P.S. R. ENGINEERING COLLEGE

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

Approved by AICTE, New Delhi & Accredited by NBA and

by NAAC with A+ Grade, Recognized under 12(B) of the UGC Act, 1956)

An ISO 9001: 2015 Certified Institution

Sevalpatti (P.O), Sivakasi – 626140.

Department of Computer Science and Engineering

CURRICULUM

AND

SYLLABI

Academic Council Meeting on 30.05.23

Regulations – 2023

M.E. Computer Science and Engineering

(Full-time)

(Candidates admitted from 2023–2024 onwards)

P.S.R. ENGINEERING COLLEGE

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

Approved by AICTE, New Delhi & Accredited by NBA and

by NAAC with A+ Grade, Recognized under 12(B) of the UGC Act, 1956)

An ISO 9001: 2015 Certified Institution

Sevalpatti (P.O), Sivakasi – 626140.

REGULATIONS – 2023

CURRICULUM AND SYLLABI

FOR

M.E., COMPUTER SCIENCE AND ENGINEERING

(FULL-TIME)

(Candidates admitted from 2023–2024 onwards)

INSTITUTE VISION & MISSION

Vision	• To contribute to the society through excellence in technical education with societal values and thus a valuable resource for industry and the humanity.
Mission	• To create an ambience for quality learning experience by providing sustained care and facilities. • To offer higher level training encompassing both theory and practices with human and social values. • To provide knowledge- b a s e d services and professional skills to adapttomorrow's technology and embedded global changes.

DEPARTMENT VISION & MISSION

Vision	To impart holistic education in Computer Science and Engineering to cater the needs in academia, industry and society.
Mission	• Offering under graduate and post graduate programmes by providing effective and balanced curriculum and equip themselves to gear up to the ethical challenges awaiting them. • To confer continuous activities in technical and research that will enable the students to face the real time challenges in the field of Computer Science and Engineering. • To provide training for the students in a socially responsible manner with inculcating integrity and human values.

PROGRAM SPECIFIC OUTCOMES (PSO)

1. Proficiency in Computer Science and Engineering problem identification, formulation, analysis, design, execution and safety using appropriate tools.
2. Solve problems in the algorithms, system software, multimedia, web design, cloud, big data analytics and networking disciplines of Computer Science and Engineering with competence in modern tool usage.
3. Apply modern construction techniques, equipment and management tools so as to complete the project within specified time and funds.
4. Graduates will have a broad understanding of economical, environmental, societal and health involved in infrastructural development and ability to function within multidisciplinary teams.

PROGRAM OUTCOMES (POs)

1. An ability to independently carry out research/ investigation and development work to solve practical Problems in key areas of Computer Science and Engineering.
2. An ability to write and present a substantial report/document.
3. Able to demonstrate Computer Science and Engineering Problems critically in development project and find suitable solution.
4. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
5. Able to design a system, component or process as per needs and specifications.
6. Able to use modern engineering tools, software and equipment to analyze problems.

P.S.R. ENGINEERING COLLEGE, SIVAKASI – 626140.

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

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Consolidated Curriculum Structure

(PG REGULATION 2023 – M.E. (CSE))

Sem-ester	Core Theory Courses					Program Elective Course(s)			Open Elective Course	Mandatory Course	Audit Course(s)	Core Practical Course(s)			Total Credits
I	232CS11 Advanced Data Structures and Algorithms (3)	232CS12 Cloud Computing (3)	232CS13 Data Science (3)	232CS14 Network Vulnerability (3)	232CS15 Information Security (3)	-	-	-	-	232SE13 Research Methodology and IPR (3)	232ACXX Audit Course – I (0)	232CS17 Advanced Data Structures Laboratory (2)	232CS18 Data Science Laboratory (2)	-	***22***
II	232CS21 Advanced Operating Systems (3)	232CS22 Soft Computing (3)		-	-	*232CSExx Program Elective – I (3)*	*232CSExx Program Elective – II (3)*	*232CSExx Program Elective – III (3)*	-	-	232ACXX Audit Course – II (0)	232CS26 Soft Computing Laboratory (2)	232CS27 Technical Seminar (1)		***18***
III	232CS31 Agile Methodologies (3)	-	-			*232CSExx Program Elective – IV (3)*	*232CSExx Program Elective – V (3)* -	-	*232OExx Open Elective (3)*	-	-	232CS31 Project Phase – I (6)	-	-	***18***
IV	-	-	-			-			-	-	-	232CS41 Project Phase – II (12)	-	-	***12***
														TOTAL CREDITS	***70***

P.S.R. ENGINEERING COLLEGE (Autonomous), SIVAKASI – 626140.

PG REGULATION – 2023
CHOICE BASED CREDIT SYSTEM

M.E. COMPUTER SCIENCE AND ENGINEERING

CURRICULUM [I – IV SEMESTERS – FULL-TIME]
(Candidates admitted from 2023–2024 onwards)

Total Credits: 70

SEMESTER – I

S. No.	Course Code	Course Title	Category	L–T–P	Credit
Core Theory:					
1	232CS11	Advanced Data Structures and Algorithms	PC	3–0–0	3
2	232CS12	Cloud Computing	PC	3–0–0	3
3	232CS13	Data Science	PC	3–0–0	3
4	232CS14	Network Vulnerability	PC	3–0–0	3
5	232CS15	Information Security	PC	3–0–0	3
Mandatory Course:					
6	232SE13	Research Methodology and IPR	MC	3–0–0	3
Audit Course:					
7	232ACXX	*Audit Course – I*	AC	2–0–0	0
Practical:					
8	232CS17	Advanced Data Structures and Algorithms Laboratory	PC	0–0–4	2
9	232CS18	Data Science Laboratory	PC	0–0–4	2
					No. of Credits: 22

SEMESTER – II

S. No.	Course Code	Course Title	Category	L–T–P	Credit
Core Theory:					
1	232CS21	Advanced Operating Systems	PC	3–0–0	3
2	232CS22	Soft Computing	PC	3–0–0	3
Program Elective:					
3	232CSEXX	*Program Elective – I*	PE	3–0–0	3
4	232CSEXX	*Program Elective – II*	PE	3–0–0	3
5	232CSEXX	*Program Elective – III*	PE	3–0–0	3
Audit Course:					
6	232ACXX	*Audit Course – II*	AC	2–0–0	0
Practical:					
7	232CS27	Soft Computing Laboratory	PC	0–0–4	2
8	232CS28	Technical Seminar	EEC	0–0–2	1
					No. of Credits: 18

SEMESTER – III

S. No.	Course Code	Course Title	Category	L–T–P	Credit
Program Core:					
1	232CS31	Agile Methodologies	PC	3–0–0	3
Program Elective:					
2	232CSEXX	*Program Elective – IV*	PE	3–0–0	3
3	232CSEXX	*Program Elective – V*	PE	3–0–0	3
Open Elective:					

4	232OEXX	*Open Elective*	OE	3–0–0	3
Practical:					
5	232CS39	Project Phase – I	PROJ	0–0–12	6
					No. of Credits: 18

SEMESTER – IV					
S. No.	**Course Code**	**Course Title**	**Category**	**L–T–P**	**Credits**
Practical:					
1	232CS49	Project Phase – II	PROJ	0–0–24	12
					No. of Credits: 12
					Total No. of Credits: 22+18+18+12=70

PROGRAM ELECTIVES					
S. No.	**Course Code**	**Course Title**	**Category**	**L–T–P**	**Credits**
1	232CSE01	Big Data Mining and Analytics	PE	3–0–0	3
2	232CSE02	Block Chain and Cryptography	PE	3–0–0	3
3	232CSE03	Compiler for HPC	PE	3–0–0	3
4	232CSE04	Computer Vision	PE	3–0–0	3
5	232CSE05	Database Technologies	PE	3–0–0	3
6	232CSE06	Data Preparation and Analysis	PE	3–0–0	3
7	232CSE07	Deep Learning	PE	3–0–0	3
8	232CSE08	Digital Image Processing	PE	3–0–0	3
9	232CSE09	Digital Forensics	PE	3–0–0	3
10	232CSE10	GPU Computing	PE	3–0–0	3
11	232CSE11	Human and Computer Interaction	PE	3–0–0	3
12	232CSE12	Sensors and IoT	PE	3–0–0	3
13	232CSE13	Introduction to Intelligent Systems	PE	3–0–0	3
14	232CSE14	Linguistic Computing	PE	3–0–0	3
15	232CSE15	Machine Learning	PE	3–0–0	3
16	232CSE16	Mobile Applications and Services	PE	3–0–0	3
17	232CSE17	Optimization Techniques	PE	3–0–0	3
18	232CSE18	Software Defined Networks	PE	3–0–0	3
19	232CSE19	Storage and Server Security	PE	3–0–0	3
20	232CSE20	Wireless Sensor Networks	PE	3–0–0	3

OPEN ELEVTIVES					
S. No.	**Course Code**	**Course Title**	**Category**	**L–T–P**	**Credits**
1.	232OE21	Web Analytics and Development	OE	3–0–0	3
2.	232OE22	Data Analysis for Business Intelligence	OE	3–0–0	3

AUDIT COURSES					
S. No.	**Course Code**	**Course Title**	**Category**	**L–T–P**	**Credit**
1	232AC01	Report Preparation Tools	MC	2–0–0	0
2	232AC02	Constitution of India	MC	2–0–0	0
3	232AC03	Disaster Management	MC	2–0–0	0
4	232AC04	நற்றமிழ் இலக்கியம்	MC	2–0–0	0

PC – Program Core, PE – Program Elective, OE – Open Elective, AC – Audit Course,

MC – Mandatory Course, PROJ – Project

S. No.	**Course Categories**	**Total Number of Credits PSREC (R2023) (70)**		**Total Number of Credits Anna University R2021 (75)**	
		Credit Distribution	**% of weightage of Credits**	**Credit Distribution**	**% of weightage of Credits**
1.	**Programme Core (PC)**	30	42.83 %	34	45.33 %
2.	**Programme Elective (PE)**	15	21.43 %	13	17.33 %
3.	**Open Elective (OE)**	3	4.3 %	3	4 %
4.	**Employability Enhancement Courses (EEC)**	19	27.14 %	19	25.33 %
5.	**Research Methodology and IPR Courses (RMC)**	3	4.3 %	2	2.67 %
6.	**Foundation Course**	-	-	4	5.33 %
7.	**Audit Courses (MC)**	*(Non-Credit)*			
Total Credits		**70**		**75**	

S. No.	**Course Categories**	**Credits per Semester**				**Total Credits**	**% of Credits**
		I	**II**	**III**	**IV**		
1	**PC**	19	8	3	-	30	42.83 %
2	**PE**		9	6	-	15	21.43 %
3	**OE**	-	-	3	-	3	4.3 %
4	**EEC**	-	1	6	12	19	27.14 %
5	**RMC**	3	-	-	-	3	4.3 %
6	**Foundation Course**	-	-	-	-	-	-
7	**Audit Course (MC)**	√	√	-	-	*Non-Credit*	-
Total Credits		**22**	**18**	**18**	**12**	**70**	

232CS11	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	1	Category:	PC
Prerequisite:	Fundamentals of Data Structure				
Aim:	To understand the advanced algorithms of graphs and trees				

Course Outcomes: The Students will

CO1:	Explain the implementation of symbol table using hashing techniques.
CO2:	Illustrate the hierarchical data structures and its operations
CO3:	Discuss the algorithms for text processing applications.
CO4:	Summarize the usage of graphs and its applications
CO5:	List the operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
CO6:	State the NP Completeness of problems.

INTRODUCTION	**9**
Dictionaries: Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hashing - Closed hashing: Separate chaining - Binary tree : Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.	
TEXT PROCESSING	**9**
Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Types of Tries-Standard Tries, Compressed Tries and Suffix Tries, The Huffman Coding Algorithm.	
GRAPH MATCHING AND FLOW NETWORKS	**9**
Algorithm to compute maximum matching-Characterization of maximum matching by augmenting paths- Edmond's Blossom algorithm to compute augmenting path. Maxflow- mincut theorem-Ford-Fulkerson Method to compute maximum flow-Edmond-Karp maximum-flow algorithm	
MATRIX COMPUTATIONS	**9**
Strassen's algorithm and introduction to divide and conquer paradigm-Inverse of a triangular matrix-Relation between the time complexities of basic matrix operations- LUP-decomposition-Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm-More examples of dynamic programming.	
NP-COMPLETENESS	**9**
Examples, proof of NP-hardness and NP-completeness-Approximation algorithms-Randomized Algorithms-Interior Point Method-Advanced Number Theoretic Algorithm-Recent trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures	
Total Hours	**45**

References:

1. Mark Allen Weiss, "*Data Structures and Algorithm Analysis in C++*", 4th Edition, Pearson, 2014.
2. M T Goodrich, Roberto Tamassia, Algorithm Design, John Wiley, 2002.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms", Prentice-Hall,3/e, 2011.
4. Alfred V. Aho, John E. Hopcroft, Jeffrey D.Ullman, "*The Design and Analysis of Computer*

Algorithms", Addison-Wesley Pub. Co., 1974.
5. Kleinberg, Tardos, "*Algorithm Design*", Pearson Education, 1/e, 2009.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3				2		3	2	2	
CO2	3		2		3		3	3	3	
CO3	2						2	2		
CO4	3		2		3		3	1	3	
CO5	3						1	2		
CO6	2						1	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS12	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	1	Category:	MC

Aim:	To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
Prerequisite:	--

Course Outcomes: The Students will

CO1:	Apply virtualization for efficient resource utilization.
CO2:	Explore cloud computing models and services
CO3:	Apply cloud platforms for different applications.
CO4:	Implement various services using cloud programming models.
CO5:	Interpret the security and resource allocation issues of cloud computing.
CO6:	Design Cloud Services and Set a private cloud

CLOUD INFRASTRUCTURE	**9**
Scalable Computing over the Internet – Technologies for Network based Systems - System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture-Cloud Computing and Services Model – Public, Private and Hybrid Clouds – Cloud Eco System - IaaS - PaaS – SaaS	
VIRTUALIZATION STRUCTURES	**9**
Implementation Levels of Virtualization - Virtualization Structures – Tools and Mechanisms - Virtualization of CPU,Memory, I/O Devices - Virtual Clusters and Resource Management – Virtualization for Data-Center Automation	
CLOUD SYSTEM MODEL	**9**
Architectural Design of Compute and Storage Clouds – Layered Cloud Architecture Development – Design Challenges - Public Cloud Platforms- GAE, AWS, and Azure- Inter Cloud Resource Management – VM Management - Resource Provisioning and Platform Deployment - Global Exchange of Cloud Resources - Cloud Security and Trust Management.	
CLOUD SECURITY - MIDDLEWARE AND TESTING	**9**
Parallel and Distributed Programming Paradigms – MapReduce , Twister and Iterative MapReduce – Hadoop Library from Apache – Mapping Applications - Programming Support - Google App Engine, Amazon AWS - Cloud Software Environments - Eucalyptus, Open Nebula, Open Stack.CloudSim – Architecture - Cloudlets – VM creation – Broker – VM allocation – Hosts – Data Center.	
CLOUD APPLICATIONS	**9**
Cloud Computing Risk Issues – Cloud Computing Security Challenges – Cloud Computing Security Architecture -Trusted cloud Computing – Identity Management and Access Control – Autonomic Security. Case Studies: Tools for Building Private Cloud: IaaS using Eucalyptus, PaaS on IaaS-App Scale	
Total Hours	**45**

References:

1. John W.Rittinghouse and James F.Ransome, "*Cloud Computing: Implementation, Management, and Security*", CRC Press, 2010.
2. George Reese, "*Cloud Application Architectures: Building Applications and Infrastructure in the Cloud*" O'Reilly
3. Rajkumar Buyya, Christian Vecchiola, S.Tamarai Selvi, "*Mastering Cloud Computing*", TMGH,2013.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		2				2			
CO2	2		1					2		
CO3	2	2						1		
CO4	2									
CO5	3	2					1	1		2
CO6	3	1	1				1	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS13	DATA SCIENCE	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	2	Category:	PC

Aim:	To provide the knowledge about user data security and protecting data assets.
Course Outcomes: The Students will	
CO1:	Ability to obtain fundamental knowledge on data science.
CO2:	Apply data pre-processing techniques.
CO3:	Analyze the performance using Machine Learning Algorithms.
CO4:	Make use of R tools in the context of real-world problems.
CO5:	Develop mathematical knowledge and study various optimization techniques to perform data science operations.
CO6:	Demonstrate numerous open source data science tools to solve real-world problems through industrial case studies.

BASICS OF DATA SCIENCE	**9**
Introduction; Typology of problems; Importance of linear algebra, statistics and optimization from a data science perspective; Structured thinking for solving data science problems, Structured and unstructured data.	
DATA PREPROCESSING	**9**
Introduction to Data Preprocessing – Reading, Selecting, Filtering Data – Filtering Missing Values – Manipulating, Sorting, Grouping, Rearranging, Ranking Data.	
CLASSIFICATION AND CLUSTERING	**9**
Introduction to machine learning: Supervised, Unsupervised Learning – Regression: Linear Regression and Logistic Regression -- Classification Methods: K Nearest Neighbors, Naïve Bayes, Decision Trees - Clustering: k means, Hierarchical clustering.	
HANDLING DATA USING R	**9**
R Objects, variables, datatypes, matrices, list, Control Structures, Functions, Data Frames, Reading and Writing Data File, Model Building.	
OPTIMIZATION	**9**
Unconstrained optimization; Necessary and sufficiency conditions for optima; Gradient descent methods; Constrained optimization, KKT conditions; Tools and Techniques: Open source tools such as R, Octave, Scilab. Python libraries:SciPy and sci-kitLearn, PyBrain, Pylearn2; Weka.	

Text Books:

1. Hadley Wickhmen, Garrette Grolemund, R for Data Science: Import, Tidy, Transform, Visualize and Model Data, OReilly, 2017.

Total Hours:	**45**

References:

1. Avrim Blum, John Hopcroft, Ravindran Kannan, "*Foundations of Data Science*", Cambridge University Press, 2020.Carl Shan, Henry Wang, William Chen, Max Song. The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists. The Data Science Bookshelf. 2016.
2. Ani Adhikari and John DeNero, '*Computational and Inferential Thinking: The Foundations of Data Science*', GitBook, 2019.
3. Cathy O'Neil and Rachel Schutt, '*Doing Data Science: Straight Talk from the Frontline'*, O'Reilly Media, 2013.
4. V. Hogg, J. W. McKean and A. Craig, *Introduction to Mathematical Statistics,* Pearson Education India,8/e, 2019.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1				1	1	1	
CO2	2	1	1				1	2	1	
CO3	2		1			2	2	2	1	
CO4	3				2	3	1	1		
CO5	3				1	1	1	1		
CO6	2		3		1	1	1	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS14	NETWORK VULNERABILITY	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:		Category:	PE

Aim:	To provide the knowledge about importance of networks and its vulnerabilities.

Course Outcomes: The Students will be able to

CO1:	Construct the vulnerability life cycle using available standards and models
CO2:	Identify the agents and perform active and passive scanning
CO3:	Diagnose the vulnerabilities and their impacts using various testing methods
CO4:	Examine the various vulnerability Assessment Tools and its effect in a given network
CO5:	Gain Knowledge on Hacking Impacts, Hacker Framework and Vulnerability Analysis
CO6:	Examine the Use of Discovery Reports

INTRODUCTION — **9**

Introduction-VA -life cycle -Origins of VM -Introducing the Security Industry and Its Flaws -Sources of Vulnerabilities -Why VM Is Important -The Vulnerability Creation Process -Risk of Major Financial Loss -Loss of Revenue -Lost Productivity -The VM Program and Technology Development and Roles

HARDWARE — **9**

The Appliance Model-User-Supplied Hardware and Virtualization-Agents-Agent Architecture-Advantages and Disadvantages-Detection Methods-Passive Network Analysis-Advantages and Disadvantages-Detection Methods-Active Scanning Technology-Advantages and Disadvantages

DETECTION METHODS — **9**

Discovery -Black Box Testing -White Box Testing-Web Application Testing -Hybrid Approach-Inference Scanning

STANDARDS — **9**

CVE-Structure -Limitations of CVE -The Standard for Vulnerability Test Data -Definitions Schema -System Characteristics Schema -Results Schema -The Standard for Vulnerability Severity Rating -CVSS Nomenclature -NVD -CPE -XCCDF -SCAP-VA.

NETWORK VULNERABILITIES AND TOOLS — **9**

Overview of vulnerability scanning, Open Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Open source tools -NMAP -NMAP commands –NMAP Scripting -Nessus -Advantages and Disadvantages of VA Tools.

Total Periods: 45

References:

1. Park Foremann, “Vulnerability Management”, CRC Press, 2010.
2. Abhishek Singh , Baibhav Singh , Hirosh Joseph, “Vulnerability Analysis and Defence for the Internet”, Springer Science+Business Media, 2008.
3. Thomos Bonold, Mathieu Feuillet, “Network Performance Analysis”, Wiley Publication, 2011.
4. Malcolm Harkins, Managing Risk and Information Security, Apress, 2012

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3			3		3			3
CO2	2	2	3				2	3		
CO3	3	2					2			2
CO4	2	3					3	2		
CO5	2	3	3		2		2			
CO6		3						3		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS15	INFORMATION SECURITY	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	2	Category:	PC

Aim:	To provide the knowledge about user data security and protecting data assets.
Course Outcomes: The Students will	
CO1:	Describe the legal and ethical requirements related to ethical hacking.
CO2:	Examine the tools for conducting ethical hacking.
CO3:	Understand different kinds of security attacks.
CO4:	Classify legal and ethical issues related to vulnerability.
CO5:	Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.
CO6:	Detect malicious sites through initial malware analysis

INTRODUCTION	**9**
Ethics of Ethical Hacking, Ethical Hacking and the Legal System, Proper and Ethical Disclosure.	
PENETRATION TESTING AND TOOLS	**9**
Using Metasploit, Using the Backtrack Linux Distribution, Managing a Penetration Test.	
SECURITY ATTACKS	**9**
Understanding and Detecting Content-Type Attacks, Web Application Security Vulnerability, VoIP Attacks, SCADA Attacks	
VULNERABILITY ANALYSIS	**9**
Passive Analysis, Advanced Static Analysis with IDA Pro,Advanced Reverse Engineering	
CLIENT-SIDE VULNERABILITY AND MALWARE	**9**
Client-side browser exploits, Exploiting Windows Access Control Model for Local ElevationPrivilege, Intelligent Fuzzing with Sulley, From Vulnerability to Exploit. Collecting Malware and Initial Analysis, Hacking Malware.	
Total Hours :	**45**

References:

1. Shon Harris, Allen Harper, Chris Eagle and Jonathan Ness, "*Gray Hat Hacking: The Ethical Hacker's Handbook*", 3/e, 2011.
2. Patrick Engebretson, "*The Basics of Hacking and Penetration Testing – Ethical Hacking andPenetration Testing Made Easy*", Syngress Media, 2/e, 2013.
3. Ec-Council, "*Ethical Hacking and Countermeasures: Attack Phases*", Delmar Cengage Learning, 2009.
4. Michael T. Simpson, Kent Backman, James E. Corley, "*Hands-On Ethical Hacking and Network Defense*", Cengage Learning, 2012.
5. Jon Erickson, "*Hacking: The Art of Exploitation*", No Starch Press, 2/e, 2008.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2				1	2	1	
CO2	3		2		1		2	2	1	
CO3	1		1				1	1		
CO4	1		1		1		2	1		
CO5	2		3		2	1	3	2	2	
CO6	2		2			1	3	2	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232SE13	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	**Sem:**	1	**Category:**	MC
Aim:	To provide the idea about research methods and its complications.				
Prerequisite:	--				

Course Outcomes: The Students will

CO1:	Formulate a research problem for a given engineering domain.
CO2:	List the methods used for collecting data from various sources.
CO3:	Analyze the available data for given research problem.
CO4:	Develop technical writing and presentation skills.
CO5:	Identify the need of information about Intellectual Property Right.
CO6:	Summarize the concepts related to patents and copyright.

RESEARCH DESIGN	**9**
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.	
DATA COLLECTION AND SOURCES	**9**
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.	
DATA ANALYSIS AND TECHNICAL WRITING	**9**
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	
INTELLECTUAL PROPERTY RIGHTS	**9**
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.	
PATENTS	**9**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.	
Total Hours	**45**

References:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "*Business Research Methods*", Tata McGraw Hill Education, 11/e, (2012).
2. Catherine J. Holland, "*Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets*", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "*Patent searching: tools & techniques*", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "*Professional Programme Intellectual Property Rights, Law and practice*", September 2013.
5. Stuart Melville and Wayne Goddard, "*Research methodology: An Introduction for Science & Engineering Students*", 1996.
6. Wayne Goddard and Stuart Melville, "*Research Methodology: An Introduction*", 2004
7. Ranjit Kumar, "*Research Methodology: A Step by Step Guide for beginners*", Pearson Education, 2/e, 2005.
8. Robert P.Merges, Peter S.Menell, Mark A.Lemley,"*Intellectual Property in New Technological Age*", 2016.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3		2				2			
CO2	3							2		
CO3	3							3		
CO4	2	2					3	2		
CO5	3	2	2		2		2	2		2
CO6	1	3	1	2			1	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS17	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

Programme:	M.E. Computer Science and Engineering	Sem:	1	Category:	PC
Aim:	To provide knowledge about the advanced techniques of data structures.				
Prerequisite:	--				

Course Outcomes: The Students will

CO1:	Implement tree data structure.
CO2:	Analyze the working of various Tree operations.
CO3:	Implement program for graph representation.
CO4:	Understand the concept of hashing
CO5:	Build operations like insert and search record in the database.
CO6:	Make use of concept & features like extended binary search tree.

LIST OF EXPERIMENTS

1. Implement an Expression Tree - Produce its Pre-order, In-order, and Post-order traversals.
2. Implementation of a Merge Sort
3. Implement Binary Search Tree
4. Implementation of AVL Tree
5. Implement Hashing techniques
6. Implementing the following Graph traversal algorithms:
7. Depth first traversal
8. Breadth first traversal
9. Implement a Backtracking algorithm for Knapsack problem
10. Implement Topological sorting
11. Implement Shortest Path using Dijkstra's algorithm
12. Implement Minimum Spanning Tree using prim's algorithm

	Total Hours	60

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2		2		3	3	1	
CO2	3	2	1		1		2	1	1	
CO3	3	2	3		3		3	1	2	
CO4	3	2	1		2		3	2	2	
CO5	3	2	2		2		2	2		
CO6	3	2	1		2		3	1	3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS18	DATA SCIENCE LABORATORY				L	T	P	C
					0	0	4	2
Programme:	M.E. Computer Science and Engineering	**Sem:**	**1**	**Category:**			**PC**	
Aim:	To understand and utilize the data science concepts.							
Prerequisite:	--							
Course Outcomes: The Students will be able to								
CO1:	Solve real world problems using R Programming							
CO2:	Analyze and Summarize different types of data sets.							
CO3:	Develop Spark paradigm.							
CO4:	Make use of the classification and Regression Model and Work with Hive.							
CO5:	Build the concepts and able to develop API.							
CO6:	Apply various Modeling techniques for performing Prediction.							
LIST OF EXPERIMENTS								
Exercises to solve real world problems in Machine Learning using R. • Installing the R platform. • Loading the dataset. • Summarizing the dataset. • Visualizing the dataset. • Evaluating some algorithms. • Making some predictions.								
Run a basic Word count program to understand Spark paradigm.								
Install Hive and use Hive to create, alter, drop databases.								
Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.								
Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.								
Write a Map Reduce Program – Weather Data Analysis For Analyzing Hot And Cold Days								
							Total Hours	**60**

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		2		1		2	3		
CO2	1	2	3		2		3	2		
CO3	3	2	2		3		2	2		
CO4		3	2		2		3	3		
CO5		1			2		3	2		
CO6	2	2	1				3	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS21	ADVANCED OPERATING SYSTEMS			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	**2**	**Category:**		**PC**	
Aim:	To understand the principles in the design of modern operating systems, distributed and multiprocessor operating systems						

Course Outcomes: The Students will be able to

CO1:	Analyze the design issues of Distributed Operating Systems.
CO2:	Examine the Distributed Mutual Exclusion Algorithms and its implementations.
CO3:	Compare the performance of various Distributed deadlock detection algorithms.
CO4:	Identify the requirements Distributed File System and Distributed Shared Memory.
CO5:	Formulate the solutions to schedule the Distributed Load Balancing.
CO6:	Evaluate design issues of Multiprocessor Operating Systems.

ARCHITECTURES OF DISTRIBUTED SYSTEMS	**9**
System Architecture Types, Distributed Operating Systems, Issues in Distributed Operating Systems, Communication Primitives.	
DISTRIBUTED MUTUAL EXCLUSION	**9**
The Classification of Mutual Exclusion Algorithms, Lamport's Algorithm, The Ricart-Agrawala Algorithm, Maekawa's Algorithm, Suzuki-Kasami's Broadcast Algorithm, Singhal's Heurisric Algorithm, Raymond's Heuristic Algorithm.	
DISTRIBUTED DEADLOCK DETECTION	**9**
Preliminaries, Deadlock Handling Strategies in Distributed Systems, Issues in Deadlock Detection and Resolution, Control Organizations for Distributed Deadlock Detection, Centralized- Deadlock – Detection Algorithms, Distributed Deadlock Detection Algorithms, Hierarchical Deadlock Detection Algorithms.	
DISTRIBUTED RESOURCE MANAGEMENT	**9**
Distributed File System: Architecture, Mechanisms for Building Distributed File Systems, Design Issues. **Distributed Shared Memory:** Architecture and Motivation, Algorithms for Implementing DSM, Memory Coherence, Coherence Protocols, Design Issues. **Distributed Scheduling:** Issues in Load Distributing, Components of a Load Distributed Algorithm, Stability, Load Distributing Algorithms, Requirements for Load Distributing, Task Migration, Issues in task Migration.	
MULTIPROCESSOR SYSTEM ARCHITECTURES	**9**
Introduction, Motivation for multiprocessor Systems, Basic Multiprocessor System Architectures, Structures of Multiprocessor Operating Systems, Operating Design Issues, Threads, Process Synchronization, Processor Scheduling.	
Total Hours	**45**

Text Book:

1. Mukesh Singhal, Niranjan G. Shivaratri, "*Advanced Concepts in Operating Systems*", Tata McGraw-Hill Edition2001.

Reference Books:

1. Andrew S. Tanenbaum, Maarten Van Steen, "*Distributed Systems*", Pearson Prentice Hall, *2/e*, 2007

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3		3	3	3	2	2	2		
CO2	3		3		3	3	3	3		
CO3	3		3	2	3	2	3	3		
CO4	3		3		3		3	2		
CO5	3		3		2		3	2		
CO6	3		3	3		2	2	1	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS22	SOFT COMPUTING			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	**2**	**Category:**		**PC**	
Aim:	To understand the concepts of soft computing and fundamentals and applications						

Course Outcomes: The Students will be able to

CO1:	Outline the concept of soft computing and optimization methods
CO2:	Summarize the working principles of genetics algorithms and its parameters.
CO3:	Choose different optimizations methods in soft computing
CO4:	List out the fuzzy sets with fuzzy logic controller.
CO5:	Construct different neural networks likes MLFFNN, RBFL, SOM, CPNN, RNN
CO6:	Examine the real-world soft computing applications in autonomous robots and data analysis.

INTRODUCTION	**9**
Hard Computing -Soft Computing-Hybrid Computing-Introduction to Optimization-Traditional Methods of Optimization.	
INTRODUCTION TO GENETIC ALGORITHMS	**9**
Working Cycle of a Genetic Algorithm-Binary-Coded GA-GA-parameters Setting-Constraints Handling in GA-Advantages and Disadvantages of Genetic Algorithms-Combination of Local and Global Optimum Search Algorithms-Real-Coded GA-Micro-GA-Scheduling GA.	
OPTIMIZATION METHODS	**9**
Overview of Other Non-Traditional Optimization Methods-Simulated Annealing-Particle Swarm Optimization-Multi-Objective Optimization-Some Approaches to Solve Multi-Objective Optimization Problems	
FUZZY SET AND REASONING	**9**
Introduction to Fuzzy Sets-Crisp Sets-Fuzzy Sets-Measures of Fuzziness and Inaccuracy of Fuzzy Sets-Fuzzy Reasoning and Clustering-Introduction-Fuzzy Logic Controller-Fuzzy Clustering	
NEURAL NETWORKS AND APPLICATIONS	**9**
Fundamentals of Neural Networks-Introduction-Static vs. Dynamic Neural Networks-Training of Neural Networks-Some Examples of Neural Networks-Multi-Layer Feed-Forward Neural Network (MLFFNN) - Radial Basis Function Network-Recurrent Neural Networks. Applications of Soft Computing in Design and Development of Intelligent Autonomous Robots-Applications of Soft Computing in Data Analysis.	
Total Hours	**45**

Text Book

1. Dilip K. Pratihar " *Soft computing fundaments and applications*" , Alpha Science International Ltd , Oxford, U.K.

Reference Books:

1. James A. Freeman and David M. Skapura, "*Neural Networks Algorithms, Application and Programming Techniques*", Pearson Education, 2003.
2. George J. Klir and Bo Yuan, "*Fuzzy Sets and Fuzzy Logic-Theory and Applications*", Prentice Hall,1995.
3. David E. Goldberg, "*Genetic Algorithms in Search, Optimization and Machine Learning*", AddisonWesley, 1997.
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "*Neuro-Fuzzy and Soft Computing*", PHI,2003.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3				2	2	2		
CO2	3	3				3	3	3		
CO3	3	2		2		2	3	3		
CO4	3	2			3	2	3	2		
CO5	3	2			2		3	2		
CO6	3	2	3				2	1		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS27	SOFT COMPUTING LABORATORY		L	T	P	C
			0	0	4	2
Programme:	M.E. Computer Science and Engineering	**Sem:** 2	**Category:**		**PC**	
Aim:	To understand the concepts of analysis of data and soft computing algorithms.					
Course Outcomes: The Students will be able to						
CO1:	Select various implement algorithms					
CO2:	Choose various output functions in GA					
CO3:	Outline optimizations techniques and Fuzzy inference systems					
CO4:	Develop the simulating FIS					
CO5:	Select neural networks in user applications					
CO6:	Recall different analysis algorithms likes SVM					
LIST OF EXPERIMENTS						
1. Implement Various classification Algorithms						
2. Coding and Minimizing a Fitness Function Using the Genetic Algorithm						
3. Custom Output Function for Genetic Algorithm						
4. Implement optimizations techniques likes PSO.						
5. Implement Building FIS						
6. Simulating and Developing FIS for user application						
7. Implement Neural Network in user application						
8. Implement Support Vector Machine algorithm to analysis user dataset						
		Total Hours	**60**			

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3			2		3	3		2
CO2	2	2					3	2		
CO3	1	3	2		3		3	3		3
CO4	2	2					2	2		
CO5		3			2		2	3		
CO6		3					2	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS28	TECHNICAL SEMINAR				L	T	P	C
					0	0	4	2
Programme:	M.E. Computer Science and Engineering	**Sem:**	**2**	**Category:**			**PROJ**	
Aim:	To identify and solve the engineering problem, provide solution to Engineering community and present the technical solution.							
Prerequisite:	--							

Course Outcomes: The Students will

CO1:	Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
CO2:	Select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO3:	Present the findings of their technical solution in a written report.
CO4:	Demonstrate the design methodology for the project.
CO5:	Improve their communication skills, presentation skills and other soft skills.
CO6:	Gain the knowledge about various magazine, newsletters and journals related to their field.

SYLLABUS CONTENTS:

The students are required to search / gather the material / information on a specific a topic Comprehend it and present / discuss in the class. They can take up small problems in the field of design engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	3	3	2	3	3
CO2	3	2	2	3	2	3	3	2	3	3
CO3	1	3	3	3	3	2	3	3	3	3
CO4	2	3	3	3	3	2	2	2	2	3
CO5	3	3	2	2	2	2	3	2	3	3
CO6	1	2	3	3	2	3	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS31	AGILE METHODOLOGIES			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	**2**	**Category:**		**PC**	
Aim:	To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software						

Course Outcomes: The Students will be able to

CO1:	Outline the importance of interacting with business stakeholders in determining the requirements for a software system
CO2:	Summarize the iterative software development processes: how to plan them, how to execute them
CO3:	Understand the impact of social aspects on software development success
CO4:	Develop techniques and tools for improving team collaboration and software quality
CO5:	Construct Software process improvement as an ongoing task for development teams.
CO6:	Show how agile approaches can be scaled up to the enterprise level

AGILE METHODOLOGY — 9

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

AGILE PROCESSES — 9

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

AGILITY AND KNOWLEDGE MANAGEMENT — 9

Agile Information Systems – Agile Decision Making - Earls Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

AGILITY AND REQUIREMENTS ENGINEERING — 9

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

AGILITY AND QUALITY ASSURANCE — 9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

Total Hours — 45

Text Book

1. David J. Anderson and Eli Schragenheim, ―Agile Management for Software Engineering:Applying the Theory of Constraints for Business Results‖, Prentice Hall, 2003.
2. Hazza and Dubinsky, ―Agile Software Engineering, Series: Undergraduate Topics inComputer Science‖, Springer, 2009.

Reference Books:

1. Craig Larman, ―Agile and Iterative Development: A Manager_s Guide‖, Addison-Wesley,2004.

2. Kevin C. Desouza, ―Agile Information Systems: Conceptualization, Construction, and Management‖, Butterworth-Heinemann, 2007.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1			3	3			3	2	3	
CO2	1		2	3	2		3	2	3	
CO3	3		3	3	1	3	3	3	3	3
CO4	2		3	3	1		2	2	2	2
CO5	2		2	2	2		3	2	3	1
CO6	1		3	3			2	3	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS39	PROJECT PHASE – I				L	T	P	C
					0	0	20	10
Programme:	M.E. Computer Science and Engineering	**Sem:**	3	**Category:**			**PROJ**	
Aim:	To identify and solve the engineering problem, provide solution to Engineering community and present the technical solution.							
Prerequisite:	232CS26 – Mini Project with Seminar							

Course Outcomes: The Students will

CO1:	Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
CO2:	Select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO3:	Present the findings of their technical solution in a written report.
CO4:	Demonstrate the design methodology for the project.
CO5:	Improve their communication skills, presentation skills and other soft skills.
CO6:	Gain the knowledge about various magazine, newsletters and journals related to their field.

SYLLABUS CONTENTS:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of Society
- Relevance to value addition to existing facilities in the Institution
- Relevance to Industry need
- Problems of National importance
- Research and development in various domain

The student should complete the following:

- Literature Survey Problem Definition
- Motivation for study and Objectives
- Preliminary Design / Feasibility / Modular approaches
- Implementation and Verification
- Report and Presentation

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	3	3	2	3	3
CO2	3	2	2	3	2	3	3	2	3	3
CO3	1	3	3	3	3	2	3	3	3	3
CO4	2	3	3	3	3	2	2	2	2	3
CO5	3	3	2	2	2	2	3	2	3	3
CO6	1	2	3	3	2	3	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CS49	PROJECT PHASE – II				L	T	P	C
					0	0	32	16
Programme:	M.E. Computer Science and Engineering	**Sem:**	**4**	**Category:**			**PROJ**	
Aim:	To identify and solve the engineering problem, provide solution to Engineering community and present the technical solution.							
Prerequisite:	232CS31 – Project Phase – I							

Course Outcomes: The Students will

CO1:	Demonstrate a sound technical knowledge of their selected project topic.
CO2:	Undertake problem identification, formulation and solution.
CO3:	Performa literature search to review current knowledge and developments in the chosen project.
CO4:	Undertake detailed technical work in the chosen area using one or more of theoretical studies and modeling.
CO5:	Prepare an interim report describing the work undertaken and results.
CO6:	Present the work in a forum involving seminar, conference, project Expo and poster presentations.

SYLLABUS CONTENTS:

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication and testing of proposed research work.
- The viva-voce examination will be based on the above report and work.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	3	3	2	3	3
CO2	3	2	2	3	2	3	3	2	3	3
CO3	1	3	3	3	3	2	3	3	3	3
CO4	2	3	3	3	3	2	2	2	2	3
CO5	3	3	2	2	2	2	3	2	3	3
CO6	1	2	3	3	2	3	2	3	2	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE01	BIG DATA MINING AND ANALYTICS	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:		Category:	PE

Aim:	To understand about the big data mining and analytics. Provide solutions for problems in Big Data.

Course Outcomes: The Students will be able to

CO1:	To understand the computational approaches to Modeling, Feature Extraction.
CO2:	Design algorithms by employing Map Reduce technique for solving Big Data problems.
CO3:	Identify similarities using appropriate measures.
CO4:	Point out problems associated with streaming data and handle them.
CO5:	Discuss algorithms for link analysis and frequent itemset mining.
CO6:	Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

DATA MINING AND LARGE-SCALE FILES **9**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining – Distributed File Systems– Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

SIMILAR ITEMS **9**

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

MINING DATA STREAMS **9**

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows

LINK ANALYSIS AND FREQUENT ITEMSETS **9**

Page Rank –Efficient Computation – Topic Sensitive Page Rank – Link Spam – Market Basket Model – Apriority algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

CLUSTERING **9**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non – Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems

Total Periods: **45**

References:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”,Cambridge University Press, Second Edition, 2014.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT Press,2001.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2	2			3	3	3	
CO2			1	2		2	2			
CO3	3		2	2			3	2	2	
CO4	3		2	1			3	2	2	
CO5	3		2	2			3	3	2	
CO6	2		2	1			2	3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE02	BLOCK CHAIN AND CRYPTOGRAPHY			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	-	**Category:**		**PE**	
Prerequisite:							
Aim:	To gain knowledge about block chain and crypto currencies implementation.						

Course Outcomes: The Students will be able to

CO1:	Demonstrate the need and usage of cryptographic algorithms in block chain technology.
CO2:	Discuss trends in Distributed Systems and correctness of smart contracts in Block chain
CO3:	Apply network virtualization.
CO4:	Understand the idea of peer to peer services and file system.
CO5:	Apply remote method invocation and objects.
CO6:	Design process and resource management systems.

BLOCK CHAIN AND SMART CONTRACTS	**9**
Introduction to crypto economics - Byzantine agreement - Extensions of BFT (Ripple, Stellar) – Block chain Dynamics - Classification of Block chain Platforms - Hard and soft forks - Sharding Side chain. Smart Contracts, Oracles - Basics of contract law – Smart contracts and their potential Trust in Algorithms.	
CRYPTOGRAPHY AND OTHER TECHNOLOGIES	**9**
Application of Cryptography to Block chain - Using hash functions to chain blocks - Digital Signatures to sign transactions - Using hash functions for Proof-of-Work. – examples of implementations with them tradeoffs.	
IMPLEMENTATION	**9**
Supply Chain and Identity on Block chain – Blockchain interaction with existing infrastructure – Trust in block chain data - Scaling Blockchain – reading and writing data. Differentiate nodes, sparse data and Merkle trees	
BITCOIN	**9**
The big picture of the industry – size, growth, structure, players - Bitcoin versus Cryptocurrencies versus Block chain, Litecoin, Zcash, - Distributed Ledger Technology (DLT) - Strategic analysis of the space	
BLOCKCHAIN APPLICATIONS AND CHALLENGES	**9**
Risks and Limitations of Blockchain - Lightning and Ethereum state channels, Hyperledger, Block chain platforms, regulators, application providers, Case study: Blockchain for Health Insurance.	
Total Hours	**45**

References:

1. Don Tapscott and Alex Tapscott, "*Blockchain Revolution: How the Technology Behind Bitcoin and Other Cryptocurrencies Is Changing the World*", Portfolio, 2018.
2. Paul Vigna and Michael J. Casey, "*The Age of Cryptocurrency: How Bitcoin and the Blockchain Are Challenging the Global Economic Order"*, Picador. 2016.
3. Alan T. Norman, "*Block chain Technology Explained: The Ultimate Beginner's Guide About Blockchain Wallet, Mining, Bitcoin, Ethereum, Litecoin, Zcash, Monero, Ripple, Dash, IOTA And Smart Contracts*", CreateSpace Independent Publishing Platform, 2017.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	3	1		2		3	2		
CO2	3	3	2		3			3		
CO3	1	3		2			2	2		
CO4		2	1	1			1			
CO5	3	2	2	3			2	3	1	
CO6	3	2	3		1		3		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE03	COMPILER FOR HPC					L	T	P	C
						3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	**3**	**Category:**		**PE**			
Aim:									

Course Outcomes: The Students will be able to

CO1:	Remember the basic concepts of complier and parallel computing.
CO2:	Use the knowledge of Message Passing in the various types of Dimensional Matrix.
CO3:	Apply simple intermediate code optimizations techniques for improving the analysis performance.
CO4:	Analyze the various compiler generation tools in DAG.
CO5:	Illustrate the Parallel Architecture in the Synchronization primitives.
CO6:	Apply the Parallelizing compiler concepts in the various kinds of compilation.

COMPILERS AND PARALLER PLATFORMS	**9**
Compilers - Phases of a compiler - Cousins of the Compiler - Compiler construction tools – Lexical Analysis - Role of Lexical Analyzer - Specification and recognition of Tokens. Syntax Analysis – The role of the parser - Context-free grammars - Writing a grammar - Top down parsing - Bottom-up Parsing - LR parsers - Constructing an SLR(1) parsing table-Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing.	
DESIGN ISSUES OF HPC	**9**
Programming Using the Message-Passing Paradigm: Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, One-Dimensional Matrix-Vector Multiplication, Single-Source Shortest-Path, Sample Sort, Groups and Communicators, Two-Dimensional Matrix-Vector Multiplication	
INTERMEDIATE CODE GENERATION AND CODE OPTIMIZATION	**9**
Intermediate languages - Declarations - Assignment Statements - Boolean Expressions – Case Statements - Back patching - Procedure calls - Introduction to code optimization - Principal Sources of Optimization - Optimization of basic Blocks - loops in flow graphs - Peephole optimization -Introduction to Global Data Flow Analysis.	
CODE GENERATION	**9**
Issues in the design of a code generator - The target machine - Run-time storage management – Basic blocks and flow graphs - Next-use information - A simple code generator - Register allocation and assignment - The DAG representation of basic blocks - Generating code from DAGs.	
PROGRAMMING SYNCHRONIZATION	**9**
Synchronization: Parallel Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms Programming Shared Address Space Platforms: Thread Basics-The POSIX Thread API, Thread Basics: Creation and Termination, Synchronization Primitives in Pthreads-OpenMP: a Standard for Directive Based Parallel Programming	
Total Hours	**45**

References:

1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman, "*Compilers Principles, Techniques and Tools*", Pearson Education Asia, 2003
2. K. Muneeswaran, "*Compiler Design*", Oxford University Press, 2013
3. Allen I. Holub "*Compiler Design in C*", Prentice Hall of India, 2003.
4. C.N.Fischer and R. J. LeBlanc, "*Crafting a compiler with C*", Benjamin Cummings, 2003.
5. J.P. Bennet, "*Introduction to Compiler Techniques*", Second Edition, TMGH, 2003.
6. Kai Hwang,"*Advanced Computer Architecture: Parallelism, Scalability, Programmability*", McGraw Hill 1993.
7. John J. Donovan "*System Programming*", Tata McGraw-Hill Edition, 2000.
8. David Culler Jaswinder Pal Singh, "*Parallel Computer Architecture: A hardware/Software Approach*", Morgan Kaufmann,1999

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1		1	1				2	1		
CO2	2	1					2			
CO3	1	2			2		1			1
CO4	1	2	2				2	2		
CO5	2	1					2	1		
CO6	2	2					1	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE04	COMPUTER VISION	L	T	P	C
		3	0	0	3

Programme:	B.E. Computer Science and Engineering	Sem:		Category:	PE
Prerequisite:	Digital Image processing				

Aim:	To understand the concepts of computer vision

Course Outcomes: The Students will be able to

CO1:	Explain the fundamental image processing techniques required for computer vision
CO2:	Discuss about the geo-metric relationships between 2D images and the 3D world.
CO3:	Demonstrate the concepts related to feature extraction and filtering techniques
CO4:	Recall the image segmentation and detection methods in computer vision
CO5:	Design new algorithms to solve re-cent state of the art computer vision problems
CO6:	Build a complete system to solve a computer vision problem

IMAGE PROCESSING FOUNDATIONS	9

Introduction, Image Formation – geometric primitives and transformations, photometric image formation, digital camera, Image Processing – point operators, linear filtering, neighborhood operators, fourier transforms, and segmentation.

DEPTH ESTIMATION AND MULTI CAMERA VIEWS	9

Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration.

FEATURE EXTRACTION AND SEGMENTATION	9

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

PATTERN ANALYSIS	9

Clustering: K-Means, K-Medoids, Mixture of Gaussians, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

APPLICATIONS	9

Application: Photo album –Face detection –Face recognition –Eigen faces –Active appearance and 3D shape models of faces Application: Surveillance –foreground-background separation –particle filters –Chamfer matching, tracking –combining views from multiple cameras –human gait analysis Application: In-vehicle vision system: locating roadway –road markings.

Total Periods:	45

Text Book:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.

References:

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

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1			3		3	2		
CO2	3	3			2		2	2		2
CO3	3	2			3		3	2		
CO4	2	2			2		3	2		
CO5	3	3			3		3	3		3
CO6	3	2					2			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE05	DATABASE TECHNOLOGIES	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	-	Category:	PE
Aim:	To understand the fundamental concepts of database technologies				
Prerequisite:	---				

Course Outcomes: The Students will be

CO1:	Understand the basics of ER models and query processing
CO2:	Illustrate the concepts of distributed databases and protocols
CO3:	Apply the object-oriented concepts in the database technology
CO4:	Analyze the data warehouse and mining techniques
CO5:	Summarize the various types of databases
CO6:	Explain the current issues in the database technologies

RELATIONAL MODEL ISSUES

ER Model - Normalization – Query Processing – Query Optimization – Transaction Processing - Concurrency Control – Recovery - Database Tuning.

DISTRIBUTED DATABASES

Parallel Databases – Inter and Intra Query Parallelism – Distributed Database Features – Distributed Database Architecture – Fragmentation – Distributed Query Processing – Distributed Transactions Processing – Concurrency Control – Recovery – Commit Protocols.

OBJECT ORIENTED DATABASES

Introduction to Object Oriented Data Bases - Approaches - Modeling and Design -Persistence – Query Languages - Transaction - Concurrency – Multi Version Locks –Recovery – POSTGRES – JASMINE – GEMSTONE - ODMG Model.

EMERGING SYSTEMS

Enhanced Data Models - Client/Server Model - Data Warehousing and Data Mining -Web Databases – Mobile Databases- XML and Web Databases.

CURRENT ISSUES

Rules - Knowledge Bases - Active and Deductive Databases - Multimedia Databases–Multimedia Data Structures – Multimedia Query languages - Spatial Databases.

Total Hours | **45**

References:

1. Thomas Connolly and Carlolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education
2. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Fifth Edition,Pearson Education, 2006.
3. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”,Fifth Edition, Tata McGraw Hill, 2006.
4. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	2	2	3	2	2	2	2		
CO2	2		2	2	2		2	2		
CO3	2		3	2	2		2	2		
CO4	2		3	2	2		2	2		
CO5	2		2	2			2	3		
CO6	3		2	2	2		2	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE06	DATA PREPARATION AND ANALYSIS		L	T	P	C
			3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:** -	**Category:**		**PE**	
Aim:	To prepare the data for analysis and develop meaningful data visualization.					

Course Outcomes: The Students will be able to

CO1:	Formulate the data for performing the Analysis.
CO2:	Analyze the real time issues.
CO3:	Identify the idea of transformation and segmentation.
CO4:	Analyze the statistics for clustering.
CO5:	Summarize the visualizations and network hierarchy.
CO6:	State the rules and grouping of data.

INTRODUCTION	**9**
Data Analytics- data and analysis in the real world- analytical tools- data extraction using SQL-real world analytical organizations-big data analytics-	
DATA GATHERING AND PREPARATION	**9**
Data formats, parsing and transformation, Scalability and real -time issues.	
DATA CLEANING	**9**
Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation.	
EXPLORATORY ANALYSIS	**9**
Descriptive and comparative statistics, Clustering and association, Hypothesis generation.	
VISUALIZATION AND GROUPING	**9**
Designing visualizations, Time series, Geo located data, Correlations and connections, Hierarchies and networks, interactivity. Introduction, Clustering, Associative rules and decision trees.	
Total Hours	**45**

References:

1. Glenn J. Myatt, "*Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining*", John Wiley & Sons, Inc., 2007.
2. Federico Castanedo, "*Data Preparation in the Big Data Era*", O'Reilly Media, Inc, 2015.
3. Dorian Pyle, "*Data Preparation for Data Mining*", Morgan Kaufmann Publishers, Inc., 1999.
4. Q. Ethan Mccallum, "*Bad Data Handbook: Cleaning up the Data so you can get back to work*", O'Reilly Media, Inc, 2015.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1					3	2	2	
CO2	1		2					3	1	
CO3	2	2					2	2		
CO4	2		2				3	1	3	
CO5	3	1					1	2		
CO6	2							2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE07	DEEP LEARNING	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:		Category:	PE

Aim:	To understand about the deep learning concepts and neural network algorithms.

Course Outcomes: The Students will be able to

CO1:	Understand the basis of Machine Learning.
CO2:	Explore various Deep Learning Networks
CO3:	Implement Convolutional and Recurrent Neural Algorithms
CO4:	Analyze optimization and generalization in deep learning
CO5:	Explore the deep learning applications
CO6:	Summarize the real time implementation of Deep Learning

MACHINE LEARNING BASICS — **9**

Introduction to machine learning - Linear models (SVMs and Perceptrons, logistic regression). Learning Algorithms – Capacity, Overfitting and underfitting – Hyperparameters and Validation Sets – Estimators, Bias and Variance – Maximum Likelihood Estimation – Bayesian Statistics – Supervised Learning Algorithms – Unsupervised Learning Algorithms – Stochastic Gradient Descent – Building a Machine Learning Algorithm – Challenges Motivating deep learning.

DEEP NETWORKS — **9**

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and other Differentiation Algorithms – Regularization: Dataset Augumentation – Noise Robustness -Early Stopping, Bagging and Dropout - batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

CONVOLUTION & RECURRENT NETWORKS — **9**

Convolutional Neural Networks: The Convolution Operation – Motivation – Pooling – Variants of the basic Convolution Function – Structured Outputs – Data Types – Efficient Convolution Algorithms. Recurrent Neural Networks: Bidirectional RNNs – Deep Recurrent Networks – Recursive Neural Networks.

OPTIMIZATION AND GENERALIZATION — **9**

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

CASE STUDY AND APPLICATIONS — **9**

Imagenet- Object Detection – Object Tracking - Audio WaveNet - Natural Language Processing Word2Vec - Joint Detection - Face Recognition - Scene Understanding - Gathering Image Captions.

Total Periods: 45

References:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation,2016.
2. Dr.Adrian Rosebrock, ―Deep Learning for Computer Vision with Python: Starter Bundle‖, PyImage Search, 1st edition, 2017.
3. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.

4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2			3	3	3	
CO2		2	1	2			2			
CO3	3	2	2	2	2		3	2	2	
CO4	3	1	2	1	2		3	2	2	
CO5	3	2	2	2	2		3	3	2	
CO6	2	1	2	1	3		2	3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE08	DIGITAL IMAGE PROCESSING					L	T	P	C
						3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**		**Category:**		**PE**			
Aim:	To understand analytical methods which are widely used in image processing; linear and nonlinear filtering.								
Course Outcomes: The Students will be able to									
CO1:	Apply principles and techniques of digital image processing in applications related to digital imaging system design and analysis.								
CO2:	Analyze and implement image Enhancement techniques								
CO3:	Apply the various Image transforms techniques.								
CO4:	Analyze the different image segmentations on applications.								
CO5:	Understand the image compression and restoration methods.								
CO6:	Summarize the real time application and implementation of image processing techniques								

DIGITAL IMAGE PROCESSING FUNDAMENTALS	**9**
Components of Image Processing System. , Elements of Visual Perception, MTF of Visual System, Image Sensing and Acquisition, Image formation model, Image Sampling & Quantization Spatial and Gray Level Resolution, Basic Relationships between Pixels. Statistical parameters, Measures and their significance, Mean, standard deviation, variance, SNR, PSNR etc.	
IMAGE ENHANCEMENT	**9**
Gray level transformations, histogram processing, equalization, Arithmetic and logical operations between images, Basics of spatial filtering, smoothening and sharpening spatial filters. Image Enhancement in frequency Domain: smoothening and sharpening frequency domain filters. Color Image processing: Intensity filtering, gray level to color transformation, Basics of full color image Processing.	
IMAGE TRANSFORMS	**9**
FFT, DCT, the KL Transform, Walsh/Hadamard Transform, Haar Transform, Wavelet Transform.	
IMAGE SEGMENTATION	**9**
Point, line & Edge detection, Gradient operators, Canny edge detector, Edge linking & boundary detection, Hough transform, Thresholding, use of boundary characteristic for histogram improvement& Local thresholding, Region based segmentation.	
IMAGE COMPRESSION AND RESTORATION	**9**
Data redundancies, Variable length coding, Predictive coding, Transform coding, Image compression standards, sub band coding, Lossless Predictive, Lossy Compression- Lossy Predictive. Fundamentals of JPEG, MPEG, fractals. Image Degradation Mode, Noise Models, and Restoration in Presence of Noise in spatial Domain, Linear Filtering.	
Total Periods:	**45**

References:

1. Gonzalez and Woods, "Digital Image Processing", Pearson Education,2018
2. Arthur Weeks Jr., "Fundamentals of Digital Intake Processing", PHI Intelligence", Vol.115, Springer,2008
3. A. K. Jain, "Fundamentals of Digital Image Processing"; Pearson Education
4. Pratt William, "Digital Image Processing", John Wiley & Sons,2007

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2	2			3	3	3	
CO2		2	1	2			2			
CO3	3	2	2	2	2		3	2	2	
CO4	3	1	2	1	2		3	2	2	
CO5	3	2	2	2	2		3	3	2	
CO6	2	1	2	1	3		2	3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE09	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	-	Category:	PE
Aim:	To gain knowledge about the forensic digital environments.				

Course Outcomes: The Students will be able to

CO1:	Illustrate the relevant legislation and codes of ethics
CO2:	Discuss the Computer forensics and digital detective and various processes, policies and procedures
CO3:	Summarize the E-discovery, guidelines and standards, E-evidence, tools and environment.
CO4:	Implement Email, web forensics and network forensics
CO5:	Apply crime data and analyze it.
CO6:	State the different security tools to identify the crimes.

DIGITAL FORENSICS SCIENCE	**9**
Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues-Forensics science, computer forensics, and digital forensics.**:**	
CYBER CRIME SCENE ANALYSIS	**9**
Discuss the various court orders etc., methods to search and seizure electronic evidence, retrieved and un-retrieved communications, Discuss the importance of understanding what court documents would be required for a criminal investigation.	
EVIDENCE MANAGEMENT & PRESENTATION	**9**
Create and manage shared folders using operating system, importance of the forensic mindset, define the workload of law enforcement, explain what the normal case would look like, define who should be notified of a crime, parts of gathering evidence, Define and apply probable cause. Evidence Collection- Collection Methods, Evidence Marking and Packaging, Establishing the Chain of Custody, Reporting.	
COMPUTER FORENSICS	**9**
Prepare a case, begin an investigation, understand computer forensics workstations and software, conduct an investigation and Complete a case, Critique a case. **Network Forensics:** open-source security tools for network forensic analysis, requirements for preservation of network data.	
MOBILE FORENSICS AND LEGAL ASPECTS OF DIGITAL FORENSICS	**9**
Mobile forensics techniques, Mobile forensics tools. IT Act 2000, Amendment of IT Act 2008. Recent trends in mobile forensic technique and methods to search and seizure electronic evidence.	
Total Hours	**45**

References:

1. John Sammons, "*The Basics of Digital Forensics*", 2/e, 2014.
2. John Vacca, "*Computer Forensics: Computer Crime Scene Investigation*", Laxmi Publications, 2015.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2				3	2		
CO2	1							1		2
CO3	2	2	3				2	2		
CO4	2	2	2				2			
CO5	2		3				1	3		3
CO6	3	2					2	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE10	GPU COMPUTING			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	-	**Category:**			**PE**
Aim:	To understand about the parallel programming and deep learning concepts.						

Course Outcomes: The Students will be able to

CO1:	Recall the fundamental concepts of graphics
CO2:	Illustrate the memory hierarchy and its performance evaluations
CO3:	Summarize the synchronization of CPU and GPU
CO4:	Explain the types of functions and libraries in GPU computing
CO5:	Apply the debugging programs, asynchronous and synchronous processing.
CO6:	Experiment with various case studies and heterogeneous process.

INTRODUCTION **9**

History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs.

MEMORY **9**

Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different memories

SYNCHRONIZATION **9**

Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU. Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.

SUPPORT & STREAMS **9**

Debugging GPU Programs. Profiling, Profile tools, Performance aspects
Asynchronous processing, tasks, Task-dependence, overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based-Synchronization - Overlapping data transfer and kernel execution, pitfalls.

CASE STUDIES **9**

Image Processing, Graph algorithms, Simulations, Deep Learning. **Advanced topics**: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing

Total Hours **45**

References:

1. *"Programming Massively Parallel Processors: A Hands-on Approach*" David Kirk, Wen-meiHwu;Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. *"CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman*" 2012 (ISBN: 978-0124159334)

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3				3			3
CO2	2	2					1	3		1
CO3	3	3	2				1	2		2
CO4	3	3	2		2		2	2		2
CO5	3	2	3		3		3	3		1
CO6	2	2			3		3	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE11	HUMAN AND COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:		Category:	PC
Prerequisite:					

Aim:	To provide the knowledge about human and computer information processing.

Course Outcomes: The Students will be able to

CO1:	Relate the capabilities of both humans and computers from the viewpoint of human information processing.
CO2:	Outline typical human–computer interaction (HCI) models, styles, and various historic HCI Paradigms
CO3:	Construct an interactive design process and universal design principles to designing HCI systems
CO4:	Illustrate and use HCI design principles, standards and guidelines
CO5:	Summarize the structure of models and theories of human computer interaction and vision
CO6:	Develop an interactive web interface a basis of models studied

FOUNDATIONS OF HCI	**9**
The Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	
DESIGN & SOFTWARE PROCESS	**9**
Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	
USER SUPPORT & GROUPWARE	**9**
User Support-Introduction- requirements of user support - approaches to user support - adaptive help systems - designing user support systems - Groupware-introduction - Groupware systems – computer mediated communication - meeting and decision support systems - shared applications and artifacts.	
MEMORY SYSTEMS	**9**
Basic concepts – Semiconductor RAM – ROM – Speed – Size and cost – Cache Memories – Improving cache performance – Performance Considerations – Virtual memory – Memory management requirements –Secondary storage	
MOBILE HCI AND WEB TECHNOLOGY	**9**
Mobile Ecosystem: why mobile, designing for context, developing a mobile strategy, Types of Mobile Applications: Widgets, Applications, Games, Mobile Information Architecture, Mobile Design: Elements of Mobile Design, Tools. Web technology and issues – Static web content –Dynamic web content- Groupware systems –DSS –Frameworks for groupware-Information and data visualization.	
Total Periods:	**45**

References:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "*Human Computer Interaction*", Pearson Education, 3/e, 2004 (UNIT I, II & III).

2. Brian Fling, "*Mobile Design and Development*", O"Reilly Media Inc., 1/e, 2009 (UNIT-IV).

3. Bill Scott and Theresa Neil, "*Designing Web Interfaces*", O"Reilly, 1/e, 2009. (UNIT-V)

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1					1		
CO2	2	1	1					2	2	1
CO3	3	2	3	1			3	2	2	
CO4	1	1		1			2		2	
CO5	1	1		1				1	1	
CO6	2	1	1	1			1	1	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE12	SENSORS AND IOT					L	T	P	C
						3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**		**Category:**		**PC**			
Prerequisite:									
Aim:	To provide the knowledge on the sensor characteristics and the fundamental principles of sensing and basics components of the Internet of Things								
Course Outcomes: The Students will be able to									
CO1:	Extrapolate the characteristics of sensors by knowing the physical principles of sensors								
CO2:	Apply appropriate motion-related sensors, flow sensors, light detectors, temperature and chemical sensors for real time applications								
CO3:	Identify the various components of IoT, the different communication technologies and sensors								
CO4:	Discover the usage of IoT communication protocols in wireless sensor network technology								
CO5:	Build IoT applications by communicating with external world using wired / wireless protocols								
CO6:	Develop IoT programs for different applications								

PRINCIPLES OF SENSING	**9**
Data acquisition – Sensor characteristics: Transfer function – Calibration – Accuracy – Calibration error - Nonlinearity – Saturation – Repeatability – Reliability – Uncertainty. Physical principles of sensing: electric charges, fields, potentials – capacitance – magnetism – resistance – piezoelectric effect – pyroelectric effect – Hall effect – thermoelectric effects – sound waves –Temperature and thermal properties of materials - heat transfer – light – dynamic models of sensor elements.	
TYPES OF SENSORS	**9**
Occupancy and motion detectors: Ultrasonic – microwave motion – optical presence sensors – Pressure-gradient sensors - gravitational sensors. Flow sensors: Basics of flow dynamics - Pressure gradient technique - Ultrasonic - Electromagnetic - Breeze - Drag Force sensors. Light Detectors: Photodiodes – phototransistor – photoresistors – Cooled detectors – Image sensors – Thermal detectors: Bolometers, Active far-infrared sensors – optical design – gas flame detectors. Temperature Sensors: coupling with objects – temperature reference points – thermoresistive sensors. Chemical sensors: characteristics – classes of chemical sensors – biochemical sensors	
INTRODUCTION TO IOT	
Definitions and functional requirements – Vision and concept – identification – Open research issues – security and privacy – Components of Internet of Things: Control units – Sensors – Communication modules – Power sources. Communication technologies: RFID – Bluetooth – ZigBee – WiFi – RF Links – Wired Communication. Basics of sensors and actuators – Sensor technology – Actuators.	
IOT ECOSYSTEM USING WIRELESS TECHNOLOGIES	**9**
Sensor data communication protocols – Radio frequency identification (RFID) technology – Wireless sensor networks technology – Architecture for IoT using mobile devices - Mobile technologies for supporting IoT ecosystem - Energy harvesting for power conservation in the IoT system - Data analytics – Knowledge acquiring, managing and storing processes.	
PROGRAMMING THE MICROCONTROLLER FOR IOT	**9**
Arduino / equivalent Microcontroller platform: Microcontrollers – Development environment – Writing Arduino / equivalent software – Programming microcontroller for IoT. Reading from sensors – Connecting microcontroller with mobile devices: Communicating using Bluetooth and USB. Connecting microcontroller using Ethernet and WiFi.	
Total Periods:	**45**

References:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw-Hill Education Pvt. Ltd., 2018.
2. Charalampos Doukas, "Building Internet of Things with the Arduino", Create Space, April 2002.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.
4. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.
5. Daniele Miorandi , Sabrina Sicari, Francesco De Pellegrini, Imrich Chlamtac , "Internet of Things: Vision, applications and research challenges", Ad Hoc Networks, No. 10, pp. 1497–1516, 2012.
6. "A Survey on Security and Privacy Issues in Internet-of-Things", IEEE Internet of Things Journal, Vol. 4, Issue5, pp. 1250 – 1258, 2017.
7. Luigi Atzor, Antonio Iera, Giacomo Morabito, "The Internet of Things: A survey", Computer Networks, No. 54, pp. 2787-2805, 2010.
8. Li-Minn Ang, Kah Phooi Seng, Adamu Murtala Zungeru, and Gerald K. Ijemaru, "Big Sensor Data Systems for Smart Cities", IEEE Internet of Things Journal, Vol. 4, No. 5, pp. 1259-1271, 2017.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2				2	2	1		2	
CO2	2		2		2	2	2		2	
CO3	2				2	2	2		2	
CO4	3		2		3	3	2	2	2	
CO5	3				3	3	2	2	2	
CO6	3			2	3	3	2	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE13	INTRODUCTION TO INTELLIGENT SYSTEM	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	-	Category:	PE
Aim:	To gain knowledge about intelligence system and its algorithms.				

Course Outcomes: The Students will be able to

CO1:	Comprehend different types of problem solving and search algorithms and its applications
CO2:	Realize the concepts and Knowledge representation and reasoning
CO3:	Acquire in-depth knowledge about the reasoning
CO4:	Appreciate the concept of Machine learning
CO5:	Uncover the state-of-the-art of present technology
CO6:	Examine the real-world intelligence systems and future directions analysis.

INTRODUCTION — **9**

Overview of AI problems, examples of successful recent AI applications. The Turing test, Rational versus non-rational reasoning. Search Strategies: Problem spaces, problem solving by search. Uninformed search. Heuristics and informed search. Minimax Search, Alpha-beta pruning. Space and time efficiency of search.

KNOWLEDGE REPRESENTATION AND REASONING — **9**

The Propositional logics, First Order Predicate Logic, Forward and Backward Chaining, Resolution, Rule -based production systems; case-based reasoning systems and model-based reasoning systems

UNCERTAIN KNOWLEDGE AND REASONING — **9**

Uncertainly, Representing Knowledge in an Uncertain Domain, Conditional Probability, Joint Probability, Bays theorem, Belief Networks, Simple Inference in Belief Networks.

LEARNING — **9**

Inductive and deductive learning, unsupervised and supervised learning, reinforcement learning, explanation based Learning, concept learning from examples, Quinlan's ID3, classification and regression trees, Bayesian methods.

APPLICATIONS — **9**

Intelligent systems in health and medicine, Machine learning and representation learning, Statistical and structural pattern recognition, Semantic technologies, Information Retrieval, Information Extraction, Natural Language Processing, Robot.

Total Hours — **45**

References:

1. Dan W. Patterson,‖ Introduction to Artificial Intelligence and Expert Systems‖ , 1st Edition, Pearson Education, 2015.
2. S.Russel, P.Norvig, —Artificial Intelligence - A Modern Approach‖, 3rd Edition, Pearson Education Ltd., 2014.
3. Christopher M.Bishop, —Pattern Recognition and Machine Learning‖, 1st Edition, Springer,2016.
4. Rajendra Akerkar, —Foundations of the Semantic Web, Narosa Publishing House, New Delhiand Alpha Science Intern, 2009.
5. Michael Negnevitsky, Artificial Intelligence: A Guide to Intelligent Systems. 2nd edition, Addison Wesley, 2005.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		2		2	2	2	3		
CO2	2						2			
CO3	2		2				2			
CO4					3	2	2	3	2	
CO5	3			2					3	
CO6	3		3	3	3	3	3	3	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE14	LINGUISTIC COMPUTING			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	-	**Category:**		**PE**	
Aim:	To gain knowledge about fundamental concepts of ComputationalLinguistics						

Course Outcomes: The Students will be able to

CO1:	Outline the concept of Computational Linguistics
CO2:	Form a mathematical model for NLP
CO3:	Work with word processing techniques
CO4:	Examine the syntactic and semantic processing for the natural language text
CO5:	Apply alignment and translation techniques in linguistics applications
CO6:	Examine the real-world applications of linguistics computing.

INTRODUCTION TO COMPUTATIONAL LINGUISTICS — **9**

Introduction: Computational Linguistics and Natural language processing – History of NLP – Early NLP systems – Phases of natural language processing – Evaluation of NLP systems - Origins and challenges of NLP – Basic English concepts –- Language and Grammar - Processing Indian Languages - Language Modeling: Various Grammar based Language Models - Statistical Language Model.

MATHEMATICAL FOUNDATION — **9**

Elementary probability theory – Probability spaces – Conditional probability and spaces – Bayes theorem – Random variable – Expectation and variance – Notation – Joint and conditional distribution – Determining p Standard distributions – Bayesian statistics - Essential information theory – Entropy – Joint entropy and conditional entropy – Mutual information – Noisy channel model – Relative entropy – Relation to language – The entropy of English

WORD PROCESSING — **9**

Collocations – Frequency – Mean and variance – Hypothesis testing – Mutual information - Notation of Collocations - Regular Expressions - Finite-State Automata - Morphological Parsing - Spelling Error Detection and correction - Lexical Acquisition

SYNTACTIC AND SEMANTIC PROCESSING — **9**

Syntactic Analysis: Word Classes and Part of Speech Tagging - Context-free Grammar – Constituency – Parsing - Probabilistic Parsing - Semantic Analysis: Meaning Representation - Lexical Semantics – Ambiguity - Word Sense Disambiguation.

APPLICATIONS AND TECHNIQUES — **9**

Statistical alignment and machine translation – Text alignment – Word alignment – Statistical machine translation – Clustering – Hierarchical clustering – Non hierarchical clustering – Background on information retrieval – Vector space model – Term distribution model – Latent semantic indexing – Discourse segmentation - Text categorization.

Total Hours — **45**

References:

1. Ela Kumar, “Natural Language Processing”, I.K International, New Delhi 2011.
2. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 2003.
3. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
4. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice

Hall, 2nd Edition,, 2008.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2					2	3	2	2	
CO2	2		2			2	2	2	2	
CO3			2		2	2	2	2	2	
CO4	2					2		2	2	
CO5	2		2		2	2		3	2	
CO6	3		3	2	3	3	3	3	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE15	MACHINE LEARNING	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:		Category:	PE

Aim:	To understand about appreciate supervised learning and their application concepts and algorithms of unsupervised learning

Course Outcomes: The Students will be able to

CO1:	Understand the learning model and Probability Distributions
CO2:	Design a Neural Network for an application of your choice.
CO3:	Implement Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
CO4:	Use a tool to implement typical Clustering algorithms for different types of applications.
CO5:	Design and implement an HMM for a Sequence Model type of application.
CO6:	Identify applications suitable for different types of Machine Learning with suitable justification

INTRODUCTION **9**

Machine Learning–Types of Machine Learning –Machine Learning process- preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.

SUPERVISED LEARNING **9**

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multi-layer Perceptron, Feed- forward Network, Error Back propagation - Support Vector Machines.

UNSUPERVISED LEARNING **9**

Clustering- K-means – EM Algorithm- Mixtures of Gaussians –Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis.

PROBABILISTIC GRAPHICAL MODELS **9**

Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields- Hidden Markov Models – Conditional Random Fields(CRFs).

ADVANCED LEARNING **9**

Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory – Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.

Total Periods: **45**

References:

1. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.
2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman andHall, CRC Press, Second Edition, 2014.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.

5. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2	2			3	3	3	
CO2			1	2			2			
CO3	3		2	2			3	2	2	
CO4	3		2	1			3	2	2	
CO5	3		2	2			3	3	2	
CO6	2		2	1	3	3	2	3	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE16	MOBILE APPLICATION AND SERVICES	L	T	P	C
		3	0	0	3

Programme:	M.E Computer Science and Engineering	Sem:	3	Category:	PE
Prerequisite:					

Aim:	To provide the knowledge about mobile application and its services.
Course Outcomes: The Students will be able to	
CO1:	Explore the differences between mobile based application and conventional application
CO2:	Design UI in the context of mobile application
CO3:	Learn about architecture and developing mobile applications for Android
CO4:	Write Android application involving connectivity to database and sensors.
CO5:	Learn about the various services of android applications.
CO6:	Develop android applications.

INTRODUCTION	**9**
Brief History of Mobile Software Development - Mobile Web Vs. Mobile App - Hardware and Software for different Mobile frameworks - Difference between Mobile and Desktop applications	
MOBILE USER INTERFACE DESIGN	**9**
Mobile Application users - Basic Design principles - Mobile Information Design - Mobile Platforms: Android, IOS, Blackberry OS, Windows Phone	
APPLICATION DEVELOPMENT FOR ANDROID – I	**9**
Android Platform - Different SDKs and their growth - Android Architecture - Android Development Environment Setup - Anatomy of Android Application - Views & Layouts - List View - Adapters - HTTP Connection initiation.	
APPLICATION DEVELOPMENT FOR ANDROID – II	**9**
Database Integration - Android Preferences - Broadcast Receivers - Content providers - Usage of different sensors –- intent filters.	
MOBILE WEBSITES AND SERVICES	**9**
Choosing a Mobile Web Option, Adaptive Mobile Websites, Dedicated Mobile Websites Mobile Web Apps with HTML5. Overview of services in Android - Implementing a Service - Service lifecycle - Inter Process Communication (AIDL Services) -Web Services: Consuming web services - Receiving HTTP Response - Telephony Services	
Total Hours:	**45**

References

1. Wei-Meng Lee, *Beginning Android™ 4 Application Development*, 2012 by John Wiley & Sons.
2. Jeff Mc Wherter and Scott Gowell, *" Professional Mobile Application Development"* Wrox,2012
3. Carmen Delessio, Lauren Darcey, Shane Conder "*Teach Yourself Android Application Development in 24 Hours*", 3/e, SAMS publication, 2013.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	2			2		3	2		3
CO2	2	2	3	2			2		1	
CO3	2	2						2		
CO4	3						3	1	2	
CO5	3				2			2		1
CO6	3		2				3		3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE17	OPTIMIZATION TECHNIQUES			L	T	P	C
				3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	-	**Category:**		**PE**	
Aim:	To provide insight to the mathematical formulation of real-world problems.						

Course Outcomes: The Students will be able to

CO1:	Relate key concepts and applications of various optimization techniques
CO2:	Identify the appropriate optimization technique for the given problem
CO3:	Formulate appropriate objective functions and constraints of optimization problems.
CO4:	Apply the methods of optimization in real life situation.
CO5:	Do analysis in real time problems
CO6:	Work with various optimization techniques tools.

OPTIMIZATION AND TECHNIQUES	**9**
Engineering application of Optimization, Formulation of design problems as mathematical programming problems. Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions.	
LINEAR PROGRAMMING	**9**
Standard form of a linear programming problem, Simplex method, Duality in linear programming, Quadratic programming, Stochastic linear programming, Relevant applications.	
NON-LINEAR PROGRAMMING	**9**
Unimodal function, Interpolation methods, Direct and indirect methods, Relevant applications.	
GEOMETRIC PROGRAMMING AND INTEGER PROGRAMMING	**9**
Unconstrained and constrained geometric programming problems, Geometric programming with mixed inequality: Integer linear programming, Integer nonlinear programming, Relevant applications.	
GAME THEORY AND GENETIC ALGORITHMS	**9**
Introduction, Characteristics of Game Theory, Two Person, Zero sum games, Pure strategy. Dominance theory; Representation methods, Selection methods, Operators, Replacement methods, Relevant applications.	
Total Hours	**45**

Text Book:

1. Rao, S. S., & Rao, S. S., Engineering optimization: theory and practice. John Wiley & Sons

Reference Book:

1. Hadley, G., *Linear programming*, Narosa Publishing house.
2. Taha, H. A., *Operations research: An introduction*. Pearson Education India.
3. Deb. K, *Optimization for engineering design: Algorithms and examples*. PHI LearningPvt. Ltd.
4. Kumar, D. N., *Multicriterion analysis in engineering and management*. PHI LearningPvt. Ltd.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2					3			
CO2	3		3					2	2	
CO3			2					3		
CO4	2			2				2		
CO5	3	2					3		3	
CO6	2		2			3		2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE18	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	-	Category:	PE

Aim:	To provide basic knowledge on software defined networking andapplications

Course Outcomes: The Students will be able to

CO1:	Analyze the evolution of software defined networks
CO2:	Understand the advanced and emerging networking technologies
CO3:	Apply and analyze the network functions and virtualization
CO4:	Obtain skills to do advanced networking research and programming
CO5:	Design and develop various SDN
CO6:	Summarize the various real time applications of SDN

INTRODUCTION	**9**
Engineering application of Optimization, Formulation of design problems as mathematical programming problems. Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions.	
OPEN FLOW & SDN CONTROLLERS	**9**
Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – General Concepts -SDN Controllers	
DATA CENTERS	**9**
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN– VxLAN–Network Virtualization using Generic Routing Encapsulation (NVGRE).	
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.	
SDN APPLICATION	**9**
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – FloodlightController – Bandwidth Calendaring – Data Center Orchestration.	
Total Hours	**45**

Reference Book:
1. Paul Goransson and Chuck Black, ―Software Defined Networks: A Comprehensive Approach‖, Second Edition, Morgan Kaufmann publishers, 2016.
2. Patricia A. Morreale, James M. Anderson, ―Software Defined Networking design and deployment‖, First Edition, CRC Press publishers, 2015.
3. Thomas D. Nadeau, Ken Gray, ―SDN: Software Defined Networks‖, First Edition, O'Reilly Media publishers, 2013.
4. Oswald Coker and Siamak Azodolmolky, ―Software Defined Networking with Open Flow, Packt Publishing Limited‖, Second Edition, 2017.
5. Fei Hu, Editor, ―Network Innovation through Open Flow and SDN: Principles and Design‖, CRC Press, 2014.
6. Siamak Azodolmolky, ―Software Defined Networking with Open Flow‖, First Edition, Packet publishing, 2013.
7. Vivek Tiwari, ―SDN and Open Flow for Beginners‖, Amazon Digital Services, Inc., 2013.
8. Vishal Shukla, ―Introduction to Software Defined Networking - Open Flow & VxLAN‖, Create space Independent Publishing Platform, 2013.

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		2			2	3	2	2	
CO2			2			2	2	2	2	
CO3	2		2		2	3	3	2	3	
CO4	2		2		2	2	2	2	2	
CO5			2	2	3	2	2		2	
CO6	3			3	2	3	3		2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE19	STORAGE AND SERVER SECURITY	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:		Category:	PE

Aim:	To understand about the cloud storage environments and its security.

Course Outcomes: The Students will be able to

CO1:	Recall the opportunities and challenges of information management in complex business environments.
CO2:	Classify the information storage management design in a cloud environment, how it relates to the business objectives of an organization.
CO3:	Inspect a global storage solution can be optimized so that it can be delivered successfully from the cloud.
CO4:	Examine the security of virtual systems.
CO5:	Make use of best reliable access to information both locally and remotely using storage technologies.
CO6:	Access the security issues related to multi-tenancy.

VIRTUALIZED DATA CENTER ARCHITECTURE	**9**
Cloud infrastructures; public, private, hybrid. Service provider interfaces; Saas, Paas, Iaas. VDC environments; concept, planning and design, business continuity and disaster recovery principles. Managing VDC and cloud environments and infrastructures.	
INFORMATION STORAGE SECURITY & DESIGN	**9**
Storage strategy and governance; security and regulations. Designing secure solutions; the considerations and implementations involved. Securing storage in virtualized and cloud environments. Monitoring and management; security auditing and SIEM.	
OPTIMIZATION AND SECURITY ENHANCEMENT	**9**
Global storage management locations, scalability, operational efficiency. Global storage distribution; terabytes to petabytes and greater. -Policy based information management-File systems or object storage. IBM security virtual server protection, virtualization-based sandboxing; Storage Security-HIDPS, log management, Data Loss Prevention. Location of the Perimeter.	
INFORMATION AVAILABILITY DESIGN	**9**
Designing backup/recovery solutions to guarantee data availability in a virtualized environment. Design a replication solution, local remote and advanced. Investigate Replication in NAS and SAN environments	
MULTI-TENANCY ISSUES	**9**
Vulnerabilities- Management console vulnerabilities, management server vulnerabilities, administrative VM vulnerabilities, guest VM vulnerabilities, hypervisor vulnerabilities, hypervisor escape vulnerabilities, configuration issues, malware (botnets etc).	
Total Periods:	**45**

References:

1. Greg Schulz, "*Cloud and Virtual Data Storage Networking*", Auerbach Publications [ISBN: 978-1439851739], 2011.
2. Ronald L. Krutz, Russell Dean Vines, "*Cloud Security*" [ISBN: 0470589876], 2010.
3. Vmware "*VMware Security Hardening Guide*" White Paper, June 2011.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2		2		3	3		
CO2	2		1				2	2		3
CO3	3		2	2			3			
CO4	3		2	1			3	2		
CO5	3		2	2			3	3		2
CO6	2		2	1			2	3		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232CSE20	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	-	Category:	PE
Aim:	To understand the fundamental concepts of wireless sensor networks and have a basic knowledge of the various protocols and its functions.				

Course Outcomes: The Students will be

CO1:	Recall the basic WSN technology and architecture.
CO2:	State the issues in physical layer.
CO3:	Compare the medium access control protocols
CO4:	Summarize the key routing protocols for sensor networks and main design issues.
CO5:	Select the appropriate routing protocol for a specific sensor network.
CO6:	Develop simple sensor programs.

INTRODUCTION	**9**
Challenges For Wireless Sensor Networks-Comparison of Sensor Network with Ad Hoc Network - Single Node Architecture-Hardware Components-Energy Consumption of Sensor Nodes-Network Architecture -Sensor Network Scenarios -Design Principles-Applications of wireless sensor networks.	
PHYSICAL LAYER	**9**
Wireless Channel and Communication Fundamentals -Physical Layer and Transceiver Design Consideration in Wireless Sensor Networks – IEEE Standards: Bluetooth, IEEE 802.11b - Representative sensor nodes -WINS, µamps.	
DATA LINK LAYER	**9**
MAC Protocols -Fundamentals of Wireless MAC Protocols, Low Duty Cycle Protocols and Wakeup Concepts - Contention Based Protocols - Schedule Based Protocols -Link Layer Protocols - Error Control - Framing -Traffic -Adaptive Medium Access Protocol (TRAMA) -The IEEE 802.15.4 MAC Protocol.	
NETWORK LAYER – I & II	**9**
Gossiping and Agent-Based Unicast Forwarding–Energy Efficient Unicast, Broadcast and Multicast - Geographic Routing -Mobile Nodes. Data Centric and Content Based Networking-LEACH, PEGASIS - Location Based Routing -GF, GAF, GEAR, GPSR -Real Time Routing Protocols -TEEN, APTEEN, SPEED, RAP -Data Aggregation.	
SENSOR PROGRAMMING	**9**
Programming Challenges in Wireless Sensor Networks- Tiny Operating System – Event Driven Programming-Contiki OS -Techniques for Protocol Programming-Introduction to Network Simulator 3 (ns-3), Description of the ns-3 core module and simulation example.	
Total Hours	**45**

References:

1. Holger Karl, Andreas willig, "*Protocol and Architecture for Wireless Sensor Networks*", John Wiley publication, 1/e, 2010.
2. KazemSohraby, Daniel Minoli, TaiebZnati, "*Wireless Sensor Networks, Technology, Protocols and Applications*",Wiley-Interscience, 1/e, 2007.
3. Feng Zhao, Leonidas Guibas, "*Wireless Sensor Networks: An Information Processing Approach*", Elsevier Publication, USA, 2004.
4. SudipMisra, Isaac Woungang, Subhas Chandra Misra, "*Guide to Wireless Sensor Networks*", Springer Publication, 2006.
5. SitharamaIyengar S, NandanParameshwaran, Balkrishnan N and Chuka D Okye, "*Fundaments of Sensor Network Programming, Applications and Technology*", John Wiley & Sons, USA, 2011.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	3			2		2	3		3
CO2	2	2			2		3	3		
CO3	3	3	2		3		3	2		2
CO4	3	2			2		3	3		
CO5	3	3					2	2		
CO6		3					2	2		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232OE01	BUSINESS INTELLIGENCE AND ANALYTICS					L	T	P	C
						3	0	0	3
Programme:	M.E. Computer Science and Engineering	**Sem:**	**3**	**Category:**		**PC**			
Prerequisite:	Nil								
Aim:	Introduce the Business intelligence and Analytics concepts ,techniques and models Understand the modeling process behind business analytics .To analyze different data analysis tools and techniques								
Course Outcomes: The Students will be able to									
CO1:	Understand the fundamental of Business Intelligence and Analytics to design a customized solution								
CO2:	Familiarize on Data warehousing concepts and reporting methods of descriptive analytics								
CO3:	Recall the Data Mining methods and models of Predictive analytics.								
CO4:	Summarize the Decision Support System Modeling and Risk –Decision modeling on Prescriptive analytics								
CO5:	Understand about the Forecasting Techniques and Regression Forecasting models.								
CO6:	Understand the fundamental of Big Data Analytics tools and techniques								

INTRODUCTION TO BUSINESS INTELLIGENCE AND BUSINESS ANALYTICS	**9**
Introduction to Business Intelligence–Designing Business Intelligence Application- Requirements Gathering, Establishing the Technical Architecture, Designing a Business Intelligence Solution , Designing Dimensional Models , Designing the Physical Databases- Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics	
DESCRIPTIVE ANALYTICS	**9**
Data Warehousing- Definitions and Concepts -- Data Warehousing Architectures – Data Integration and the Extraction, Transformation, and Load (ETL) Processes - Transaction processing- Data Warehouse Development Approaches - Data Warehousing Implementation Issues - Data Warehouse Administration, Security Issues, and Future Trends- Business Reporting, Visual Analytics, and Business Performance Management	
PREDICTIVE ANALYTICS	**9**
Data Mining Concepts- Definitions, Characteristics, and Benefits - How Data Mining Works - Data Mining Versus Statistics Data Mining Process - Data Mining Methods - Data Mining and Privacy Issues - Regression – Classification –Association Rules – clustering -Techniques for Predictive Modeling – ANN- SVM	
PRESCRIPTIVE ANALYTICS	**9**
Decision Support Systems Modeling - Mathematical Models for Decision Support -Certainty, Uncertainty, and Risk- Decision Modeling with Spreadsheets - Mathematical Programming Optimization - Decision Analysis with Decision Tables and Decision Trees - Problem-Solving Search Methods -Problem-Solving Search Methods	
FORECASTING TECHNIQUES AND BIG DATA ANALYTICS	**9**
Forecasting Techniques-Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Fundamentals of Big Data Analytics – Technologies - Data Scientist - Big Data and Data Warehousing - Automated Decision Systems and Expert Systems	
Total Periods:	**45**

Text Book:	

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "*Business Intelligence and Analytics*",10th Edition, Pearson , 2015.
2. Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey, "*Business analytics Principles, Concepts, and Applications*" Pearson FT Press, 2014.

References:

1. S. Christian Albright, Wayne L. Winston, *Business Analytics: Data Analysis & Decision Making*, 6/e, CENGAGE INDIA , 2017.
2. Dinabandhu Bag, "*Business Analytics*" Routledge, 1st edition, 2016.
3. Rick Sherman, *Business Intelligence Guidebook: From Data Integration to Analytics*, Morgan Kaufmann, 1/e, 2014.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2					3	3		
CO2	2	2	3				2	3		
CO3	3	2						3	2	
CO4	3	3						3	2	
CO5	3	3			3		3	2		
CO6	2	2			3			3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232OE21	WEB ANALYTICS AND DEVELOPMENT	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	3	Category:	PC
Prerequisite:	Nil				

Aim:	Introduce the web analytics and development concepts, techniques and models Understand the use of tools and techniques of web analytics.

Course Outcomes: The Students will be able to

CO1:	Understand the concepts and terminologies related to web analytics.
CO2:	Realize various parameters used for web analytics and their impact.
CO3:	Explore the use of tools and techniques of web analytics.
CO4:	Get experience on websites, web data insights and conversions.
CO5:	Appreciate the concept of web goals
CO6:	learn to analyze and understand the content of images

INTRODUCTION — **9**

Web Analytics – Basics – Traditional Ways – Expectations – Data Collection – Click stream Data – Weblogs – Beacons – JavaScript Tags – Packet Sniffing –Outcomes data – Competitive data – Search Engine Data.

QUALITATIVE ANALYSIS — **9**

Customer Centricity – Site Visits – Surveys – Questionnaires –Website Surveys – Post visits – Creating and Running- Benefits of surveys – Critical components of successful strategy

WEB ANALYTIC CONCEPTS — **9**

URLS – Cookies – Time on site – Page views – Understand standard reports – Website content quality – Navigation reports – Search Analytics – Internal search, SEO and PPC –Measuring Email and Multichannel Marketing - Competitive intelligence and Web 2.0Analytics – Segmentation – Connectable reports.

GOOGLE ANALYTICS — **9**

Analytics - Cookies - Accounts vs Property - Tracking Code -Tracking Unique Visitors - Demographics - Page Views & Bounce Rate Acquisitions -Custom Reporting.

GOALS & FUNNELS — **9**

Filters - Ecommerce Tracking - Real Time Reports - Customer Data Alert - Adwords Linking - Adsense Linking -Attribution Modeling - Segmentation -Campaign Tracking - Multi-Channel Attribution.

Total Periods: 45

Text Book:

1. Avinash Kaushik, ―Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity ―, 1st edition, Sybex, 2009.
2. Michael Beasley, ―Practical Web Analytics for User Experience: How Analytics can help you Understand your Users‖, Morgan Kaufmann, 2013.
3. Magy Seif El-Nasr, Anders Drachen, Alessandro Canossa, eds., ―Game Analytics: Maximizing the Value of Player Data‖, Springer, 2013.

References:	
1.Bing Liu, ―Web Data Mining: Exploring Hyperlinks, Content, and Usage Data‖, 2nd Edition, Springer, 2011. 2. Justin Cutroni, ―Google Analytics‖, O'Reilly, 2010. 2. Eric Fettman, Shiraz Asif, Feras Alhlou , ―Google Analytics Breakthrough‖, John Wiley & sons, 1st edition, 2016.Vision", Academic Press, Third Edition, 2012.	

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2			2		3	3	2	
CO2	2	2	3		2		2	3	2	
CO3	3	2			3			3		
CO4	3	3			2			3		3
CO5	3	3			3		3	2		
CO6	2	2			3			3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232OE22	DATA ANALYSIS FOR BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

Programme:	M.E. Computer Science and Engineering	Sem:	3	Category:	PC
Prerequisite:	Nil				

Aim:	Introduce the concept of data analysis and its application on business problems and formulate the statistical model with the given data. classify and visualize the data

Course Outcomes: The Students will be able to

CO1:	Realize the concept of data analysis and its application on business problems
CO2:	Formulate the statistical model with the given data
CO3:	Avoid overfitting of the model and cluster similar objects together
CO4:	Classify and visualize the data for the given problem
CO5:	Mine and extract useful business information
CO6:	Design the real time reports, tracking and data alerts

INTRODUCTION **9**

Web Analytics – Basics – Traditional Ways – Expectations – Data Collection – Click stream Data – Weblogs – Beacons – JavaScript Tags – Packet Sniffing –Outcomes data – Competitive data – Search Engine Data.

QUALITATIVE ANALYSIS **9**

Customer Centricity – Site Visits – Surveys – Questionnaires –Website Surveys – Post visits – Creating and Running- Benefits of surveys – Critical components of successful strategy

WEB ANALYTIC CONCEPTS **9**

URLS – Cookies – Time on site – Page views – Understand standard reports – Website content quality – Navigation reports – Search Analytics – Internal search, SEO and PPC –Measuring Email and Multichannel Marketing - Competitive intelligence and Web 2.0Analytics – Segmentation – Connectable reports.

GOOGLE ANALYTICS **9**

Analytics - Cookies - Accounts vs Property - Tracking Code -Tracking Unique Visitors - Demographics - Page Views & Bounce Rate Acquisitions -Custom Reporting.

GOALS & FUNNELS **9**

Filters - Ecommerce Tracking - Real Time Reports - Customer Data Alert - Adwords Linking - Adsense Linking -Attribution Modeling - Segmentation -Campaign Tracking - Multi-Channel Attribution.

Total Periods: **45**

Text Book:

1. Avinash Kaushik, ―Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity ―, 1st edition, Sybex, 2009.

2. Michael Beasley, ―Practical Web Analytics for User Experience: How Analytics can help you Understand your Users‖, Morgan Kaufmann, 2013.

3. Magy Seif El-Nasr, Anders Drachen, Alessandro Canossa, eds., ―Game Analytics: Maximizing the Value of Player Data‖, Springer, 2013.

References:	
1.Bing Liu, ―Web Data Mining: Exploring Hyperlinks, Content, and Usage Data‖, 2nd Edition, Springer, 2011. 2. Justin Cutroni, ―Google Analytics‖, O'Reilly, 2010. 2. Eric Fettman, Shiraz Asif, Feras Alhlou , ―Google Analytics Breakthrough‖, John Wiley & sons, 1st edition, 2016.Vision", Academic Press, Third Edition, 2012.	

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2			2		3	3	2	
CO2	2	2			2		2	3	2	
CO3	3	2			3			3		
CO4	3	3			2			3		3
CO5	3	3			3		3	2		
CO6	2	2	3		3		3	3		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232AC02	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

Programme:	M.E. Computer Science and Engineering	Sem:	-	Category:	MC
Aim:					
Prerequisite:	--				

Course Outcomes: The Students will be able to

CO1:	Demonstrate the premises informing the twin themes of liberty and freedom from a civil rights perspective.
CO2:	Compare the growth of Indian opinion regarding modern Indian intellectuals' constitutional role
CO3:	Recall the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO4:	Outline the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO5:	Relate the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO6:	Examine the passage of the Hindu Code Bill of 1956.

HISTORY OF MAKING OF THE INDIAN CONSTITUTION	**4**
History - Drafting Committee (Composition & Working). Philosophy of the Indian Constitution: Preamble - Salient Features.	
CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES	**4**
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.	
ORGANS OF GOVERNANCE	**4**
Parliament – Composition - Qualifications and Disqualifications - Powers and Functions – Executive – President – Governor - Council of Ministers - Judiciary, Appointment and Transfer of Judges – Qualifications - Powers and Functions.	
LOCAL ADMINISTRATION AND PACHAYAT RAJ IN INDIA	**6**
District's Administration head: Role and Importance – Municipalities: Introduction, Mayor and role of Elected Representative - CEO of Municipal Corporation. Pachayat raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	
ELECTION COMMISSION	**6**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.	
Total Hours	**24**

References:

1. *The Constitution of India*, 1950 (Bare Act)", Government Publication.
2. Dr. S. N. Busi, "*Dr. B. R. Ambedkar framing of Indian Constitution*", 1/e, 2015.
3. M. P. Jain, "*Indian Constitution Law*", 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, "*Introduction to the Constitution of India*", Lexis Nexis, 2015.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1				3						1
CO2				1						2
CO3				2						1
CO4				2						1
CO5				3						1
CO6				1						3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232AC03	DISASTER MANAGEMENT			L	T	P	C
				2	0	0	0
Programme:	M.E. Computer Science and Engineering	**Sem:**	-	**Category:**		**MC**	

Course Outcomes: The Students will be able to

CO1:	Demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2:	Evaluate disaster risk reduction critically and humanitarian response policy and practice from multiple perspectives.
CO3:	Develop an understanding on standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO4:	Understand the strengths and weaknesses of disaster management approaches.
CO5:	Plan and program according to the situation.
CO6:	Identify risk and mitigation during the time of disaster.

INTRODUCTION: **4**

Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

REPERCUSSIONS OF DISASTERS AND HAZARDS **4**

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, Outbreaks of Disease and Epidemics, War and Conflicts.

DISASTER PRONE AREAS IN INDIA **4**

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.

DISASTER PREPAREDNESS AND MANAGEMENT **6**

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.

RISK ASSESSMENT AND DISASTER MITIGATION **6**

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. Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation.Programs ofDisaster Mitigation in India.

Total Hours **24**

References:

1. Nishith Rai, Singh AK, "*Disaster Management in India: Perspectives, issues and strategies*", New Royal book Company,2012.
2. PardeepSahni, AlkaDhameja, Uma Medury, (Eds.), "*Disaster Mitigation Experiences and Reflections*", Prentice Hall of India, New Delhi,2011.
3. Goel S. L., "*Disaster Administration and Management Text and Case Studies*", Deep & Deep Publication Pvt. Ltd., New Delhi,2007.

Course Outcomes	Programme Outcomes (POs)						Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1				3						1
CO2				1						2
CO3				2						1
CO4				2						1
CO5				3						1
CO6				1						3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

232AC04	நற்றமிழ் இலக்கியம்			L	T	P	C
				2	0	0	0
Programme:	M.E. Computer Science and Engineering	**Sem:**	-	**Category:**		**MC**	

UNIT I **சங்க இலக்கியம்**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV **அருள்நெறித் தமிழ்**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V **நவீன தமிழ் இலக்கியம்**

1. உரைநடைத் தமிழ்,
- தமிழின் முதல் புதினம்,
- தமிழின் முதல் சிறுகதை,
- கட்டுரை இலக்கியம்,
- பயண இலக்கியம்,
- நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
   -https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
   - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
   - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்