apply the error detection and error correction methods for bit streams									2	K3	1,2,3,8,9,12		1
C301.4	Utilize various types of routing techniques to forward packets									3	K3	1,2,3,8,9,10,12		1
C301.5	Describe the mechanisms involved in transport layer									4	K2	1,2,8,9,10,12		1
C301.6	Classify different application layer protocols									5	K3	1,2,3,8,9,10,12		1
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C301.1	2	1	-	-	-	-	-	-	-	-	-	1	2	-
C301.2	3	2	1	-	-	-	-	1	1	-	-	1	2	-
C301.3	3	2	1	-	-	-	-	1	1	-	-	1	2	-
C301.4	3	2	1	-	-	-	-	1	1	1	-	1	2	-
C301.5	2	1	-	-	-	-	-	1	1	1	-	1	2	-
C301.6	3	2	1	-	-	-	-	1	1	1	-	1	2	-
C301	3	2	1	-	-	-	-	1	1	1	-	1	2	-

20CS503	THEORY OF COMPUTATION	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To construct automata for any given pattern and find its equivalent regular expressions
- To design a context free grammar for any given language
- To understand Turing machines and their capability
- To know the relation between regular language, context free language and corresponding recognizers.

PRE-REQUISITE:

Course code: 20BS303
Course Name: Discrete Mathematics

UNIT – I FINITE AUTOMATA 12

Introduction - Basic mathematical notation and techniques – Basic definitions: Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) - Language acceptance – Design of FA - Equivalence of NFA and DFA - Finite Automata with epsilon transitions - Equivalence of NFA's with and without epsilon transitions.

UNIT – II REGULAR EXPRESSIONS AND LANGUAGES 12

Regular Languages - Regular Expression - Equivalence of finite Automaton and regular expressions: Finite Automata into Regular Expression – Regular Expression into Finite Automata - Pumping Lemma for Regular sets – Problems based on Pumping Lemma.

UNIT – III CONTEXT FREE GRAMMAR AND LANGUAGES 12

Grammar Introduction– Types of Grammar - Context Free Grammars and Languages – Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG: Elimination of Null productions - Unit productions - Useless symbols – Normal Forms of CFG: Chomsky Normal Form (CNF) – Greiback Normal Form (GNF) – Problems related to CNF and GNF.

UNIT – IV PUSH DOWN AUTOMATA 12

Definition of the Pushdown Automata (PDA) – Instantaneous descriptions of PDA – Languages of a Pushdown Automata – Design of PDA for language sets - Equivalence of Pushdown Automata and CFG - Deterministic Pushdown Automata.

UNIT – V TURING MACHINE 12

Definition and representation of Turing machine – Language acceptance by Turing Machine - Computable languages and functions – Programming techniques for Turing machine construction – Recursive and Recursive enumerable languages - Properties of recursive and recursive enumerable languages - A language that is not Recursively Enumerable (RE) - Post's Correspondence Problem.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. J.E. Hopcroft, R. Motwani and J.D. Ullman, “Introduction to Automata Theory, Languages and Computations”, 3rd Edition, Pearson Education, 2013.
2. J. Martin, “Introduction to Languages and the Theory of computation”, 4th Edition, Tata Mc Graw Hill, 2011.

REFERENCES:

1. Michael Sipser, “Introduction to the Theory of Computation”, Third Edition, Cengage Learning, 2012.
2. H.S Behera, Janmenjoy Nayak and Hadibandhu Pattnayak, "Formal Languages and Automata Theory", Vikas Publishing House Pvt. Ltd, 2014.
3. Thomas A. Sudkamp,” An Introduction to the Theory of Computer Science, Languages and Machines”, Third Edition, Pearson Education, 2007.
4. Peter Linz, " An introduction to formal languages and Automata", 6th edition, Jones & Bartlett Learning, 2016.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : THEORY OF COMPUTATION		**Course Code : 20CS503**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C303.1	Construct finite automata for different regular expressions and languages	1	K3	1,2,3,8,9,10,12	1,2
C303.2	Develop context free grammar for the given languages	2	K3	1,2,3,8,9,12	1,2
C303.3	Transfer the context free grammar into its various normal forms	3	K3	1,2,3,8,9,12	1,2
C303.4	Develop Pushdown automata for the given languages	4	K3	1,2,3,8,9,12	1,2
C303.5	Construct Turing machine model for solving simple computational problems	5	K3	1,2,3,8,9,12	1,2
C303.6	Illustrate recursive and recursive enumerable languages	5	K3	1,2,3,8,9,10,12	1,2

CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C303.1	3	2	1	-	-	-	-	2	2	1	-	1	3	1
C303.2	3	2	1	-	-	-	-	2	2	-	-	1	3	1
C303.3	3	2	1	-	-	-	-	2	2	-	-	1	3	1
C303.4	3	2	1	-	-	-	-	2	2	-	-	1	3	1
C303.5	3	2	1	-	-	-	-	2	2	-	-	1	3	1
C303.6	3	2	1	-	-	-	-	2	2	1	-	1	3	1
C303	3	2	1	-	-	-	-	2	2	1	-	1	3	1

20MC501	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

OBJECTIVES:

- To enable the student to understand the importance of the constitution
- To understand the structure of executive, legislature, and judiciary
- To understand the philosophy of fundamental rights, duties and Emergency Provisions.
- To understand the autonomous nature of constitutional bodies like Supreme Court and high court.
- To understand the central and state relation financial and administrative.

PRE-REQUISITE: NIL

UNIT – I INTRODUCTION 3

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) - Philosophy of the Indian Constitution-Preamble-Salient Features.

UNIT – II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES 3

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State Policy-Fundamental Duties.

UNIT – III ORGANS OF GOVERNANCE 3

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions.

UNIT – IV EMERGENCY PROVISIONS 3

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT – V LOCAL ADMINISTRATION 3

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction-PRI- Zila PachayatElected officials and their roles- CEO ZilaPachayat- Position and role-Block level-Organizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 15 periods

TEXT BOOKS:

1. Rajesh Kumar, Universal's Guide to the Constitution of India. Universal Law Publications, 2016.
2. D.C. Gupta, Indian Government and Politics, Vikas Pub,2018.

REFERENCES:

1. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes, Universal Law Publication
2. J.C. Johari, Indian Government and Politics, Shoban Lal & Co, 2012.
3. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Rights Guarantees in India, Oxford University Press, 2012.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CONSTITUTION OF INDIA		Course Code : 20MC501			
CO	**Course Outcomes**	**Unit**	**K –CO**	**POs**	**PSOs**
C306.1	Explain history and philosophy of Indian Constitution.	1	K2	6,8,9,10	-
C306.2	Explain the premises informing the twin themes of liberty and freedom from a civil rights perspective.	2	K2	6,8,9,10	-
C306.3	Explain the powers and functions of Indian government	3	K2	6,8,9,10	-
C306.4	Explain the emergency rules of Indian Constitution.	4	K2	6,8,9,10	-
C306.5	Explain the structure and functions of local administration.	5	K2	6,8,9,10	-

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C306.1	-	-	-	-	-	3	-	2	2	2	-	-	-	-
C306.2	-	-	-	-	-	3	-	2	2	2	-	-	-	-
C306.3	-	-	-	-	-	3	-	2	2	2	-	-	-	-
C306.4	-	-	-	-	-	3	-	2	2	2	-	-	-	-
C306.5	-	-	-	-	-	3	-	2	2	2	-	-	-	-
C306	-	-	-	-	-	3	-	2	2	2	-	-	-	-

20CS504	SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To understand the phases in a software project
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To design with static and dynamic UML diagrams.
- To learn various testing and project management.

PRE-REQUISITE: NIL

UNIT – I SOFTWARE PROCESS AND AGILE DEVELOPMENT 9

Introduction to Software Engineering, Software Process, Process Models – Introduction to Agility - Agile Process - Extreme programming - XP Process.

LAB COMPONENT 6

1. Write down the problem statement for a suggested system of sample projects.

UNIT - II REQUIREMENTS ANALYSIS AND SPECIFICATION 9

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management - Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

LAB COMPONENT 6

1. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system
2. Develop Data Flow Diagram (DFD) model (level-0, level-1) of the project

UNIT - III SOFTWARE DESIGN AND UML MODEL 9

Design Engineering: Design process and design quality, design concepts, the design model. Creating a Architectural Design: Architectural styles, Architectural Design, Architectural Mapping using Data Flow. Conceptual model of UML: basic structural modeling, use case diagram, class diagrams, sequence diagrams, collaboration diagrams, state chart diagram, activity diagram, component diagrams, deployment diagram

LAB COMPONENT 12

1. Identify use cases to develop the Use Case model and model the class diagram.
2. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
3. Draw relevant State Chart and Activity Diagrams for the same system.
4. Implement the system as per the detailed design

UNIT - IV SOFTWARE TESTING 9

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging.

LAB COMPONENT 6

1. Test the software system for all the scenarios identified as per the use case diagram

UNIT - V SOFTWARE PROJECT MANAGEMENT 9

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model –Risk Management – Identification, Projection -RMMM Plan.

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Roger S. Pressman, — Software Engineering – A Practitioner's Approach, Eighth Edition, Mc Graw-Hill International Edition, 2015
2. Ian Sommerville, — Software Engineering, 10th Edition, Pearson Education Asia, 2016.
3. Craig Larman, — Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development, Third Edition, Pearson Education, 2005.

REFERENCES:

1. Rajib Mall, — Fundamentals of Software Engineering, Third Edition, PHI Learning Private Limited, 2009.
2. Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 1999.
3. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOFTWARE ENGINEERING		**Course Code : 20CS504**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C306.1	Apply the software process models and Identify the problem statement for a suggested system of project.	I	K3	1,2,3,8,9,10,11,12	1,2
C306.2	Build the SRS and DFD using software requirements for classical analysis.	II	K3	1,2,3,8,9,10,11,12	1,2
C306.3	Examine the identified objects and functionality of the system using USE CASE and CLASS model.	III	K4	1,2,3,4,5,8,9,10,11,12	1,2
C306.4	Demonstrate the code from objects interaction and implementation models for the system.	III	K3	1,2,3,5,8,9,10,11,12	1,2
C306.5	Illustrate the developed code using testing strategies.	IV	K3	1,2,3,5,8,9,10,11,12	1,2
C306.6	Calculate the software project effort and cost.	V	K3	1,2,3,8,9,10,11,12	1,2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C306.1	3	2	1	-	-	-	-	3	3	3	3	3	3	3
C306.2	3	2	1	-	-	-	-	3	3	3	3	3	3	3
C306.3	3	3	2	1	3	-	-	3	3	3	3	3	3	3
C306.4	3	2	1	-	3	-	-	3	3	3	3	3	3	3
C306.5	3	2	1	-	3	-	-	3	3	3	3	3	3	3
C306.6	3	2	1	-	-	-	-	3	3	3	3	3	3	3
C306	3	2	1	1	3	-	-	3	3	3	3	3	3	3

20EC512	EMBEDDED SYSTEM DESIGN AND IoT	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To educateconceptsofmicrocontrollerdesign.
- To learnthearchitecture ofARMprocessor and peripherals.
- To learn Smart Objects and IOT Architectures
- To learn about various IOT-related protocols
- To develop IOT infrastructure for popular applications

PRE-REQUISITE: NIL

UNIT – I INTRODUCTION TO 8051 MICROCONTROLLER 9

Introduction to Microcontrollers - Architecture of 8051 - Pin Description - Instruction set - Addressing Modes - Assembly language programming - Software Development tools: IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging.

LAB COMPONENT 6

1. Arithmetic Operations of 8051 Microcontroller
2. Interfacing ADC and DAC using 8051.

UNIT - II ARM PROCESSOR AND PERIPHERALS 9

Introduction to embedded systems – built in features for embedded target architecture – selection of embedded processor – ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART.

LAB COMPONENT 6

1. Study of ARM evaluation system
2. Interfacing LED and PWM.
3. Interfacing real time clock and serial port.

UNIT - III INTRODUCTION TO IoT 9

Evolution of Internet of Things – Enabling Technologies – IOT Architectures: oneM2M, IOT World Forum (IOT WF) 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

LAB COMPONENT 12

1. Familiarization of Rasperry Pi/Arduino kit and perform necessary software installation.
2. To interface LED with Rasperry Pi/Arduino to turn ON LED for 1second after every 2 Seconds.
3. To interface motor with Rasperry Pi/Arduino.

UNIT - IV IoT PROTOCOLS 9

IOT Access Technologies: Physical Layer, MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoraWAN – Network Layer: Constrained Nodes and Constrained Networks – IP versions, Optimizing IP for IOT: From 6LoWPAN to 6 Lo.

LAB COMPONENT 6

1. To interface sensor with Rasperry Pi/Arduino to print temperature readings.
2. To interface Bluetooth with Rasperry Pi to send sensor data to smartphone using Bluetooth.

UNIT - V CASE STUDIES/INDUSTRIAL APPLICATIONS 9

IoT Levels and Deployment templates, IoT Application : Home Automation, Smart Cities, Environment Parking, Energy, Retail, Logistics, Agriculture, Industry, Health and Life style.

LAB COMPONENT 6

1. To interface WiFi module with Rasperry Pi.
2. To interface camera/IR Sensor with Rasperry Pi.
3. To study of upload temperature data to Thingspeak Cloud using Rasperry Pi.

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Marilyn Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufmann Publisher, Third Edition, 2012.
2. 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

REFERENCES:

1. LylaB.Das,―EmbeddedSystems:AnIntegratedApproach‖PearsonEducation,2013.
2. M. Senthilkumar, M.Saravanan, S.Jeevananthan, Microprocessors and Microcontrollers- OxfordUniversityuPress 2013.
3. ArshdeepBahga, Vijay Madisetti, ―Internet of Things – A hands-on approach, Universities Press, 2015Pearson Education, 2007.
4. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols, Wiley, 2012 .
5. Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, ―From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence‖, Elsevier, 2014.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: Embedded System Design and IoT		Course Code: 20EC512			
CO	**Course Outcomes**	**Unit**	**K**	**POs**	**PSOs**
C307.1	Use the 8051 Microcontroller to write Assembly Language Programs.	1	K3	1-3, 8-10, 12	1
C307.2	Illustrate the ARM Processors Architecture, and Instruction Set for programming the LPC 2148	2	K3	1-3, 8-10, 12	1
C307.3	Apply the concept of ARM Processor for interfacing peripherals to control a system.	2	K3	1-3, 8-10, 12	1
C307.4	Illustrate the concept of Internet of Things with the support of IoT Architectural Model.	3	K3	1-3,5,6 8-10, 12	1
C307.5	Demonstrate IoT with the support of Raspberry Pi/Arduino.	3	K3	1-3,5,6, 8-10, 12	1
C307.6	Classify different IoT Protocols for its implementation in the real world scenario.	4	K3	1-3, 8-10, 12	1
C307.7	Utilize the IoT concepts for solving the Industrial Applications.	5	K3	1-6, 5,6,8-10, 12	1

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C307.1	3	2	1	-	-	-	-	1	1	1	-	1	3	-
C307.2	3	2	1	-	-	-	-	1	1	1	-	1	3	-
C307.3	3	2	1	-	1	1	-	1	1	1	-	1	3	-
C307.4	3	2	1	-	-	-	-	1	1	1	-	1	3	-
C307.5	3	2	1	-	1	1	-	1	1	1	-	1	3	-

20CS5L1	NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To learn and use network commands.
- To learn socket programming.
- To implement and analyze various network protocols.
- To learn and use simulation tools.
- To use simulation tools to analyze the performance of various network protocols.

LIST OF EXPERIMENTS

1. Learn to use commands like TCP dump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like:
   a) Echo client and echo server
   b) Chat
   c) File Transfer
4. Simulation of DNS using UDP sockets.
5. Write a code simulating ARP /RARP protocols.
6. Write a program to implement RPC (Remote Procedure Call)
7. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
8. Study of TCP/UDP performance using Simulation tool.
9. Simulation of error correction code (like CRC).
10. Performance evaluation of Routing protocols using Simulation tool.
11. Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer**.**
    a) Link State routing
    b) Flooding
    c) Distance vector

TOTAL: 60 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

1. Windows 7 or higher
2. C / C++ / Java / Python / Equivalent Compiler
3. Network simulator like NS2/Glomosim/OPNET/ Packet Tracer / Equivalent

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : NETWORKS LABORATORY		Course Code : 20CS5L1			
CO	**Course Outcomes**	**Exp**	**K-CO**	**POs**	**PSOs**
C307.1	Demonstrate the different Network Commands	1	K3	1,2,3,8,9,10	1,2
C307.2	Develop Simple Socket Programming	2,3,4	K3	1,2,3,8,9,10	1,2
C307.3	Develop the code for Data Link Layer Protocol Simulation	5,6	K3	1,2,3,8,9,10	1,2
C307.4	Examine Congestion Control Algorithm using Network Simulator	7	K4	1,2,3,4,8,9,10	1,2
C307.5	Develop the code for Transport Layer Protocol Simulation	8,9	K3	1,2,3,8,9,10	1,2
C307.6	Illustrate the performance of various network Routing Protocols	10,11	K4	1,2,3,4,8,9,10	1,2

CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C307.1	3	2	1	-	-	-	-	2	2	3	-	-	2	2
C307.2	3	2	1	-	-	-	-	2	2	3	-	-	2	2
C307.3	3	2	1	-	-	-	-	2	2	3	-	-	2	2
C307.4	3	3	2	1	-	-	-	2	2	3	-	-	2	2
C307.5	3	2	1	-	-	-	-	2	2	3	-	-	2	2
C307.6	3	3	2	1	-	-	-	2	2	3	-	-	2	2
C307	3	3	1	1	-	-	-	2	2	3	-	-	2	2

SEMESTER VI

20CS602	**CRYPTOGRAPHY AND NETWORK SECURITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To understand OSI security architecture and classical encryption techniques.
- To understand the Symmetric cryptography techniques.
- To understand the public key cryptography Systems.
- To understand the various message authentication functions.
- To understand the different level of security and services.

PRE-REQUISITE:

Course Code : 20CS501
Course Name : Computer Networks

UNIT – I INTRODUCTION 10

Security trends - Legal, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

UNIT – II SYMMETRIC CRYPTOGRAPHY 8

Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic-Euclid‘s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.

UNIT – III PUBLIC KEY CRYPTOGRAPHY 9

Mathematics Of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler‘s totient function, Fermat‘s and Euler‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT – IV MESSAGE AUTHENTICATION AND INTEGRITY 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509

UNIT – V SECURITY PRACTICE AND SYSTEM SECURITY 9

Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – Malware, Ransomware – Viruses – Firewalls.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 7th Edition, 2017.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2nd Edition 2017.

REFERENCES:

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
4. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000
5. Bruce Schneier and Neils Ferguson, "Practical Cryptography", First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
6. Douglas R Simson "Cryptography – Theory and practice", First Edition, CRC Press, 1995.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CRYPTOGRAPHY AND NETWORK SECURITY		**Course Code : 20CS602**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C312.1	Describe the fundamental theory of cryptography and OSI security architecture in networks.	1	K2	1,2	1,2
C312.2	Apply the classical encryption techniques for network security.	1	K3	1,2,3,8,9,10,12	1,2
C312.3	Illustrate the different cryptographic operations of symmetric cryptographic algorithms	2	K3	1,2,3,8,9,10,12	1,2
C312.4	Illustrate the different cryptographic operations of public key cryptography	3	K3	1,2,3,8,9,12	1,2
C312.5	Apply the various security mechanisms to build different Authentication services.	4	K3	1,2,3,8,9,12	1,2
C312.6	Explain the various Security practices and System security standards.	5	K2	1,2,8,9,10,12	1,2

CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C312.1	2	1	-	-	-	-	-	-	-	-	-	-	3	2
C312.2	3	2	1	-	-	-	-	1	1	1	-	1	3	2
C312.3	3	2	1	-	-	-	-	1	1	1	-	1	3	2
C312.4	3	2	1	-	-	-	-	1	1	-	-	1	3	2
C312.5	3	2	1	-	-	-	-	1	1	-	-	1	3	2
C312.6	2	1	-	-	-	-	-	1	1	1	-	1	3	2
C312	3	2	1	-	-	-	-	1	1	1	-	1	3	2

20CS603	COMPILER DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the various phases of compiler.
- To learn the various parsing techniques.
- To understand intermediate code generation and run-time environment.
- To learn to implement front-end of the compiler.
- To learn to implement code generator.

PRE-REQUISITE:

Course Code : 20CS503
Course Name : Theory of Computation

UNIT – I INTRODUCTION TO COMPILERS 9

Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.

UNIT – II SYNTAX ANALYSIS 12

Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar – Top Down Parsing - General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR(0) Item - Construction of SLR Parsing Table -Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC.

UNIT – III INTERMEDIATE CODE GENERATION 8

Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

UNIT – IV RUN-TIME ENVIRONMENT AND CODE GENERATION 8

Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management - Issues in Code Generation - Design of a simple Code Generator.

UNIT – V CODE OPTIMIZATION 8

Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks-Global Data Flow Analysis - Efficient Data Flow Algorithm.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles,Techniques and Tools, Second Edition, Pearson Education, 2013.
2. V. Raghavan, Principles of Compiler Design, Tata McGraw Hill Education Publishers, 2010.

REFERENCES

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. Allen I. Holub, Compiler Design in C, Prentice-Hall Software Series, 1993.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : COMPILER DESIGN		Course Code : 20CS603			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C313.1	Construct lexical analyzer for a sample language.	1	K3	1,2,3,8,9	1,2
C313.2	Apply different parsing algorithms to develop the parsers for a given grammar.	2	K3	1,2,3,8,9, 10,12	1,2
C313.3	Describe the syntax-directed translation and run-time environment.	2	K2	1,2,8,9	1,2
C313.4	Develop code optimization techniques for source program.	3	K3	1,2,3,8,9, 10,12	1,2
C313.5	Build a simple code generator for source program.	4	K3	1,2,3,8,9	1,2
C313.6	Develop a scanner and a parser using LEX and YACC tools.	5	K3	1,2,3,8,9, 10,12	1,2

CO-PO Mappinng

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C313.1	3	2	1	-	-	-	-	2	2	-	-	-	3	1
C313.2	3	2	1	-	-	-	-	2	2	1	-	1	3	1
C313.3	2	1	-	-	-	-	-	2	2	-	-	-	3	1
C313.4	3	2	1	-	-	-	-	2	2	1	-	1	3	1
C313.5	3	2	1	-	-	-	-	2	2	1	-	1	3	1
C313.6	3	2	1	-	-	-	-	2	2	-	-	-	3	1
C313	3	2	1	-	-	-	-	2	2	1	-	1	3	1

20CS604	MACHINE LEARNING	L	T	P	C
		3	0	2	4

OBJECTIVES:

- 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.

PRE-REQUISITE: NIL

UNIT - I SUPERVISED LEARNING: REGRESSION **9**

Paradigms of Machine Learning - Examples- Types of Learning - Types of supervised learning - Introduction to Regression - Linear regression - Geometrical Interpretation - Iterative solution: Gradient descent - Performance metrics of machine learning - Python libraries suitable for Machine Learning.

LAB COMPONENT

1. Installing Anaconda-Jupiter Notebook-Learn Python ML Packages.
2. Implement data loading methods - understanding data with statistics, visualization - Data Preprocessing - Data Labeling. **6**

UNIT - II SUPERVISED LEARNING: CLASSIFICATION **9**

K-Nearest Neighbour Classification - Distance metric and Cross-Validation - Computational efficiency of KNN - Introduction to Decision Trees - Entropy and Information Gain - Naive Bayes classifier - Perceptron and its learning algorithm - Support Vector Machine.

LAB COMPONENT

3. Logistic Regression Implementation: Implement the standard Logistic Regression model generally used for classifying data into binary classes such as pass/fail, win/lose, alive/dead or healthy/sick.
4. Decision Tree Implementation: Implement the standard Decision Tree Class used for classifying data into various classes using a tree-like model of decisions and their possible consequences. **6**

UNIT - III UNSUPERVISED LEARNING **9**

K-means Clustering - LLyod's Algorithms - Convergence and Initialization - Covariance Matrix and Eigen direction - PCA

LAB COMPONENT

5. Tumor Prediction: Detect Brain tumor images from the given data set.
6. Dimensionality Reduction: Analyze PCA for the appropriate data set. **6**

UNIT - IV RECOMMENDER SYSTEMS **9**

Recommender Systems - Introduction - Non-Personalized Recommender Systems - Content-Based Recommender Systems - Recommender System Evaluation.

LAB COMPONENT

7. Movie/Book/Any Product recommendation by using content based filtering. **6**

UNIT - V CASE STUDIES **9**

Text Classification: Build a classifier model using Naive Bayes algorithm to predict the topic of an article present in a newspaper. **Twitter Sentiment Analysis:** Analyse the tweets posted on twitter to predict the sentiment of the tweet i.e. positive, negative or neutral.

LAB COMPONENT

8. Mini Project **6**

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, “Mathematics for Machine Learning”, Cambridge University Press, 2020.
2. Gopal sakarkar, gaurav patil and prateek dutta, “Machine Learning Algorithms using Python Programming”, Nova Science Publishers, Newyork, 2021.

REFERENCES:

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, CRC Press, 2009.
3. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
4. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press, 2004.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MACHINE LEARNING					**Course Code : 20CS604**
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C316.1	Identify the category of the learning problem, and measure its performance like recall, precision etc.	1	K3	1,2,3,8,9,10,12	1,2
C316.2	Apply the classification algorithms like K-NN, Decision Tree, Naive Bayes, Logistic Regression to label the data set.	2	K3	1,2,3,8,9,10,12	1,2
C316.3	Apply unsupervised algorithms namely K-means and PCA to cluster the given data set.	3	K3	1,2,3,8,9,10,12	1,2
C316.4	Apply Content-based recommender systems and Collaborative Filtering to implement recommender systems.	4	K3	1,2,3,8,9,10,12	1,2
C316.5	Identify any societal problem and examine by applying acquired knowledge of machine learning in order to develop a mini project	5	K4	1,2,3,4,6,8,9,10,11, 12	1,2
C316.6	Combine all the modules of mini project through effective team work after efficient testing, and compile a detailed report.	5	K4	1,2,3,4,5,8,9,10, 11, 12	1,2

CO – PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C316.1	3	2	1	-	-	-	-	2	2	2	-	2	3	1
C316.2	3	2	1	-	-	-	-	2	2	2	-	2	3	1
C316.3	3	2	1	-	-	-	-	2	2	2	-	2	3	1
C316.4	3	2	1	-	-	-	-	2	2	2	-	2	3	1
C316.5	3	3	2	1	-	1	-	2	2	2	1	2	3	1
C316.6	3	3	2	1	1	-	-	2	2	2	1	2	3	1
C316	3	2	1	1	1	1	-	2	2	2	1	2	3	1

20CS605	WEB TECHNOLOGY	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To be familiar with web pages design using HTML, XML, Style Sheets.
- To be exposed to creation of user interfaces using Java Frames & Applets.
- To be able to create dynamic web pages using server side scripting.
- To learn to write server side applications.
- To be familiar with PHP & AJAX programming

PRE-REQUISITE: NIL

UNIT – I WEBSITE BASICS, HTML 5, CSS 9

Web Essentials: Clients, Servers and Communication – The Internet – HTML5 – Tables – Lists – Image – HTML5 control elements –Drag and Drop – Audio – Video controls - CSS – Inline, embedded and external style sheets

LAB COMPONENT 6

1. Create Simple website with 5 pages (Home, About, Gallery, Course, Contact). Gallery and contact page with contact us form is must.
2. Create a web page with the following using HTML
   i) To embed an image map in a web page ii) To fix the hot spots iii) Show all the related information when the hot spots are clicked.
3. Create a web page with all types of Cascading style sheets.

UNIT - II CLIENT SIDE PROGRAMMING 9

Java Script: An introduction to JavaScript, Regular Expressions - Exception Handling - Validation-Built-in objects-Event Handling-DHTML with JavaScript.

LAB COMPONENT 6

1. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
2. Client Side Scripts for Validating Web Form Controls using DHTML

UNIT - III JAVA, JAVA SERVLET, JSP 9

Applet : Graphics programming- Frame — Components- layout management, Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions – Database Connectivity: JDBC program example – JSP: -Creating HTML forms by embedding JSP code.

LAB COMPONENT 6

1. Write programs in Java to create applets incorporating the following features Create a color palette with matrix of buttons Set background and foreground of th control text area by selecting a color from color palette. In order to select Foreground c background use check box control as radio buttons To set background images
2. Write programs in Java using Servlets: To invoke servlets from HTML forms To invok servlets from Applets.
3. Write programs in Java to create three-tier applications using JSP and Databases fo conducting on-line examination for displaying student mark list. Assume that studer information is available in database which has been stored in a database server.

UNIT - IV PHP and XML 9

An introduction to PHP- Built-in functions-Form Validation- Regular Expressions - File handling – Cookies - Connecting to Database.

XML: Basic XML- Document Type Definition- XML Parsers and Validation, XSL and XSLT Transformation.

LAB COMPONENT 6

1. Programs using XML – Schema – XSLT/XSL
2. Programs using PHP for real time applications

UNIT - V AJAX AND WEB SERVICES 9

AJAX: Ajax Client Server Architecture-XML Http Request Object, Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL) - Consuming a web service.

LAB COMPONENT 6

1. Programs using AJAX .
2. Consider a case where we have two web Services- an airline service and a travel agent and the travel agent is searching for an airline. Implement this scenario using Web Services and Data base

TOTAL: 75 PERIODS

TEXT BOOKS:

1. Deitel and Deitel and Nieto, — Internet and World Wide Web - How to Program,Prentice Hall, 5th Edition, 2011.

REFERENCES:

1. Stephen Wynkoop and John Burke —Running a Perfect Website, QUE, 2nd Edition,1999.
2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
3. Jeffrey C and Jackson, —Web Technologies A Computer Science Perspective, Pearson Education, 2011.
4. Gopalan N.P. and Akilandeswari J., —Web Technology, Prentice Hall of India, 2011.
5. UttamK.Roy, —Web Technologies, Oxford University Press, 2011.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : WEB TECHNOLOGY		Course Code : 20CS605			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Use HTML / CSS tag to create static and dynamic web pages	1	K3	1,2,3,5,8,9,10,12	2
CO2	Apply the Java script to design a simple application and form validation	2	K3	1,2,3,5,8,9,10,12	2
CO3	Explain the Java Servlet architecture and database connectivity	3	K2	1,2,8,9,10	2
CO4	Build an applications using server side script languages	3	K3	1,2,3,5,8,9,10,12	2
CO5	Develop web related applications using PHP and XML	4	K3	1,2,3,5,8,9,10,12	2
CO6	Develop an interactive web service using AJAX	5	K3	1,2,3,5,8,9,10,12	2

CO – PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	2	-	-	2	2	2	-	2	-	2
CO2	3	2	1	-	2	-	-	2	2	2	-	2	-	2
CO3	2	1	-	-	-	-	-	2	2	2	-	-	-	2
CO4	3	2	1	-	2	-	-	2	2	2	-	2	-	2
CO5	3	2	1	-	2	-	-	2	2	2	-	2	-	2
CO6	3	2	1	-	2	-	-	2	2	2	-	2	-	2
C	3	2	1	-	2	-	-	2	2	2	-	2	-	2

20MC801	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	--

OBJECTIVES:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

UNIT – I INTRODUCTION 6

Disaster: Definition, Factors and Significance, Difference between Hazard and Disaster.

Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT – II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines,Landslides and Avalanches.

Man-made Disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Out breaks of Disease and Epidemics, War and Conflicts.

UNIT – III DISASTER PRONE AREAS IN INDIA 6

Disaster Prone are as in India: Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post – Disaster Diseases and Epidemics.

UNIT – IV DISASTER PREPAREDNESS AND MANAGEMENT 6

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard.

Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies.

Media Reports: Governmental and Community Preparedness.

UNIT - V RISK ASSESSMENT 6

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co - Operation In Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

TOTAL: 30 PERIODS

REFERENCES:

1. Nishith Rai and A.K. Singh, "Disaster Management in India: Perspectives, Issues and Strategies", New Royal Book Company, 2007.
2. Pardeep Sahni, Alka Dhameja and Uma Medury, "Disaster Mitigation: Experiences and Reflections", Prentice Hall India Learning Private Limited, 2001.
3. S.L.Goel,"Disaster Administration and Management: Text and Case Studies",Deep & Deep Publication Pvt.Ltd., 2007

20CS6L1	MOBILE APPLICATION DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the components and structure of mobile application development frameworks for Android OS based mobiles.
- To understand how to work with various mobile application development frameworks.
- To learn the basic and important design concepts and issues of development of mobile applications.
- To understand the capabilities and limitations of mobile devices

LIST OF EXPERIMENTS

1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers and event listeners.
3. Develop an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases.
5. Develop an application that makes use of Notification Manager
6. Implement an application that uses Multi-threading
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Write a mobile application that creates alarm clock
10. Write a mobile application that makes use of RSS feed
11. Develop a mobile application to send an email.
12. Develop a Mobile application for simple needs (Mini Project)

TOTAL: 60 PERIODS

LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:

C / C++ / Java or equivalent compiler GnuPG, Snort, N-Stalker or Equivalent
HARDWARE**:** Standalone desktops - 30 Nos. (or) Server supporting 30 terminals or more.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Mobile Application Development Laboratory		**Course Code : 20CS6L1**			
CO	**Course Outcomes**	**EXP**	**K-CO**	**POs**	**PSOs**
C317.1	Develop mobile applications using GUI and Layouts.	1,2	K3	1,2,3,8,9,10,12	1,2
C317.2	Develop mobile applications using Event Listener.	2,3	K3	1,2,3,8,9,10,12	1,2
C317.3	Develop mobile applications using Databases.	4	K3	1,2,3,8,9,10,12	1,2
C317.4	Develop mobile applications using Notification Manager	5	K3	1,2,3,8,9,10,12	1,2
C317.5	Develop mobile applications using RSS Feed, Internal/External Storage, SMS, Multi- threading and GPS.	6,7,8	K3	1,2,3,8,9,10,12	1,2
C317.6	Create own mobile app for simple needs	9-12	K6	1,2,3,4,5,6,8,9, 10,11,12	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C317.1	3	2	1	-	-	-	-	2	2	3	-	1	2	3
C317.2	3	2	1	-	-	-	-	2	2	3	-	1	2	3
C317.3	3	2	1	-	-	-	-	2	2	3	-	1	2	3
C317.4	3	2	1	-	-	-	-	2	2	3	-	1	2	3
C317.5	3	2	1	-	-	-	-	2	2	3	-	2	2	3
C317.6	3	3	2	1	1	1	-	2	3	3	1	3	2	3
C317	3	2	1	1	1	1	-	2	2	3	1	2	2	3

20CSV11	CLOUD COMPUTING TECHNIQUES	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

PRE-REQUISITE: NIL

UNIT - I CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE 6

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing
Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges.

LAB COMPONENT: 6

1. Install Virtualbox /VMware / Equivalent open source cloud Workstation with different flavours of Linux or Windows OS on top of windows 8 and above.

UNIT - II VIRTUALIZATION BASICS 6

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts – Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

LAB COMPONENT: 6

1. Install a C compiler in the virtual machine created using a virtual box and execute Simple Programs

UNIT - III VIRTUALIZATION INFRASTRUCTURE AND DOCKER 6

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating
Virtualization – Application Virtualization – Virtual clusters and Resource Management – Containers
vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker
Images and Repositories.

LAB COMPONENT: 6

1. Find a procedure to transfer the files from one virtual machine to another virtual machine.
2. Creating and Executing Your First Container Using Docker.

UNIT - IV CLOUD DEPLOYMENT ENVIRONMENT 6

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments – Eucalyptus
– OpenStack.

LAB COMPONENT: 6

1. Install Google App Engine. Create a hello world app and other simple web applications using python/java.
2. Use the GAE launcher to launch the web applications.

UNIT - V CLOUD SECURITY 6

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architectureand Practice.

LAB COMPONENT: **6**

1. Install Hadoop single node cluster and run simple applications like word count.
2. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.

TOTAL: 60 PERIODS

TEXT 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.
2. James Turnbull, "The Docker Book", O'Reilly Publishers, 2014.
3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 2010.

REFERENCES:

1. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc., 2009..

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Cloud Computing Techniques		**Course Code : 20CSV11**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Describe the cloud architecture, cloud deployment & service models and challenges of cloud design	1	K2	1,2,8,9	1,2
CO2	Apply the concept of virtualization and its types	2	K3	1,2,8,9	1,2
CO3	Experiment with virtualization of hardware resources	3	K2	1,2,8,9	1,2
CO4	Use Docker in cloud environment	3	K3	1,2,8,9	1,2
CO5	Develop and deploy services on the cloud and set up a cloud environment	3	K3	1,2,8,9	1,2
CO6	Explain security challenges in the cloud environment	4	K2	1,2,8,9	1,2

CO-PO Mapping

COs	**PO 1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**
CO1	2	1	-	-	-	-	-	1	1	-	-	-	2	2
CO2	3	2	1	-	-	-	-	1	1	1	-	-	2	2
CO3	2	1	-	-	1	-	-	1	1	1	-	-	2	2
CO4	3	2	1	-	1	-	-	1	1	1	-	-	2	2
CO5	3	2	1	-	1	-	-	1	1	1	-	-	2	2
CO6	2	1	-	-	-	-	-	1	1	-	-	-	2	2

20CSV21	DATA WAREHOUSING AND DATA MINING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- 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.

PRE-REQUISITE:

Course Code : 20CS402
Course Name : Database Management Systems

UNIT - I DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING (OLAP) 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 - II DATA MINING - INTRODUCTION 9

Introduction– Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns. 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 - III 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 - IV CLASSIFICATION AND CLUSTERING 9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines —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

UNIT - V DATA MINING TOOLS 9

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database – Data mining tools: WEKA, Hadoop, Spark, R tool – Learning algorithms, Clustering algorithms, Association–rule learners.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2. Alex Berson and Stephen J.Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition, 5th Reprint 2016.

REFERENCES:

1. K.P. Soman, Shyam Diwakar and V. Ajay, Insight into Data Mining Theory and Practice, Eastern Economy Edition, Prentice Hall of India, 2006.
2. Ian H.Witten and Eibe Frank, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, Second Edition.
3. Daniel T.Larose, “Data Mining Methods and Models”, Wiley-Interscience, 2006.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DATA WAREHOUSING AND DATA MINING		Course Code : 20CSV21			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss data warehouse system and business analysis with OLAP tools	1	K2	1,2	1,2
CO2	Describe various pre-processing and visualization techniques for data analysis	2	K2	1,2,8,9,10	1,2
CO3	Apply frequent pattern and association rule mining techniques	3	K3	1,2,3,8,9,10	1,2
CO4	Select and apply an appropriate classification algorithm for labeled data	4	K3	1,2,3,8,9,10, 12	1,2
CO5	Apply various clustering techniques for unlabeled data	4	K3	1,2,3,8,9,10, 12	1,2
CO6	Apply learning and clustering algorithms using data mining tools	5	K3	1,2,3,8,9,10, 12	1,2

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	2	1
CO2	2	1	-	-	-	-	-	1	1	-	-	-	2	1
CO3	3	2	1	-	-	-	-	1	1	1	-	-	2	1
CO4	3	2	1	-	-	-	-	1	1	1	-	1	2	1
CO5	3	2	1	-	-	-	-	1	1	1	-	1	2	1
CO6	3	2	1	-	-	-	-	1	1	1	-	1	2	1

20CSV31	CLOUD SERVICE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

PRE-REQUISITE : NIL

UNIT - I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT - II CLOUD SERVICES STRATEGY 9

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT - III CLOUD SERVICE MANAGEMENT 9

Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT - IV CLOUD SERVICE ECONOMICS 9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT - V CLOUD SERVICE GOVERNANCE & VALUE 9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES:

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CLOUD SERVICE MANAGEMENT		Course Code : 20CSV31			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the fundamentals of cloud service management	1	K2	1,2	2
CO2	Describe the cloud service strategies like cloud policy, risk management and change management etc.,	2	K2	1,2,8,9	2
CO3	Explain the life cycle and benchmarks of cloud services	3	K2	1,2,8,9	2
CO4	Illustrate deployment and migration of cloud services	3	K2	1,2,8,9	2
CO5	Discuss the economic based cloud services	4	K2	1,2,8,9,10	2
CO6	Explain the strong theoretical foundation leading to cloud service governance & measuring the value of cloud-based services	5	K2	1,2,8,9,10	2

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	1	-	-	-	-	-	1	1	-	-	-	-	2
CO3	2	1	-	-	-	-	-	1	1	-	-	-	-	2
CO4	2	1	-	-	-	-	-	1	1	-	-	-	-	2
CO5	2	1	-	-	-	-	-	1	1	1	-	-	-	2
CO6	2	1	-	-	-	-	-	1	1	1	-	-	-	2

20CSV41	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To learn the fundamentals of software defined networks.
2. To understand the separation of the data plane and the control plane.
3. To study about the SDN Programming.
4. To study about the various applications of SDN

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO SOFTWARE DEFINED NETWORK 9

SDN Origins and Evolution – Introduction – Why SDN? - Centralized and Distributed Control and Data Planes - The Genesis of SDN

UNIT - II OPEN FLOW AND SDN CONTROLLERS 9

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via HypervisorBased Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts.

UNIT - III DATA CENTERS 9

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

UNIT - IV 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 - V SDN FRAMEWORK 9

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Paul Goransson and Chuck Black, Software Defined Networks: A Comprehens Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013

REFERENCES:

1. SiamakAzodolmolky, Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. Vivek Tiwari, SDN and Open Flow for Beginnersǁ, Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : Software Defined Networks		**Course Code : 20CSV41**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the key benefits of SDN by separation of Data and Control Planes.	1	K2	1, 2, 8, 9	1
CO2	Discuss the openflow specification and different controllers of SDN.	2	K2	1, 2, 8, 9	1
CO3	Describe various Data centers and SDN solutions for the Data Center networks.	3	K2	1, 2,8, 9	1
CO4	Develop various applications of SDN using current languages and tools.	4	K3	1, 2, 3, 8, 9	1
CO5	Explain the various concepts of Network function virtualization in SDN programming.	4	K2	1, 2, 8, 9	1
CO6	Explain different framework and controller used in SDN	5	K2	1, 2,8,9	1

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	1	1	1	-	-	2	-
CO2	2	1	-	-	-	-	-	1	1	1	-	-	2	-
CO3	2	1	-	-	-	-	-	1	1	1	-	-	2	-
CO4	3	2	1	-	-	-	-	1	1	1	-	-	2	-
CO5	3	2	-	-	-	-	-	1	1	1	-	-	2	-
CO6	3	2	-	-	-	-	-	1	1	1	-	-	2	-

		L	T	P	C
20ADV51	STORAGE TECHNOLOGIES	3	0	0	3

OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

PRE-REQUISITE: NIL

UNIT - I STORAGE SYSTEMS **9**

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. Data Center Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT - II INTELLIGENT STORAGE SYSTEMS AND RAID **5**

Components of an intelligent storage system, Components, addressing, and performance of hard
disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale out storage Architecture.

UNIT- III STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION **13**

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol,connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture.

UNI - IV BACKUP, ARCHIVE AND REPLICATION **12**

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT - V SECURING STORAGE INFRASTRUCTURE **6**

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes.

TOTAL: 45 PERIODS

OUTCOMES:
On Completion of the course, the students should be able to:

CO1: Demonstrate the fundamentals of information storage management and various models of
Cloud infrastructure services and deployment
CO2: Illustrate the usage of advanced intelligent storage systems and RAID
CO3: Identify various storage networking architectures - SAN
CO4: Apply storage subsystems and Virtualization
CO5: Examine the different role in providing disaster recovery and remote replication technologies
CO6: Infer the security needs and security measures to be employed in information

TEXT BOOKS

1. EMC Corporation, Information Storage and Management, Wiley, India
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas,

REFERENCES:

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

20CSV61	INFORMATION RETRIEVAL TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Information Retrieval.
- To understand machine learning techniques for text classification and clustering.
- To understand various search engine system operations.
- To learn different techniques of recommender system.

PRE-REQUISITE:NIL

UNIT - I INTRODUCTION **9**

Information Retrieval – Early Developments – The IR Problem – The User s Task – Information versus Data Retrieval - The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes - The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces.

UNIT - II MODELING AND RETRIEVAL EVALUATION **9**

Basic IR Models - Boolean Model - TF-IDF (Term Frequency/Inverse Document Frequency) Weighting - Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.

UNIT - III TEXT CLASSIFICATION AND CLUSTERING **9**

A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing.

UNIT - IV WEB RETRIEVAL AND WEB CRAWLING **9**

The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations -- Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

UNIT - V RECOMMENDER SYSTEM **9**

Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighborhood models.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ricardo BaezaYates and Berthier RibeiroNeto, Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
2. Ricci, F, Rokach, L. Shapira, B.Kantor, Recommender Systems Handbook, First Edition, 2011.

REFERENCES:

1. C. Manning, P. Raghavan, and H. Schütze, Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : INFORMATION RETRIEVAL TECHNIQUES												**Course Code : 20CSV61**		
CO	**Course Outcomes**											**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the IR components and Web Search Engine Framework											1	K2	1, 2, 8, 9	1,2
CO2	Discuss various information retrieval models											2	K2	1, 2,8,9	1,2
CO3	Apply appropriate method of classification or clustering											3	K3	1, 2, 3, 8,9	1,2
CO4	Explain the Web Search Engine architecture and ranking functions											4	K2	1, 2,8,9	1,2
CO5	Discuss Web Link Analysis algorithms and advanced search											4	K2	1, 2,8,9	1,2
CO6	Illustrate recommendation techniques and develop content-based Recommender Systems											5	K3	1, 2, 3,5, 8,9	1,2
CO-PO Mapping															
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	
CO1	2	1	-	-	-	-	-	1	1	-	-	2	2	2	
CO2	2	1	-	-	-	-	-	1	1	-	-	2	2	2	
CO3	3	2	1	-	-	-	-	1	1	-	-	2	2	2	
CO4	2	1	-	-	-	-	-	1	1	-	-	2	2	2	
CO5	2	1	-	-	-	-	-	1	1	-	-	2	2	2	
CO6	3	2	1	-	1	-	-	1	1	-	-	2	2	2	
C	2	2	1	-	1	-	-	1	1	-	-	2	2	2	

20SCV71	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

PRE-REQUISITE:NIL

UNIT - I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 9

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography, hash functions, authentication, and digital signatures.

UNIT - II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD 9

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key.

UNIT - III ACCESS CONTROL AND IDENTITY MANAGEMENT 9

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention.

UNIT - IV CLOUD SECURITY DESIGN PATTERNS 9

Introduction to Design Patterns, Cloud bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud.

UNIT - V MONITORING, AUDITING AND MANAGEMENT 9

Proactive activity monitoring - Incident Response, Monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Raj Kumar Buyya , James Broberg, AndrzejGoscinski, “Cloud Computing": Wiley 2013
2. Dave shackleford, “Virtualization Security", SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, “Cloud Security and Privacy", OREILLY 2011

REFERENCES:

1. Mark C. Chu-Carroll “Code in the Cloud",CRC Press, 2011
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SECURITY AND PRIVACY IN CLOUD		Course Code : 20SCV71			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the fundamental concepts of cloud security	1	K2	1,2,8,9	1,2
CO2	Illustrate the various cloud security design for cloud	2	K2	1,2,8,9	1,2
CO3	Apply data protection strategies for cloud	2	K3	1,2,5,8,9,10	1,2
CO4	Identify the cloud requirements, storage and network access control options	3	K2	1,2,8,9	1,2
CO5	Explain the different types of architectural and design considerations for security in the cloud.	4	K2	1,2,8,9	1,2
CO6	Explain the various risks, audit and monitoring mechanisms in the cloud.	5	K2	1,2,8,9	1,2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	-	-	-	1	1
CO2	2	1	-	-	-	-	-	1	1	-	-	-	1	1
CO3	3	2	1	-	1	-	-	1	1	-	-	-	1	1
CO4	2	1	-	-	-	-	-	1	1	-	-	-	1	1
CO5	2	1	-	-	-	-	-	1	1	-	-	-	1	1
CO6	2	1	1	-	-	-	-	1	1	-	-	-	1	1
C	2	1	1	-	1	-	-	1	1	-	-	-	1	1

20ITV81	REINFORCEMENT LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

Objectives :

- To introduce the fundamentals of Reinforcement Learning
- To illustrate model-based prediction and control using dynamic programming
- To illustrate model-free prediction and control
- To introduce planning and learning with tabular methods
- To explain approximation of a value function

PRE-REQUISITE: NIL

UNIT I INTRODUCTION **9**

Introduction to Reinforcement learning, examples - Elements of reinforcement learning - Limitations and Scope- An extended example - multi-armed bandits - k-armed bandit problem - action-value methods - the 10-armed testbed - incremental implementation - tracking a nonstationary problem - optimistic initial values - upper-confidence-bound action selection - associative search

UNIT II MARKOV DECISION PROCESS AND MODEL-BASED PREDICTION AND CONTROL **9**

Finite Markov Decision Process - The Agent–Environment Interface - Goals and Rewards - Returns and Episodes - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - Optimal Policies and Optimal Value Functions - Optimality and Approximation - Dynamic Programming - Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration - Generalized Policy Iteration - Efficiency of Dynamic Programming - Asynchronous Dynamic Programming

UNIT III MODEL-FREE PREDICTION AND CONTROL **9**

Model-free learning - Model-free prediction - Monte Carlo methods - Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Temporal-Difference Learning - TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - n-step Bootstrapping - n-step TD Prediction - n-step Sarsa - Model-free control - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off policy learning - Importance sampling - Off-policy Monte Carlo Control - Sarsa: On-policy TD Control - Q-learning: Off-policy TD control

UNIT IV PLANNING AND LEARNING WITH TABULAR METHODS **9**

Models and planning - Dyna: Integrated Planning, Acting and Learning - When the model is wrong - Prioritized Sweeping - Real-time Dynamic Programming - Monte Carlo Tree Search

UNIT V VALUE FUNCTION APPROXIMATION **9**

On-policy Prediction with Approximation - Value Function Approximation - The Prediction Objective (VE) - Stochastic-gradient and Semi-gradient Methods - Linear Methods - Least-Squares TD.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An introduction, 2nd edition, The MIT Press, 2015.
2. Martijn van Otterlo, Marco Wiering, Reinforcement Learning: State-of-the-Art, Springer Verlag Berlin Heidelberg, 2012.
3. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd edition, Pearson, 2015.

REFERENCES:

1. Good fellow, Y. Bengio, A. Courville, Deep Learning, MIT Press Ltd., 2016.
2. Reinforcement Learning with MATLAB, Math Works Inc., 2020.

20CSV12	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

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PRE-REQUISITE:

Course Code **:**20CS501
Course Name :Computer Networks

UNIT - I INTRODUCTION 9

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

UNIT - II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION 9

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

UNIT - III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS 9

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

UNIT - IV PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES 9

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

UNIT - V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Peter Mika, Social Networks and the Semantic Webll, First Edition, Springer 2007.
2. BorkoFurht, Handbook of Social Network Technologies and Applicationsll, 1st Edition, Springer, 2010.

REFERENCES:

1. GuandongXu ,Yanchun Zhang and Lin Li, Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling, IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, The Social Semantic Web, Springer, 2009.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOCIAL NETWORK ANALYSIS		**Course Code : 20CSV12**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the semantic web concepts and applications of social network analysis.	1	K2	1, 2, 8,9	2
CO2	Discuss about modeling and knowledge representation using ontology of social network.	2	K2	1, 2, 8,9	2
CO3	Illustrate the extraction and mining communities in web social networks.	3	K2	1, 2, 8,9	2
CO4	Illustrate the various methods for predicting human behaviour in social communities.	4	K2	1, 2, 8,9	2
CO5	Describe the privacy issues in trust network analysis.	4	K2	1, 2, 8,9	2
CO6	Make use of visualization techniques for social network applications	5	K3	1, 2, 3, 8,9	2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	1	1	-	-	-	2	2
CO2	2	1	-	-	-	-	-	1	1	-	-	-	2	2
CO3	2	1	-	-	-	-	-	1	1	1	-	-	2	2
CO4	2	1	-	-	-	-	-	1	1	-	-	-	2	2
CO5	2	1	-	-	-	-	-	1	1	-	-	-	2	2
CO6	3	2	1	-	-	-	-	1	1	1	-	-	2	2
C	2	1	1	-	-	-	-	1	1	1	-	-	2	2

20ITV22	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the nature of continuous and discrete systems
- To develop synchronous and asynchronous model of processes
- To specify both safety and liveness requirements in temporal logic
- To debug the correctness of the protocol using model checking
- To develop and analyze model of timed and hybrid systems
- To understand zero behaviors and its hybrid automata

PRE-REQUISITE: NIL

UNIT I INTRODUCTION 9

Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanics- actor models-properties of systems-feedback control-Discrete dynamics: Discrete systems- Finite state machines

UNIT II SYNCHRONOUS AND ASYNCHRONOUS MODEL 9

Synchronous model: Reactive components-properties of components-composing components- synchronous design, Asynchronous model- asynchronous processes-asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT 9

Safety specifications- verifying invariants- Enumerative search- Temporal logic- Model checking- reachability analysis- proving liveness

UNIT IV TIMED MODEL AND REAL-TIME SCHEDULING 9

Timed processes- Timing based protocols: Timing-Based Distributed Coordination-Audio Control Protocol- Timed automata: Model of Timed Automata-Region Equivalence-Matrix-Based Representation for Symbolic Analysis, Real-time scheduling.

UNIT V HYBRID SYSTEMS 9

Classes of Hybrid Systems-Hybrid dynamic models: Hybrid Processes-Process Composition-Zeno Behaviors-Stability- designing hybrid systems- linear hybrid automata

TOTAL: 45 PERIODS

TEXT BOOKS

1. Rajeev Alur, Principles of cyber-physical systems, The MIT press, 2015
2. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Lulu.com, Second Edition, 2015.

REFERENCE:

1.Sang C.Suh , U.JohnTanik and John N.Carbone , Applied Cyber-Physical systems, Springer,2014

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CYBER PHYSICAL SYSTEMS											**Course Code : 20ITV22**			
CO	**Course Outcomes**									**Unit**	**K-CO**	**POs**		**PSOs**
CO1	Ability to understand knowledge, opportunities, challenges and Logical Foundations of Cyber Physical Systems.									1	K2	1, 2, 8, 9		1,2
CO2	Ability to develop model for synchronous, asynchronous, continuous and discrete systems.									2	K2	1, 2, 8,9,10		1,2
CO3	Ability to identify safety specifications and critical properties of Cyber Physical Systems.									3	K2	1, 2, 5, 8, 9		1,2
CO4	Ability to design and analyze the stability of hybrid systems.									4	K2	1, 2, 5, 8, 9,10		1,2
CO5	Ability to apply automata for timed systems.									5	K2	1, 2, 5, 8, 9		1.2
CO6	Ability to understand Zeno Behaviors									5	K2	1, 2, 5, 8, 9		1,2
CO-PO Mapping														
CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2	1			-	-	-	1	1		-	-	1	1
CO2	2	1			-	-	-	1	1	1	-	-	1	1
CO3	2	1			1	-	-	1	1	-	-	1	1	1
CO4	2	1			1	-	-	1	1	1	-	1	1	1
CO5	2	1			1	-	-	1	1	-	-	1	1	1
CO6	2	1			1			1	1				1	1
C	2	1			1			1	1		1		1	1

20SCV32	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To understand basic digital forensics and techniques.
- To understand digital crime and investigation.
- To understand how to be prepared for digital forensic readiness.
- To understand and use forensics tools for iOS devices.
- To understand and use forensics tools for Android devices.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO DIGITAL FORENSICS **6**

Forensic Science – Digital Forensics – Digital Evidence – The Digital Forensics Process – Introduction – The Identification Phase – The Collection Phase – The Examination Phase – The Analysis Phase – The Presentation Phase.

Lab Component: **6**

1. Installation of Sleuth Kit on Linux. List all data blocks. Analyze allocated as well as unallocated blocks of a disk image.

UNIT - II DIGITAL CRIME AND INVESTIGATION **6**

Digital Crime – Substantive Criminal Law – General Conditions – Offenses – Investigation Methods for Collecting Digital Evidence – International Cooperation to Collect Digital Evidence.

Lab Component: **6**

1. Data extraction from call logs using Sleuth Kit.

UNIT - III DIGITAL FORENSIC READINESS **6**

Introduction – Law Enforcement versus Enterprise Digital Forensic Readiness – Rationale for Digital Forensic Readiness – Frameworks, Standards and Methodologies – Enterprise Digital Forensic Readiness – Challenges in Digital Forensics.

Lab Component: **6**

1. Data extraction from SMS and contacts using Sleuth Kit.

UNIT - IV iOS FORENSICS **6**

Mobile Hardware and Operating Systems - iOS Fundamentals – Jailbreaking – File System – Hardware – iPhone Security – iOS Forensics – Procedures and Processes – Tools – Oxygen Forensics – MobilEdit – iCloud.

Lab Component: **6**

1. Install Mobile Verification Toolkit or MVT and decrypt encrypted iOS backups.
2. Process and parse records from the iOS system.

UNIT-V ANDROID FORENSICS **6**

Android basics – Key Codes – ADB – Rooting Android – Boot Process – File Systems – Security – Tools – Android Forensics – Forensic Procedures – ADB – Android Only Tools – Dual Use Tools – Oxygen Forensics – MobilEdit – Android App Decompiling.

Lab Component: **6**

1. Extract installed applications from Android devices.
2. Extract diagnostic information from Android devices through the adb protocol.
3. Generate a unified chronological timeline of extracted records.

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Andre Arnes, “Digital Forensics”, Wiley, 2018.
2. Chuck Easttom, “An In-depth Guide to Mobile Device Forensics”, First Edition, CRC Press, 2022.

REFERENCE:

1. Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : DIGITAL AND MOBILE FORENSICS		**Course Code : 20SCV32**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain various digital forensics process	1	K2	1,2	1,2
CO2	Discuss various digital crime and investigation methods.	2	K2	1,2,8,9	1,2
CO3	Illustrate the digital forensic readiness and challenges in digital forensic	3	K2	1,2,8,9	1,2
CO4	Identify and extract digital evidence from iOS devices.	4	K2	1,2,8,9	1,2
CO5	Discuss the basics of Android forensics	5	K2	1,2,8,9	1,2
CO6	Apply needed tools in Android devices	5	K3	1,2,3,5,8,9, 10	1,2

CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	1	2
CO2	2	1	-	-	-	-	-	1	1	-	-	-	1	2
CO3	2	1	-	-	-	-	-	1	1	-	-	-	1	2
CO4	2	1	-	-	-	-	-	1	1	-	-	-	1	2
CO5	2	1	-	-	-	-	-	1	1	-	-	-	1	2
CO6	3	2	1	-	1	-	-	1	1	1	-	-	1	2
	2	1	1	-	1	-	-	1	1	1	-	-	1	2

20ITV42	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		3	0	0	3

Objectives :

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

PRE-REQUISITE: NIL

UNIT I INTRODUCTION TO BLOCKCHAIN **9**

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle

UNIT II BITCOIN AND CRYPTOCURRENCY **9**

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III BITCOIN CONSENSUS **9**

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW, monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases

UNIT IV HYPERLEDGER FABRIC & ETHEREUM **9**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity

UNIT V BLOCKCHAIN APPLICATIONS **9**

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

REFERENCES:

1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction.
3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly,
4. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

20SCV52	WEB APPLICATION SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of web application security
- To focus on wide aspects of secure development and deployment of web applicatic
- To learn how to build secure APIs
- To learn the basics of vulnerability assessment and penetration testing
- To get an insight about Hacking techniques and Tools

PRE-REQUISITE:NIL

UNIT - I FUNDAMENTALS OF WEB APPLICATION SECURITY **9**

The history of Software Security-Recognizing Web Application Security Threats, Web Application Security, Authentication and Authorization, Secure Socket layer, Transport layer Security, SessionManagement-Input Validation

UNIT - II SECURE DEVELOPMENT AND DEPLOYMENT **9**

Web Applications Security - Security Testing, Security Incident Response Planning,The Microsoft Security Development Lifecycle (SDL), OWASP Comprehensive Lightweight Application Security Process (CLASP), The Software Assurance Maturity Model (SAMM)

UNIT - III SECURE API DEVELOPMENT **9**

API Security- Session Cookies, Token Based Authentication, Securing Natter APIs: Addressing threats with Security Controls, Rate Limiting for Availability, Encryption, Audit logging, Securing service-to-service APIs: API Keys , OAuth2, Securing Microservice APIs: Service Mesh, Locking Down Network Connections, Securing Incoming Requests.

UNIT - IV VULNERABILITY ASSESSMENT AND PENETRATION TESTING **9**

Vulnerability Assessment Lifecycle, Vulnerability Assessment Tools: Cloud-based vulnerability scanners, Host-based vulnerability scanners, Network-based vulnerability scanners, Database- based vulnerability scanners, Types of Penetration Tests: External Testing, Web ApplicationTesting, Internal Penetration Testing, SSID or Wireless Testing, Mobile Application Testing.

UNIT - V HACKING TECHNIQUES AND TOOLS **9**

Social Engineering, Injection, Cross-Site Scripting(XSS), Broken Authentication and Session Management, Cross-Site Request Forgery, Security Misconfiguration, Insecure Cryptographic Storage, Failure to Restrict URL Access, Tools: Comodo, OpenVAS, Nexpose, Nikto, Burp Suite, etc.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andrew Hoffman, Web Application Security: Exploitation and Countermeasures for ModernWeb Applications, First Edition, 2020, O'Reilly Media, Inc.
2. Bryan Sullivan, Vincent Liu, Web Application Security: A Beginners Guide, 2012, TheMcGraw-Hill Companies.
3. Neil Madden, API Security in Action, 2020, Manning Publications Co., NY, USA.

REFERENCES:

1. Michael Cross, Developer's Guide to Web Application Security, 2007, Syngress Publishing,Inc.
2. Ravi Das and Greg Johnson, Testing and Securing Web Applications, 2021, Taylor &Francis Group, LLC.
3. Prabath Siriwardena, Advanced API Security, 2020, Apress Media LLC, USA.
4. Malcom McDonald, Web Security for Developers, 2020, No Starch Press, Inc.
5. Allen Harper, Shon Harris, Jonathan Ness, Chris Eagle, Gideon Lenkey, and TerronWilliams Grey Hat Hacking: The Ethical Hacker's Handbook, Third Edition, 2011, The McGraw-Hill Companies.

20CSV62 ENGINEERING SECURE SOFTWARE SYSTEMS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Know the importance and need for software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

PRE-REQUISITE:NIL

UNIT - I NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS **9**

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory Based Attacks: Low-Level Attacks Against Heap and Stack - Defense Against Memory-Based Attacks.

UNIT - II SECURE SOFTWARE DESIGN **9**

Requirements Engineering for secure software - SQUARE process Model - Requirements elicitation and prioritization- Isolating The Effects of Untrusted Executable Content - Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles.

UNIT - III SECURITY RISK MANAGEMENT **9**

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

UNIT - IV SECURITY TESTING **9**

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing – Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection - Tools for Penetration Testing.

UNIT - V SECURE PROJECT MANAGEMENT **9**

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Julia H. Allen, “Software Security Engineering”, Pearson Education, 2008
2. Evan Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, First edition, Syngress Publishing, 2011
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, “The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)”, Addison-Wesley Professional, 2006.

REFERENCES:

1. Robert C. Seacord, “Secure Coding in C and C++ (SEI Series in Software Engineering)”, Addison-Wesley Professional, 2005.
2. Jon Erickson, “Hacking: The Art of Exploitation”, 2nd Edition, No Starch Press, 2008.
3. Mike Shema, “Hacking Web Apps: Detecting and Preventing Web Application Security Problems”, First edition, Syngress Publishing, 2012
4. Bryan Sullivan and Vincent Liu, “Web Application Security, A Beginner's Guide”, Kindle Edition, McGraw Hill, 2012
5. Lee Allen, “Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)”, Kindle Edition, Packt Publishing,2012
6. Jason Grembi, “Developing Secure Software”

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : **ENGINEERING SECURE SOFTWARE SYSTEMS**													**Course Code : 20CSV62**	
CO	**Course Outcomes**												**Unit**	**K-CO**	**POs**	**PSOs**
C304.1	Identify various vulnerabilities related to memory attacks and low level attacks.												1	2	1,2,8,9,10	1
C304.2	Apply security principles in software development and secure design.												2	3	1,2,3,8,9,10, 11	1
C304.3	Discuss the risk factors in software systems and risk assessment techniques.												3	2	1,2,8,9,10, 11	1
C304.4	Apply various testing techniques related to software security in the testing phase of software development												4	3	1,2,3,8,9,10, 11	1
C304.5	Discuss the web application security , bypassing Firewalls and tools for penetration testing.												4	2	1,2,8,9,10	1
C304.6	Illustrate secure project management and its framework.												5	3	1,2,3,8,9,10, 11	1
CO-PO Mapping																
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**		
C304.1	2	1		-	-	-	-	3	1	1	-	-	2	-		
C304.2	3	2	1	-	-	-	-	3	1	1	2	-	2	-		
C304.3	2	1		-	-	-	-	3	1	1	2	-	2	-		
C304.4	3	2	1	-	-	-	-	3	1	1	2	-	2	-		
C304.5	2	1		-	-	-	-	3	1	1	-	-	2	-		
C304.6	3	2	1	-	-	-	-	3	1	1	2	-	2	-		

20SCV82	MALWARE ANALYSIS	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To introduce the fundamentals of malware, types and its effects
- To enable to identify and analyse various malware types by static analysis
- To enable to identify and analyse various malware types by dynamic analysis
- To deal with detection, analysis, understanding, controlling, and eradication of malware

PRE-REQUISITE:NIL

UNIT - I INTRODUCTION AND BASIC ANALYSIS **6**

Goals of Malware Analysis, AV Scanning, Hashing, Finding Strings, Packing and Obfuscation, PE file format, Static, Linked Libraries and Functions, Static Analysis tools, Virtual Machines and their usage in malware analysis, Sandboxing, Basic dynamic analysis, Malware execution, Process Monitoring, Viewing processes, Registry snapshots.

Lab Component: **6**

1. Experimentation on Initial Infection Vectors and Malware Discovery
2. Implementation on Sandboxing Malware and Gathering Information From Runtime Analysis

UNIT - II ADVANCED STATIC ANALYSIS **6**

The Stack, Conditionals, Branching, Rep Instructions, Disassembly, Global and local variables, Arithmetic operations, Loops, Function Call Conventions, C Main Method and Offsets. Portable Executable File Format, The PE File Headers and Sections, IDA Pro, Function analysis, Graphing, The Structure of a Virtual Machine, Analyzing Windows programs, Anti-static analysis techniques, obfuscation, packing, metamorphism, polymorphism.

Lab Component: **6**

1. Implementation on Portable Executable (PE32) File Format
2. Implementation on Executable Metadata and Executable Packers

UNIT - III ADVANCED DYNAMIC ANALYSIS **6**

Live malware analysis, dead malware analysis, analyzing traces of malware, system calls, api calls, registries, network activities. Anti-dynamic analysis techniques, VM detection techniques, Evasion techniques, , Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching

Lab Component: **6**

1. Experimentation on Malware Self - Defense, Compression, and Obfuscation Techniques
2. Experimentation on Malware behaviour analysis

UNIT - IV MALWARE FUNCTIONALITY **6**

Down loaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Handles, Mutexes, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.

Lab Component: **6**

1. Experimentation on analyzing Malicious Microsoft Office and Adobe PDF Documents
2. Experimentation on Mobile malware analysis
3. Experimentation on Packing and Unpacking of malware

UNIT - V ANDROID MALWARE ANALYSIS **6**

Android Malware Analysis: Android architecture, App development cycle, APKTool, APKInspector, Dex2Jar, JD-GUI, Static and Dynamic Analysis, Case studies.

Lab Component: **6**

1. Experimentation on Rootkit AntiForensics and Covert Channels
2. Experimentation on Modern Rootkit Analysis
3. Experimentation on Malware traffic analysis

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press, 2012,ISBN: 9781593272906
2. Bill Blunden, “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System”, Second Edition,Jones & Bartlett Publishers, 2009.

REFERENCES:

1. Jamie Butler and Greg Hoglund, “Rootkits: Subverting the Windows Kernel” by 2005, Addison-Wesley Professional.
2. Bruce Dang, Alexandre Gazet, Elias Bachaalany, SébastienJosse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
3. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O’Reilly, 2015.
4. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis",CRC Press, Taylor & Francis Group, 2015.
5. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : MALWARE ANALYSIS		**Course Code : 20SCV82**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the various concepts of malware analysis and their technologies used.	1	K2	1,2,8,9	1,2
CO2	Apply the skills necessary to carry out independent analysis of modern malware samples using static analysis techniques	2	K3	1,2,3,5,8,9	1,2
CO3	Apply the knowledge to carry out malware analysis of using dynamic analysis techniques	3	K3	1,2,3,5,8,9	1,2
CO4	Implement experimentation on Malware behaviour analysis	3	K3	1,2,3,5,8,9, 10	1,2
CO5	Explain the methods and techniques used by professional malware analysts	4	K2	1,2,8,9	1,2
CO6	Illustrate the concept of Android malware analysis their architecture, and App development	5	K3	1,2,3,5,8,9, 10	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	1	1	-	-	-	1	2
CO2	3	2	1	-	2	-	-	1	1	-	-	-	1	2
CO3	3	2	1	-	2	-	-	1	1	-	-	-	1	2
CO4	3	2	1	-	2	-	-	1	1	1	-	-	1	2
CO5	2	1	-	-	-	-	-	1	1	-	-	-	1	2
CO6	3	2	1	-	2	-	-	1	1	1	-	-	1	2

20ITV13	PRINCIPLES OF PROGRAMMING LANGUAGES	L	T	P	C
		3	0	0	3

Objectives :

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event and ling in programming languages
- To develop programs in non-procedural programming paradigms.

PRE-REQUISITE: NIL

UNIT I SYNTAX AND SEMANTICS **9**

Evolution of programming languages – describing syntax – context-free grammars – attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom-up

UNIT II DATA,DATATYPES, AND BASIC STATEMENTS **9**

Names–variables–binding–type checking –scope–scope rules–life time and garbage collection

– primitive data types – strings – array types – associative arrays – record types – union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and boolean expressions – assignment statements – mixed mode assignments – control

UNIT III UB PROGRAMS AND IMPLEMENTATIONS **9**

Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simplesubprograms–stackanddynamiclocalvariables–nestedsubprograms–blocks–

UNIT IV OBJECT ORIENTATION, CONCURRENCY, AND EVENT HANDLING **9**

Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency–exception handling–event handling.

UNIT V FUNCTIONALANDLOGICPROGRAMMINGLANGUAGES **9**

Introduction to lambda calculus –fundamentals of functional programming languages – Programming with Scheme–Programming with ML–Introduction to logic and logic programming– Programming with Prolog–multi-paradigm languages

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Robert W. Sebesta, “Concepts of Programming Languages”, Twelfth Edition (Global Edition), Pearson, 2022.

2. Scott,“ProgrammingLanguagePragmatics”,FourthEdition,Elsevier,2018.

REFERENCES:

1. R.KentDybvig,"TheSchemeprogramminglanguage",FourthEdition,PrenticeHall,2011.
2. Jeffrey D. Ullman," Elements of ML programming", Second Edition, Pearson, 1997
3. W.F.Clocksin and C.S.Mellish, "Programming in Prolog: Using the ISO Standard" Fifth Edition, Springer,2003.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : PRINCIPLES OF PROGRAMMING LANGUAGES		**Course Code : 20ITV13**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the syntax ,semantics and parsing of programming languages	1	K2	1,2,8,9	1,2
CO2	Use data, data types, and basic statements of programming languages	2	K3	1,2,3,8,9, 10	1,2
CO3	Identify the issues of subprograms and apply the relevant concepts to subprograms implementation	3	K3	1,2,3,8,9, 10	1,2
CO4	Demonstrate the basic concepts of object-oriented programming and concurrency using semaphores monitors	4	K3	1,2,3,8,9, 10,12	1,2
CO5	Illustrate the mechanism of threads and exception handling	4	K3	1,2,3,8,9, 10,12	1,2
CO6	Compare features and applications of functional and logic programming language	5	K4	1,2,3,4,8,9, 10,12	1,2

CO-PO Mapping														
CO	**PO1**	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO2**
CO1	2	1	-	-	-	-	-	1	1	-	-	-	2	2
CO2	3	2	1	-	-	-	-	1	1	1	-	-	2	2
CO3	3	2	1	-	-	-	-	1	1	1	-	-	2	2
CO4	3	2	1	-	-	-	-	1	1	1	-	2	2	2
CO5	3	2	1	-	-	-	-	1	1	1	-	2	2	2
CO6	3	3	2	1	-	-	-	1	1	1	-	2	2	2
C	3	2	1	1	-	-	-	1	1	1	-	2	2	2

20CSV23	UI AND UX DESIGN	L	T	P	C
		2	0	2	3

OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- To understand the various Research Methods used in Design
- To explore the various Tools used in UI & UX

PRE-REQUISITE: NIL

UNIT – I FOUNDATIONS OF DESIGN 6

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking - Brainstorming and Game storming - Observational Empathy.

Lab Component: 6

1. Designing a Responsive layout for an societal application
2. Brainstorming feature for proposed product
3. Defining the Look and Feel of the new Project

UNIT – II FOUNDATIONS OF UI DESIGN 6

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles – Branding - Style Guides.

Lab Component: 6

1. Exploring various UI Interaction Patterns
2. Developing an interface with proper UI Style Guides

UNIT – III FOUNDATIONS OF UX DESIGN 6

Introduction to User Experience - Why You Should Care about User Experience – Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goal.

Lab Component: 6

1. Exploring various open source collaborative interface Platform
2. Hands on Design Thinking Process for a new product

UNIT – IV WIREFRAMING, PROTOTYPING AND TESTING 6

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing – Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

Lab Component: 6

1. Developing Wireflow diagram for application using open source software.
2. Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)

UNIT – V RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE 6

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods – Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams – Flow Mapping - Information Architecture.

Lab Component: **6**

1. Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping
2. Sketch, design with popular tool and build a prototype and perform usability testing and identify improvements

TOTAL: 60 PERIODS

TEXT BOOKS:

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021

REFERENCES:

1. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3 rd Edition , O’Reilly 2020
2. Steve Schoger, Adam Wathan “Refactoring UI”, 2018
3. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web & Mobile”, Third Edition, 2015.
4. https://www.nngroup.com/articles/
5. https://www.interaction-design.org/literature.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : UI AND UX DESIGN		**Course Code : 20CSV23**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Differentiate divergent and convergent thinking and explain brainstorming and game storming	1	K2	1,2	2
CO2	Discuss the fundamental needs of UI design	2	K2	1,2,8,9	2
CO3	Illustrate methods and tools to the process of UX design for research	3	K2	1,2,8,9	2
CO4	Explain the sketching principles, responsive design and wire framing	4	K2	1,2,8,9	2
CO5	Discuss the design of UI and UX prototyping and testing with suitable tools	4	K2	1,2,8,9	2
CO6	Identifying and writing problem statements, appropriate research methods and creating scenarios	5	K2	1,2,8,9	2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO2	2	1	-	-	-	-	-	1	1	-	-	-	-	1
CO3	2	1	-	-	-	-	-	1	1	-	-	-	-	1
CO4	2	1	-	-	-	-	-	1	1	-	-	-	-	1
CO5	2	1	-	-	-	-	-	1	1	-	-	-	-	1
CO6	2	1	-	-	-	-	-	1	1	-	-	-	-	1

20CSV31	CLOUD SERVICE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Introduce Cloud Service Management terminology, definition & concepts
- Compare and contrast cloud service management with traditional IT service management
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems

PRE-REQUISITE : NIL

UNIT - I CLOUD SERVICE MANAGEMENT FUNDAMENTALS 9

Cloud Ecosystem, The Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud Service Deployment Models.

UNIT - II CLOUD SERVICES STRATEGY 9

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT - III CLOUD SERVICE MANAGEMENT 9

Cloud Service Reference Model, Cloud Service Life Cycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT - IV CLOUD SERVICE ECONOMICS 9

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT - V CLOUD SERVICE GOVERNANCE & VALUE 9

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES:

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CLOUD SERVICE MANAGEMENT		**Course Code : 20CSV31**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the fundamentals of cloud service management	1	K2	1,2	2
CO2	Describe the cloud service strategies like cloud policy, risk management and change management etc.,	2	K2	1,2,8,9	2
CO3	Explain the life cycle and benchmarks of cloud services	3	K2	1,2,8,9	2
CO4	Illustrate deployment and migration of cloud services	3	K2	1,2,8,9	2
CO5	Discuss the economic based cloud services	4	K2	1,2,8,9,10	2
CO6	Explain the strong theoretical foundation leading to cloud service governance & measuring the value of cloud-based services	5	K2	1,2,8,9,10	2

CO-PO Mapping														
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	-	-	-	-	-	-	-	-	-	-	-	2
CO2	2	1	-	-	-	-	-	1	1	-	-	-	-	2
CO3	2	1	-	-	-	-	-	1	1	-	-	-	-	2
CO4	2	1	-	-	-	-	-	1	1	-	-	-	-	2
CO5	2	1	-	-	-	-	-	1	1	1	-	-	-	2
CO6	2	1	-	-	-	-	-	1	1	1	-	-	-	2

20ITV43	SOFTWARE TESTING AND AUTOMATION	L	T	P	C
		3	0	0	3

Objectives :

- To understand the basics of software testing
- To learn how to do the testing and planning effectively
- To build test cases and execute them
- To focus on wide aspects of testing and understanding multiple facets of testing
- To get an insight about test automation and the tools used for test automation

PRE-REQUISITE: NIL

UNIT I FOUNDATIONS OF SOFTWARE TESTING 9

Black-Box Testing and White-Box Testing, Software Testing Life Cycle, V-model of Software Testing, Program Correctness and Verification, Reliability versus Safety, Failures, Errors and Faults (Defects), Software Testing Principles, Program Inspections, Stages of Testing: Unit Testing, Integration Testing, System Testing

UNIT II TEST PLANNING 9

The Goal of Test Planning, High Level Expectations, Intergroup Responsibilities, Test Phases, Test Strategy, Resource Requirements, Tester Assignments, Test Schedule, Test Cases, Bug Reporting, Metrics and Statistics.

UNIT III TEST DESIGN AND EXECUTION 9

Test Objective Identification, Test Design Factors, Requirement identification, Testable Requirements, Modeling a Test Design Process, Modeling Test Results, Boundary Value Testing, Equivalence Class Testing, Path Testing, Data Flow Testing, Test Design Preparedness Metrics, Test Case Design Effectiveness, Model-Driven Test Design, Test Procedures, Test Case Organization and Tracking, Bug Reporting, Bug Life Cycle.

UNIT IV ADVANCED TESTING CONCEPTS 9

Performance Testing: Load Testing, Stress Testing, Volume Testing, Fail-Over Testing, Recovery Testing, Configuration Testing, Compatibility Testing, Usability Testing, Testing the Documentation, Security testing, Testing in the Agile Environment, Testing Web and Mobile

UNIT V TEST AUTOMATION AND TOOLS 9

Automated Software Testing, Automate Testing of Web Applications, Selenium: Introducing Web Driver and Web Elements, Locating Web Elements, Actions on Web Elements, Different Web Drivers, Understanding Web Driver Events, Testing: Understanding Testing.xml, Adding Classes, Packages, Methods to Test, Test Reports.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Yogesh Singh, “Software Testing”, Cambridge University Press, 2012
2. Unmesh Gundecha, Satya Avasarala, "Selenium WebDriver 3 Practical Guide" - Second Edition 2018

REFERENCES:

1. Glenford J. Myers, Corey Sandler, Tom Badgett, The Art of Software Testing, 3rd Edition, 2012, John Wiley & Sons, Inc.
2. Ron Patton, Software testing, 2nd Edition, 2006, Sams Publishing
3. Paul C. Jorgensen, Software Testing: A Craftsman's Approach, Fourth Edition, 2014, Taylor & Francis Group.
4. Carl Cocchiaro, Selenium Framework Design in Data-Driven Testing, 2018, Packt Publishing
5. Elfriede Dustin, Thom Garrett, Bernie Gaurf, Implementing Automated Software Testing, 2009, Pearson Education, Inc.
6. Satya Avasarala, Selenium WebDriver Practical Guide, 2014, Packt Publishing.
7. Varun Menon, TestNg Beginner's Guide, 2013, Packt Publishing.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : SOFTWARE TESTING AND AUTOMATION													**Course Code : 20ITV43**	
CO	**Course Outcomes**												**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Discuss the basic concepts of software testing and the need for software testing												1	K2	1,2,8,9	2
CO2	Explain test planning and different activities involved in test planning												2	K2	1,2,8,9	2
CO3	Identify the test objectives and apply different method of test strategies												3	K3	1,2,3,5,8,9, 10	2
CO4	Apply advanced testing concepts like Fail-Over testing, usability testing, security testing etc.												4	K3	1,2,3,5,8,9, 10	2
CO5	Describe the Testing methods for web and mobile applications												4	K2	1,2,8,9,10	2
CO6	Use automatic software testing tools like Selenium web driver for automating web-based application testing												5	K3	1,2,3,5,8,9, 10	2
CO-PO Mapping																
CO	**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	3	2	1	-	2	-	-	2	2	1	-	-	-	2		
CO4	3	2	1	-	2	-	-	2	2	1	-	-	-	2		
CO5	2	1	-	-	-	-	-	2	2	1	-	-	-	2		
CO6	3	2	1	-	2	-	-	2	2	1	-	-	-	2		
C	3	2	1	-	2	-	-	2	2	1	-	-	-	2		

20ITV63	COMPUTER VISION	L	T	P	C
		3	0	0	3

Objectives :

- To understand the fundamental concepts related to Image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition

PRE-REQUISITE: NIL

UNIT I INTRODUCTION TO IMAGE FORMATION AND PROCESSING 9

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II FEATURE DETECTION, MATCHING AND SEGMENTATION 9

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT III FEATURE-BASED ALIGNMENT & MOTION ESTIMATION 9

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical

UNIT IV 3D RECONSTRUCTION 9

Shape from X - Active rangefinding - Surface representations - Point-based representationsVolumetric representations - Model-based reconstruction - Recovering texture maps

UNIT V IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumi graphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding- Recognition databases and test sets.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

20ITV73	DEVOPS	L	T	P	C
		2	0	2	4

Objectives :

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ ContinuousDeployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve realworld problems

PRE-REQUISITE: NIL

UNIT I INTRODUCTION TO DEVOPS **6**

Devops Essentials - Introduction To AWS, GCP, Azure - Version control systems: Git and

Lab Component: **6**

1. Install Jenkins in Cloud

2. Install Ansible and configure ansible roles and to write playbook

UNIT II COMPILE AND BUILD USING MAVEN & GRADLE **6**

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of

Lab Component: **6**

1. Build a simple application using Gradle

UNIT III CONTINUOUS INTEGRATION USING JENKINS **6**

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace

Lab Component: **6**

1. Create CI pipeline using Jenkins
2. Create a CD pipeline in Jenkins and deploy in Cloud

UNIT IV CONFIGURATION MANAGEMENT USING ANSIBLE **6**

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible.

Lab Component: **6**

1. Create an Ansible playbook for a simple web application infrastructure

UNIT V BUILDING DEVOPS PIPELINES USING AZURE **6**

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Build a sample code, Modify azure-pipelines.yaml file.

Lab Component: **6**

1.Create Maven Build pipeline in Azure

2.Run regression tests using Maven Build pipeline in Azure

TOTAL: 60 PERIODS

TEXT BOOKS :

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginner to Expert in Easy Step-By-Step Exercises”, Second Edition, Kindle Edition, 2016.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014

REFERENCES:

1. Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure (English Edition) Paperback – 1 January 2020 by Mitesh
2. Jeff Geerling, “Ansible for DevOps: Server and configuration management
3. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
4. Mariot Tsitoara, “Ansible Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019

20ITV81	REINFORCEMENT LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

Objectives :

- To introduce the fundamentals of Reinforcement Learning
- To illustrate model-based prediction and control using dynamic programming
- To illustrate model-free prediction and control
- To introduce planning and learning with tabular methods
- To explain approximation of a value function

PRE-REQUISITE: NIL

UNIT I INTRODUCTION **9**

Introduction to Reinforcement learning, examples - Elements of reinforcement learning - Limitations and Scope- An extended example - multi-armed bandits - k-armed bandit problem - action-value methods - the 10-armed testbed - incremental implementation - tracking a nonstationary problem - optimistic initial values - upper-confidence-bound action selection - associative search

UNIT II MARKOV DECISION PROCESS AND MODEL-BASED PREDICTION AND CONTROL **9**

Finite Markov Decision Process - The Agent–Environment Interface - Goals and Rewards - Returns and Episodes - Unified Notation for Episodic and Continuing Tasks - Policies and Value Functions - Optimal Policies and Optimal Value Functions - Optimality and Approximation - Dynamic Programming - Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration - Generalized Policy Iteration - Efficiency of Dynamic Programming - Asynchronous Dynamic Programming

UNIT III MODEL-FREE PREDICTION AND CONTROL **9**

Model-free learning - Model-free prediction - Monte Carlo methods - Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Temporal-Difference Learning - TD Prediction - Advantages of TD Prediction Methods - Optimality of TD(0) - n-step Bootstrapping - n-step TD Prediction - n-step Sarsa - Model-free control - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off policy learning - Importance sampling - Off-policy Monte Carlo Control - Sarsa: On-policy TD Control - Q-learning: Off-policy TD control

UNIT IV PLANNING AND LEARNING WITH TABULAR METHODS **9**

Models and planning - Dyna: Integrated Planning, Acting and Learning - When the model is wrong - Prioritized Sweeping - Real-time Dynamic Programming - Monte Carlo Tree Search

UNIT V VALUE FUNCTION APPROXIMATION **9**

On-policy Prediction with Approximation - Value Function Approximation - The Prediction Objective (VE) - Stochastic-gradient and Semi-gradient Methods - Linear Methods - Least-Squares TD.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An introduction, 2nd edition, The MIT Press, 2015.
2. Martijn van Otterlo, Marco Wiering, Reinforcement Learning: State-of-the-Art, Springer Verlag Berlin Heidelberg, 2012.
3. Artificial Intelligence: A Modern Approach, Stuart J. Russell and Peter Norvig, 3rd edition, Pearson, 2015.

REFERENCES:

1. Good fellow, Y. Bengio, A. Courville, Deep Learning, MIT Press Ltd., 2016.
2. Reinforcement Learning with MATLAB, Math Works Inc., 2020.

20CSV74	AGILE METHODOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Provide iterative, incremental development process leads to faster delivery of more useful software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques and Analyze the essence of agile development methods.
- To understand the benefits and pitfalls of working in an Agile team and Develop prototyping in the software process..
- To understand Agile development and testing.

Pre-requisite: NIL

UNIT - I FUNDAMENTALS OF AGILE 9

The Genesis of Agile – Introduction and background – Agile Manifesto and Principles – Overview of Scrum – Extreme Programming – Feature Driven development – Lean Software Development – Agile project management – Design and development practices in Agile projects - Continuous Integration – Refactoring - Pair Programming - Simple Design - AgileTools.

UNIT - II AGILE SCRUM FRAMEWORK 9

Introduction to Scrum – Project phases – Agile Estimation – Planning game –Product backlog – Sprint backlog - Iteration planning – User story definition –Characteristics and content of user stories – Acceptance tests and Verifying stories – Project velocity – Burndown chart – Sprint planning and retrospective – Daily scrum – Scrum roles — Product Owner - Scrum Master - Scrum Team - Scrum case study - Tools for Agile project management.

UNIT - III AGILE REQUIREMENTS ENGINEERING ANDTESTING 9

Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment – Concurrency in Agile Requirements Generation – The Agile lifecycle and its impact on testing –Test Driven Development (TDD) – acceptance tests and scenarios – Planning and managing testing cycle – Exploratory testing - Risk based testing - Regression tests - Test Automation – Tools to support the Agile tester.

UNIT - IV AGILE SOFTWARE DESIGN AND DEVELOPMENT 9

Agile design practices- Role of design Principles including Single Responsibility Principle- Open Closed Principle- Liskov Substitution Principle – Interface Segregation Principles- Dependency Inversion Principle in Agile Design - Need and significance of Refactoring- Refactoring Techniques- Continuous Integration - Automated build tools - Version control.

UNIT - V QUALITY ASSURANCE AND INDUSTRYTRENDS 9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance – Agile Approach in Global Software Development. Agile applicability-Agile in Distributed teams – Business benefits –Challenges in Agile – Risks and Mitigation.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Hazza and Dubinsky, Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, 2009
2. Ken Schawber, Mike Beedle, Agile Software Development with Scrum, Pearson, 2008.
3. Robert C.Martin, Agile Software Development, Principles, Patterns and Practices, Prentice Hall, 2002.

REFERENCES:

1. Lisa Crispin, Janet Gregory, "AgileTesting: A Practical Guide for Testers and AgileTeams", Addison Wesley, 2008
2. Kevin C. Desouza, Agile Information Systems: Conceptualization, Construction, and Management, Butterworth Heinemann, 2007
3. Alistair Cockburn, Agile Software Development: The Cooperative Game", Addison Wesley, 2006.
4. Mike Cohn Publisher, "User Stories Applied: For Agile Software", Addison Wesley, 2004
5. Craig Larman, Agile and Iterative Development: A Manager's Guide, Addison Wesley, 2004.

20CSV84 VIRTUAL REALITY AND AUGMENTED REALITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn rapidly evolving and commercially viable field of computer science.
- To become familiar with geometric modeling and computer graphics.
- To learn various types of Hardware and Software in virtual Reality systems

PRE-REQUISITE:NIL

UNIT - I INTRODUCTION TO VIRTUAL REALITY 9

Virtual Reality and Virtual Environment: Introduction-Computer graphics-Real time computer graphics-Flight Simulation-Virtual environment requirement-benefits of virtual reality-Historical development of VR-Scientific Landmark.

UNIT - II AUGMENTED REALITY 9

Taxonomy-technology and features of augmented reality-difference between AR and VR-Challenges with AR-AR systems and functionality-Augmented reality method-visualization techniques for augmented reality-enhancing interactivity in AR environments-evaluating AR systems.

UNIT - III COMPUTER GRAPHICS AND GEOMETRIC MODELING 9

Introduction-The Virtual world space-positioning the virtual observer-The perspective projection-Human vision-Stereo perspective projection- Colour theory-Geometrical Transformations-Introduction-frames of reference-Modeling transformations-scaling the VE-Collision detection.

UNIT - IV DEVELOPMENT TOOLS AND FRAMEWORK 9

Human factors-Hardware-Software-The somatic senses-Sensor hardware-Head coupled displays-Acoustic hardware-Integrated VR systems-Modeling virtual world-Physical simulation.

UNIT - V AUGMENTED AND VIRTUAL REALITY APPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment-Education- The Future: Introduction – Virtual environments – modes of interaction. Case study on Oculus Rift - Head mounted display.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jernej Barbic-Mirabelle D'Cruz Marc Erich Latoschik, Melslater Patrick Bourdot Edition 2017.
2. Timothy Jung M.claudia tom Diek Philip A.Rauschnabel 2019

REFERENCES:

1. Grigore C. Burdea, Philippe Coiffet , Virtual Reality Technology, Wiley 2016
2. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan A. Kaufmann, 2013
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications,
4. Foundations of Effective Design, Morgan Kaufmann, 2009.
5. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.

OUTCOMES:
AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : VIRTUAL REALITY AND AUGMENTED REALITY		Course Code : 20CSV84			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
CO1	Explain the Virtual Reality and Environment, Virtual Reality Requirements and benefits	1	K2	1,2,8,9	1,2
CO2	Illustrate the visualization techniques for augmented reality	2	K2	1,2,8,9, 10	1,2
CO3	Discuss the concept of Computer Graphics And Geometric Modeling	3	K2	1,2,8,9	1,2
CO4	Use various types of Hardware and software in virtual Reality systems	4	K3	1,2,3,8,9, 12	1,2
CO5	Apply Development Tools And Framework for Virtual Reality	4	K3	1,2,3, 5,6,8,9, 12	1,2
CO6	Analyze and Design a system or process to meet given specifications with Realistic Engineering Constraints	5	K4	1,2,3,4, 5,6,8,9, 10, 12	1,2

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	-	-	-	-	-	1	1	-	-	-	2	3
CO2	2	1	-	-	-	-	-	1	1	-	-	-	2	3
CO3	2	1	-	-	-	-	-	1	1	-	-	-	2	3
CO4	3	2	1	-	-	-	-	1	1	1	-	1	2	3
CO5	3	2	1	-	2	1	-	2	2	1	-	1	2	3
CO6	3	3	2	1	1	1	-	2	2	2	-	1	2	3
C	3	2	1	1	1	1	-	1	1	1	-	1	2	3

20ADV14	DATA AND INFORMATION SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To equip the students' knowledge on digital signature, email security and web security

UNIT-I INTRODUCTION **9**

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT- II SECURITY INVESTIGATION **9**

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies

UNIT- III DIGITAL SIGNATURE AND AUTHENTICATION **9**

Digital Signature and Authentication Schemes: Digital Signature-Digital Signature Schemes and their Variants- Digital Signature Standards-Authentication: Overview- Requirements Protocols - Applications - Kerberos -X.509 Directory Services

UNI-IV E-MAIL AND IP SECURITY **9**

E-mail and IP Security: Electronic mail security: Email Architecture -PGP – Operational Descriptions- Key management- Trust Model- S/MIME.IP Security: Overview- Architecture - ESP, AH Protocols IPSec Modes – Security association - Key management.

UNIT-V WEB SECURITY **9**

Web Security: Requirements- Secure Sockets Layer- Objectives-Layers -SSL secure Communication- Protocols - Transport Level Security. Secure Electronic Transaction- Entities DS Verification-SET processing.

TOTAL:45 PERIODS

TEXTBOOKS

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN- 10 : 9390385636
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10 : 8120344707

REFERENCES:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015

20ITV24	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

Objectives :

- To know the background of classical computing and quantum computing.
- To learn the fundamental concepts behind quantum computation.
- To study the details of quantum mechanics and its relation to Computer Science.
- To gain knowledge about the basic hardware and mathematical models of quantum computation.
- To learn the basics of quantum information and the theory behind it.

PRE-REQUISITE: NIL

UNIT I QUANTUM COMPUTING BASIC CONCEPTS 9

Complex Numbers - Linear Algebra - Matrices and Operators - Global Perspectives Postulates of Quantum Mechanics – Quantum Bits - Representations of Qubits - Superpositions

UNIT II QUANTUM GATES AND CIRCUITS 9

Universal logic gates - Basic single qubit gates - Multiple qubit gates - Circuit development - Quantum error correction

UNIT III QUANTUM ALGORITHMS 9

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm

UNIT IV QUANTUM INFORMATION THEORY 9

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem - Classical information over noisy quantum channels

UNIT V QUANTUM CRYPTOGRAPHY 9

Classical cryptography basic concepts - Private key cryptography - Shor's Factoring Algorithm - Quantum Key Distribution - BB84 - Ekart 91

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Parag K Lala, Mc Graw Hill Education, "Quantum Computing, A Beginners Introduction", First edition (1 November 2020).
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Tenth Edition, Cambridge University Press, 2010.
3. Chris Bernhardt, The MIT Press; Reprint edition (8 September 2020), "Quantum Computing for Everyone".

REFERENCES:

1. Scott Aaronson, "Quantum Computing Since Democritus", Cambridge University Press, 2013.
2. N. David Mermin, "Quantum Computer Science: An Introduction", Cambridge University Press, 2007.

20ITV42 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES

L	T	P	C
3	0	0	3

Objectives :

- To understand the basics of Blockchain
- To learn Different protocols and consensus algorithms in Blockchain
- To learn the Blockchain implementation frameworks
- To understand the Blockchain Applications
- To experiment the Hyperledger Fabric, Ethereum networks

PRE-REQUISITE: Nil

UNIT I INTRODUCTION TO BLOCKCHAIN **9**

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions- The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic -Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II BITCOIN AND CRYPTOCURRENCY **9**

A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay

UNIT III BITCOIN CONSENSUS **9**

Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW ,monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases

UNIT IV HYPERLEDGER FABRIC & ETHEREUM **9**

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity

UNIT V BLOCKCHAIN APPLICATIONS **9**

Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance,etc- Case Study.

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”,

REFERENCES:

1. Daniel Drescher, “Blockchain Basics”, First Edition, Apress, 2017
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016
3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, O’Reilly, 2015
4. Ritesh Modi, “Solidity Programming Essentials: A Beginner’s Guide to Build Smart Contracts for Ethereum and Blockchain”, Packt Publishing
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

20ITV64	3D PRINTING AND DESIGN	L	T	P	C
		3	0	0	3

Objectives :

- To discuss on basics of 3D printing
- To explain the principles of 3D printing technique
- To explain and illustrate inkjet technology
- To explain and illustrate laser technology
- To discuss the applications of 3D printing

PRE-REQUISITE: NIL

UNIT I INTRODUCTION **9**

Introduction; Design considerations – Material, Size, Resolution, Process; Modelling and viewing - 3D; Scanning; Model preparation – Digital; Slicing; Software; File formats

UNIT II PRINCIPLE **9**

Processes – Extrusion, Wire, Granular, Lamination, Photopolymerisation; Materials - Paper, Plastics, Metals, Ceramics, Glass, Wood, Fiber, Sand, Biological Tissues, Hydrogels, Graphene; Material Selection - Processes, applications, limitations;

UNIT III INKJET TECHNOLOGY **9**

Printer - Working Principle, Positioning System, Print head, Print bed, Frames, Motion control; Print head Considerations – Continuous Inkjet, Thermal Inkjet, Piezoelectric Drop-On-Demand; Material Formulation for jetting; Liquid based fabrication – Continous jet, Mulitjet; Powder based

UNIT IV LASER TECHNOLOGY **9**

Light Sources – Types, Characteristics; Optics – Deflection, Modulation; Material feeding and flow

– Liquid, powder; Printing machines – Types, Working Principle, Build Platform, Print bed

UNIT V INDUSTRIAL APPLICATIONS **9**

Product Models, manufacturing – Printed electronics, Biopolymers, Packaging, Healthcare, Food, Medical, Biotechnology, Displays; Future trends;

TOTAL: 45 PERIODS

TEXT BOOKS :

1. Christopher Barnatt, 3D Printing: The Next Industrial Revolution, CreateSpace Independent Publishing Platform, 2013.
2. Ian M. Hutchings, Graham D. Martin, Inkjet Technology for Digital Fabrication, John Wiley & Sons, 2013.

REFERENCES:

1. Chua, C.K., Leong K.F. and Lim C.S., Rapid prototyping: Principles and applications, second edition, World Scientific Publishers, 2010
2. Ibrahim Zeid, Mastering CAD CAM Tata McGraw-Hill Publishing Co., 2007
3. Joan Horvath, Mastering 3D Printing, APress, 2014

20SCV54	CYBER SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand various types of cyber-attacks and cyber-crimes
- To learn threats and risks within context of the cyber security
- To have an overview of the cyber laws & concepts of cyber forensics
- To study the defensive techniques against these attacks

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION 9

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, Cyber Threats - Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc.

UNIT - II CYBER FORENSICS 9

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

UNIT -III CYBER CRIME: MOBILE AND WIRELESS DEVICES 9

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

UNIT -IV 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

UNIT - V CYBERCRIME 9

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

TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2013
2. B.B.Gupta, D.P.Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, 2018.

REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press, 2016
2. Chwan-Hwa (John) Wu, J. David Irwin, Introduction to Computer Networks and Cyber security, CRC Press T&F Group, 2013.

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name : CYBER SECURITY		**Course Code : 20SCV54**			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
C303.1	Identify the fundamental concepts of cyber security and the layers of cyber security based on real time scenarios	1	K3	1,2,3,6,8,9,12	1
C303.2	Illustrate the process of digital forensics, analysis and challenges in computer forensics	2	K4	1,2,3,4,6,8,9,12	1
C303.3	Analyze the security challenges and prevention measures for the security attacks on mobile and wireless devices	3	K4	1,2,3,4,6,8,9,12	1
C303.4	Discuss the concepts of privacy Attacks, Data linking and profiling	4	K2	1,2,6,8,9,10,12	1
C303.5	Explain the privacy policies and their specifications in various domains	4	K2	1,2,6,8,9,10,12	1
C303.6	Infer the category of the cyber security attacks and analyze its security measures	5	K4	1,2,3,4,6,8,9,12	1

CO-PO Mapping

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
C303.1	3	2	1	-	-	3	-	2	2	2	-	2	1	1
C303.2	3	3	2	1	-	3	-	2	2	2	-	2	1	1
C303.3	3	3	2	1	-	3	-	2	2	2	-	2	1	1
C303.4	2	1	-	-	-	3	-	2	2	2	-	2	1	1
C303.5	2	1	-	-	-	3	-	2	2	2	-	2	1	1
C303.6	3	3	2	1	-	3	-	2	2	2	-	2	1	1

20ADV15	BUSINESS INTELLIGENCE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence
- To understand various types of analytics for Business Forecasting
- To model the supply chain management for analytics.
- To apply analytics for different functions of a business

PRE-REQUISITE: NIL

UNIT I INTRODUCTION TO BUSINESS ANALYTICS 9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation –Deployment and Iteration

UNIT II BUSINESS INTELLIGENCE 9

Data Warehouses and Data Mart - Knowledge Management – Types of Decisions – Decision Making Process- Decision Support Systems –Business Intelligence –OLAP– , Analytic functions

UNIT III BUSINESS FORECASTING 9

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models –Data Mining and Predictive Analysis Modeling–Machine Learning for Predictive analytics.

UNIT IV HR & SUPPLY CHAIN ANALYTICS 9

HumanResources–PlanningandRecruitment–TrainingandDevelopment-Supplychainnetwork - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR &Supply Chain

UNIT V MARKETING& SALES ANALYTICS 9

Marketing Strategy, Marketing Mix, Customer Behavior– selling Process – Sales Planning –Analytics applications in Marketing and Sales

TOTAL:45PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

1. Explain the real world business problems and model with analytical solutions.
2. Identify the business processes for extracting Business Intelligence
3. Apply predictive analytics for business fore-casting
4. Apply analytics for supply chain and logistics management
5. Use analytics for marketing and sales.
6. Discuss the application layer concepts

REFERENCES:

1. R. EvansJames, Business Analytics, 2017
2. RNPrasad, Seema Acharya, Fundamentals of Business Analytics, 2016
3. PhilipKotler and KevinKeller, Marketing Management, 15thedition,PHI,2016
4. VSPRAO, Human Resource Management, 3rdEdition, ExcelBooks,2010.
5. MahadevanB,“OperationsManagement-TheoryandPractice”,3rdEdition,PearsonEducation, 2018.

20ADV25	DATA COMMUNICATION AND COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits
- To explore the various layers of OSI Model
- To introduce UDP and TCP Models.

UNIT-I DATA COMMUNICATIONS 9

Components–Direction of Dataflow– Networks– Components and Categories–Types of Connections – Topologies –Protocols and Standards – ISO / OSI model, Example Networks such as ATM, Frame Relay, ISDN Physical layer: Transmission modes, Multiplexing,Transmission Media, Switching, Circuit Switched Networks, Datagram Networks, Virtual Circuit Networks.

UNIT- II DATA LINK LAYER 9

Introduction, Framing, and Error– Detection and Correction– Parity– LRC – CRC Hamming code, Flow and Error Control, Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols. 111Medium Access sub layer: ALOHA, CSMA/CD, LAN –Ethernet IEEE802.3, IEEE802.5– IEEE802.11,Randomaccess,Controlledaccess,Channelization

UNIT- III NETWORK LAYER 9

Logical Addressing, Inter networking,Tunneling, Address mapping, ICMP,IGMP,Forwarding,Uni-Cast Routing Protocols, Multi cast Routing Protocols.

UNI-IV TRANSPORT LAYER 9

Process to Process Delivery, UDP and TCP protocols, Data Traffic, Congestion, Congestion Control, QoS,
Integrated Services, Differentiated Services, QoS in Switched Networks.

UNIT-V APPLICATION LAYER 9

Domain namespace, DNS in internet, electronic mail, SMTP, FTP, WWW, HTTP, SNMP.

TOTAL:45PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

1. Familiarize the basic layers and its functions in computer networks
2. Evaluate the performance of a network
3. Concepts of the basics of how data flows from one node to another
4. Analyze and design routing algorithms
5. Design protocols for various functions in the network
6. Know about the working of various application layer protocols

TEXTBOOKS

1. Data Communications and Networking, BehrouzA. Forouzan, Fourth EditionTMH,2006.
2. ComputerNetworks,AndrewSTanenbaum,4th Edition.Pearson Education, PHI

REFERENCES

1. Data communications and Computer Networks, P.C .Gupta, PHI.
2. An Engineering Approach to Computer Networks, S. Keshav, 2nd Edition, PearsonEducation.
3. Understanding communications and Networks, 3rd Edition, W.A. Shay, Cengage Learning.
4. Computer Networking: A Top-Down Approach Featuring the Internet. James F.Kurose & Keith W. Ross, 3 rd Edition, Pearson Education.
5. Data and Computer Communication, William Stallings, Sixth Edition, Pearson Education, 2000.

20ADV34	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the basics in deep neural networks
- To understand the basics of associative memory and unsupervised learning networks
- To apply CNN architectures of deep neural networks
- To analyze the key computations underlying deep learning, then use them to build and traindeep neural networks for various tasks.
- To apply generative models for suitable applications.

UNIT-I INTRODUCTION 6

Neural Networks-Application Scope of Neural Networks-Artificial Neural Network: An Introduction-Evolution of Neural Networks-Basic Models of Artificial Neural Network- Important Terminologies of ANNs-Supervised Learning Network

UNIT -II ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS 6

Training Algorithms for Pattern Association-Auto associative Memory Network-Hetero associative Memory Network-Bidirectional Associative Memory (BAM)-Iterative Auto associative Memory Networks-Fixed Weight Competitive Nets(MAXNET, Hamming Network)-Kohonen Self-Organizing Feature Maps.

UNIT -III THIRD-GENERATION NEURAL NETWORKS 6

Convolutional Neural Networks-Deep Learning Neural Networks-Extreme Learning Machine Model-Convolutional Neural Networks: The Convolution Operation – Motivation –Pooling – Variants of the basic Convolution Function – Efficient Convolution Algorithms

UNIT -IV DEEP FEED FORWARD NETWORKS 6

A Probabilistic Theory of Deep Learning- Gradient Learning – Chain Rule and Backpropagation Regularization: Dataset Augmentation – Noise Robustness -Early Stopping, Bagging and Dropout.

UNIT V RECURRENT NEURAL NETWORKS 6

Recurrent Neural Networks: Introduction – Recursive Neural Networks – Bidirectional RNNs – Deep Recurrent Networks – Applications: Image Generation, Image Compression, Natural Language Processing.

30 PERIODS

LAB EXPERIMENTS: **30 PERIODS**

1. Implement simple vector addition in TensorFlow.
2. Implement a regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement character and Digit Recognition using ANN.
6. Implement an Image Classifier using CNN in TensorFlow/Keras.
7. Perform Sentiment Analysis using RNN
8. Recommendation system from sales data using Deep Learning

TOTAL: 60 PERIODS

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

1. Understand the basic models of ANN
2. Apply Convolution Neural Network for Image Classification.
3. Understand the basics of associative memory and unsupervised learning networks.
4. Apply CNN and its variants for suitable applications.
5. Analyze the key computations underlying deep learning and use them to build and train deepneural networks for various tasks.
6. Apply Recurrent Neural Network and its variants for text analysis

TEXT BOOKS:

1. Ian Good fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
2. Francois Chollet, “Deep Learning with Python”, Second Edition, Manning Publications,2021.

REFERENCES:

1. Introduction to Neural Networks Using Matlab 6.0 - S. N. Sivanandam, S. N Deepa Aurélien Géron, “Hands-On Machine Learning with Scikit-Learn and TensorFlow”, Oreilly,2018.
2. Josh Patterson, Adam Gibson, “Deep Learning: A Practitioner’s Approach”, O’Reilly Media, 2017.
3. Charu C. Aggarwal, “Neural Networks and Deep Learning: A Textbook”, Springer International Publishing, 1st Edition, 2018.
4. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
5. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
6. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017.S Rajasekaran, G A Vijayalakshmi Pai, “Neural Networks, FuzzyLogic and GeneticAlgorithm, Synthesis and Applications”, PHI Learning, 2017.
7. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017
8. James A Freeman, David M S Kapura, “Neural Networks Algorithms, Applications, and Programming Techniques”, Addison Wesley, 2003

20ADV45	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and Maintain the software bot.

PRE-REQUISITE: NIL

UNIT - I INTRODUCTION TO ROBOTIC PROCESS AUTOMATION 9

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA fromAutomation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms.Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, WorkflowFiles

UNIT - II AUTOMATION PROCESS ACTIVITIES 9

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flowfor Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboardmanagement, File operations Controls: Finding the control, waiting for a control, Act on a control,UiExplorer, Handling Events

UNIT- III APP INTEGRATION, RECORDING AND SCRAPING 9

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse andkeyboard actions to perform operation, Scraping data from website and writing to CSV.Process Mining

UNI - IV EXCEPTION HANDLING AND CODE MANAGEMENT 9

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crashdumps, Error reporting. Code management and maintenance: Project organization, Nestingworkflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT - V DEPLOYMENT AND MAINTENANCE 9

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploybots, License management, Publishing and managing updates. RPA Vendors -Open Source RPA, Future of RPA

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

CO1: Understand the robotic process automation and its applications
CO2: Illustrate control flows and work flows for the target process
CO3: Demonstrate recording, web scraping and process mining by automation
CO4:Determineexception handling in automation processes
CO5:Understand Code management and maintenance in automation
CO6: Understand the Orchestrator for controlling of automated bots.

TEXT BOOKS

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath by Alok Mani Tripathi, PacktPublishing, 2018.
2. Tom Taulli , “The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems”, Apress publications, 2020.

REFERENCES:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston(Author), Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018
2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots,Automate Repetitive Tasks & Become An RPA Consultant, Amazon Asia-Pacific Holdings Private Limited, 2018
3. A Gerardus Blokdyk, “Robotic Process Automation Rpa A Complete Guide “, 2020

20ADV55	TEXT AND SPEECH ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

UNIT-I NATURAL LANGUAGE BASICS **9**

Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stop- words – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

UNIT- II TEXT CLASSIFICATION **9**

Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Overview of Deep Learning models – RNN – Transformers – Overview of Text summarization and Topic Models

UNIT- III QUESTION ANSWERING AND DIALOGUE SYSTEMS **9**

Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

UNI-IV TEXT-TO-SPEECH SYNTHESIS **9**

Overview. Text normalization. Letter-to-sound. Prosody, Evaluation. Signal processing - Concatenative and parametric approaches, WaveNet and other deep learning-based TTS systems

UNIT-V AUTOMATIC SPEECH RECOGNITION **9**

Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

1. Explain existing and emerging deep learning architectures for text and speech processing
2. Apply deep learning techniques for NLP tasks,
3. Understand the language modeling and machine translation
4. Explain coreference and coherence for text processing
5. Build question-answering systems, chatbots and dialogue systems
6. Apply deep learning models for building speech recognition and text-to-speech systems

TEXTBOOKS

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Third Edition, 2022.

REFERENCES:

1. DipanjanSarkar, “Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data”, APress,2018.
2. TanveerSiddiqui, Tiwary U S, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
3. LawrenceRabiner, Biing-Hwang Juang, B. Yegnanarayana, “Fundamentals of Speech Recognition” 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, “Natural language processing with Python”, O’REILLY.

20ITV65	FUZZY LOGIC AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To impact knowledge on fuzzy logic principles
- To understand models of ANN
- To explain the concepts of fuzzy sets are introduced and their role in applications of semantic interpreters, control systems and reasoning system
- To use the fuzzy logic and neural network for application related to design and manufacture.

PRE-REQUISITE: NIL

UNIT I INTRODUCTION TO FUZZY LOGIC PRINCIPLES 9

Basic concepts of fuzzy set theory – operations of fuzzy sets – properties of fuzzy sets – Crisp relations – Fuzzy relational equations – operations on fuzzy relations – fuzzy systems – propositional logic – Inference – Predicate Logic – Inference in predicate logic – fuzzy logic principles – fuzzy quantifiers – fuzzy inference – fuzzy rule based systems – fuzzification and defuzzification – types.

UNIT II ADVANCED FUZZY LOGIC APPLICATIONS 9

Fuzzy logic controllers – principles – review of control systems theory – various industrial applications of FLC adaptive fuzzy systems – fuzzy decision making – Multi objective decision making – fuzzy classification – means clustering – fuzzy pattern recognition – image processing applications – systactic recognition – fuzzy optimization

UNIT III INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9

Fundamentals of neural networks – model of an artificial neuron – neural network architectures – Learning methods – Taxonomy of Neural network architectures – Standard back propagation algorithms – selection of various parameters – variations Applications of back propagation algorithms.

UNIT IV OTHER ANN ARCHITECTURES 9

Associative memory – exponential BAM – Associative memory for real coded pattern pairs – Applications adaptive reasonance theory – introduction – ART 1 – ART2 –Applications – neural networks based on competition – kohenen self organizing maps –learning vector quantization – counter propagation networks – industrial applications.

UNIT V RECENT ADVANCES 9

Fundamentals of genetic algorithms – genetic modeling – hybrid systems – integration of fuzzy logic, neural networks and genetic algorithms – non-traditional optimization techniques like ant colony optimization – Particle swarm optimization and artificial immune systems – applications in design and manufacturing.

TOTAL: 45 PERIODS

TEXT BOOKS :

1.S.Rajasekaran.G.A.Vijayalakshmi Pai “Neural Networks, fuzzy logic and genetic algorithms”, prentice hall of India private limited, 2003

2. Timothy J.Ross, “Fuzzy logic with engineering applications”, McGraw Hill, 1995

3. Zurada J.M. “Introduction to artificial neural systems”, Jaico publishing house, 1994

REFERENCES:

1. Klir.G, Yuan B.B. “Fuzzy sets and fuzzy logic prentice Hall of India private limited, 1997.

2. Laurance Fausett, “Fundamentals of neural networks”, Prentice hall, 1992

3. Gen, M. and R. Cheng “Genetic algorithm and engineering design”, john wiley 1997

OUTCOMES:

AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:

Course Name: FUZZY LOGIC AND APPLICATIONS										**Course Code : 20ITV65**				
CO	**Course Outcomes**									**Unit**	**K-CO**	**POs**		**PSOs**
CO1	Understand basic knowledge of the fuzzy sets, operations and their properties.									1	K2	1,2		
CO2	Understand the fundamental concepts of Fuzzy functions and Fuzzy logic									2	K2	1,2,8,10		
CO3	Apply the concepts of Fuzzy sets in image processing, pattern reorganization and decision making									2	K2	1,2,3		1,2
CO4	Understand the fundamental of neural network and architecture									3	K2	1,2,8,10		
CO5	Understand the advanced neural network and architecture									4	K2	1,2		
CO6	Apply non-traditional optimization techniques in design and manufacturing applications.									5	K3	1,2,3,8,10		1,2
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1												
CO2	2	1						2		2				
CO3	3	2	1											1
CO4	2	1						2		2			1	
CO5	2	1												
CO6	3	2	1					2		2			1	1
C	2	2	1					1		1			1	1

20ADV75	ETHICS AND AI	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the morality and ethics in AI
- Learn about the Ethical initiatives in the field of artificial intelligence
- Study about AI standards and Regulations
- Study about social and ethical issues of Robot Ethics
- Study about AI and Ethics- challenges and opportunities

UNIT-I INTRODUCTION **9**

DefinitionofmoralityandethicsinAI-Impactonsociety-Impactonhumanpsychology-Impactonthelegalsystem-Impactontheenvironmentand the planet-Impact on trust

UNIT- II ETHICAL INITIATIVES IN AI **9**

International ethical initiatives-Ethical harms and concerns-Case study: health care robots, Autonomous Vehicles, Warfare and weaponization

UNIT- III AI STANDARDS AND REGULATION **9**

Model Process for Addressing Ethical Concerns During System Design-Transparency of Autonomous Systems-Data Privacy Process- Algorithmic Bias Considerations - OntologicalStandardforEthicallyDrivenRoboticsandAutomationSystems

UNI-IV ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS **9**

Robot-Roboethics- Ethics and Morality- Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society- Harmonization of Principles- Ethics and Professional Responsibility- Roboethics Taxonomy.

UNIT-V AI AND ETHICS- CHALLENGES AND OPPORTUNITIES **9**

Challenges - Opportunities- ethical issues in artificial intelligence- Societal Issues Concerning the Application of Artificial Intelligence in Medicine- decision-making role in industries-National and International Strategies on AI.

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

1. Learn about morality and ethics in AI
2. Acquire the knowledge of real time application ethics, issues and its challenges.
3. Understand the ethical harms and ethical initiatives in AI
4. Learn about AI standards and Regulations like AI Agent, Safe Design of Autonomous and Semi-Autonomous Systems
5. Understand the concepts of Roboethics and Morality with professional responsibilities.
6. Learn about the societal issues in AI with National and International Strategies on AI

TEXTBOOKS

1. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield ,"The ethics of artificial intelligence: Issues and initiatives", EPRS | European Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 – March 2020
2. Patrick Lin, Keith Abney, George A Bekey," Robot Ethics: The Ethical and Social Implications of Robotics", The MIT Press- January 2014.

REFERENCES:

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh," AI Ethics", The MIT Press Essential Knowledge series, April 2020

20ADV85	HEALTH CARE ANALYTICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand the health data formats, health care policy and standards
- Learn the significance and need of data analysis and data visualization
- Understand the health data management frameworks
- Learn the use of machine learning and deep learning algorithms in healthcare
- Apply healthcare analytics for critical care applications

UNIT-I INTRODUCTIONINTRODUCTION TO HEALTHCARE ANALYSIS 9

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

UNIT- II ANALYTICS ON MACHINE LEARNING 9

Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection.

UNIT- III HEALTH CARE MANAGEMENT 9

IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Decision Support System – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare

UNI-IV HEALTHCARE AND DEEP LEARNING 9

Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System

UNIT-V CASE STUDIES 9

Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT –Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis

TOTAL:45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

1. Use machine learning and deep learning algorithms for health data analysis
2. Apply the data management techniques for healthcare data
3. Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications
4. Demonstrate health data analytics for real time applications
5. Understand emergency care system using health data analysis
6. Apply health care analytics in Healthcare and Emerging Technologies

REFERENCES:

1. ChandanK.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.
2. Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
3. NilanjanDey, AmiraAshour , Simon James Fong, ChintanBhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
4. Hui Jang, Eva K.Lee, “HealthCare Analysis : From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
5. Kulkarni ,Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020.

SEMESTER VI – OPEN ELECTIVE

		L	T	P	C
20OE401	**FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE**	**3**	**0**	**0**	**3**

OBJECTIVES:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI

PRE-REQUISITE:NIL

UNIT-I INTRODUCTION 9

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.

UNIT-II PROBLEM SOLVING METHODS 9

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

UNIT - III KNOWLEDGE REPRESENTATION 9

First Order Predicate Logic– Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information.

UNIT - IV SOFTWARE AGENTS 9

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT - V APPLICATIONS 9

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
2. I. Bratko, 'Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

REFERENCES:

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc., First Edition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press,2009.
3. William F. Clocksin and Christopher S. Mellish, "Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.
4. Gerhard Weiss, "Multi Agent Systems", Second Edition, MIT Press, 2013.
5. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.

Course Name : Fundamentals Of Artificial Intelligence										**Course Code: 20OE401**				
CO	**Course Outcomes**									**Unit**	**K-CO**	**POs**	**PSOs**	
COE305.1	Explain the problem solving approaches to AI problems									1	K2	1,2,8,9,12	1,2	
COE305.2	Apply appropriate search algorithms for any AI problems									2	K3	1,2,3,8,9,10	1,2	
COE305.3	Solve a problem using first order and predicate logic									3	K3	1,2,3,8,9,10	1,2	
COE305.4	Describe the concepts of software agents									4	K2	1,2,8,9	1,2	
COE305.5	Discuss the software agents for solving AI problems									4	K2	1,2,8,9	1,2	
COE305.6	Describe the applications for Natural Language Processing									5	K2	1,2,1,8,9,10,12	1,2	
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
COE305.1	2	1	-	-	-	-	-	1	1	-	-	1	2	2
COE305.2	3	2	1	-	-	-	-	1	1	1	-	-	2	2
COE305.3	3	2	1	-	-	-	-	1	1	1	-	-	2	2
COE305.4	2	1	-	-	-	-	-	1	1	-	-	-	2	2
COE305.5	2	1	-	-	-	-	-	1	1	-	-	-	2	2
COE305.6	3	2	1	-	-	-	-	1	1	1	-	1	2	2
COE305	3	2	1	-	-	-	-	1	1	1	-	1	2	2

20OE402	INTRODUCTION TO DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of data models and to depict a database system using ER diagrams
- To study relational database and to write SQL queries to store/retrieve data to/from database
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures for real time applications
- To understand working procedures of query processing and query optimization techniques
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design
- To study concepts of advanced databases

PRE-REQUISITE:NIL

UNIT-I DATABASE FUNDAMENTALS 8

Purpose of Database System – Views of data – Database System Architecture – Introduction to Data Models –Introduction to Relational Model – Constraints – keys – Entity Relationship Model – Entity Sets – Attributes - Extended E-R features – ER reduction to Relational Schemas.

UNIT-II RELATIONAL DATABASE 10

Structure of Relational Database –SQL Fundamentals – Basic Queries – Set Operations – Aggregate Functions – Clauses – Subqueries – Correlated Subqueries – Joins – Views – Authorization – Advanced SQL – Triggers – Cursors – Procedure – Functions – Embedded SQL – Dynamic SQL

UNIT - III 9

Need for Database Design – Functional Dependencies – Closure of Functional Dependencies – Attribute Closure – Dependency Preservation – Decomposition – Canonical Cover – First Normal Form – Second Normal Form – Third Normal Form – Second Normal Form – Third Normal Form – Boyce Codd Normal Form – Multivalued Dependencies - Fourth Normal Form – Join Dependencies – Fifth Normal Form.

UNIT - IV TRANSACTIONS 9

Transaction Concepts – ACID properties – Transaction States – Serializability – Conflict Serializability – View Serializability – Concurrency Control – Lock Based Protocols – Deadlocks – Time Based Protocols – Stamp Based Protocols – Validation Based Protocols – Recovery System,

UNIT - V STORAGE AND QUERY PROCESSING 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, Tata McGraw Hill, 2019.
2. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education, 2016.

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, “Database Management Systems”, Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta,"Database Management Systems”, Tata McGraw Hill, 2011

Course Name : Introduction To Database Management Systems														**Course Code: 20OE402**	
CO	**Course Outcomes**													**Unit**	**K-CO**	**POs**	**PSOs**
COE305.1	Explain the fundamental elements of relative database management systems.													1	K2	1,2	1,2
COE305.2	Formulate SQL queries for the given relational tables.													2	K2	1,2,8,9,10	1,2
COE305.3	Apply normal forms to identify the redundancy in database tables.													3	K3	1,2,3,8,9,10	1,2
COE305.4	Explain various protocols in transaction processing.													4	K2	1,2,8,9,10,12	1,2
COE305.5	Discuss file organization in database storage system.													5	K2	1,2,8,9,10,12	1,2
COE305.6	Apply algorithms for SELECT and JOIN operations.													5	K3	1,2,3,8,9,10,12	1,2
CO-PO Mapping																	
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**			
COE305.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1			
COE305.2	2	1	-	-	-	-	-	1	1	1	-	-	2	1			
COE305.3	3	2	1	-	-	-	-	1	1	1	-	-	2	1			
COE305.4	2	1	-	-	-	-	-	1	1	1	-	1	2	1			
COE305.5	2	1	-	-	-	-	-	1	1	1	-	1	2	1			
COE305.6	3	2	1	-	-	-	-	1	1	1	-	1	2	1			
COE305	3	1	1	-	-	-	-	1	1	1	-	1	2	1			

20OE403	COMPUTER COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To understand the protocol layering and physical level communication.

- To analyze the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

PRE-REQUISITE:NIL

UNIT-I INTRODUCTION AND PHYSICAL LAYER 9

Networks – Network Types – Classification of computer Networks LAN, WAN, MAN, Network Topology: BUS, STAR, RING, MESH- Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit Switching, Packet Switching.

UNIT-II DATA-LINK & MEDIA ACCESS LAYER 9

Introduction – Link Layer Addressing – Framing, Physical Addressing, Flow control-noisy and noiseless channels, Error Control – Error detection and Error correction codes- Access control ALOHA,CSMA,CSMA/CD,TDMA,FDMA- Ethernet - Wireless LANs -IEEE 802.11, Bluetooth – Connecting Devices.

UNIT - III NETWORK LAYER 9

Network Layer Services – Performance – Logical Addressing- IPV4,IPV6- Network Layer Protocols- IP, ICMP,IGMP – Unicast Routing Algorithms - Distance Vector, Link state algorithms, Multicasting Basics Routing.

UNIT - IV TRANSPORT LAYER 9

Introduction – Transport Layer Protocols-. TCP, UDP – Services – Port Numbers -Flow control-TCP congestion control, Congestion avoidance mechanisms, Quality of service.

UNIT - V APPLICATION LAYER 9

WWW and HTTP– FTP – Email –Telnet –SSH – DNS.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data Communications and Networking”, Fifth Edition TMH, 2013.
2. William Stallings, “Data and Computer Communications”, Tenth Edition, Pearson Education, 2013

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. Nader F. Mir, “Computer and Communication Networks”, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. James F. Kurose, Keith W. Ross, “Computer Networking, A Top-Down Approach Featuring the Internet”, Sixth Edition, Pearson Education, 2013.

Course Name : Computer Communication Networks		Course Code: 20OE403			
CO	**Course Outcomes**	**Unit**	**K-CO**	**POs**	**PSOs**
COE305.1	Explain the basic concepts of communication networks	1	K2	1,2	1,2
COE305.2	Apply the error detection and error correction methods for bit streams	2	K3	1,2,3,8,9,10	1,2
COE305.3	Classify various media access control protocols techniques of communication networks	2	K2	1,2,8,9,10,12	1,2
COE305.4	Utilize various types of routing techniques to forward packets	3	K2	1,2,8,9	1,2
COE305.5	Illustrate the mechanisms involved in transport layer	4	K2	1,2,8,9,10	1,2
COE305.6	Classify different application layer protocols	5	K2	1,2,8,9,10,12	1,2

CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
COE303.1	2	1	-	-	-	-	-	-	-	-	-	-	2	1
COE303.2	3	2	1	-	-	-	-	1	1	1	-	-	2	1
COE303.3	2	1	-	-	-	-	-	1	1	1	-	1	2	1
COE303.4	2	1	-	-	-	-	-	1	1	-	-	-	2	1
COE303.5	2	1	-	-	-	-	-	1	1	1	-	-	2	1
COE303.6	2	1	-	-	-	-	-	1	1	1	-	1	2	1
COE303	2	1	1	-	-	-	-	1	1	1	-	1	2	1

20OE404	CLOUD INFRASTRUCTURE AND TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

PRE-REQUISITE:NIL

UNIT-I INTRODUCTION TO CLOUD COMPUTING 9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT-II VIRTUALIZATION 9

Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT - III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT - IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT - V CASE STUDIES 9

Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Buyya R., Broberg J., Goscinski A., “Cloud Computing: Principles and Paradigm”, First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2017

REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, “Mastering Cloud Computing”, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach”, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)”, O'Reilly, 2009.

Course Name : Cloud Infrastructure And Technologies										**Course Code: 20OE404**				
CO	**Course Outcomes**									**Exp. No**	**K-CO**	**POs**	**PSOs**	
COE304.1	Explain the main concepts, key technologies, strengths and limitations of cloud computing.									1	K2	1,2	1,2	
COE304.2	Describe the key and enabling technologies that help in the development of cloud.									2	K2	1,2,8,9	1,2	
COE304.3	Discuss and use the architecture of compute and storage cloud with its service and delivery models.									3	K2	1,2,8,9	1,2	
COE304.4	Explain the core issues of cloud computing such as resource management and security.									4	K2	1,2,8,9,10,12	1,2	
COE304.5	Discuss the Cloud Environment using current cloud technologies									4	K2	1,2,8,9,10,12	1,2	
COE304.6	Illustrate the appropriate technologies, algorithms and approaches for implementation and use of cloud									5	K3	1,2,3,8,9,10,12	1,2	
CO-PO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
COE304.1	2	1	-	-	-	-	-	-	-	-	-	-	1	2
COE304.2	2	1	-	-	-	-	-	1	1		-	-	1	2
COE304.3	2	1	-	-	-	-	-	1	1		-	-	1	2
COE304.4	2	1	-	-	-	-	-	1	1	1	-	1	1	2
COE304.5	2	1	-	-	-	-	-	1	1	1	-	1	1	2
COE304.6	3	2	1	-	-	-	-	1	1	1	-	1	1	2
COE304	2	1	1	-	-	-	-	1	1	1	-	1	1	2