REVISED STUDY AND EVALUATION SCHEME

FROM

1st TO IVth SEMESTER

MASTER OF ENGINEERING PROGRAMME

REGULAR AND MODULAR PROGRAMME

IN

COMPUTER SCIENCE AND ENGINEERING

OFFERED BY

PANJABUNIVERSITY, CHANDIGARH

(Batch 2021-23)

Vision

The department aims to be recognized as an eminent department in Computer Science and Engineering education and research for the benefit of society globally

Mission

1. To sustain world-class computing infrastructure for the enhancement of technical knowledge in the field of Computer Science and Engineering.
2. To excel in research and innovation for the discovery of new knowledge and technologies.
3. To produce technocrats, entrepreneurs, and business leaders of the future.
4. To foster human values for national growth and life-long learning amongst all the stakeholders.

Program Educational Objectives (PEOs):

PEO 1: Apply the knowledge of Computer Science and Engineering to solve real world problems and communicate its solutions to various research platforms

PEO 2: Pursue higher studies and research in different research labs and institutes of higher repute at national and international level

PEO 3: Analyze and provide solutions to various industrial problems and work as a software professional in industry of repute

Program Outcomes (PO):

PO 1: An ability to independently carry out research and development work to solve societal / industrial problems

PO 2: An ability to compile and present research pursued in the scientific peer system

PO 3: An ability to demonstrate a high degree of knowledge in a selective domain

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Scheme of Evaluation (Semester-wise)
M.E. (Computer Science & Engineering)
(Examination 2021-2022)

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1. Duration of the Programmes

i) **For Regular M.Tech./M.E. Programmes**

The normal duration of M.Tech./ME programmes including Thesis will be 2 academic years (4 semesters). The maximum period of completion of the programme including Thesis shall be 3 academic years (6 semesters).

ii) **For Modular M.Tech. /M.E. Programmes**

The normal duration of Modular M.Tech./M.E. Programmes including Thesis will be 3 academic years, (6 spells, each spell of 5 weeks duration including Saturdays/ &Sundays). The maximum period of completion of the programme including Thesis shall be 5 academic years (10 spells).

Scheme for ME CSE

First Semester

Sr.No	Course No.	Course Title	Hours / Week	Credits	University External Marks	Internal Sessional Marks	Total
1.	CS 8101	Advance Algorithms	4	4	50	50	100
2.	CS 8102	Advance Databases	4	4	50	50	100
3.	CS 8103	Advance Computer Networks	4	4	50	50	100
4.	Branch Elective – I		4	4	50	50	100
5.	Branch Elective – II		4	4	50	50	100
6.	CS 8150	Software Lab-I	4	2	-	100	100
7.	CS 8151	Principles of Designing (optional)		-	-	-	-
Total			24	22	250	350	600

Elective-I Bucket
CS 8104 Software Testing and Quality Management
CS 8105 Advance Software Engineering
CS 8106 Project Management
CS8107 Business Intelligence
CS 8108 Building Enterprise Applications

Elective –II Bucket

CS 8109 Advance Computer Architecture
CS 8110 Parallel and Distributed Computing
CS 8111 Cloud Computing
CS 8112 Modeling and Simulation

Second Semester

Sr.No	Course No.	Course Title	Hours / Week	Credits	University External Marks	Internal Sessional Marks	Total
1	CS 8201	Digital Image Processing	4	4	50	50	100
2	CS 8202	Research Methodology	4	4	50	50	100
3	CS 8203	Soft Computing	4	4	50	50	100
4	CS 8250	Software Lab-II	6	3	-	100	100
5	Branch Elective – III		3	3	50	50	100
6	Branch Elective –IV		3	3	50	50	100
7.	CS 8251 Research Seminar		2	1	-	100	100
Total:			26	22	250	450	700

Elective-III Bucket

CS 8204 Data Warehousing and Mining
CS 8205 Machine learning
CS 8206 Data Acquisition and Hardware Interfacing

Elective –IV Bucket

CS 8207 Network Security
CS 8208 Multimedia Computing and Communications
CS 8209 Wireless Networks
CS8210 Telecommunication Technologies

Third Semester

Sr.No.	Course No.	Course Title	Hours / Week	Credits	University External Marks	Internal Sessional Marks	Total
1		Elective V	3	3	50	50	100
2		Elective –VI	3	3	50	50	100
3	CS 8350	Preliminary Thesis Work	20	10	--	100	100
Total			26	16	100	200	300

Elective-V Bucket

CS 8301 Natural Language Processing
CS 8302 Machine Vision
CS 8303 Open Source Software
CS 8304 Information Retrieval

Elective –VI Bucket

CS 8305 Cyber Laws and IPR
CS 8306 Business Process Re-Engineering
CS 8307 Technology Management
CS 8308 Human Resource Development and Training Methods

Fourth Semester

Sr. No.	Course No.	Course Title	Hours / Week	Credits	University External Marks	Internal Sessional Marks	Total
1	CS 8450 Thesis		25	15	100	100	200
Total			25	15	100	100	200

Instructions for Internal Examiners to award marks/grades for Thesis:-

S. No.	Grade	Condition
1	A+	Publication from Thesis in SCI indexed journal.
2	A	Publication from Thesis in Scopus indexed journal.
3	B+	Publication from Thesis in Proceedings of Conference which is Scopus indexed.
4	B	Presented paper in International Conference.
5	C+	Presented paper in National Conference.

b) M. TECH/ME MODULAR PROGRAMMES

Spell - 1

Code No.	Subject	Total	Theory	Sessional Marks	Total	Credits
	Core Subject - 1	4	50	50	100	4
	Core Subject - 2	4	50	50	100	4
	Total	8	100	100	200	8

Spell - 2

Code No.	Subject	Total	Theory	Sessional Marks	Total	Credits
	Core Subject -3	4	50	50	100	4
	Core Subject - 4	4	50	50	100	4
	Software Lab-1	5	--	100	100	3
	Total	13	100	200	300	11

Spell - 3

Code No.	Subject	Total	Theory	Sessional Marks	Total	Credits
	Core Subject -5	4	50	50	100	4
	Core Subject - 6	4	50	50	100	4
	Research Seminar	-	--	100	100	2
	Total	8	100	200	300	10

Spell - 4

Code No.	Subject	Total	Theory	Sessional Marks	Total	Credits
	Elective -1	4	50	50	100	4
	Elective - 2	4	50	50	100	4
	Software Lab-II	6	--	100	100	3
	Total	14	100	200	300	11

Spell – 5

Code No.	Subject	Total	Theory	Sessional Marks	Total	Credits
	Branch Elective Subject -3	3	50	50	100	3
	Branch Elective Subject - 4	3	50	50	100	3
	Preliminary Thesis CSE 8350	--	--	100	100	10

	Total	06	100	200	300	16

Spell - 6

Code No.	Subject	Total	Theory	Sessional Marks	Total	Credits
	Elective Subject -5	3	50	50	100	3
	Elective Subject –6	3	50	50	100	3
	CS 8450 Thesis	--	100	100	200	15
	Total	06	200	200	400	21

Branch: Computer Science and Engineering

Title	ADVANCE ALGORITHMS		Credits	04
Code	CS 8101	Semester: - Ist	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	ADA		Contact Hours	45
			Time	3 Hours
Objectives	This course will provide the in-depth knowledge of different algorithm design methodologies and the various research concepts involved			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

	SECTION-A	
Models of Computation and Algorithms Stored program model, Random Access Machines and Turing machines, Algorithms and their complexity, Performance analysis: - Time and space complexity, asymptotic notation. Analyzing recursive algorithms using recurrence relations: Substitution method, Recursion-tree method, Master method.		7
Divide and Conquer, and Greedy Algorithm Design Methodologies Introduction, Quick sort, Strassen's matrix multiplication, Minimum spanning tree, Single source shortest path problem and their performance analysis.		8
Branch-and-Bound, and Lower Bound Theory Introduction, 0-1 knapsack problem, Traveling salesman problem, comparison trees for sorting, searching and merging.		7
	SECTION-B	
Dynamic Programming and Backtracking Algorithm Design Methodologies Introduction, Traveling salesperson problem, Knapsack problem, multistage graphs, Floyd-Warshall algorithm, N-Queens problem, and their performance analysis.		7
Parallel Random Access Machine Algorithms Introduction, computation model, fundamental techniques and algorithms, selection, sorting, merging, graph problems.		6
Advanced String Matching Algorithms Naïve string matching algorithm, Robin-Karp algorithm, string matching with finite automata, Knuth-Morris-Pratt algorithm.		5
P, NP and Approximation Algorithms Basic Concepts, Non Deterministic algorithms, NP-Complete and NP-hard classes, introduction to approximation, absolute approximations, polynomial time approximation schemes.		5

Suggested Books	1. Cormen, Leiserson, Rivest and Stein: Introduction to algorithms, Prentice-Hall of INDIA. 2. Horowitz, Sahni and Rajsekaran: Fundamentals of Computer Algorithms, Galgotia. 3. Aho, Hopcroft, Ullman: The Design and analysis of algorithms", Pearson Education.

Course Outcomes	1. Understand the necessary mathematical abstraction to solve problems
	2. Select and employ suitable algorithm design approach to develop algorithm for solving specific problem
	3. Come up with analysis of efficiency and proofs of correctness of the algorithm
	4. Design and build solutions for a real world problem by developing efficient algorithms

Branch: Computer Science and Engineering

Title	ADVANCE DATABASES		Credits	04
Code	CS 8102	Semester: - Ist	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	Database management systems, Advanced database systems		Contact Hours	45
			Time	3 Hours
Objectives	This course offers a good understanding of emerging database technologies and prepares students to be in a position to design databases in variety of technologies like xml, object oriented etc.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction: Database System Concepts and Architecture, Data Independence, Data Models, SQL: DDL, DML, DCL, Database Integrity, Normalization: 1NF, 2NF, 3NF, BCNF, 4NF, 5NF.	6
Advanced Transaction Processing and Concurrency Control: Transaction Concepts, Concurrency Control: Locking Methods, Timestamping Methods, Optimistic Methods for Concurrency Control, Concurrency Control in Distributed Systems.	6
Object Oriented and Object Relational Databases: Object Oriented Concepts with respect to Database Systems, Object Oriented Data Model, OODB, OODBMS, ODMG, ODL, OQL, ORDBMS, ORDBMS Design, ORDBMS Query Language.	5
Parallel and Distributed Databases: Parallel Databases, Distributed Databases, Differences between them, Architecture of Distributed Databases, Architecture of Parallel Databases, Key elements of Parallel Database Processing, Fragmentation, Replication and Allocation for distributed databases, Intra-query parallelism, Inter-query parallelism, Intra-operation parallelism, Inter-operation parallelism.	6
SECTION-B	
Backup and Recovery Techniques: Backup and Recovery Concepts, Types of Database Failures, Types of Database Recovery, Recovery Techniques: Deferred Update, Immediate Update, Shadow Paging, Checkpoints, Buffer Management, Recovery Control in Distributed Systems.	5
XML and Internet Databases: Structured, Semi Structured, and Unstructured Data, XML Hierarchical Data Model, XML Documents, DTD, XML Schema, XML Querying: XPath, XQuery.	4
Emerging Database Technologies: Introduction to Deductive Database Systems, Temporal Databases, Multimedia Databases, Mobile Databases, Main Memory Databases, Spatial and Multidimensional Databases.	8
Data Warehousing and Mining: Introduction to OLAP, OLTP and differences between them, Data Warehouse, Data Warehouse Architecture, Data Marts, Data Mining, Data Mining Process, Knowledge Discovery.	5

Suggested Books	1. RamezElmasri, ShamkantNavathe: Fundamentals of Database Systems, Fifth Edition, Pearson Education, 2007. 2. C.J. Date: An Introduction to Database Systems, Eighth Edition, Pearson Education. 3. S. K. Singh: Database Systems Concepts, Design and Applications, Pearson Education. 4. Raghu Ramakrishnan, Johannes Gehrke: Database Management Systems, Tata McGraw-Hill. 5. Abraham Silberschatz, Henry F. Korth, S. Sudarshan : Database System Concepts, Tata McGraw-Hill
Course Outcomes	On completion of this course, a student must be able to 1. Understand different database concepts and issues related to Transaction and Concurrency control in databases. 2. Identify object-oriented, relational, parallel and distributed databases and database technologies like xml. 3. Demonstrate an understanding of various backup and recovery techniques in a database.. 4. Familiarize with concepts of data mining and knowledge discovery.

Branch: Computer Science and Engineering

Title	ADVANCE COMPUTER NETWORKS		Credits	04
Code	CS 8103	Semester: - 1st	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	Computer Networks		Contact Hours	45
			Time	3 Hours
Objectives	Upon completion of this course, participants will have gained knowledge of computer network concepts and the following: ● Fundamentals of IPv6 and MobileIPv6 ● Application and importance of Software Defined Networks ● Fundamentals of Mobile Computing and related technologies ● Basic concepts of Cellular networks and working of GSM, GPRS, 3G and 4G Understanding architecture, application and challenges of MANET, VANET and WSN			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction: Overview of Computer Networks, ISO-OSI and TCP/IP reference models, MAC protocols for LANs, Gigabit Ethernet, Wireless LAN	6
IPv6: Overview of IP and IPv4, **IPv6**: Basic protocol, Extensions and options, Tunneling, Addressing, Neighbor Discovery, Auto-configuration, IPv6 in an IPv4 Internet Migration and Coexistence, **Mobile IPv6**: Overview, Route Optimization, Handover and its impacts on TCP and UDP, Security requirements.	10
Transport Layer: Conventional TCP, TCP extensions for wireless networks	3
Software Defined Networks: Introduction, Evolution and Importance of SDN, Control and Data Planes, Role of SDN Controllers, Application areas of SDN.	5
SECTION-B	
Mobile Computing: Introduction, Mobile Computing Architecture, Technologies: Bluetooth, RFID, WiMAX, Security Issues in Mobile Computing.	5
Cellular Technologies: **Cellular Concept:** Introduction, Frequency Reuse, Channel Assignment, Handoff Strategies, Interference, Cell Splitting and Sectoring. **GSM**:GSM-services, features, system architecture, **GPRS**: Introduction, network architecture, data services, applications and limitations, 3G and 4G.	8
Ad Hoc Networks: Introduction to Adhoc networks, Issues in Adhoc networks and Pro-active and Reactive routing protocols. VANETS: Introduction, architecture, applications and challenges WSNs: Introduction, architecture, applications and challenges.	8

Suggested Books	1. Behrouz A. Forouzan: Data Communications and Networking, 2nd Edition, McGraw-Hill. 2. Andrew S. Tanenbaum, David J. Wetherall: Computer Networks, Pearson. 3. Hesham Soliman: Mobile IPv6 Mobility in Wireless Internet, Pearson Education. 4. Thomas D. Nadeau, Kengray: Software Defined Networks, O'Reilly. 5. Ashok K. Talukdar: Mobile Computing- Technology, Applications and Service Creation, 2nd Edition, McGraw-Hill. 6. Theodore S. Rappaport: Wireless Communications Principles and Practice, Prentice Hall. 7. Hannes Hartenstein, Kenneth Laberteaux: VANET Vehicular Applications and Inter-networking Technologies, Wiley. 8. Kazem Sohraby, Daniel Minoli, Taieb Znati: Wireless Sensor Networks- Technology, Protocols and Applications, Wiley. 9. Requests for Comments (RFCs) & Internet Drafts, published by Internet Engineering Task Force (www.rfc-editor.org).
Course Outcomes	On completion of this course, a student must be able to 1. Understand network reference models (e.g TCP/IP, OSI) and protocols (MAC, IPv6, etc.) to compare their performance and application in different areas. 2. Analyze various issues in working of transport protocols for wired and wireless networks. 3. Utilize knowledge to apply the latest networking technologies like 4G, SDNs, RFID, etc in designing mobile and wireless networks. 4. Demonstrate critical mind for constructing and evaluating an adhoc wireless network, routing protocols and security issues for VANETs.

Branch: Computer Science and Engineering

Title	SOFTWARE LAB-I		Credits	03
Code	CS 8150	Semester: - Ist	L T P	006
Max. Marks	100	Internal: - 100	Elective	N
Pre-requisites	Testing techniques, models			
			Time	6 Hours

Branch: Computer Science and Engineering

Title	PRINCIPLES OF DESIGNING		Credits	
Code	CS 8151	Semester: -1st	L T P	
Max. Marks			Elective	Optional Course
Pre-requisites			Contact Hours	45
			Time	3 Hours
Objectives	1. Conceptualisation and development of innovative, commercially important and socially sound decisions related to engineering products, processes and systems. 2. To train students to translate academic developments in electronics, computational, materials and energy engineering to real life applications of interest to industry for accelerated start of career.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	Hrs
Introduction to designing Fundamentals of engineering designs and applications; social, economic, sustainability, environmental and aesthetic rationales in design engineering, design decisions related to competitiveness of products, processes, services and systems. Impact of product design on business and market, product portfolio development through continuity in designing.	7
Managing technologies and innovations Technology road mapping, market and trend analyses for design decisions, managing technology and innovations, protecting designs by intellectual property rights, IPR gap analysis, creative thinking, technology sharing and transfer, founding start up companies, raising seed funding, challenges of conceiving, creating and growing a new venture.	7
Design process Principles, tools and strategies for conceptualising the need and presenting designs - product specifications, digital tools, analog drawings, design modeling: mathematical modeling, simulation using computers, and creation of 2D and 3D scale models. Engineering fundamentals related to mechanical, electrical, electronic and computational concepts in designing; environmental, sustainability, life cycle analysis, upstream manufacturing economics and downstream assembly, distribution, recyclability, robustness, maintenance and safety aspects in design development; functional prototypes, iterations, validation of product concept, product development .	7
SECTION-B	
Materials in Engineering Designs Mechanical and structural properties of materials, application related needs, stress analysis and fracture, heat transfer, conductivity, transparency, surface properties etc. Nanomaterials, transparent ceramics, polymers, biocompatible materials, composites for biomechanical applications. Case studies through examples and minor projects on designing materials for dental restorative applications, energy harvesting technologies and transparent ceramics.	8

Computational Designs Theory and applications of computational design and manufacturing methods, use of tools like, computer aided design, computer aided engineering, computer aided manufacturing, Digital image capture and reconstruction, additive and subtractive manufacturing using CAD CAM, milling and 3D approaches. Examples by case studies and minor projects for designing prosthetics and orthosis.	6
Challenges of Energy in Engineering Designs Energy source, quality, costing, storage, utilisation, conservation and sustainability in engineering designs. Examples by case studies and minor projects on small energy capture, storage and management technologies.	4
Smart Systems in Engineering Designs Smart system technologies, real time sensing and communication, embedded intelligence, designing for internet of things, data acquisition and hardware interfacing and robotics. Case studies and minor projects related to devices for visually and hearing challenged individuals, traffic sensing and information analysis.	6

Suggested Books	1. Michael Luchs, Scott Swan, Abbie Griffin, 2015. Design Thinking. 405 pages, John Wiley & Sons, Inc (ISBN 978-1-118-97180-2) 2. Geoffrey Boothroyd, Peter Dewhurst and Winston A Knight, 2011. Product Design for Manufacture and Assembly. CRC Press. 3. Nigel Cross, 2008. Engineering Design Methods: Strategies for Product Design. Wiley & Sons (ISBN 978-0-470-51926-4) 4. Richard G Budynas and J Keith Nisbett, 2010. Mechanical Engineering Design. . Mc Graw Hill (ISBN 978-0-07-352928-8).

Course Outcomes	On completion of this course, a student must be able to
	    1. Develop and design engineering products that are commercially and socially viable.
	    2. Develop real-time applications using engineering design.

Title	SOFTWARE TESTING AND QUALITY MANAGEMENT		Credits	04
Code	CS 8104	**Semester:** - 1st	L T P	4 0 0
Max. Marks	**External:** - 50	**Internal:** - 50	Elective	N
Pre-requisites	Software Engineering		Contact Hours	45
			Time	3 Hours
Objectives	This course offers a good understanding of methods and techniques of software testing and quality management concepts and prepares students to be in a position to develop error free and quality software.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction: Software Engineering, Software Process Models, Management Process, Scheduling, Estimation, Software Metrics.	5
Software Quality: Quality Concepts,Quality Control,Quality Assurance,Cost of Quality, SQA Activities, Total Quality Management Principles,Software Reviews,Formal Technical Reviews,Software Reliability,Software Safety, ISO Approaches to Quality Assurance Systems.	5
Standards, Practices, Conventions and Metrics: Quality Assurance Standards, ISO 9000,ISO 9001:2000, ISO 9126 Quality Factors, CMM, Six Sigma, Software Quality Assurance Metrics,Advantages, QA Techniques, Introduction to SPICE.	6
Risk and Software Configuration Management: Software Risks, The RMMM Plan, Software Configuration Management Process: Version Control, Change Control.	5
SECTION-B	
Software Testing: Testing, Test Strategies for Conventional and Object Oriented Software, Unit and Integration Testing, Validation Testing, System Testing, Metrics for Source Code, Metrics for Testing, Debugging.	5
Testing Techniques for Conventional and Object Oriented Software: Black Box and White Box Testing, Basis Path Testing, Control Structure Testing, Object Oriented Testing Methods: Applicability of Conventional Test Case Design Methods, Testing Methods Applicable at the Class Level.	6
Testing Process: Test Plan development, Requirement Phase Testing, Design Phase Testing, Program Phase Testing, Execute Test and Record Results.	6
Testing Specialized Systems and Applications: Testing Client/Server Systems, Testing Web based Systems, Testing in Multiplatform Environment, Testing Off-the-Shelf Software, Testing for Real Time Systems, Testing Security.	7

Suggested Books	1. Ian Somerville: Software Engineering, Seventh Edition, Pearson Education. 2. William E. Perry: Effective Methods for Software Testing, Second Edition, John Wiley & Sons. 3. R.S. Pressman: Software Engineering: A Practitioner's Approach, Sixth Edition, Tata McGraw-Hill. 4. Boris Beizer: Software Testing Techniques, Second Edition, Dreamtech. 5. Nina S Godbole: Software Quality Assurance – Principles and Practice, Narosa. 6. S.L. Pfleeger, J.M. Atlee: Software Engineering: Theory and Practice, Second Edition, Pearson Education. 7. K.K. Aggarwal, Yogesh Singh: Software Engineering, Second Edition, New Age International. 8. PankajJalote: An Integrated Approach to Software Engineering, Second dition, Narosa.

Branch: Computer Science and Engineering

Title	ADVANCE SOFTWARE ENGINEERING		Credits	03
Code	CS 8105	Semester: - I	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Software Engineering		Contact Hours	45
			Time	3 Hours
Objectives	This course offers a good understanding of latest software engineering concepts like Agile software development, Web Apps and Mobile Apps design principles along with test automation, security engineering, and prepares students to be in a position to design quality software using latest software engineering techniques.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Nature of Software The Changing Nature of Software, WebApps, Mobile Apps, Cloud Computing, Software Process Structure, Process Assessment and Improvement, Specialized Process Models, The Unified Process, Personal and Team Process Models	5
Agile Development The Genesis of Agile, Agility principles, Extreme programming, Agile process models, Scrum, Tools, Agile teams, Design and development practices in Agile projects, Pair Programming	5
Requirements Modeling and Design Concepts Requirements Modeling: Scenario-based and class-based methods, Requirements Modeling for Web and Mobile Apps, WebApp Design, MobileApp Design	7
Agile Testing The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester	6
SECTION-B	
Object Oriented Software and UML Object-Oriented Analysis and Design Concepts, Metrics for Object-Oriented Design, Use Case Diagrams, Class Diagrams, Component Diagrams, Deployment Diagrams, Activity Diagrams, Package Diagrams, Sequence Diagrams	6
Testing Web and Mobile Apps Testing concepts for WebApps, Testing process, Content Testing, User Interface Testing, Navigation Testing, Performance Testing, Testing MobileApps, Testing Object-Oriented applications	6
Security Engineering Analyzing Security Requirements, Security and Privacy in an Online World, Security Engineering Analysis, Security Assurance, Security Risk Analysis, Verification of Trustworthy Systems	4
Advanced Topics Reengineering, Reverse Engineering, Restructuring, Forward Engineering, Software Process Improvement, The SPI Process, The CMMI, SPI Frameworks, Emerging software engineering trends	6

Suggested Books	1. Agile Software Development, Principles, Patterns and Practices, by Robert C. Martin, Pearson Education. 2. Software Engineering: A Practitioner's Approach, 8/e, by Roger S Pressman and Bruce R Maxim, McGraw-Hill. 3. Agile Testing: A Practical Guide for Testers and Agile Teams, by Lisa Crispin, Janet Gregory, Pearson. 4. Object-Oriented Analysis and Design With Applications, by Grady Booch et al., Pearson Education. 5. Web Engineering: A Practitioner's Approach, By Roger Pressman and David Lowe, McGraw-Hill. 6. The Unified Modeling Language User Guide by Grady Booch, Rumbaugh and Jacobson, Pearson Education. 7. Mobile Applications: Architecture, Design, and Development by Valentino Lee, Heather Schneider, Robbie Schell, Prentice Hall
Course Assessment Methods	Assessment will consist of following components 1. Two Minors (30% Weightage) 2. Quiz (7.5%) 3. Assignment (7.5%) 4. Attendance (5%) 5. Final Exam (50%)
Course Outcomes	On completion of this course, a student must be able to 1. Understand the concepts of Agile software development and the design of Web Apps and Mobile Apps. 2. Apply various requirements modeling techniques like scenario-based and class-based methods. 3. Demonstrate the design of Web Apps and Mobile Apps by applying learned principles. 4. Test Object Oriented Applications, Web Apps and Mobile Apps. 5. Familiarize with emerging concepts like Software Process Improvement and Security Engineering

Branch: Computer Science and Engineering

Title	PROJECT MANAGEMENT		Credits	04
Code	CS 8106	Semester: - 1st	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Software Engineering		Contact Hours	45
			Time	3 Hours
Objectives	The objective of the subject is to provide a strategic perspective and demonstrating means to manage projects. Emphasizing on various project aspects and problems related to them.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction to project management: Introduction, Importance of software project management, Project and different types of project, What is management?, Problems with software projects, Environmental Appraisal with Projects, Requirement Specification, Management Control, Steps in project planning	5
Programme management and project evaluation: Programme Management, Managing resources within programme, Strategic programme management, Aids to programme management, Evaluation / Assessment of projects, Cost-benefit Analysis, Cash flow forecasting, Cost-benefit evaluation techniques, Risk evaluation	8
Project approach and Software effort estimation: Selection of an appropriate project technology, Choice of process model, Data Structure, Delivery Model, Basis for software estimation, Problem with over and under estimates, Estimation Techniques, Expert judgment, Albrecht Function Point Analysis, Function points Mark II, COSMIC Function point, COCOMO Model	10

SECTION-B	
Activity Planning: Objective of Planning, Project Schedule, Activities – Sequencing and Scheduling, Development of Project Network, Time Estimation, Forward and backward Pass, Critical Path and Activities.	5
Risk Management Risk, Risk categories, identification, assessment, planning, management PERT and CPM Models, Monte Carlo Simulation	5
Resource Allocation, Monitoring and Control Resources, Nature of Resources, Resource Requirement, Scheduling, Counting and Costing, Monitoring Framework, Cost Monitoring, Earned Value Analysis, Project targets, Change Control Management	6
Managing people and Organizing teams Management Spectrum, Associating human resource with job, Motivation, Oldham- job Characteristics Model, Decision Making, Leadership, Stress, Health and Safety.	6

Suggested Books	1. Bob Hughes & Mike Cotterell: Software Project Management, 4th, Tata McGraw Hill Publication . 2. Prasanna Chandra: Projects – Panning, Analysis, Selection, Financing, Implementation and Review, 6th, Tata McGraw Hill Publication. 3. JeffreyPinto: Project Management, Pearson Publications

Branch: Computer Science and Engineering

Title	BUSINESS INTELLIGENCE		Credits	04
Code	CS 8107	Semester: - 1st	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Database Management System		Contact Hours	45
			Time	3 Hours
Objectives	1. To introduce the concepts of Business process their requirements, key performance indicators and their evaluation in a typical Business houses. 2. To introduces the concept of data warehouses and use of multi dimensional databases and Online Analytical processing. 3. To introduce the basic data mining concepts like Association Rule Analysis, classification, clustering and their use in different application domains.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	Hrs
Introduction to Business Intelligence: Introduction to OLTP and OLAP, BI Definitions & Concepts, Business Applications of BI, BI Framework, Role of Data Warehousing in BI, BI Infrastructure Components – BI Process, BI Technology, BI Roles & Responsibilities	8
Basics of Data Integration (Extraction Transformation Loading) Concepts of data integration need and advantages of using data integration, introduction to common data integration approaches, introduction to ETL, Introduction to data quality, data profiling concepts and applications.	8
Introduction to Multi-Dimensional Data Modeling, Introduction to data and dimension modeling, multidimensional data model, ER Modeling vs. multi dimensional modeling, concepts of dimensions, facts, cubes, attribute, hierarchies, star and snowflake schema, introduction to business metrics and KPIs, creating cubes using SSAS	8
SECTION-B	
Basics of Enterprise Reporting Introduction to enterprise reporting, concepts of dashboards, balanced scorecards, and overall architecture	6
Introduction to Big Data Analytics: Failure of traditional Distributed Systems, Hadoop Architecture, HDFS, NoSQL databases, HBASE, MongoDB, JSON, Map Reduce Paradigm, Stream computing, High level Components: PIG, JAQL	15

Suggested Books	S. No.	Authors	Title	Publisher	Edition	Year	Other Details
	1.	R N Prasad, Seema Acharya	Fundamentals of Business Analytics	Wiley India	First Edition	2011	
	2.	.Han and M. Kamber	Data Mining: Concepts and Techniques	Morgan Kaufman publishers, Harcourt India pvt. Ltd	Latest Edition	2010	
	3.	David Loshin	Business Intelligence: The Savvy Manager's Guide.	Knowledge Enterprise.	Latest Edition	2011	
	4.	Larissa Terpeluk Moss, Shaku Atre	Business Intelligence roadmap	Addison Wesley	Latest Edition	2012	
	5.	Cindi Howson	Successful Business Intelligence: Secrets to making Killer BI Applications	Tata McGraw Hill	Latest Edition	2012	
	6.	Mike Biere	Business intelligence for the enterprise	Addison Wesley	Latest Edition	2010	

Course Assessment Methods	Assessment will consists of following components
	1. Two Minors (30% Weightage) 2. Quiz (7.5%) 3. Assignment (7.5%) 4. Attendance (5%) 5. Final Exam (50%)

Course Outcomes	On completion of this course, a student must be able to
	1. Understand fundamental Business processes, their requirements, evaluation using key performance indicators, 2. Demonstrate an understanding of BI framework and its implementation using open source tools. 3. Demonstrate an understanding of various concepts related to data warehousing and OLAP. 4. Use different data mining representation techniques used in different domains.

Branch: Computer Science and Engineering

Title	BUILDING ENTERPRISE APPLICATIONS		Credits	4
Code	CS 8108	Semester: - 1st	L T P	4 0 0
Max. Marks	External: 50	Internal: 50	Elective	Y
Pre-requisites	Database Systems (CSE412)		Contact Hours	45
			Time	3 Hours
Objectives	1. To introduce the concepts of Enterprise applications and different issues related to their implementation 2. To introduces the architecture of different Enterprise applications and different design modeling techniques for construction. 3. To introduce the different testing techniques for Enterprise application and methodologies used to roll out these applications.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	Hrs
Introduction to Enterprise application Introduction to enterprise applications and their types, software engineering methodologies, life cycle of raising an enterprise application, introduction to skills required to build an enterprise application, key determinants of successful enterprise applications, and measuring the success of enterprise applications.	8
Incepting enterprise application and business process modelling Inception of enterprise applications, enterprise analysis, business modelling, requirements elicitation, use case modelling, prototyping, non functional requirements, requirements validation, planning and estimation.	7
Enterprise Architecture and designing enterprise application Concept of architecture, views and viewpoints, enterprise architecture, logical architecture, technical architecture - design, different technical layers, best practices, data architecture and design – relational, XML, and other structured data representations, Infrastructure architecture and design elements - Networking, Internetworking, and Communication Protocols, IT Hardware and Software, Middleware, Policies for Infrastructure Management, Deployment Strategy, Documentation of application architecture and design.	8
SECTION-B	
Constructing enterprise application Construction readiness of enterprise applications - defining a construction plan, defining a package structure, setting up a configuration management plan, setting up a development environment, introduction to the concept of Software Construction Maps, construction of technical solutions layers, methodologies of code review, static code analysis, build and testing, dynamic code analysis – code profiling and code coverage.	12
Testing and rolling out enterprise application Types and methods of testing an enterprise application, testing levels and approaches, testing environments, integration testing, performance testing, penetration testing, usability testing, globalization testing and interface testing, user acceptance testing, rolling out an enterprise application.	10

Suggested Books	S. No.	Authors	Title	Publisher	Edition	Year	Other Details
	1.	Anubhav Pradhan, Satheesha B. Nanjappa, Senthil K. Nallasamy, Veerakumar Esakimuthu	Raising Enterprise Applications	Wiley India	First Edition	2012	
	2.	Brett McLaughlin	Building Java Enterprise Applications,	O' Reily Media	Latest Edition	2010	
	3.	Soren Lauesen	Software Requirements : Styles & Techniques.	Addison Wesley	Latest Edition	2012	
	4.	Brian Berenbach, Daniel J. Paulish, Juergen Kazmeier, Arnold Rudorfer	Software Systems Requirements Engineering: In Practice	McGraw-Hill/Osborne Media,	Latest Edition	2009	
	5.	Dean Leffingwell, Don Widrig	Managing Software Requirements : A Use Case Approach,	Pearson	First Edition	2003	
	6.	Vasudev Verma	Software Architecture: A Case Based Approach	Pearson	First Edition	2009	
	7.	Srinivasan Desikan, Gopalaswamy Ramesh	SOFTWARE TESTING Principles and Practices,	Pearson	First Edition	2006	

Course Assessment Methods	Assessment will consists of following components
	1. Two Minors (30% Weightage)
	2. Quiz (7.5%)
	3. Assignment (7.5%)
	4. Attendance (5%)
	5. Final Exam (50%)

Course Outcomes	On completion of this course, a student must be able to
	1. Understand fundamental of Enterprise applications and key determinants to measure the success.
	2. Demonstrate an understanding of different modelling techniques used to design Enterprise applications.
	3. Construct applications by understanding the design..
	4. Test and roll out the enterprise applications in real environment.

Branch: Computer Science and Engineering

Title	ADVANCE COMPUTER ARCHITECTURE		Credits	04
Code	CS 8109	Semester: - Ist	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	Computer Architecture and Organization		Contact Hours	45
			Time	3 Hours
Objectives	This course offers a good understanding of various functional units of a computer system and prepares the students to be in a position to design a basic computer system.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction to Parallel Computer Models: The State of Computing, Multiprocessors and Multicomputers, A Taxonomy of MIMD Computers, Multi-vector and SIMD Computers, Vector Supercomputers, SIMD Supercomputers, Parallel Random Access Machines	4
Program and Networks Properties: Conditions of Parallelism, Data and Resource Dependences, Hardware and Software Parallelism, The Role of Compilers, Program Partitioning and Scheduling: Grain Sizes and Latency, Grain Packing and Scheduling, Static Multiprocessor Scheduling, Program Flow Mechanisms: Control Flow Vs Data Flow, Demand-Driven Mechanism, Comparison of Flow Mechanisms, System Interconnect Architectures: Network Properties and Routing, Static Connection Networks, Dynamic Connection Networks.	6
Principles of Scalable Performance: Performance Metrics and Measures: Parallelism Profile in Programs, Harmonic Mean Performance, Efficiency, Utilization and Quality, Standard Performance Measures, Speedup Performance Laws: Amdahl's Law for a Fixed Workload, Gustafon's Law for Sealed Problems, Scalability Analysis and Approaches: Scalability Metrics and Goals	6
Processors and Memory Hierarchy: Advance Processor Technology: Instruction Set Architecture, CISC and RISC Scalar Processors, Superscalar and Vector Processors: Superscalar Processors, The VLIW Architecture, Memory Hierarchy Technology: Hierarchical Memory Technology, Inclusion, Coherence and Locality	6
SECTION-B	
Multiprocessors and Multicomputers: Multiprocessor System Interconnects: Hierarchical Bus system, Crossbar Switch and Multiport Memory, Multistage and Combining Networks, Cache Coherence and Synchronization Mechanisms:The Cache Coherence Problem, Snoopy Bus Protocol, Hardware Synchronization Mechanisms.	6
Multivector and SIMD Computers: Vector Processing Principles: Vector Instruction Types, Vector Access Memory Schemes, Multivector Multiprocessors: Performance- Directed Design rules,SIMD Computer Organization: Implementation Models, The CM-2 architecture.	5

Parallel Programming Environment: Software Tools and Environment, Synchronization and Multiprocessing Modes: Principles of Synchronization, Multiprocessor Execution Modes, Shared-Variable Program Structures, Locks for Protected Access, Semaphores and Applications, Monitors and Applications, Message-passing Program Development, Distributing the Computation, Synchronous Message Passing, Asynchronous Message Passing	6	
Suggested Books	1. Kai Hwang: Advanced Computer Architecture: Parallelism, Scalability, Programmability, Tata McGraw-Hill. 2. Michael J. Quinn: Parallel Computing – Theory and Practice, 2nd Edition, McGraw hill. 3. S.G. Akl : Design and Analysis of Parallel Algorithms, Prentice Hall. 4. S. Lakshmivarahan and S.K. Dhall: Analysis and Design of Parallel Algorithms - Arithmetic and Matrix Problems, McGraw Hill International Edition. 5. S.K. Ghosal : A Practical Approach to Parallel Computing, Universities Press (India) Limited	

Branch: Computer Science and Engineering

Title	PARALLEL AND DISTRIBUTED COMPUTING		Credits	04
Code	CS 8110	Semester: - 1st	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Software engineering, testing tools		Contact Hours	45
			Time	3 Hours
Objectives	The course tells about programming paradigms used in parallel computation, about the organization of parallel systems, and about the application of programs and systems to solve interesting problems.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction Basic issues and model Asynchrony, delay, failure concurrency, Communication topology, load balancing, scaling	5
Basic Approaches Agreement and consensus problems, transactions, Algorithms for reduction, scans (also non-parallel issues). Analysis: work/time complexity.	12

SECTION-B	
Shared Memory Models and primitives, PRAM, VRAM, semaphores, spin-locks, Barriers' implementations, NESL, Threads, distributed shared memory.	10
Parallel Architectures Survey of Architectures KSR, TMC, MasPar, workstation clusters	3
Algorithm Development and Analysis Parallel algorithms, Connected components (dense and sparse case), Sorting, distributed algorithms, Clock synchronization	12

Suggested Books	1. Kai, Hwang: Computer Architecture and parallel processing, Tata McGraw Hill Co. 2. F.T.Leighto: Introduction to Parallel Algorithms and Architectures: Arrays, Trees, 3. Hypercubes, Morgan Kaufinann Publishers, San Mateo, California Joseph JaJa: An Introduction to Parallel algorithms, Addison Wesley. 4. Patterson: Computer Architecture-Quantitative Analysis	

Branch: Computer Science and Engineering

Title	CLOUD COMPUTING			Credits	04
Code	CS8111	Semester: - 1st		L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50		Elective	Y
Pre-requisites	Business and financial skills,Java and. NET framework skills, understanding of security protocols			Contact Hours	45
				Time	3 Hours
Objectives	This course offers a good understanding of cloud computing concepts and prepares students to be in a position to design cloud based applications for distributed systems.				
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.				

SECTION-A	
Overview of Computing Paradigms Recent Trends in Computing: Distributed Computing, Cluster Computing, Grid Computing, Utility Computing, Cloud Computing; Evolution of Cloud Computing: Migrating into a Cloud.	5
Cloud Computing Basics Cloud Computing Overview; Characteristics; Applications; Benefits; Limitations; Challenges, SOA; Cloud Computing Service Models: Infrastructure as a Service; Platform as a Service; Software as a Service; Cloud Computing Deployment Models: Private Cloud; Public Cloud; Community Cloud; Hybrid Cloud, Major Cloud Service providers	6
Virtualization Concepts Overview of Virtualization Technologies, Types of Virtualization, Benefits of Virtualization, Hypervisors; VM Provisioning & Migration: VM Lifecycle, VM Provisioning Process, VM Migration Techniques.	6
Scheduling in Cloud Overview of Scheduling problem, Different types of scheduling, Scheduling for independent and dependent tasks, Static vs. Dynamic scheduling, Optimization techniques for scheduling.	5
SECTION-B	
Cloud Storage Overview; Storage as a Service, Benefits and Challenges, Storage Area Networks(SANs), Case Study of Amazon S3	5
Cloud Security Infrastructure Security: Network Level Security, Host Level Security and Application Level Security; Data Security: Data Security & Privacy Issues; Identity & Access Management; Legal Issues in Cloud Computing	6
Mobile Cloud Computing Overview of Mobile Cloud Computing, Advantages, Challenges, Using Smartphones with the Cloud, Offloading techniques - their pros and cons, Mobile Cloud Security.	6

SLA Management: Overview of SLA, Types of SLA, SLA Life Cycle, SLA Management Process	4
Case Study of Implementation tools/Simulators.	2

Suggested Books	1. Anthony T. Velte, Toby J. Velte, and Robert Elsenpeter: Cloud Computing: A Practical Approach, McGraw Hill, 2010. 2. Rajkumar Buyys, James Broberg, AndrzejGoscinski (Editors): Cloud Computing: Principles and Paradigms, Wiley, 2011 3. Barrie Sosinsky: Cloud Computing Bible, Wiley, 2011. 4. Judith Hurwitz, Robin Bloor, Marcia Kaufman,Fern Halper: Cloud Computing for Dummies, Wiley, 2010. 5. BorkoFurht, Armando Escalante (Editors): Handbook of Cloud Computing, Springer, 2010.
Course Outcomes	On completion of this course, a student must be able to 1. Learn recent trends in computing and core concepts of cloud computing paradigm, and implement your own cloud. 2. Understand SLA management in Cloud Computing 3. Understand and apply virtualization in the cloud computing system. 4. Understand scheduling of tasks in cloud and, design and implement scheduling algorithms for cloud. 5. Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS. 6. Understand various security issues in the cloud 7. Understand, design and implement various mobile offloading techniques in mobile cloud computing.

Branch: Computer Science and Engineering

Title	MODELING AND SIMULATION			Credits	04
Code	CS 8112	Semester: - 1st		L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50		Elective	Y
Pre-requisites	Discrete mathematics, basic idea of Matlab			Contact Hours	45
				Time	3 Hours
Objectives	This course should provide the students with good understanding of various techniques of Simulation. At the end of this course students will be having good knowledge of simulation concepts and simulation languages				
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.				

<table>
<tr><td colspan="2" align="center">SECTION-A</td></tr>
<tr><td>Introduction:
What is modeling and simulation. application areas, definition and types of system, model and simulation, introduction to discrete-event and continuous simulation.</td><td>2</td></tr>
<tr><td>Simulation Methods:
Discrete-event Simulation, Time advance Mechanisms, Components and organization of Discrete-event simulation, Flowchart of next-event time advance approach, Continuous Simulation, Random Number generation methods.</td><td>10</td></tr>
<tr><td>Queuing Models:
Single server queuing system, introduction to arrival and departure time, flowcharts for arrival and departure routine. Event graphs of queuing model. Determining the events and variables.</td><td>8</td></tr>
<tr><td colspan="2" align="center">SECTION-B</td></tr>
<tr><td>Distribution Functions:
Stochastic activities, Discrete probability functions, Cumulative distribution function, Continuous probability functions. Generation of random numbers following binomial distribution, poisson distribution, continuous distribution, normal distribution, exponential distribution, uniform distribution.</td><td>10</td></tr>
<tr><td>Programming in MATLAB:
Introduction, Branching statements, loops, functions, additional data types, plots, arrays, inputs/outputs etc.</td><td>7</td></tr>
<tr><td>Programming in GPSS and C/C++:
Basic Introduction to Special Simulation Languages:-GPSS and Implementation of Queuing Models using C/C++.</td><td>6</td></tr>
<tr><td>Introduction to Simulators:
Introduction regarding features and usage of any Network simulator.</td><td>2</td></tr>
</table>

Suggested Books	1. Averill M. Law and W. David Kelton: "Simulation Modeling and Analysis", Tata McGraw-Hill Publication. 2. Geoffery Gordon: "System Simulation", Prentice-Hall of India. 3. D.S. Hira: "System Simulation", S. Chand Publication. 4. Stephen J. Chapman: "MATLAB Programming for Engineers", Thomson learning inc. 5. Jerry Banks, John S. Carson, Barry L. Nelson and David M. Nicol: "Discrete-Event System Simulation", Prentice-Hall of India. 6. Rudra Pratap: "Getting Started with MATLAB 7", Oxford University Press.
Course Outcomes	1. Understand the continuous and discrete event simulation techniques and apply them suitably to different queuing models where experimentation on actual system is risky. 2. Analyzing different procedures to generate random numbers and apply them for implementation of different simulation systems in research work. 3. 3. Understand different simulation languages like MATLAB and GPSS and apply them to simulate different systems.

Branch: Computer Science and Engineering

Title	DIGITAL IMAGE PROCESSING		Credits	04
Code	CS 8201	Semester: - 2nd	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	Computer Graphics		Contact Hours	45
			Time	3 Hours
Objectives	To introduce the different low level and high level computer vision techniques. Students are also made aware about the different image processing techniques			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

<table>
<tr><td colspan="2" align="center">SECTION-A</td></tr>
<tr><td>Introduction to Image Processing:
Digital Image representation, Sampling & Quantization, Steps in image Processing, Image acquisition, color image representation.</td><td>6</td></tr>
<tr><td>Image Transformation, Filtering & Restoration:
Intensity transform functions, histogram processing, Spatial filtering, fourier transforms and its properties, frequency domain filters, Homomorphic Filtering, color models, Pseudo coloring, color transforms, Basics of Wavelet Transforms, Image Noise and Restorations, Inverse Filtering.</td><td>12</td></tr>
<tr><td>Image Compression:
Coding redundancy, Interpixel redundancy, Psychovisual redundancy, Huffman Coding, Arithmetic coding, Lossy compression techniques, JPEG Compression.</td><td>6</td></tr>
<tr><td colspan="2" align="center">SECTION-B</td></tr>
<tr><td>Image Morphological Processing:
Introduction to basic operation on binary and grayscale images: Dilation, Erosion, Opening & Closing, Morphological Algorithms: Boundary & Region Extraction, Convex Hull, Thinning, Thickening, Skeletons, Pruning.</td><td>6</td></tr>
<tr><td>Image Segmentation, Representation & Descriptions::
Point, Line and Edge Detection, Thresholding, Edge and Boundary linking, Hough transforms, Region Based Segmentation, Contour following, Boundary representations, Region Representations, shape properties, Boundary Descriptors, Regional Descriptors, Texture representations, Object Descriptions</td><td>6</td></tr>
<tr><td>Object Recognition:
Patterns and Patterns classes, Recognition based on Decision Theoretic methods , Structural Methods</td><td>9</td></tr>
</table>

Suggested Books	1. Gonzalez and Woods: Digital Image Processing ISDN 0-201-600-781, Addison Wesley 1992.
	2. Forsyth and Ponce: Computer Vision A Modern Approach Pearson Education Latest Edition.
	3. Pakhera Malay K: Digital Image Processing and Pattern Recognition, PHI.
	4. Trucco&Verri: Introductory Techniques for 3-D Computer Vision, Prentice Hall, Latest Edition.
	5. Jayaraman and Veerakumara: Digital Image Processing, McGraw Hill.
	6. Low: Introductory Computer Vision and Image Processing, McGraw-Hill 1991, ISBN 0-07-707403-3.
	7. Jain, Kasturi and Schunk: Machine Vision, McGraw-HiII. 1995 ISBN 0070320187.
	8. Sonka, Hlavac, Boyle : Image -Processing, Analysis and Machine Vision 2nd ed. ISBN 0-534-95393-X, PWS Publishing,1999

Branch: Computer Science and Engineering

Title	RESEARCH METHODOLOGY		Credits	04
Code	CS 8202	Semester: - 2nd	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	Mathematics		Contact Hours	45
			Time	3 Hours
Objectives	To make students familiar with various methodologies of research.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Defining Research and Literature Review Need and Significance of Research, Research Process, Different Methods of Research, Different approaches to literature survey, difference between survey and review, Locating and selecting a research problem, Defining a problem statement, formulation of objectives, Retrieving literature from libraries (Online and Offline)	7
Research Design and Methodology Concept of research design, Concept of population and sample, Selection of sample size, Different types of Sampling, Methods of data collection, Concept of data measurement: Nominal, Ordinal, Interval and Ratio, Ethical issues related to data collection, Various Research Data Repositories	5
Statistical Methods of Analysis Descriptive Statistics:Mean, Median, Mode, Range, Standard Deviation, regression and correlation analysis. Inferential Statistics: Estimation of parameters, Hypothesis, Types of Hypothesis, Testing of Hypothesis, Test of Normality, Introduction to Parametric and Non Parametric tests, Test of significance: t-test, chi square test, ANOVA(1-way, 2-way), Repeated Measures ANOVA, ANCOVA, α-correction.	10

SECTION-B	
Introduction to Statistical software SPSS/Minitab/MsExcel with hands on practical session on concepts detailed in section A3.	5
Procedure for writing a research proposal and research report Purpose , types and Components of research reports, layout of report, Ethical issues related to publishing, plagiarism and self-plagiarism, Introduction to ArXive , BioarXive, Overleaf and Research Gate: Uses and Benefits.	8
Introduction of Software Hands on practical session on software useful fortechnical report writing such as MS-Word/ Open-Office (reference Management, formatting, Tracking changes, Handling Images and tables layout etc.), Google Docs, Writing document in Latex, Introduction to Mendeley. Graphical presentation of results in different types of graphs and plots.	10

Suggested Books	1. Kothari C.K. (2004) , Research Methodology-Methods and Techniques (New Age International , NewDelhi)2nd Ed. 2. Panneerselvam R., Research Methodology, PHI, 2nd Edition 3. N. Gurumani. Scientific Thesis writing and Paper Presentation. MJP Publishers

Course Outcomes	On completion of the course, the students will be able to 1. Understand the concept of research, identify research problems and learn the basics of literature review. 2. Interpret a good research design and learn the different types of sampling procedures. 3. Write research reports and publications that follow research ethics and standards. 4. Distinguish between data and their methods of measurement and collection. 5. Apply the knowledge of statistical methods of research in their field of study using different statistical softwares.

Branch: Computer Science and Engineering

Title	SOFT COMPUTING		Credits	04
Code	CS8203	Semester: - 2nd	L T P	4 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Artificial intelligence		Contact Hours	45
			Time	3 Hours
Objectives	1.To familiarize with soft computing concepts. 2.To introduce the ideas of Neural networks in applications and research oriented way. 3.To introduce the concepts of Fuzzy logic, Genetic algorithm and their applications to soft computing.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			
SECTION-A				
Introduction: Artificial Intelligence, Artificial Neural Networks, Fuzzy Systems, Genetic Algorithms, Swarm Intelligence Systems, Expert Systems			3	
Artificial Neural Networks: Classification of ANNs, McCullah Pitts Neuron, Learning Rules, Perceptron, Adaline and Madaline networks, Backpropagation Neural Networks, Kohnen Neural Network, Learning Vector Quantization, Hopfield Neural Networks, Bi-directional Associative Memory.			19	
SECTION-B				
Artificial Neural Networks: Boltzman Machines Neural Networks, Radial Bias Function Neural Networks, ART.			5	
Probabilistic reasoning and Fuzzy Logic: Knowledge representation under uncertainty, Probabilistic reasoning, Bayesian theorem, Bayesian networks, membership functions, fuzzy sets, set operations, fuzzy relations, fuzzy composition, fuzzy interpretation, defuzzification, fuzzy inference system, fuzzy logic applications, neuro-fuzzy systems.			12	
Genetic Algorithms: Evolutionary computation. Survival of the Fittest, Fitness Computations, Cross over, Mutation, Reproduction - Rank method - Rank space method etc., solving travelling salesperson problem using GA.			6	

Suggested Books	1. Stuart J.Russel, Norvig: AI: A Modern Approach, Pearson Education, Latest Edition. 2. Michael Negnevitsky: Artificial Intelligence: A Guide to Intelligent Systems, 2/E, Addison-Wesley, 2005 3. James Freeman A. and David Skapura M: Neural Networks - Algorithms, Applications & ProgrammingTechniques Addison Wesley, 1992. 4. Yegnanarayana B: Artificial Neural Networks, Prentice Hall of India Private Ltd., New Delhi, 1999 5. Hagan, M.T., Demuth, Mark Beale: Neural Network Design By Cengage Learning 6. Goldberg, David E.: Genetic algorithms in search, optimization and machine learning, Latest Edition, Addison Wesley
Course Outcomes	On completion of the course, a student must be able to 1. Illustrate different processes carried out in Bayesian Networks, Fuzzy Logic, Artificial Neural Networks and Genetic Algorithms. 2. Apply Soft computing techniques to solve character recognition, pattern classification, regression and similar research problems. 3. Find solutions for real world problems using soft computing. 4. Evaluate various techniques of soft computing to defend the best working solutions and to design hybrid systems.

Branch: Computer Science and Engineering

Title	SOFTWARE LAB-II		Credits	03
Code	CS 8250	Semester: - 2nd	L T P	0 0 6
Max. Marks	100	Internal: - 100	Elective	N
Pre-requisites	Software testing skills and some testing techniques			
			Time	6 Hours

Branch: Computer Science and Engineering

Title	DATA WAREHOUSING AND MINING		Credits	3
Code	CS 8204	**Semester:** - 2nd	**L T P**	3 0 0
Max. Marks	External: 50	Internal: 50	Elective	Y
Pre-requisites	Database Systems (CS 302), Artificial Intelligence (CS 503)		Contact Hours	45
			Time	3 Hours
Objectives	To learn various data mining techniques and different ways to analyze different data sets.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	Hrs
Introduction: Introduction to RDBMS, Data Warehouse, Transactional Databases, Data Mining Functionalities, Interestingness of pattern, classification of data mining system, major issues	6
Data Warehouse and OLAP: Difference from traditional databases, Multidimensional data model, Schema for Multi dimensional model, measures, concept hierarchies, OLAP operations, starnet query model, Data Warehouse architecture, ROLAP, MOLAP, HOLAP, Data Warehouse Implementation, Data Cube, Metadata Repositories, OLAM	6
Data Processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and concept hierarchy generation	2
Data Mining Architecture: Data Mining primitives, Task relevant data, interestingness measures, presentation and visualization of patterns, Data Mining Architecture, Concept Description, Data Generalization and Summarization, Attributed oriented induction, Analytical characterization, Mining class comparisons	6
SECTION-B	
Association Rules: Association rules mining, Mining Association rules from single level, multilevel transaction databases, multi dimensional relational databases and data warehouses, Correlational analysis, Constraint based association mining	6
Classification and Clustering: Classification and prediction, Decision tree induction, Bayesian classification, k-nearest neighbor classification, Cluster analysis, Types of data in clustering, categorization of clustering methods	6
Introduction of Mining Complex Data: Complex data objects, Mining spatial databases, Multimedia databases, Time Series and sequence databases, Text databases and World Wide Web	7

Suggested Books	S. No.	Authors	Title	Publisher	Edition	Year	Other Details
	1.	J.Han and M. Kamber	Data Mining: Concepts and Techniques	Morgan Kaufman publishers	Latest Edition		Harcourt India pvt. Ltd
	2.	Dunham	Data Mining Introductory and Advance Topics	Pearson Education	Latest Edition		

Course Assessment Methods	Assessment will consists of following components 1. Two Minors (30% Weightage) 2. Quiz (7.5%) 3. Assignment (7.5%) 4. Attendance (5%) 5. Final Exam (50%)
Course Outcomes	On completion of the course, students will be able to 1. Understand different ways to manage the large data set using data warehousing techniques. 2. Analyze various multi dimensional techniques to represent data for effective retrieval. 3. Identify different data analysis techniques like frequent pattern analysis, classification and clustering 4. Demonstrate the use of various data mining techniques on different datasets.

Branch: Computer Science and Engineering

Title	MACHINE LEARNING			Credits	3
Code	CS 8205	**Semester:** - 2nd		**L T P**	3 0 0
Max. Marks	**External:** 50	**Internal:** 50		**Elective**	Y
Pre-requisites	**Database Systems (CS 302), Artificial Intelligence (CS 503)**			**Contact Hours**	45
				Time	3 Hours
Objectives	To learn various machine learning techniques and different ways to analyze different patterns.				
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.				

SECTION-A	Hrs
Introduction to Linear Regression Model and Cost Function, Parameter Learning, Linear Regression with one variable, Multivariate Linear Regression, Computing Parameters analytically	8
Supervised Learning: Classification and Representation, Logistic Regression Model, Multiclass Classification, Solving the Problem of Overfitting, Regularization, Support Vector Machines, Large Margin Classification, Kernels, SVMs in Practice	10
Machine learning System Design: Evaluating a Learning Algorithm, Bias vs. Variance, Building a Spam Classifier, Handling Skewed Data Using Large Data Sets	7
SECTION-B	
Unsupervised Learning: Clustering, Types of data, Dimensionality reduction, Principle Component Analysis, Applying PCA, Different types of clustering, Hierarchical clustering, DBSCAN, EM Algorithm	10
Anomaly Detection & Recommender Systems: Density Estimation, Building an Anomaly Detection System, Multivariate Gaussian Distribution, Predicting Movie Ratings, Collaborative Filtering, Low Rank Matrix Factorization	10

Suggested Books							
	S. No.	**Authors**	**Title**	**Publisher**	**Edition**	**Year**	**Other Details**
	1.	Ethem Alpaydin	Introduction to Machine Leaening	PHI	Latest Edition		
	2.	Christopher M. Bishop	Pattern Recognition & Machine Learning	Springer	Latest Edition		

Course Assessment Methods	Assessment will consists of following components 1. Two Minors (30% Weightage) 2. Quiz (7.5%) 3. Assignment (7.5%) 4. Attendance (5%) 5. Final Exam (50%)

Course Outcomes	Students will be able to 1. Understand basic regression mechanism and defining cost functions 2. Analyze various supervised learning techniques and implementing machine learning system design 3. Identify different data analysis techniques like frequent pattern analysis, classification and clustering 4. Demonstrate the use of various machine learning techniques on different application datasets.

Branch: Computer Science and Engineering

Title	DATA ACQUISITION AND HARDWARE INTERFACING		Credits	03
Code	CS 8206	Semester: - 2nd	L T P	3 0 0
Max. Marks	External: - 50	Internal: 50	Elective	Y
Pre-requisites			Contact Hours	45
			Time	3 Hours
Objectives	This course will introduce various data acquisition systems and techniques and their application using different hardware interfacing mechanisms.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	Hrs
Signal conditioning and data acquisition: Analog-to-digital and digital-to-analog converters; sampling rate, multiplexing, resolution, range, and code width; grounding, isolation and noise; single-ended and differential measurements; attenuation, amplification, and filtering; excitation and linearization; impedance mismatch and loading; digital signal conditioning; signal transmission (voltage vs. current loop); and hardware architecture of a modern multi-function data acquisition card. Various DAS Configurations, Single Channel DAS, Multi-Channel DAS, IC Based DAS, Data Acquisition, Data Acquisition in PLC	9
Fundamentals of programming logic: Labview: Virtual instruments; indicators and controls; front panel and block diagram; data types and data flow programming; case and sequence structures; arrays, loops, and clusters; graphs and charts; sub VIs; and file I/O.	12
SECTION-B	
Instrument control: Components of an instrument control system (GPIB and RS-232); detecting and configuring instruments; and instrument drivers.	6
Instrumentation system design: Design specifications; functional block representation; design, debugging, and testing; interpretation and presentation of data; user interface; temperature control system design; motor speed control system design; and instrumentation project incorporating multiple sensors, signal interfacing electronics, data-acquisition hardware, instrument control	6
Buses – Industry standard architecture (ISA), peripheral component Interconnect (PCI) – Instrumentation Buses: Serial (RS232C, USB) and Parallel (GPIB) Accelerated Graphics port (AGP) – plug-and-play devices – SCSI concepts – USB architecture.	4
Project Work: Using Labview: Generation of signal (different function generators) on PC and acquiring the signal from sensor at PC again with different sampling rate and quantization level. Representations of different characteristics of acquired signals and their analysis and reporting.	8

Suggested Books	1. Rangan C. S., Sarma G. R. and Mani V. S. V., "Instrumentation Devices And Systems", Tata McGraw-Hill. 2. Helfrick Albert D. and Cooper W. D., "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall India. **References** 1. A. J. Bouvens, "Digital Instrumentation", McGraw-Hill. 2. Johnson Curtis D., "Process Control Instrumentation Technology", Prentice Hall. 3. Shawhney A. K. "A Course In Electrical And Electronics Measurements And Instrumentation", Dhanpat Rai & Sons. 4. Data acquisition technique using personal computers by Howard Austurlitz.

Course Assessment Methods	Assessment will consists of following components
	   1. Two Minors (30% Weightage)
	   2. Quiz (7.5%)
	   3. Assignment (7.5%)
	   4. Attendance (5%)
	   5. Final Exam (50%)

Course Outcomes	On completion of this course, a student must be able to
	   1. Understand the principles of operation and limitations of the data acquisition system (single and Multiple channels).
	   2. Use Labview for analysing and generating reports of various acquired signals.
	   3. Use different interface mechanism of devices for communication

Branch: Computer Science and Engineering

Title	NETWORK SECURITY		Credits	03
Code	CS 8207	Semester: - 2nd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Computer Networks		Contact Hours	45
			Time	3 Hours
Objectives	Upon completion of this course, participants will have gained knowledge of information security concepts and the following: • Understanding of Information Security (InfoSec) principles and approaches • Understanding of the basic components of InfoSec • Understanding of basic InfoSec applications • Ability to remain current with InfoSec literature • Ability to progress to independent work in the field			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction Security attacks, Security Services, Security Mechanisms, Network security model, DoS and DDoS attacks.	3
Symmetric Key Cryptography Introduction, Substitution Techniques: Caesar Cipher, Monoalphabetic, Playfair, Hill Cipher, Polyalphabetic, Vernam Cipher; Transposition techniques: Railfence; Data Encryption Standard (DES), Triple DES; Block cipher modes of operation: ECB, CBC, CFB, OFB, CTR; Advanced Encryption Standard; Stream cipher structure and RC4 algorithm; Symmetric key distribution	10
Asymmetric Key Cryptography Introduction, Fermat's and Euler's theorems; Principles of public key cryptosystems, RSA algorithm, Distribution of public keys, Diffie-Hellman key exchange.	8
Message Authentication Authentication requirements and functions, Message Authentication Code, Hash functions, Hash and MAC algorithms: MD5, SHA-1 and HMAC.	4
SECTION-B	
Digital Signatures Digital Signatures, Authentication protocols, Digital Signature Standard	4
Web Security Web Security Threats, Web Traffic Security Approaches, Secure Socket Layer, HTTPS, Transport Layer Security	4

IP Security Architecture, Authentication Header, Encapsulating, Security, Payload, Security associations, Key Management.		5
Firewalls Design Principles, Characteristics, types of firewalls, firewall configuration: configuring NAT and PAT, High availability features.		3
IDS & IPS Intruders, Intrusion Detection techniques, Deploying IPS in campus network, IPS in inline mode, IPS in promiscuous mode, Signature database in IPS.		4

Suggested Books	1. Stallings, Willam: Cryptography and Network Security-Principles and Practices, 4th edition. Pearson Education, PHI. 2. Kahate, Atul: Cryptography and Network Security, 2nd Edition, TMH 3. Forouzan, B.A.: Cryptography and Network Security, McGraw-Hill.
Course Outcomes	On completion of this course, a student must be able to 1. Identify network security threats and determine action to counter them. 2. Analyze DoS and DDoS attacks. 3. Write code for: substitution ciphers, transposition ciphers, symmetric and asymmetri cryptographic algorithms, hash functions, digital signature generation. 4. Determine firewall requirements and selection of a firewall as per need. 5. Send and receive electronic payment securely. 6. Identify appropriate cryptography scheme(s) & security mechanism for different computing environment and information systems 7. Analyze the security of different computer systems & networks 8. Develop a critical mind for evaluating the security of computer systems & networks 9. Identify/ Prevent various intrusions possible within a network. 10. Case Study of Network Packet Analysis and Session reconstruction using Pcap files

Branch: Computer Science and Engineering

Title	MULTIMEDIA COMPUTING AND COMMUNICATIONS		Credits	03
Code	CS 8208	Semester: - 2nd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	N
Pre-requisites	Database management systems, Advanced database systems		Contact Hours	45
			Time	3 Hours
Objectives	This course offers a good understanding of different multimedia computing and communication techniques			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction: Multimedia and its types, Introduction to Hypermedia, Hyper Text, Multimedia Systems and their Characteristics, Challenges, Desirable Features, Components and Applications, Trends in Multimedia	6
Multimedia Technology: Multimedia Systems Technology , Multimedia Hardware devices, Multimedia software development tools, Multimedia Authoring Tools, Multimedia Standards for Document Architecture, SGML, ODA, Multimedia Standards for Document interchange, MHEG, Multimedia Software for different media.	6
Storage Media : Magnetic and Optical Media, RAID and its levels, Compact Disc and its standards, DVD and its standards, Multimedia Servers	4
Audio: Basics of Digital Audio, Application of Digital Audio, Digitization of Sound, Sample Rates and Bit Size, Nyquist's Sampling Theorem Typical Audio Formats Delivering Audio over a Network , Introduction to MIDI (Musical Instrument Digital Interface), Components of a MIDI System Hardware Aspects of MIDI ,MIDI Messages	6
SECTION-B	
Image,Graphics and Video: Graphic/Image File Formats, Graphic/Image Data, Colour in Image and Video, Colour Image and Video Representations, Basics of Video ,Types of Colour Video Signals, Analog Video, Digital Video, TV standards	6
Video and Audio Compression : Classifying Compression Algorithms, Lossless Compression Algorithms, Entropy Encoding, Run-length Encoding, Pattern Substitution, Basics of Information theory, Huffman Coding, Huffman Coding of Images, Adaptive Huffman Coding, Arithmetic Coding, Lempel-Ziv-Welch (LZW) Algorithm, Source Coding Techniques , Transform Coding, Frequency Domain Methods, Differential Encoding, Vector Quantisation, JPEG Compression, Video Compression, H. 261 Compression, Intra Frame Coding, Inter-frame (P-frame) Coding, MPEG Compression, MPEG Video, The MPEG Video Bitstream , Decoding MPEG Video in Software , Audio Compression, Simple Audio Compression Methods, Psychoacoustics ,MPEG Audio Compression	10
Multimedia Communication: Building Communication network, Application Subsystem, Transport Subsystem, QOS, Resource Management, Distributed Multimedia Systems	7

Suggested Books	1. Multimedia Computing Communications and Applications By Ralf Steinmetz amd Klara Nahrstedt, Pearson Education, Latest Edition **Reference Books:** 1. Multimedia System Design By Prabhat K. Andleigh, Kran Thakkar, PHI, Latest Edition 2. Multimedia Computing By Li, Drew, Pearson Education, Latets Edition 3. Multimedia Communications By Fred Halsall, Pearson Education, Latest Edition
Course Outcomes	On completion of the course, students will be able to 1. Understand Multimedia systems, their characteristics and technology. 2. Familiarize with storage media, audio and video basics in multimedia computing. 3. Demonstrate an understanding of video and audio compression techniques. 4. Design a multimedia communication system.

Branch: Computer Science and Engineering

Title	WIRELESS NETWORKS		Credits	03
Code	CS8209	Semester: - 2nd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	CCNA routing and switching		Contact Hours	45
			Time	3 Hours
Objectives	This challenging and comprehensive course provides a broad perspective on the wireless networks.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Overview of wireless networks Introduction to wireless communication, architecture of wireless networks – 802.11, 2G, 3G, WLL, Wireless ATM, 802.16 and 802.20.	6
Global System for Mobile Communication (GSM) Evolution, mobile service, system architecture, radio interface, protocols, handover and security.	5
Introduction to GPRS, EDGE and CDMA2000 technologies and architectures.	4
WiMAX Networks Uses, architecture, MAC layer, physical layer, spectrum allocation issues, comparison with WiFi and limitations.	5
SECTION-B	
Mobile Ad hoc Networks (MANETs) Introduction to Ad hoc wireless networks and sensor networks, applications of Ad hoc networks, Power management.	4
Media Access Control Protocols in Ad-hoc Issues in designing MAC protocols, deign goals and classifications of MAC protocols	4
Transport layer issues in Ad-hoc networks Design goals of transport layer protocols, classification of transport layer solutions and TCP over Ad hoc wireless networks.	4
QoS and Security issues in MANETs Network security requirements, issues and challenges in security and QoS provisioning, classifications of QoS solutions.	4
Routing Protocols Issues in designing protocols, classifications of routing protocols, operation of multicast routing protocols.	5
Introduction to simulators:-NS2 and Qualnet.	4

Suggested Books	1. William Stallings: Wireless Communication and Networks, Prentice Hall. 2. C. Siva Ram Murthy and B. S Manoj: Adhoc Wireless Networks – Architecture and Protocols, Prentice Hall. 3. C. Demorais and D. P Aggarwal: Adhoc Networks – Theory and Applications, World Scientific Publications 4. Jochen Schiller: Mobile Communication, Pearson Education.

Branch: Computer Science and Engineering

Title	TELECOMMUNICATION TECHNOLOGIES		Credits	03
Code	CS 8210	Semester: - 2nd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Computer Networks		Contact Hours	45
			Time	3 Hours
Objectives	- To learn about fundamentals of telecommunication, traffic analysis etc. - To explore VoIP and unified communication. - To learn role of open source technology in telecommunication.			
Note for Examiner	The semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having 3 questions each and the candidate is required to attempt at least 2 questions from each part.			

SECTION-A	
INTRODUCTION: Introduction to telecomm technologies- 3G mobile networks: standardization, UMTS, WCDMA, TDCDMA, cdma2000, 3G mobile applications and services-real time services, non-real time services, All IP mobile networks, Communication channels, Unified Communication Environment.	9
Voice over IP: Introduction, Economics of VoIP, VoIP and OSI model comparison, H.323 vs. SIP, RSVP, RTP & RTCP, IP services, Next Generation networks: its architecture, IP multimedia sub system, multi service intelligent edge, MPLS architecture.	8
Open source in telephony: Introduction to Ubuntu/Cent OS/Debian, methods of switching and its uses, Soft Switch: Free Switch, Asterisk, YATE etc.	7

SECTION-B	
Traffic Analysis and Management: QoS provisioning in the Internet, Integrated services, differentiated services, Introduction of mobility to the Internet, QoS Parameters: Time, Jitter, Delay, etc. Teletraffic theory: Birth–Death process, Multidimensional Erlang Formula, priority queuing, Error control impact on traffic, modeling of wireless network and Principles of dimension.	8
Security: Security Services, Data protection, Trust services, SSL/TLS/SSH etc.	5
Standards: Understanding and Compliance of IETF RFCs – 3261, 3262, 3263, 3389, 2327, 3265, 2326 and 3711.	8
Suggested Books	- Telecommunication Essentials, Lillian Goleniewski, Pearson Publisher - Traffic Analysis and Design of Wireless IP Networks, Toni Janevski, Artech House Publisher - www.rfc-editor.org - www.freeswitch.com - www.asterisk.org - www.yate.ro

Course Outcomes	On completion of the course, students will be able to
	1. Understand the architecture and techniques behind the practical implementations of 3G (Third Generation) technologies.
	2. Apply the concepts of VOIP to design IP based PBX systems.
	3. Examine the QoS parameters of IP based telecommunication services for analysis and management of Tele-traffic.
	4. Analyse the security, privacy and trust issues of IP based telecommunication services.
	5. Evaluate the compliance of telecommunication systems against RFCs.

Branch: Computer Science and Engineering

Title	NATURAL LANGUAGE PROCESSING		Credits	03
Code	CS 8301	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	first-order predicate logic, Grammars, languages for the parsing		Contact Hours	45
			Time	3 Hours
Objectives	This course is designed to introduce students to the fundamental concepts and ideas in natural language processing (NLP), and to get them up to speed with current research in the area.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction to NLP: Introduction and Survey of applications, Levels of linguistic processing: morphology, syntax, semantics, Tokenization, Stemming, N-grams Modeling	4
Language processors and Understanding: recognizers, transducers, parsers, generators, Language as a rule-based system, Language understanding as an inferential activity.	10
Resources for NLP: Introduction to lexicons and knowledge bases.	2
Computational morphology lemmatization, Part-of-Speech Tagging, Finite-State Analysis, noun phrase chunking.	5
SECTION-B	
Syntactic Processing: Basic parsing: Top Down and Bottom Up parsing, Chart parsing, Deterministic parsing, Statistical parsing, Grammars with features, Unification Grammars, The Lexicon	6
Semantic Interpretation: Lexical semantics, Semantics and logical form, Resolving ambiguities: Word Sense Disambiguation, Linking syntax and semantics, Linking syntax and semantics in restricted domains	6
Context and World Knowledge: Discourse: linguistic context, Ellipsis; World knowledge, Discourse structure Conversation and co-operation, Implementing "co-operative responses", Information Retrieval and Information Extraction.	6
NLP concepts: named entity recognition, coreference resolution, question answering, text classification, document clustering, text summarization, machine translation, Basics of Machine Learning.	6

Suggested Books	1. Allen, J.: Natural language understanding, 2nd Edition, Redwood City, CA: 1994. Benjamin/Cummings. 2. Covington, M.A: Natural Language Processing for Prolog. Programmers, (1994), Prentice Hall 3. Jurafsky, D. and Martin: Speech and Language Processing, (2000), Prentice Hall 4. Gazdar, G. &Mellish, C.: Natural Language Processing in Prolog: An Introduction to Computational Linguistics,(1989), Addison Wesley
Course Outcomes	1. Students will gain understanding of linguistic phenomena and will explore the linguistic features relevant to each NLP task. 2. Students will develop understanding in syntactic and semantic processing of text. 3. Students will be familiar with different NLP Concepts and Resources for doing research in NLP.

Branch: Computer Science and Engineering

Title	MACHINE VISION			Credits	03
Code	CSE 8302		Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50		Internal: - 50	Elective	Y
Pre-requisites	Mathematics, Physical Science, digital imaging and digital image processing.			Contact Hours	45
				Time	3 Hours
Objectives	To introduce the different low level and high level computer vision techniques. Students are also made aware about the different pattern recognition approaches.				
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.				

SECTION-A	
Introduction Camera Models, & Views, basics of image processing, introductions to image segmentation and representation.	6
Early Vision Vision goals, Linear Filters , Edge Detection, Texture, The Geometry of Multiple Views, Stereopsis, Affine Structure from Motion, Projective Structure from Motion.	8

SECTION-B	
High-level Vision: Geometric Methods Model-Based Vision, Smooth Surfaces and their Outlines, Aspect Graphs, Range Data	7
High-level Vision: Probabilistic and Inferential Methods Finding Templates using Classifiers, Recognition by Relations between Templates, Geometric Templates from Spatial Relations	8
Applications Digital Libraries, Image Rendering, Medical applications, Human activity recognition, Face Recognition	8

Suggested Books	
	1. Forsyth and Ponce: Computer Vision A Modern ApproachPearson Education Latest Edition 2. Trucco&Verri: Introductory Techniques for 3-D Computer Vision, Prentice Hall, Latest Edition 3. Low: Introductory Computer Vision and Image Processing, McGraw-Hill 1991, ISBN 0-07-707403-3 4. Jain, Kasturi and Schunk: Machine Vision, McGraw-HiII. 1995 ISBN 0070320187. 5. Sonka, Hlavac, Boyle: Image -Processing, Analysis and Machine Vision 2nd ed. ISBN 0-534-95393-X, PWS Publishing,1999

Title	OPEN SOURCE SOFTWARE		Credits	03
Code	CS8303	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Basic idea of Operating System		Contact Hours	45
			Time	3 Hours
Objectives	This course should provide the students with a fairly good knowledge and understanding of Open Source Software. After completion of this subject students should be able to use copyright free Open Source Software (OSS) products in research and collaborate in enhancement of these OSS products.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction Open Source origins, Differences among Open Source, freeware, proprietary and other software. Principle & Techniques of Open Source Development, Issues in Open Source Software Development.	5
Legal issues Copyright and IPR, Open Source Licenses, Open Standards	4
Open Source Operating Systems Linux's History and flavors, Installation of Linux: File system of linux, Network & packages Configuration, LILO, GRUB, Linux's fdisk. Overview of Linux structure, general purpose Linux commands; working with editor. Introduction to Open Office, Introduction to c/c++ programming in linux environment, shell programmingand Python Programming	12
SECTION-B	
Internet - The technology Open standards. W3C Protocols. Role of XML in Open Source Software Development.	4
Open Source Web Development Tools PHP syntax (variables, control structures, functions), File Handling: Uploading files. Using PHP to open, read, write and close external files and manipulate data. Security: Avoiding security pitfalls by careful coding.	10
Case Studies related to successful implementation of open source software.	3
Suggested Books	1. Elizabeth Naramore, Jason Gerner, Yann Le Scouarnec, Jeremy Stolz, Michael K. Glass: Beginning PHP5, Apache, MySQL Web Development, Wiley Publishing Inc. 2. Graham Glass, King Ablas: Unix for Programmers and Users, Pearson Education 3. Wesley J chun, . Core Python Programming Pearson Education 4. http://spoken-tutorial.org/ 5. www.opensource.org 6. www.w3.org

Course Outcomes	On completion of this course, a student must be able to 1. Understand fundamentals and essentials of Open Source Software 2. Understand the basic concepts of processes, programs and the components of an Open Source Operating System 3. Understand state-of-the-art and Comparison of Open Source with Closed Source 4. Demonstrate knowledge of Open Source and to develop Applications in PhP and Python

Title	INFORMATION RETRIEVAL		Credits	03
Code	CS 8304	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	efficient text indexing, link-based algorithms, and Web metadata		Contact Hours	45
			Time	3 Hours
Objectives	This subject will provide the knowledge of various concepts involved in efficient information retrieval that leads to the development of efficient Web crawling techniques.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A

Introduction Introduction to Information Retrieval. Inverted indices and boolean queries. Query optimization. The nature of unstructured and semi-structured text.	5
The term vocabulary and postings lists Text encoding: tokenization, stemming, lemmatization, stop words, phrases. Optimizing indices with skip lists. Proximity and phrase queries. Positional indices.	5
Dictionaries and tolerant retrieval Dictionary data structures. Wild-card queries, permuterm indices, n-gram indices. Spelling correction and synonyms: edit distance, soundex, language detection.	6
Index construction Postings size estimation, sort-based indexing, dynamic indexing, positional indexes, n-gram indexes, distributed indexing, real-world issues.	5

SECTION-B

Scoring Term weighting and the vector space model. Parametric or fielded search. Document zones. The vector space retrieval model. weighting. The cosine measure. Scoring documents.	6
Computing scores in a complete search system Components of an IR system. Efficient vector space scoring. Nearest neighbor techniques, reduced dimensionality approximations, random projection.	6
Classification Naive Bayes models. Spam filtering, K Nearest Neighbors, Decision Trees, Support vector machine classifiers.	6
Web Crawling What makes the web different? Web search overview, web structure, the user, paid placement, search engine optimization. Web size measurement, Crawling and web indexes. Near-duplicate detection, Link analysis, Learning to rank, focused web crawler and its different architectures.	6
Suggested Books	1. C. Manning, P. Raghavan, and H. Schütze: *Introduction to Information Retrieval*, CambridgeUniversity Press,2008 2. R. Baeza-Yates, B. Ribeiro-Neto: *Modern Information Retrieval,* Addison-Wesley, 1999

Branch: Computer Science and Engineering

Title	CYBER LAWS AND IPR		Credits	03
Code	CS 8305	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: 50	Elective	N
Pre-requisites	-		Contact Hours	45
			Time	3 Hours
Objectives	To introduce the concepts related to cyberspace, cyber law, E-commerce, IPR and IT Act.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	Hrs
Basics of Computer & Internet Technology Internet, ISP & domain name; Network Security; Encryption Techniques and Algorithms; Digital Signatures.	8
Introduction to Cyber World Introduction to Cyberspace and Cyber Law; Different Components of cyber Laws; Cyber Law and Netizens.	2
E-Commerce Introduction to E-Commerce; Different E-Commerce Models; E-Commerce Trends and Prospects; E-Commerce and Taxation; Legal Aspects of E-Commerce.	7

SECTION-B	
Intellectual Property Rights IPR Regime in the Digital Society; Copyright and Patents; International Treaties and Conventions; Business Software Patents; Domain Name Disputes and Resolution.	12
IT Act, 2000 Aims and Objectives; Overview of the Act; Jurisdiction; Role of Certifying Authority; Regulators under IT Act; Cyber Crimes-Offences and Contraventions; Grey Areas of IT Act.	12
Project Work Candidates will be required to work on a project. At the end of the course studentswill make a presentation and submit the project report.	4

Suggested Books	S. No.	Authors	Title	Publisher	Edition	Year	Other Details
	1.	NandanKamath	A Guide to Cyber Laws & IT Act 2000 with Rules & Notification	Galgotia Publications			
	2	Keith Merill& DeeptiChopra	Cyber Cops, Cyber Criminals& Internet	(IK Inter.)			
	3	Diane Row Land	Information Technology La	TATA McGraw Hill			
	4	Vakul Sharma	Handbook of Cyber Law	(McMillian)			

Course Outcomes	On completion of the course, students will be able to
	1. Understand the basic concepts of Computer and Internet technology. 2. Familiarize with different cyber laws in literature and E-commerce. 3. Demonstrate an understanding of IPR and IT Act. 4. Design and implement a related project.

Branch: Computer Science and Engineering

Title	BUSINESS PROCESS RE-ENGINEERING		Credits	03
Code	CS 8306	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Market strategy, latest trends in market		Contact Hours	45
			Time	3 Hours

Objectives	Upon completion of this course, students should be able: • To use information technology (IT) for redesigning business processes and organizations • To understand the assumptions embedded in changing business with IT • To evaluate problems in the planning and implementation of organizational change • To assess the relationship of process reengineering to other initiatives to improve the performance of organizations • To evaluate a variety of approaches to using IT to improve organizations • To understand the behavioral and political issues surrounding the use of IT in organizational change.
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.

<table>
<tr><td colspan="2" align="center">SECTION-A</td></tr>
<tr><td>Introduction:
Definition of Business Process Reengineering</td><td>5</td></tr>
<tr><td>Implementation of Business Process Reengineering
Development of Process Objectives, Identification of Processes to be reengineered, Measurement of existing Processes, Utilization of Information Technology, Design and Evaluation of Process Prototypes</td><td>10</td></tr>
<tr><td>The Reengineering Structure
The Business Process Reengineering Leader, The Process Owner, The Reengineering Teams, Other Employees involved</td><td>10</td></tr>
<tr><td colspan="2" align="center">SECTION-B</td></tr>
<tr><td>Change Management as an Enabler of Business Process Reengineering
Why Change Management?, Nature of Change, Process of Change, Roles of Change, Resistance to Change, Commitment to Change ,Culture and Change, Resilience and Change</td><td>10</td></tr>
<tr><td>Common Mistakes in Business Process Reengineering
Reengineering too many Processes, Inadequate Training of Process Owners and Team Members, Improper Monitoring, Wastage of Time, Delay in Showing Results, Discontinuance after Achievement</td><td>10</td></tr>
</table>

Suggested Books	
	1. B.R. Dey : Business Process reengineering and change management, Wiley 2. Jennifer Joksch : Business Process Reengineering and the important Role of Change Management 3. VikramSethi, William King: Organizational Transformation Through Business Process Reengineering : Applying Lessons Learned, Pearson Education

Branch: Computer Science and Engineering

Title	TECHNOLOGY MANAGEMENT		Credits	03
Code	CS 8307	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Statistics, Mathematics		Contact Hours	45
			Time	3 Hours
Objectives	To make the students aware of latest techniques for managing the upcoming technologies in the software field.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			
SECTION-A				
Introduction to Technology Management Business Strategy for New Technologies: Adding value, Gaining competitive advantage, Timing and capability development.				8
Technology Forecasting Techniques of Forecasting, Technology Forecasting alliance and Relevance strategic Practicality and Technology transfer.				8
Management of Research, Development and Innovation Technology mapping, Comparison of types of R&D projects and development approaches - radical platform and Incremental projects, Innovation process. Management of Intellectual Property Rights Strategic value of patents, Trade secrets and licensing				9
SECTION-B				
Managing Scientist and Technologists Identification, Recruitment, Retention, Team work and Result orientation. Investment in Technology Management roles and skills for New Technology Technology for managerial productivity and Effectiveness, Just in time Venture capital and Technology development				20

Suggested Books	1. John Humbleton Elsevier: Management of High Technology Research and Development.
	2. Charles W.L. HiIVGareth R. Jones: Strategic Management, Houghton Mifflin Co.
	3. S.A.Bergn: R&D Management, Basil Blackwell Inc.,
	4. Spyros Maksidakis& Steven C. Wheelwright: The Handbook of Forecasting - A Management Guide, John Wiley & Sons.
	5. C. Marie Crawford: New Product Management, IR WIN, USA.
	6. David Hutchin: Just-in-Time, Gower Technical Press.
	7. Technology and Management, Cassell Educational Ltd., London

Branch: Computer Science and Engineering

Title	HUMAN RESOURCE DEVELOPMENT AND TRAINING METHODS		Credits	03
Code	CS 8308	Semester: - 3rd	L T P	3 0 0
Max. Marks	External: - 50	Internal: - 50	Elective	Y
Pre-requisites	Business, Commerce and Management Studies		Contact Hours	45
			Time	3 Hours
Objectives	This course will provide students with an understanding of human development as a continual process, with an ongoing requirement of adapting and adjusting to the environment. The course will also assist students in developing a practical understanding of the process of human development.			
Note for Examiner	The Semester question paper of a subject will be of 50 marks having 7 questions of equal marks. First question, covering the whole syllabus and having questions of conceptual nature, will be compulsory. Rest of the paper will be divided into two parts having three questions each and the candidate is required to attempt at least two questions from each part.			

SECTION-A	
Introduction to Human Resource Development: Evolution , Mission and Purpose Components of HRD , HRD problems and issues related to Indian Industry and technical education , HRD in the context of new Industrial Policy	6
Staff Development, Professional Development and Career Development : Stages of HRD , Initial or Induction Training , Training for job-related/professional development , Training for horizontal and vertical mobility of employees	6
Concept of Training : Assumptions for prevailing and alternative concept of training, action through training or action through force	5
Training Strategy: Strategic issues; Basic phases; Modalities in training; formulating a coherent strategy.	5
SECTION-B	
Training Methods: Learning on the job - Training in the fields, Simulating real life - role playing and games, Incidents and cases - Individualized training, Seminars and syndicates; Lecture method	6

Developing Group and the Climate : The Social process; Indicators of group development; training climate	5
Evaluation of Training: Issues for evaluations; Role of the Training System with evaluators from other constituencies	6
Systems Approach to HRD: Definition and importance of needs assessment, methods employed in needs assessment,(Interviews, Questionnaire, Tests, Records and Reports Study, Job Analysis and Performance Reviews), strategies for HRD: on the job, off the job, Programme Planning, Design, Implementation and Evaluation .	6
Suggested Books	1. JW Gilley and SA Eggland: Principles of Human Resource Development 2. PP Arya and BB Tandon : Human Resource Development 3. RF Mayer and Peter Pipe : HRD Training and Development