SCHEME OF INSTRUCTION & EXAMINATION
B.E (INFORMATION TECHNOLOGY)

V Semester (2020-21)

S. No.	Course Code	Course Title	Scheme of Instruction: Periods Per week L	T	D/P	Contact per week Hrs	Scheme of Examination: Maximum Marks CIE	SEE	Duration in Hrs	Credits
Theory Course										
1.	PC 501 IT	Web Application Development	3	1	-	4	30	70	3	3
2.	PC 502 IT	Operating Systems	3	1	-	4	30	70	3	3
3.	PC 503 IT	Automata Theory	3	1	-	4	30	70	3	3
4.	PC 504 IT	Computer Networks	3	1	-	4	30	70	3	3
5.	PC 505 IT	**Software Engineering**	3	-	-	3	30	70	3	3
6.	PE-I	Professional Elective – I	3	-	-	3	30	70	3	3
Practical/Laboratory Courses										
7.	PC531 IT	Computer Networks Lab	-	-	2	2	25	50	3	1
8.	PC532 IT	Operating Systems Lab	-	-	2	2	25	50	3	1
9.	PC533 IT	Web Application Development Lab	-	-	2	2	25	50	3	1
Total			**21**	**04**	**06**	**31**	**285**	**640**	**-**	**21**

Profession Elective – I	
Course Code	Course Title
PE 511 IT	Artificial Intelligence
PE 512 IT	Computer Graphics
PE 513 IT	Image Processing

Course Code	Course Title						Core/Elective
PC 501 IT	**WEB APPLICATION DEVELOPMENT**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objective:

- To develop dynamic web applications using the concepts of HTML 5.0 and CSS
- To understand the document structure and schemas and represent data in that format
- To develop applications using JQuery and represent objects in JSON notation
- To implement applications using angular JS
- To understand the MEAN Stack and SMACK stack and develop applications using the framework

Course Outcomes:

Students will able to

- Design and develop dynamic web sites using Html 5.0, CSS, JQuery.
- Develop web content publishing applications that accesses data in XML or JSON format
- Develop single page web applications using Angular JS
- Design and develop big data applications using Mean stack and SMACK stack Frameworks.

UNIT I

HTML and CSS

Introduction: Web Application Fundamentals: protocols and web servers

HTML 5.0: Basic tags, Form elements and attributes, validation

Cascading Style Sheets CSS selectors, CSS BOX Model, CSS Positioning

UNIT II

XML: The Syntax of XML, XML Document Structure, Document Type Definitions, Name Space, XML Schemas

UNIT III

Java Script and JQuery: JQuery: Introduction to JQuery, JQuery Syntax, Selectors, HTML Manipulation, Effects and Events

JSON: JSON Introduction, Syntax, Data Types, Objects, Schema, Comparison with XML.

Java Script: Introduction to JavaScript, Selecting elements in the documents, Event handling

Unit IV

Angular JS: Preparing Development Environment, Angular modules and Controllers, Input Validation, Data Binding and Templates, Angular JS Services

Unit V

MEAN Stack, SMACK Stack : Introduction to MEAN Stack, SMACK Stack, Apache, Building Backend and Testing- Angular JS, Node JS, Express and Mongo DB

Suggested Readings:

1. Robert W. Sebesta, "Programming with World Wide Web", 8th Edition, Pearson Education, 2008.
2. John Pollak, "JQuery - A Beginners Guide", McGraw Hill Education, 2014.
3. AgusKurniawan,"AngularJS Programming by Example",PE Press, First Edition
4. Colin J Ihrig, : Full Stack JavaScript Development with MEAN, SitePoint, 2015 Edition
5. Raul Estrada,:Fast Data Processing Systems with SMACK Stack,Packt, December 2016

Course Code	Course Title						Core/Elective
PC 502 IT	**OPERATING SYSTEMS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To understand the working of computer system and the basic concepts of operating system and the services provided by it.
- To understand the functions and management of different resources of the operating system (Processor, I/O, and Memory etc)
- To understand process management concepts including scheduling, synchronization, deadlocks
- To learn the mechanisms involved in memory management and I/O subsystems of an operating system.
- To understand issues of protection and security

Course Outcomes

Student will able to

- Explain the fundamental concepts and functions of operating system.
- Understand process scheduling in a multi-programming environment and implementing process scheduling algorithms.
- Write application and system calls related programs for managing processes, memory, I/O and inter-process Communication related system calls.
- Understand memory management, disk management techniques, including virtual memory and file system structure.
- Explain protection and security related issues of the computer system.

UNIT-I

Introduction: Computer System organization & Architecture, Operating System Structure &Operations, Process, Memory and Storage Managements, Protection and Security, Distributed and Special-Purpose Systems, Computing Environments.

System Structures: Operating-System Services, User Operating System Interface, System calls, Types of System Calls, System Programs, Operating-System Structure, Virtual Machines, Operating – System Generation, System Boot.

Process Concept: Overview, Process Scheduling, Operations on Processes, Interprocess communication, Examples of IPC Systems, Communication in Client/Server Systems.

Multithreaded Programming*:* Overview, Multithreading Models, Thread Libraries, Threading Issues, Operating-System Examples.

UNIT II

Process Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multi-ProcessorScheduling, Thread Scheduling: Pthreads , Operating System Examples, Algorithm Evaluation.

Process Coordination and **Synchronization**: Background, The Critical-Section Problem, Peterson'sSolution,Synchronization, Monitors, Synchronization Examples.
Deadlocks: System Model, Deadlock characterization, Methods for Handling Deadlocks,DeadlockPrevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT III

Memory-Management Strategies: Background, Swapping, Contiguous Memory Allocation, Paging,Structure
of the Page Table, Segmentation, Example: The Intel Pentium.

Virtual Memory Management: Background, Demand paging, Copy-on-write, PageReplacement,Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory, Other Considerations,
Storage Management: File System, File Concept, Access Methods, Directory Structure, File-SystemMounting, File sharing, Protection.

UNIT IV

Implementing File Systems: File System-Structure, File-System Implementation, DirectoryImplementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, Log-Structured File Systems, NFS.

Secondary –Storage Structure: Overview of Mass-Storage Structure, Disk Structure, Disk Attachment, RAID Structure, Stable-Storage Implementation, Tertiary-Storage Structure.
I/O Systems: Overview, I/O Hardware, Application I/O Interface, Kernel I/O Subsystems, Transforming I/O Request to Hardware Operations, STREAMS, Performance.

UNIT V

Protection *and Security:* Goals of Protection, Principles of Protection, Domain of protection, Access Matrix, Implementation of Access Matrix, Access control, Revocation of access rights, Capability-based Systems, Language-based protection.
System Security: The security problem, program Threats, System and System Network Threats, Cryptography as a Security tool, User Authentication, Implementing Security Defences, firewalling to protect Systems and Networks, Computer Security Classification, Case Studies- Linux System.
Real-time systems: - Overview, System Characteristics, Features of Real time kernels, Implementing Real time operating Systems, Real Time CPU Scheduling, An Example: VxWorks, Linux System.

Suggested Reading

1. Abraham Silberschatz, Peter Galvin, Greg Gagne, Operating System principles, seventh Edition, John wiley& sons publication,2006 .
2. A.Tanenbaum-Modern Operation Systems. Third edition, Pearson Education, 2008.
3. William Stallings-Operating Systems, Fifth Edition, Pearson Education, 2005.
4. Ida M.Flynn, Understanding Operating Systems, Sixth Edition, Cengage, 2011

Course Code	Course Title						Core/Elective
PC 503IT	**AUTOMATA THEORY**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objectives:

- Provides basic properties of formal languages and formal grammars, deterministic and nondeterministic finite automata, relation between types of languages and types of finite automata.
- Provides basic properties of Pushdown Automata and Turing machines and computing with Turing machines and PDA.
- Understand the challenges for Theoretical Computer Science and its contribution to other sciences

Course Outcomes

Student will able to

- Design and use deterministic, nondeterministic, and epsilon transition finite state automata and illustrate state transition on symbols of input words and establish the corresponding language of automata.
- Analyze Regular Expressions and use Laws and establish the corresponding Regular Language. Prove a given language is regular or otherwise. Use Closure and Decision Properties of Regular Language.
- Analyze ambiguity. Develop Context Free Grammars, Parse Tees and establish Context Free Language. Use Closure and Decision Properties of Regular Language.
- Design Pushdown Automata and illustrate the working. Develop deterministic Pushdown Automata and establish equivalence of language of PDA and CFG.
- Design Turing Machine and illustrate its working, implement programming techniques for Turing Machines, analyze extended and restricted Turing Machines for computational abilities, and establish the Recursively Enumerable language of Turing Machine and analyze the Undecidable problems.

UNIT I

Automata: Introduction to Finite Automata, Central Concepts of Automata Theory.
Finite Automata: An informal picture of Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, An Application, Finite Automata with Epsilon Transitions.

UNIT II

Regular Expression And languages: Regular Expressions, Finite Automata and Regular Expression, Applications of Regular Expressions, Algebric Laws for Regular Expression.
Properties of Regular Languages: Proving Languages not to be Regular, Closure Properties of Regular Languages, Decision Properties of Regular Languages, Equivalence and Minimization of Automata.

UNIT III

Context Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications, Ambiguity in Grammars and Languages

Properties of Context Free Languages: Normal Forms for Context-Free Grammars, Pumping Lemma, Closure Properties, Decision Properties of CFL's.

UNIT IV

Pushdown Automata: Definition, Language of PDA, Equivalence of PDA's and; CFG's, Deterministic Pushdown Automata.

UNIT V

Turning Machines: Problems that Computer Cannot Solve ,The Turning Machine, Programming Techniques for Turning Machines, Extensions to the Turning Machines, Restricted Turning Machines, Turning Machine and Computers. Undecidable Problems about Turning Machines, Post's Correspondence Problem, Other Undecidable Problems.

Suggested Reading

1. John E.Hopcroft, Rajeev Motwani,Jeffery D Ulman. Introduction to Automata Theory Languages And Computation, third edition, Pearson Education, 2009.
2. John C.Martin, Introduction to Languages and the Theory of computation ,third Edition, Tata McGrawHill,2003.

Course Code	Course Title						Core/Elective
PC 504IT	**COMPUTER NETWORKS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objectives:

- To study the design issues in network layer and various routing algorithms
- To introduce internet routing architecture and protocols
- To learn the flow control and congestion control algorithms in Transport Layer
- To introduce the TCP/IP suite of protocols and the networked applications supported by it
- To learn basic and advanced socket system calls

Course Outcomes:

Student will be able to

- Explain the function of each layer of OSI and trace the flow of information from one
- node to another node in the network
- Understand the principles of IP addressing and internet routing
- Describe the working of various networked applications such as DNS, mail, file transfer and www
- Implement client-server socket-based networked applications

UNIT – I

Introduction: Uses of Computer Networks, Network Hardware, Network Software: Reference Models (ISO - OSI, TCP/IP). Network Layer: Network Layer Design Issues, Routing Algorithms, Congestion Control Algorithms

UNIT – II

Internetworking: Concatenated virtual circuits, Connectionless internetworking, Tunneling, Fragmentation. Network layer in the Internet: IP protocol, IP addresses, Internet control protocols, OSPF, BGP, Mobile IP, IPv6. The Internet Transport Protocols: UDP, Internet Transport Protocols: TCP.

UNIT – III

Network Programming**:** Socket Interface: Sockets, Socket Address, Elementary Sockets, Advanced Sockets, Socket Options, Remote Procedure Calls: Introduction, Transparency Issues and Sun RPC.

UNIT – IV

Application Layer: Domain Name System: DNS Name Space, Resource Records, Name Servers. Electronic Mail: Architecture and Services, User Agent, Message Formats, Message transfer and Final Delivery. World Wide Web: Architectural Overview, Static Web Documents, Dynamic Web Documents,HTTP, Wireless Web.

UNIT – V

Network Security: Cryptography, Symmetric Key Algorithms, Public Key Algorithms, Digital Signatures, Communication Security, Authentication Protocols, Email Security, Web Security.

Suggested Reading:

1. Andrew S. Tanenbaurn, Computer Nerworks, Fourth Edition, Pearson Education.
2. W. Richard stevens, Unix Network Programming" Prentice Hall/Pearson Education,2009.
3. James F. Kurose, Keith W, Ross, Computer Networking, Atop-Down Approach Featuring the Internet, Third Edition, Pearson Education , 2005.
4. William Stallings, Computer Networking with Internet Protocols and Technology, Pearson Education,2009

Course Code	Course Title						Core/Elective
PC 505IT	**SOFTWARE ENGINEERING**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To introduce the basic concepts of software development- processes from defining a product to shipping and maintaining that product
- To impart knowledge on various phases, methodologies and practices of software development
- To understand the importance of testing in software development and study various testing strategies and software quality metrics.

Course Outcomes

Students will be able to:

- Define different software development processes and their usability in different problem domains.
- Explain the process of requirements collection, analyzing, and modeling requirements for effective understanding and communication with stakeholders.
- Design and Develop the architecture of real world problems towards developing a blueprint for implementation.
- Understand the concepts of software quality, testing and maintenance.
- Discuss the concepts related to Risk management and Software project Estimation

UNIT-I

Introduction to Software Engineering: A generic view of process, Software Engineering process framework, The Nature of Software, Software Engineering, Software Myths.

Process Models: A Generic Process Model, Prescriptive Process Models, Specialized Process Models, The Unified Process Personal and Team Process Models, Process Technology, Product and Process.

An Agile View of Process: Introduction to Agility and Agile Process, Agile Process Models

UNIT-II

Understanding Requirements: Requirements Engineering, Establishing the Groundwork, Eliciting Requirements, Building the Requirement Model, Negotiating Requirements, Validating Requirements.

Design Concepts: Design within the Context of Software Engineering, the Design Process, Design Concepts.

Architectural Design: Software Architecture, Architecture Genres, Architecture Styles, Architecture Design, Assessing Alternative Architecture Designs, Architecture Mapping Using Data Flow**.**

UNIT-III

Software Quality Assurance: Background Issues, Elements of Software Quality Assurance, SQA Tasks, Goals and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan.

Risk Management: Reactive versus Proactive Risk Strategies, Software Risks, Risk Identification, Risk Projection, Risk Refinement, Risk Mitigation, Monitoring, and Management, The RMMM Plan.

UNIT-IV

Software Testing Strategies: A Strategic Approach to Software Testing, Strategic Issues, Test Strategies for Conventional Software, Validation Testing, System Testing, The Art of Debugging.

Testing Conventional Applications: Software Testing Fundamentals, Internal and External Views of Testing, White-Box Testing, Basis Path Testing, Control Structure Testing, Black – Box Testing.

UNIT-V

Product Metrics: A Framework for Product Metrics, Metrics for the Requirements Model, Metrics for the Design Model, Metrics for Testing, Metrics for Maintenance.

Estimation: Software Project Estimation, Decomposition Techniques, Empirical Estimation Models, Specialized Estimation Techniques, The Make/Buy Decision.

Software Configuration Management: Software Configuration Management.

Software Process Improvement: The SPI Process, The CMMI, The people CMM, Other SPI Frameworks, SPI Return on Investment, SPI Trends.

Suggested Reading:

1. Roger S.Pressman, Software Engineering: A Practitioners Approach, Seventh Edition, McGrawHill, 2009.
2. Ali Behforoz and Frederic J.Hadson, Software Engineering Fundamentals, Oxford University Press, 1996.
3. Pankaj Jalote "An Integrated Approach to Software Engineering, Third Edition, Narosa Publishing house, 2008.

Course Code	Course Title						Core/Elective
PC 531IT	**Computer Networks Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
C Progr. Unix Commands	-	-	-	2	**25**	**50**	**1**

Course Objectives:

- To understand the use of client/server architecture in application development.
- To understand and use elementary socket system calls, advanced socket system calls and TCP and UDP based sockets
- To implement network routing algorithms, application layer protocols and encryption algorithms.

Course Outcomes:

Student will be able to

- Understand the usage of basic commands ipconig, ifconfig, netstat, ping, arp, telnet,ftp,finger,traceroute, whois of LINUX platform.
- Develop and Implement Client-Server Socket based programs using TCP,and UDP sockets
- Develop and Implement Distance Vector Routing Algorithm
- Develop and Implement RSA Public Key algorithm
- Construct simple network by using any modern Open Source Network Simulation Tool

List of Programs

1. Familiarization of Network Environment, Understanding and using network utilities: ipconig, ifconfig, netstat, ping, arp, telnet,ftp,finger,traceroute, whois.
2. Write a program to implement connection oriented and connectionless client for well known services i.e standard ports
3. Implementation of concurrent server service using connection oriented socket system calls(Service: Daytime, Time)
4. Implementation of concurrent server using connection less socket system calls. (Service: Echo server,String Concateation)
5. Implementation of Iterative server using connection oriented socket system calls.(Service:Calculate Employee Salary)
6. Implementation of Iterative server using connection less socket system calls. (Service: Student Grade)
7. Program to demonstrate the use of advanced socket sytem calls: readv(),writev() ,getsockname(),setsockname(),getpeername(),gethostbyname(), gethostbyaddr(),getnetbyname(),getnetbyaddr(),getprotobyname(), getservbyname(),getprotobynumber(),getserbyport().

8. Implementation of remote command execution using socket system calls.
9. Program to implement simple program using RPC.
10. Implementation of Distance Vector Routing Protocol.
11. Implementation of RSA public key algorithm
12. Case study on any open source network simulation tool.(simple routin g protocol implementation)
    Note: Well known services(standard ports): DAYTIME, TIME, CHARGEN, ECHO.

Suggested Reading:

1. W. Richard Stevens, "Unix Network Programming", Prentice Hall, Pearson Education,2009.
2. Douglas E.Comer,"Hands-on Networking with Internet Technologies", Pearson Education.

Course Code	Course Title						Core/Elective
PC532IT	**Operating Systems Lab**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**1**

Course Objectives:

- To practice

Course Outcomes:

Student will be able to

- Explore the LINUX low level I/O and Construct applications using process management and file management System calls.
- Demonstrate how threads can be created and simultaneously handled in LINUX POSIX environment.
- Understand possible Inter-Process Communication implementations using LINUX IPC Constructs.
- Assess the working behaviour of various synchronization approaches used in Deadlock management.
- Analyze the performance of process scheduling algorithms, page replacement Algorithms, and Disk scheduling Algorithms.

List of experiments:

1. Familiarity and usage of Linux System calls :
   a. Process management: fork(), exec(), wait(), sleep() ...,
   b. File management: open (), read (), write (), seek (), close ()...,

2. Write a program to Implement two process communication using IPC constructs.
   a)pipes b) shared memory c) message queues d)Semaphores..

3. Demonstrate the use of threads under LINUX platform using appropriate thread API

4. Write a program to Implement Producer Consumer Problem solution.

5. Write a program to Implement Dining philosopher's problem solution.

6. write a program to implement Processor Scheduling Algorithms
   a) FCFS b) SJF c) Round Robin.
7. Write a program to simulate Bankers Algorithm for Dead Lock Avoidance.

8. Write a program to implement Bankers Algorithm for Dead Lock Prevention.

9. Write a program to Implement Page replacement Algorithms:
   a) FIFO b) LRU

10. Write a program to implement disk scheduling algorithms.
    a) FCFS b) SCAN c) C-SCAN

Course Code	Course Title						Core/Elective
PC533IT	**WEB APPLICATION DEVELOPMENT LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**1**

Course Objective:

- To develop web pages using HTML tags and perform validation using scripting
- To implement various types of styling using CSS and transform data into various forms
- To implement applications using JQuery and Angular JS
- To understand and implement the concepts of MEAN Stack and SMACK stack

Course Outcomes:

Student will able to

- Design Web pages and perform form validation using HTML 5.0 inbuilt functions.
- Apply Styles to the web content using CSS.
- Create and process web publishing content using XML and JSON.
- Use JQuery to perform client side Dynamics.
- Create single page applications (Front End) using Angular JS.
- Design Big data applications using Mean stack or SMACK stack Frameworks.

a. Implement Basic HTML Tags
b. Implement Table Tag
    i. Implement FRAMES
c. Design a form in HTML (CV/Photos/Data Storage/Publish)
    i. Validation of form Using Java Script.
d. Implement various types of CSS.
e. Display the various forms of XML document
    i. Raw XML ii. XML using CSS iii. XML using XSLT
f. Using JQuery implement the following:
    i) Selecting Elements, Getting Values, and Setting Values.
    ii) Events
g. Using angular JS implement the following
    i) Input Validation
    ii) Backend building
h. Case study on i) MEAN Stack ii) SMACK Stack

Course Code	Course Title						Core/Elective
PE 511 IT	**ARTIFICIAL INTELLIGENCE**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To understand foundations and Applications of AI
- To learn Probabilistic Reasoning and other search algorithms.
- To design Bayesian Networks and Markov model
- To learn aspects of Reinforcement Learning

Course Outcomes

Student will able to

- Identify problems that are amenable to solution using State space search algorithms
- Understand and analyze working of an AI technique using Heuristic search
- Understand and design the Bayesian Networks
- Understand and apply the concepts of Markov Decision process.
- Apply the program and apply Reinforcement Learning

Unit-I

Introduction: History of AI, Intelligent Systems, Foundations of AI, Subareas of AI, Applications. Problem Solving – State-Space Search. State space representation.

Unit-II

Search Algorithms: Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm.

Unit-III

Probabilistic Reasoning: Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.

Unit-IV

Markov Decision process: MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

Unit-V

Reinforcement Learning: Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

Suggested Reading

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall

2. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill

3. Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.

4. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011
5 .NilsJ Nilsson (1998), Artificial Intelligence, A NewSynthesis. Elsevier.
6. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010.

Course Code	Course Title						Core/Elective
PE 512 IT	**COMPUTER GRAPHICS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- Acquire knowledge about device level algorithms for displaying two dimensional output primitives for raster graphics system.
- Acquire knowledge about the basic concepts of representing 3D objects in 2D.
- To introduce computer graphics techniques transformations, clipping, curves and surfaces.

Course Outcomes

Student will able to

- Describe the steps in graphics programming pipline
- Apply affine transformations for viewing and projections
- Create realistic images of geometrical objects in 2-D and modeling implementation
- Describe the mathematical principles to represent curves and surfaces

UNIT-I

Overview of Graphics Systems-Video display devices, raster-scansystems, Random-scan system, graphics monitors and workstations, InputDevices, hard copy devices, Graphics Software. Output Primitives, Line driving, algorithms, Circle generating algorithms, ellipse generating algorithms, pixel addressing, Filled-area primitives, Fill area functions, cell array, character generation.

UNIT-II

Attributes of output primitives:Line attributes, curve attributes, color and Gray scale level, Area fill attributes, character attributes, Bundled attributes, Enquiry function. Two dimensional Geometric transformations:Basic transformations, Homogeneous coordinates, composite transformations, other transformations, transformations between coordinate systems, affine transformations, transformation functions, Raster methods for transformations.

UNIT-III

Two dimensional viewing: Viewing pipeline, viewing transformation, viewing functions, line clipping-Cohen Sutherland line clipping Liang Bar skyline clipping. Sutherland-Hodgman polygon clipping, Weller Atherton polygon clipping.

UNIT-IV

Structures and Hierarchical Modeling: Structure concepts, editing structures, Basic modeling concepts, hierarchical modeling with structures. Graphical user interfaces and Interactive input methods: The user Dialogue, logical classification of input devices, input functions and Models, Interactive picture construction techniques.

UNIT-V

Three dimensional object representations: Polygon surface, curved lines and surfaces, splinere presentations, Bezeir curves and surfaces, B-spline curves and surfaces, CSG methods: Octress, BSP Trees. Three Dimensional Transformation Three dimensional viewing: Viewing coordinates, projections, visible surface detection methods :Back- face Detections, Depth-buffer methods, depth sorting methods, Gourand shading, Phong shading.

Suggested Reading

1.HeamDonald, PaulineBakerM.,"Computer Graphics",2nd edition, PHI,1995.
2.HaningtonS.,"ComputerGraphicsAProgramming Approach",2nd edition,McGraw Hill.
3.David F. Rogers.,"Procedural ElementsforComputerGraphics",2nd edition,TataMcGraw Hill, 2001.

Course Code	Course Title						Core/Elective
PE 513 IT	**IMAGE PROCESSING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objective:

- To gain the fundamentals of digital image processing.
- To provide mathematical foundations for digital manipulation of images; image
- acquisition; preprocessing; segmentation; Fourier domain processing; and compression.
- To be able to formulate solutions to general image processing problems

Course Outcomes

Student will able to

- Understand the fundamental concepts of a digital image processing.
- Evaluate the techniques for image enhancement and image restoration.
- Categorize various compression techniques.
- Interpret Image compression standards.
- Interpret image segmentation and representation techniques.

UNIT-I

FUNDAMENTALS Digital image, Elements of digital geometry, Components of DIP, Visual detail. Visual preliminaries- Brightness adaptation and Contrast, Acuity and contour, Texture and pattern discrimination, Shape detection and recognition, Perception of color. Image formation- Geometric Model and Photometric Model.

UNIT-II

IMAGE ENHANCEMENT Spatial Domain Methods –Binary Image, Negative of an Image, Log Transformations, Power law Transformation, contrast enhancement, Histogram equalization, Spatial Domain Filters-Smoothing filters, Sharpening filters. Frequency Domain Methods- Steps for filtering in the frequency domain, Smoothing filters, Sharpening filters.

UNIT-III

IMAGE RESTORATION A model of the image degradation, noise models, restoration in the presence of noise-spatial filtering, periodic noise reduction by frequency domain filtering, linear & position-invariant degradations, estimating the degradation function.

UNIT-IV

SEGMENTAION Points detection, line detection, edge detection methods, Histogram based image segmentation, segmentation using split and merge method, region growing method, watershed method, k-means clustering method, self-similar fractal method.

UNIT-V

REPRESENTAION, DESCRIPTION AND RECOGNITION Representation, boundary descriptors, regional descriptors, principal component analysis, relational descriptors. Recognition based on decision-theoretic and structural methods.

Suggested Reading

1 R.C Gonzalez and R.E. Woods, Digital Image Processing, 2nd Ed, Prentice Hall. 2002.

2 Anil K. Jain, Fundamentals of Image Processing, Prentice Hall, Englewood clifs, New Jersey,1989

3.G.R.Sinha and BhagavathiCharan Patel, Medical Image Processing concepts and applications,PHI,2014

4.Chanda&Majumdar, Digital image processing and analysis, Second edition PHI, 2013.

SCHEME OF INSTRUCTION & EXAMINATION
B.E (INFORMATION TECHNOLOGY)

VI SEMESTER

S. No	Course Code	Course Title	Scheme of Instruction				Scheme of Examination			Credits
			L	T	D/P	Contact Hrs/Wk	CIE	SEE	Duration in Hrs/Wk	
Theory Course										
1.	PC 601 IT Core-12	Embedded Systems	3	1	-	4	30	70	3	3
2.	PC 602 IT Core-13	Design and Analysis of Algorithms	3	1	-	4	30	70	3	3
3.	PE-II	Professional Elective -II	3	-	-	3	30	70	3	3
4.	PE -III	Professional Elective -III	3	-	-	3	30	70	3	3
5	PE -IV	Professional Elective -IV	3	-	-	3	30	70	3	3
6.	OE - 1	Open Elective -1	3	-	-	3	30	70	3	3
Practical/Laboratory Course										
7.	PC631 IT	Embedded Systems Lab	-	-	2	2	25	50	3	1
8.	PC632 IT	Design and Analysis of Algorithms Lab	-	-	2	2	25	50	3	1
8.	PW633 IT	Mini Project-I	-	-	2	2	25	50	3	1
9.	SI 671 IT	Summer Internship*	-	-	-	-	-	-	-	-
Total			**18**	**2**	**9**	**29**	**305**	**570**		**21**

Profession Elective - II	
Course Code	**Course Title**
PE 611 IT	Data Mining
PE 612 IT	Compiler Construction
PE 613 IT	Distributed Systems
PE 614 IT	AdvancedComputer Architecture

Profession Elective – III	
Course Code	**Course Title**
PE 623 IT	Object Oriented Analysis and Design
PE 624 IT	Multimedia Technologies
PE 625 IT	Machine Learning
PE 626 IT	Data Science Using R Programming

Profession Elective - IV	
Course Code	**Course Title**
PE 627CS	Computational Intelligence
PE 628 IT	Adhoc and Sensor Networks
PE 629 CS	Natural Language Processing
PE 630 IT	Information Storage and Management

Open Elective - I	
Course Code	**Course Title**
OE 601 CE	Disaster Management
OE 602 CE	Geo Spatial Techniques
OE 601 CS	Operating Systems*
OE 602 CS	OOP using Java*
OE 601 IT	Database Systems**
OE 602 IT	Data Structures**
OE 601 EC	Principles of Embedded Systems
OE 602 EC	Digital System Design using HDL Verilog
OE 601 EE	Reliability Engineering
OE 602 EE	Basics of Power Electronics
OE 601 ME	Industrial Robotics
OE 602 ME	Material Handling
OE 601 AE	Automotive Safety & Ergonomics

Course Code	Course Title						Core/Elective
PC 601 IT	**EMBEDDED SYSTEMS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To understand the architecture of 8051 microcontrollers.
- To understand the various applications of Embedded Systems using the concepts of Interfacing.
- To familiarize with smart sensors and understand various sensor applications.
- To learn the concepts of RTOS and the design process using RTOS.
- To familiarize with the design principles of SOC.

Course Outcomes

Students will able to

- Study and analysis of embedded systems.
- Design and develop embedded systems (hardware, software and firmware)
- Analyze, real time systems using RTOS and develop applications.
- Apply knowledge to interface various sensors and its applications in embedded systems.
- Understand principles of SOC design.

UNIT-I

Embedded Computing: Introduction, Complex Systems and Microprocessor, Embedded System Design Process, Formalisms for System Design, Design Examples.
Microprocessors and Microcontrollers: Microprocessors and Microcontrollers,
The 8051 Architecture: Introduction, 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory. Counter and Timers, Serial data Input/output, Interrupts.

UNIT-II

Programming using 8051. Data Transfer and Logical Instructions. Arithmetic Operations, Decimal Arithmetic. Jump and Call Instructions, Applications: Interfacing with Keyboards, Displays, D/A and A/D Conversions, Multiple Interrupts, Serial Data Communication.
Introduction to advanced architectures: ARM and SHARC, Processor and memory organization, Bus protocols: I^2C bus and CAN bus.

UNIT-III

Smart Sensors Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation.
Sensors –Applications Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors — Sensors for Manufacturing –Sensors for environmental Monitoring

UNIT-IV

Introduction to Real-Time Operating Systems: Tasks and task states, tasks and data, semaphores, and shared data; message queues, mailboxes and pipes, timer functions, events,

memory management, interrupt routines in an RTOS environment. Basic Design Using a Real-Time Operating System: Principles, semaphores and queues, hard real-time scheduling considerations, saving memory and power, An example RTOS like µ-COS (open source).

UNIT-V

Introduction to the System Approach System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Suggested Reading

1. Muhammad Ali Mazidi, Janice GillispieMazidi, Rolin D. McKinlay, " The 8051 Micro controller and Embedded Systems using Assembly and C", Prentice Hall India, 2nd Edition
2. D. Patranabis – "Sensors and Transducers" –PHI Learning Private Limited.
3. Wayne Wolf, "Computers and Components", Elsevier, Second Edition.
4. Kenneth J.Ayala, "The8051 Microcontroller", Third Edition, , Thomson.
5. David E. Simon, "An Embedded Software Primer", Pearson Education

Course Code	Course Title						Core/Elective
PC 602IT	**DESIGN AND ANALYSIS OF ALGORITHMS**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To review elementary data structures, order notation and algorithm analysis.
- To learn algorithm design strategies such as Divide-and-Conquer, greedy method, dynamic programming, back tracking and branch & bound technique.
- To understand the concepts of NP-hard and NP-complete.

Course Outcomes:

Students will be able:

- Compute and analyse complexity of algorithms using asymptotic notations.
- Write algorithms to solve various computing problems and analyse their time and space complexity.
- Understand and apply different algorithm design techniques to solve real world problems and analyse their complexities.
- To describe algorithmic complexities of various well known computing problems.

UNIT-I

Introduction: Algorithm Specification, Performance analysis, Space Complexity, Time Complexity, Asymptotic Notation(O,Omega,Theta), Practical Complexities, Performance Measurement, Review of elementary data structures, Heap and Heap Sort, Hashing, Set representation, UNION, FIND.

UNIT-II

Divide- and Conquer: The general method, finding maximum minimum. Merge sort quick sort and selection.

Greedy Method: Knapsack problem, Optimal Storage on tapes, Job sequencing with deadlines, Optimal merge patterns, Minimum Spanning Trees.

UNIT-III

Dynamic Programming and Traversal Technique: Multistage graph, All Pair Shortest Path, Optimal Binary Search trees,0/1 Knapsack, Reliability Traveling Salesman Problem, Bi connected Components and Depth First Search.

UNIT-IV

Backtracking and Branch and Bounds: 8-Queens Problem, Graph Coloring Hamilton cycle, Knapsack Problem, 0/1 Knapsack Problem, Traveling salesperson problem, Lower-Bound Theory.

UNIT-V

NP-Hard and NP-Completeness: Basic concepts, cook's theorem, NP-hard graph problems and scheduling problem, NP-hard generation problems, Decision problem, Node covering problem.

Suggested Reading

1. Horowitz E. Sahani S: Fundamentals of Computer Algorithm, Second edition, University Press, 2007.
2. Anany Levitin, Introduction to the Design & Analysis, of Algorithms, Pearson Education, 2003.
3. Aho, Hopcroft, Ulman, The Design and Analysis of Computer Algorithm, Pearson Education, 2000.
4. Parag H.Dave, Himanshu B. Dave, Design and Analysis of Algorithms, Pearson Education, 2008.

Course Code	Course Title						Core/Elective
PC631 IT	**EMBEDDED SYSTEMS LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**1**

Course Objective

- To understand basic concepts and structure of embedded systems.
- To design and develop real time applications of embedded systems

Course Outcomes

Student will able to

- Apply the basic concepts to develop an Interface for 8051 and ARM processors.
- Demonstrate the RTOS Concepts by designing real time applications.

A. Use of 8-bit and 32-bit Microcontrollers, (such as 8051 Microcontroller, ARM2148 / ARM2378, LPC 2141/42/44/46/48) Microcontroller and C compiler (Keil, Ride etc.) to:

1. Interface Input-Output and other units such as: Relays, LEDs, LCDs, Switches, Keypads, Stepper Motors, Sensors, ADCs, Timers
2. Demonstrate Communications: RS232, IIC and CAN protocols
3. Develop Control Applications such as: Temperature Controller, Elevator Controller, Traffic Controller

B. Development of Embedded Application using FPGAs, CPLDs, VHDL and Xilinx Programmable Logic Design Tools:

1. Four bit ALU
2. Pseudo Random Number Generator

C. Development and Porting of Real Time Applications on to Target machines such as Intel or other Computers using any RTOS

I. Understanding Real Time Concepts using any RTOS through Demonstration of:

1. Timing
2. Multi-Tasking
3. Semaphores
4. Message Queues
5. Round-Robin Task Scheduling
6. Preemptive Priority based Task Scheduling
7. Priority Inversion
8. Signals
9. Interrupt Service Routines

II. Application Development using any RTOS:

1. Any RTOS Booting
2. Application Development under any RTOS

Course Code	Course Title						Core/Elective
PC632 IT	**DESIGN AND ANALYSIS OF ALGORITHMS LAB**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**1**

Course Objective

Course Outcomes

Student will able to

- Develop and implement various searching and sorting techniques and estimate the complexities of searching and sorting algorithms.
- Solve knapsack problem using greedy method and dynamic programming.
- Develop and implement shortest path algorithms using Travelling salesman problem and All pair shortest path problem.
- Apply backtracking technique to solve N-queen problem.
- Construct graph traversals using breath first search and depth first search.

List of Experiments:

1. Implement Recursive Binary search and determine the time taken to search an element

2. ImplementLinear searchand determine the time taken to search an element.

3. Sort a given set of elements using Merge sort method and determine the time taken to sort the elements.

4. Sort a given set of elements using Quick sort method and determine the time taken to sort the elements.

5. Implement Knapsack problem using greedy method.

6. Implement 0/1 Knapsack problem using dynamic programming.

7. Implement any scheme to find the optimal solution for the Traveling Sales Person problem

8. Print all the nodes reachable from a given starting node in a digraph using BFS method.

9. Check whether a given graph is connected or not using DFS method

10. Develop a program to implement All pair shortest path.

11. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm-

12. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm-

13. Implement N Queen's problem using Back Tracking.

Course Code	Course Title						Core/Elective
PW633IT	**MINI PROJECT - I**						Project Work
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	-	-	-	2	**25**	**50**	**1**

Course Objectives

- To develop capability to analyse and solve real world problems with an emphasis on applying/integrating knowledge acquired.
- To take responsibility of the end product.

Course Outcomes

Student will able to

- Implement the system using SQL, data structures, C/C++, JAVA, Python and different software engineering models

The Students are required to take one of larger projects listed in the suggested readings or assigned by the teacher, implement and submit the report. The workbooks and project reports should be evaluated.

Course Code	Course Title						Core/Elective
PE 611 IT	**DATA MINING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To understand data classification, data preprocessing and data mining applications.
- To understand how patterns, associations and correlations can be obtained on data.
- To understand how classification and clustering techniques can be implemented and perform its evaluation.
- To learn how complex data mining can be performed.

Course outcomes

Student will able to

- Classify types of data, perform preprocessing of data and appreciate applications of data mining.
- Analyze data for mining frequent patterns, Associations and Correlations.
- Perform the classification by using decision tree induction, Bayes classification methods etc. and evaluate the classifier.
- Select and perform clustering, outlier analysis detection methods.
- Perform Text mining, Spatial Mining, Web mining and Multimedia mining.

UNIT-I

Introduction: fundamentals of Data Mining, Kinds of Patterns can be mined, Technologies used, Applications and issues in Data Mining.Types of Data: Attribute types, Basic Statistical Descriptions of Data, Measuring data similarity and Dissimilarity.Data Pre-Processing: Need of Pre-processing, Data Cleaning, Data Integration, Data Reduction, Data Transformation**.**

UNIT-II

Mining Frequent Patterns, Associations and Correlations: Market Basket Analysis, Association rule mining, frequent item set mining methods, mining various kinds of association rule, Constraint based frequent pattern mining.

UNIT –III

Classification: General approach to classification, Classification by Decision tree induction, Classification by back Propagation, Lazy learners, other classification methods, Prediction, Evaluating the accuracy of classifier, Increasing the accuracy of classifier.

UNIT—IV

Cluster Analysis: Basic Clustering methods, Partitioning methods, Density-based methods, Grid-based methods, and Evaluation of clustering, Outlier Analysis and detection methods.

UNIT—V

Mining Complex Data, Applications and Trends: Mining complex data: Spatial mining, Text Mining, Multimedia Mining, Web Mining, Data Mining Applications and Data Mining Trends.

Suggested Reading:

1. Han J &Kamber M, "Data Mining: Concepts and Techniques", Harcourt India, Elsevier India, Second Edition.
2. Pang-NingTan. Michael Steinback, Vipin Kumar, "Introduction to Data Mining", Pearson Education, 2008.
3. Margaret H Dunham,S.Sridhar, "Data mining: Introductory and Advanced Topics", Pearson Education, 2008.
4. Humphires,hawkins,Dy, "Data Warehousing: Architecture and Implementation", Pearson Education, 2009.
5. Anahory, Murray, "Data Warehousing in the Real World", Pearson Education, 2008.

Course Code	Course Title						Core/Elective
PC 612IT	**COMPILER CONSTRUCTION**						Core
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	1	-	-	**30**	**70**	**3**

Course Objectives

- To understand various phases in Compiler Design.
- To design Parsers and generate code for target machine.
- Understand the role of a symbol table and error recovery strategies

Course Outcomes

Student will able to

- Identify and describe the various concepts underlying the components of a compiler and the translation process.
- Explain various techniques to Scan and Parse the source code.
- Analyze attribute grammars and evaluations for SDT's and use the terminology for generating intermediate code representations.
- Analyze fundamentals of storage allocation strategies towards run-time management of data.
- Explain basic code generation, code optimization techniques.

UNIT-I

Introduction: Programs related to compilers, Translation process, Major data structures, Other issues in compiler structure, Boot strapping and porting.

Lexical analysis: The role of Lexical Analyzer, Input Buffering, Specification of Tokens, Recognition of Tokens, The Lexical-Analyzer Generator Lex.

UNIT-II

Syntax Analysis: Introduction, Top-Down parsing, Bottom-Up parsing, Introduction to LR Parsing, More powerful LR parsers, Using Ambiguous Grammars, Parser Generators YACC.

UNIT-III

Syntax Directed Translation: Syntax Directed Definitions, Evaluation Orders for SDDs, Applications of Syntax Directed Translation.

Intermediate code generation: Variants of Syntax Trees, Three-Address Code, Types and Declarations, Translation of Expressions, Type Checking, Control Flow.

UNIT-IV

Symbol Table Organization: Structure of Symbol table, Symbol Table organization for Block Structured and non-Block Structured languages, Data Structures of symbol Table.

Runtime Environments: Storage Organization, Stack Allocation of Space, Access to Non local Data on the Stack, Heap Management, Introduction to Garbage Collection.

UNIT-V

Code Generation : Issues in the Design of a Code Generator, The Target Language, Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Peephole Optimization, Register Allocation and Assignment.
Machine Independent Optimizations: The Principal Sources of Optimizations.

Suggested Reading

1. Alfred V Aho, Monica S Lam, Ravi Sethi, Jeffrey D Ullman ,"Compilers: Principles, Techniques & Tools", Pearson Education, Second Edition, 2007.
2. Leland L Bech, "System Software: An Introduction to Systems Programming", Pearson Education, Asia.
3. Kenneth C Louden, "Compiler Construction: Principles and Practice", Cengage Learning.

Course Code	Course Title						Core/Elective
PC 613 IT	**Distributed Systems**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To learn the concept and issues of distributed systems in detail.
- To study architectures and working of distributed file systems.
- To understand the processes in distributed system and communication.
- To make students understand how names are assigned in distributed systems.
- To learn examples of distributed file systems.

Course Outcomes:

After completing this course, the student will be able to

- Describe the problems and issues associated with distributed systems.
- Understand how coordination occurs in distributed systems.
- How replicas are handled in distributed systems and consistency is maintained.
- How security is implemented in distributed systems.
- Understand design trade-offs in large-scale distributed systems

UNIT-I

Introduction: What is Distributed Systems?, Design Goals, Types of Distributed System.
Architectures: Architectural Styles, Middleware Organization, System Architectures, Example Architectures.

UNIT-II

Processes: Threads, Virtualization, Clients,Servers, Code migration.
Communication: Foundations, Remote Procedure Call, Message-Oriented Communication, Multicast Communication.

UNIT-III

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming, and Attribute-Based Naming.
Coordination: Clock Synchronization, Logical Clocks, Mutual Exclusion, Election Algorithms, Location System, Distributed event matching, Gossip-based coordination

UNIT-IV

Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-Centric Consistency Models, Replica Management, and Consistency Protocols.

Fault Tolerance: Introduction to Fault Tolerance, Process Resilience, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, and Recovery.
Security: Introduction to security, Secure channels, Access control, Secure naming, Security management.

UNIT-V
Distributed File Systems: Introduction, File service architecture, Case study: Sun Network File System, Case study: The Andrew File System, Enhancements and further developments.
Distributed Multimedia Systems: Introduction, Characteristics of multimedia data, Quality of service management, Resource management, Stream adaptation, Case studies: Tiger, BitTorrent and End System Multicast.
Designing Distributed Systems: GOOGLE CASE STUDY Introduction, Overall architecture and design philosophy, Underlying communication paradigms,Data storage and coordination services, Distributed computation services.

Suggested Readings:
1. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems, PHI 3rd Edition, 2017.
2.George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Distributed Systems Concepts and Design, 5th Edition, 2012.
3.A.D. Kshemkalyani, M. Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press,2011.

Course Code	Course Title						Core/Elective
PC614 IT	**Advanced Computer Architecture**						**Elective**
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
Computer Architecture	3	-	-	-	30	70	03

Course Objectives:

- To learn various types of parallel computer model and Multi processors.
- To learn the model of computer architecture the architecture beyond the classical von Neumann model pipelining, vector and array processors.
- To understand different performance enhancement techniques of scalar architecture.
- To study the memory management and synchronization of multiprocessor and mutlicomputers.

Course Outcomes:

After completing this course, students will be able to:

- Understand the limitations of uni processor and appreciate the need of parallel processing.
- Explain the branch prediction and its utility and pipeline processors
- Explain the Vector processing models and its performance evaluation.
- Understand interconnection of networks and characteristics different approaches.
- Compare and contrast shared memory and distributed memory architecture.

UNIT-I:

Uni processor systems, enhancement to uni processor models, measuring performance and cost, Benchmarks, introduction to advanced computer architecture. Theory of Parallelism, Parallel Computer models, The State of Computing, Multiprocessors and Multicomputer.

UNIT-II:

Pipelining and superscalartechniques: Linear Pipeline Processors, Non-Linear Pipeline Processors, Instruction Pipeline design, Arithmetic pipeline design, superscalar pipeline design. Branch predication technique, performance evaluation, case study-sun microsystems-microprocessor.

UNIT-III:

Vector processor: Vector processing principles models, vector processor model, vector architecture and design, multi vector and SIMD computers, performance evaluation.

UNIT IV:

Array processors: Parallel array processor model, memory organization, interconnection networks, performance measures, static and dynamic topologies.

UNIT V:

Multi processors and multi computers: Multiprocessor model, shared memory and distributed memory architecture, cache coherence and synchronization mechanism, Three Generations of Multicomputer, Parallel computer model, performance model.

Suggested reading:

1. John L. Hennessy and David A. Patterson Morgan Kaufmann, Computer Architecture: A Quantitative Approach, 5 Edition, (An Imprint of Elsevier), 2011
2. Advanced Computer Architectures, S.G. Shiva, Special Indian edition CRC Press Taylor & Francis, 2018
3. Advanced Computer Architecture Second Edition, Kai Hwang, Tata Mc Graw Hill Publishers, 1999

Course Code	Course Title						Core/Elective
PE 623 IT	**OBJECT ORIENTED ANALSIS AND DESIGN**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objective:

- To introduce the basic concepts of Unified Modeling Language from defining Unified process and Core workflows
- To impart knowledge on various UML diagrams for the software development
- To understand the importance of each diagram in software development and understand rules to develop each diagram

Course Outcomes

Student will able to

- Understand the activities in the different phases of the object-oriented development life cycle.
- Model a real-world application by using a UML diagrams.
- Provide a snapshot of the detailed state of a system at a point in time using object diagram.
- Recognize when to use generalization, aggregation, and composition relationships.
- Specify different types of business rules in a class diagram.

UNIT-I

UML Introduction: Why we Model, Introducing the UML, Elements of UML

Basic Structural Modeling: Classes, Relationships, Common Mechanisms, Diagrams, Class Diagrams.

Advanced Structural Modeling: Advanced Classes, Advanced Relationships, Interfaces, Types and Roles, Packages, Instances, Object Diagrams, Components

UNIT-II

Basic Behavioral Modeling: Interactions, Use Cases, Use Case Diagrams, Interaction diagrams, Activity diagrams.

Advanced Behavioral Modeling: Events and Signals, State Machines, Processes and Threads, Time and space, State Chart Diagrams.

UNIT-III

Architectural Modeling: Artifacts, Deployment Collaborations, Patterns and Frame-works, Artifact Diagrams, Deployment Diagrams, Systems and Models

UNIT-IV

Unified Software Development Process: The Unified Process, The Four Ps, A Use-Case-Driven Process, An Architecture-Centric Processes, An Iterative and Incremental Process.

UNIT-V

Core Workflows: Requirements Capture, Capturing requirements as use cases, Analysis, Design, Implementation, Test

Suggested for Reading:

1. THE UNIFIED MODELING LANGUAGE USER GUIDE, Pearson Education- Grady Booch, James Rumbaugh, Ivar Jacobson
2. OBJECT-ORIENTED ANALYSIS AND DESIGN WITH APPLICATIONS, Pearson Education, 3rd Edition- Booch, Jacobson, Rumbaugh

Course Code	Course Title						Core/Elective
PE 624 IT	**MULTIMEDIA TECHNOLOGIES**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objective

- Acquire knowledge about the basic concepts of multimedia data formats, protocols, and Compression techniques of digital images.
- To learn JPEG and MPEG families of standards and wired and wireless networking protocols.
- To develop simple multimedia applications.

Course Outcomes

Student will able to

- Understand the technical details of common multimedia data formats, protocols, and compression techniques of digital images, video and audio content.
- Describe the technical details of JPEG and MPEG families of standards.
- Discuss the significance of "Quality of Service" in multimedia networking.
- Describe the principles and technical details of several wired and wireless networking protocols.
- Develop simple but demonstrative multimedia applications.

UNIT – I

Introduction to Multimedia: What is Multimedia, Multimedia and hypermedia, World Wide Web, Overview of Multimedia software Tools. Multimedia Authorizing and Tools, Multimedia Authoring, Some Useful Editing and Authoring Tools, VRML

UNIT – II

Graphics and Image Data Representation: Graphics/image data types, Popular File Formats, Color in image and Video and Color Science, color Models in Images, Color Models in Video

UNIT – III

Fundamental Concepts in Video and audio: Types of Video signals, Analog Video, Digital Video, Digitization of sound, Musical instrument Digital interface (MIDI), quantization and transmission of Audio

UNIT – IV

Multimedia Data Compression: Lossless Compression Algorithms, lossy Compression Algorithms, Image Compression Standards, The JPEG2000 Standard, Basic Video Compression Techniques, MPEG Video coding I— MPEG –I and 2, Basic Audio Compression techniques.

UNIT – V

Multimedia communication and Retrieval: Multimedia Network Communications and Applications, Wireless Networks, Content Based Retrieval in Digital Libraries

Suggested Reading

1. Ze-Nian Li & Mark S. Drew. Fundamentals of Multimedia.. Upper Saddle River, NJ: Pearson Education.

Course Code	Course Title						Core / Elective
PE 625 IT	**Machine Learning**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
- To introduce the concepts of instance based learning and decision tree induction
- To introduce the concepts of linear separability, Perceptron and SVM
- To learn the concepts of probabilistic inference, graphical models and evolutionary learning
- To learn the concepts of ensemble learning, dimensionality reduction and clustering

Course Outcomes

After completing this course, the student will be able to

1. Explain the strengths and weaknesses of many popular machine learning approaches
2. Recognize and implement various ways of selecting suitable model parameters for different machine learning techniques
3. Design and implement various machine learning algorithms in a range of real-world applications

UNIT-I

Introduction: Learning, Types of Machine Learning.
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Constructing Decision Trees, CART, Classification Example

UNIT-II

Linear Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation SUPPORT Vector Machines: Optimal Separation, Kernels

UNIT-III

Some Basic Statistics: Averages, Variance and Covariance, The Gaussian, The Bias-Variance Tradeoff
Bayesian learning: Introduction, Bayes theorem. Bayes Optimal Classifier, Naive Bayes Classifier. Graphical Models: Bayesian networks, Approximate Inference, Making Bayesian Networks, Hidden Markov Models, The Forward Algorithm.

UNIT-IV

Evolutionary Learning: Genetic Algorithms, Genetic Operators, Genetic Programming
Ensemble learning: Boosting, Bagging
Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis

UNIT-V

Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison

Suggested Readings:

Tom M. Mitchell, Machine Learning, Mc Graw Hill, 1997
Stephen Marsland, Machine Learning - An Algorithmic Perspective, CRC Press, 2009
Margaret H Dunham, Data Mining, Pearson Edition., 2003.
Galit Shmueli, Nitin R Patel, Peter C Bruce, Data Mining for Business Intelligence, Wiley India Edition, 2007
Rajjan Shinghal, Pattern Recognition, Oxford University Press, 2006.

Course Code	Course Title						Core / Elective
PE 626 IT	**Data Science using R Programming**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To learn basics of R Programming environment: R language, R- studio and R packages
- To learn various statistical concepts like linear and logistic regression, cluster analysis, time series forecasting
- To learn Decision tree induction, association rule mining and text mining

Course Outcomes

After completing this course, the student will be able to

1. Use various data structures and packages in R for data visualization and summarization
2. Use linear, non-linear regression models, and classification techniques for data analysis
3. Use clustering methods including K-means and CURE algorithm

UNIT-I

Introduction to R: Introduction, Downloading and Installing R, IDE and Text Editors, Handling Packages in R.

Getting Started with R: Introduction, Working with Directory, Data Types in R, Few Commands for Data Exploration.

Loading and Handling Data in R: Introduction, Challenges of Analytical Data Processing, Expression, Variables, Functions, Missing Values Treatment in R, using as 'Operator to Change the Structure of the Data, Victors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregation and Group Processing of a Variable, Simple Analysis Using R, Methods for Reading Data, Comparison of R GUI's for Data Input, Using R with Databases and Business Intelligence Systems.

UNIT-II

Exploring Data in R: Introduction, Data Frames, R Functions for Understanding Data in Data Frames, Load Data Frames, Exploring Data, Data Summary, Finding the Missing Values, Invalid Values and Outliers, Descriptive Statistics, Spotting Problems in Data with Visualization.

UNIT-III

Linear Regression Using R: Introduction, Model Fitting, Linear Regression, Assumptions of Linear Regression, Validating Linear Assumption.

Logistic Regression: Introduction, What Is Regression? Introduction to Generalized Linear Model, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression, Multinomial Logistic Regression Model.

UNIT-IV

Decision Tree: Introduction, What Is a Decision Tree? Decision Tree Representation in R, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Measuring Features, Hypothesis Space Search in Decision Tree Learning, Inductive Bias in Decision Tree Learning, Why Prefer Short Hypotheses, Issues in Decision Tree Learning.
Time Series in R: Introduction, What Is Time Series Data, Reading Time Series Data, Decomposing Time Series Data, Forecasts Using Exponential Smoothing, ARIMA Models.

UNIT-V
Clustering: Introduction, What Is Clustering, Basic Concepts in Clustering, Hierarchical Clustering, K- Means Algorithm, CURE Algorithm, clustering in Non-Euclidean Space, Clustering for Streams and Parallelism.
Association Rules: Introduction, Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance Based Clustering Transaction and Association.

Suggested Readings:

1. Nina Zumel, Practical Data Science with R, Manning Publications, 2014.
2. Peter Bruce and Andrew Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly, 2017.
4. Roger D Peng, R Programming for Data science, Lean Publishing, 2016.
5. Rafael A Irizarry, Introduction to Data Science, Lean Publishing,2016.

Course Code	Course Title						Core / Elective
PE 627 CS	**Computational Intelligence**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

To make the student familiar with the concepts of

- To introduce the concepts of Biological and Artificial neural networks
- To understand different neural architectures with supervised learning and their learning mechanisms
- To study different neural architectures with unsupervised learning such as PCA Networks Kohenen‘s Self-Organizing Maps
- To introduce Markov decision processes, Q-Learning and TD-Learning
- To study different models of evolution and learning, neuro-fuzzy techniques, rough set theory and their applications

Course Outcomes

After completing this course, the student will be able to

1. Design single and multi-layer feed-forward neural networks
2. Implement various unsupervised learning networks
3. Design new evolutionary operators, representations and fitness functions for specific practical problems
4. Apply fuzzy logic and rough sets to handle uncertainty and vagueness in practical problems

UNIT-I

Introduction to Computational Intelligence / Soft computing: Soft versus Hard Computing, Various paradigms of computing

Foundations of Biological Neural Networks: Introduction to Neural Networks, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN (Learning, Generalization, Memory, Abstraction, Applications), McCulloch-Pitts Model, Historical Developments

Essentials of Artificial Neural Networks: Introduction, Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity (Feed forward, feedback, Single and Multi-layer), Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules (Error Correction, Hebbian, Competitive, Stochastic), Types of Application (Pattern Classification, Pattern Clustering, Pattern Association / Memory, Function Approximation, Prediction, Optimization)

UNIT-II

Neural Architectures with Supervised Learning: Single Layer Feed Forward Neural Networks(Perception), Multilayer Feed Forward Neural Networks (Back propagation

learning), Radial Basis Function Networks, Support Vector Machines, Simulated Annealing, Boltzmann Machine, Feedback (Recurrent) Networks and Dynamical Systems
Associative Memories: Matrix memories, Bidirectional Associative Memory, Hopfield Neural Network,

UNIT-III
Neural Architectures with Unsupervised Learning: Competitive learning, Principal Component Analysis Networks (PCA), Kohonen's Self-Organizing Maps, Linear Vector Quantization, Adaptive Resonance Theory (ART) Networks, Independent Component Analysis Networks (ICA)

UNIT-IV
Reinforcement Learning: Markov Decision Processes, Value Functions, Bellman Optimality Criterion, Policy and Value Iterations, Q-Learning, TD Learning

UNIT-V
Fuzzy Logic: Basic concepts, fuzzy set theory, basic operations, fuzzification, defuzzification, neurofuzzy approach, applications
Evolutionary and Genetic Algorithms: Basic concepts of evolutionary computing, genetic operators, fitness function and selection, genetic programming, other models of evolution and learning, ant colony systems, swarm intelligence, applications
Rough Set Theory: Basic concepts, indiscernability relation, lower and upper approximation, decision systems based on rough approximation, applications

Suggested Readings:
Jacek M. Zurada. Introduction to Artificial Neural Systems, Jaico Publishers, 1992.
S. Haykin. Neural Networks: A Comprehensive Foundation, Prentice Hall, 1999.
P. S. Churchland and T. J. Sejnowski. The Computational Brain. MIT Press, 1992.
A. M. Ibrahim. Introduction to Applied Fuzzy Electronics. PHI, 2004
Z. Pawlak. Rough Sets, Kluwer Academic Publishers, 1991.

Course Code	Course Title						Core / Elective
PE 628 IT	**Adhoc and Sensor Networks**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To provide students with an understanding of wireless ad-hoc and sensor networks
- To enable them to recognize the wide range of applicability of these networks
- To provide an understanding of the major design issues, including topics such as protocol mechanisms and resource constraints.

Course Outcomes

After completing this course, the student will be able to

1. Understand the needs of Wireless Adhoc and Sensor Network in current scenario of technology.
2. Describe current technology trends for the implementation and deployment of wireless adhoc/sensor networks.
3. Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks.
4. Explain the principles and characteristics of wireless sensor networks.

UNIT-I

Wireless Transmission Technology and Systems: Introduction, Radio Technology Primer, Available Wireless Technologies. Medium Access Control Protocols for Wireless Networks: Introduction, Background, Fundamentals of MAC Protocols.

UNIT-II

Adhoc Networks: Introduction and Definitions, Adhoc Network Applications, Design Challenges. Evaluating Adhoc Network Protocols -the Case for a Test bed. Routing in Mobile Adhoc Networks: Introduction, Flooding. Proactive Routing. On Demand Routing. Proactive Versus On Demand Debate. Location based Routing.

UNIT-III

Multicasting in Adhoc Networks: Introduction, Classifications of Protocols, Multicasting Protocols, Broadcasting. Protocol Comparisons, Overarching Issues. Transport layer Protocols in Adhoc Networks: Introduction, TCP and Adhoc Networks, Transport Layer for Adhoc Networks: Overview, Modified TCP, TCP-aware Cross-Layered Solutions. Adhoc Transport Protocol.

UNIT-IV

QoS Issue in Adhoc Networks: Introduction, Definition of QoS, Medium Access Layer, Q0S Routing, Inter- Layer Design Approaches. Security in Mobile Adhoc Networks: Vulnerabilities of Mobile Adhoc Networks, Potential Attacks, Attack Prevention Techniques. Intrusion Detection Techniques.

UNIT-V

Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Sensor Taxonomy. Introduction and Overview of Wireless Sensor Networks: Introduction, Overview MAC Protocols for Wireless Sensor networks. Applications of Wireless Sensor Networks: Examples of Category 1 and Category 2 WSN applications.

Suggested Readings:

Prasant Mohapatra and Srihanamurthy, "Ad Hoc Networks Technologies and Protocols", Springer, Springer International Edition, 2009.

Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks", John Wiley & Sons.

Shivaram Murthy and B. S. Manoj, "Adhoc Networks – Principles and Protocols", Pearson Education, 2012.

Course Code	Course Title						Core / Elective
PE 629 CS	**Natural Language Processing**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To represent and analyse natural language both spoken and written, using statistical and finite sta methods for modelling and classification. To use grammar for natural language processing.
- To study knowledge representation from its semantics view point with emphasis on applications. T study basic logical form language to encode ambiguity.
- To study augmented grammars and parsers for feature systems.
- To resolve and encode ambiguity using statistical methods to estimate lexical probabilities along with critical study of probabilistic context free grammars and parsing.
- To interpret semantics covering ambiguity and link syntax to semantics.

Course Outcomes

After completing this course, the student will be able to

1. Use statistical and finite state methods for modelling and classification for representation and analysis of natural languages, and use grammars for natural language processing.
2. Apply knowledge representation and semantics to machine translation and database semantic interpretation.
3. Perform top-down and bottom-up parsing, and parsing with features.
4. Estimate lexical probabilities, resolve ambiguity, and use probabilistic context-free grammar.
5. Able to encode ambiguity in logical form language and deal with word-sense and ambiguity and to link syntax to semantics.

UNIT- I

Natural Language Processing: Introduction to Natural Language Processing, the study of Language, Applications of NLP, Evaluating Language Understanding Systems, Different levels of Language Analysis, Representations and Understanding, Organization of Natural Language Understanding Systems, Linguistic Background: An outline of English syntax Spoken Language input and output Technologies. Written language Input – Mathematical Methods – statistical Modelling and classification Finite State Methods.

Grammar for Natural Language Processing – Parsing – Semantic and Logic Form –

UNIT- II

Introduction to Semantics and Knowledge Representation: some applications like Machine translation, database interface Semantic Interpretation, word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Recent trends in NLP.

UNIT- III

Grammars and Parsing: Grammars and sentence Structure, Top-Down and Bottom-Up Parsers, Transition Network Grammars, Top- Down Chart Parsing. Feature Systems and Augmented Grammars: Basic Feature system for English, Morphological Analysis and the Lexicon, Parsing with Features, Augmented Transition Networks.

UNIT- IV

Semantic Interpretation: word senses and ambiguity, Basic logical form language, Encoding ambiguity in logical from, Thematic roles, Linking syntax and semantics, Recent trends in NLP.

UNIT-V

Ambiguity Resolution: Statistical Methods, Probabilistic Language Processing, Estimating Probabilities, Part- of-Speech tagging, Obtaining Lexical Probabilities, Probabilistic Context-Free Grammars, Best First Parsing. Semantics and Logical Form, Word senses and Ambiguity, Encoding Ambiguity in Logical Form.

Suggested Readings:

James Allen, "Natural Language Understanding", Pearson Education

Christopher D Manning and Hinrich Schutze, "Foundations of Statistical Natural Language Processing" MIT Press, 1999.

Akshar Bharti, Vineet Chaitanya and Rajeev Sangal, "NLP: A Paninian Perspective", Prentice Hall, New Delhi

D. Jurafsky, J. H. Martin, "Speech and Language Processing", Pearson

Course Code	Course Title						Core / Elective
PE 630 IT	**Information Storage and Management**						**Elective**
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	**3**	**-**	**-**	**-**	**30**	**70**	**3**

Course Objectives

- To introduce the concept of storage, emphasize the significance of storage technologies in IT infrastructure.
- To provides a comprehensive understanding of the various storage infrastructure components in data center environments.
- To learn about the architectures, features, and benefits of Intelligent Storage Systems.
- To understand various storage networking technologies such as FC-SAN, NAS, and IP-SAN; long- term archiving solution – CAS.
- To know about various business continuity solutions such as backup and replication.
- To understand information security role in storage networks and the emerging field of storage virtualization including storage resource management.

Course Outcomes

1. Evaluate storage architecture; understand logical and physical components of a storage infrastructure including storage subsystems.
2. Describe storage networking technologies such as FC-SAN, NAS, IP-SAN and data archival solution – CAS.
3. Identify different storage virtualization technologies and their benefits.
4. Understand and articulate business continuity solutions including, backup and recovery technologies, and local and remote replication solutions.
5. Identify parameters of managing and monitoring storage infrastructure and describe common storage

management activities and solutions

UNIT-I

Introduction to Information Storage: Information Storage, Evolution of Storage Architecture, Data Center Infrastructure, Virtualization and Cloud Computing. Data Center Environment: Application, Database Management System (DBMS), Host, Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application, Disk Native Command Queuing, Introduction to Flash Drives.

UNIT-II

Data Protection: RAID, Implementation Methods, Array Components, Techniques, Levels, RAID Impact on Disk Performance, RAID Comparison, Hot Spares. Intelligent Storage Systems: Components of an Intelligent Storage System, Storage Provisioning, Types of Intelligent Storage Systems.

UNIT-III

Fibre Channel Storage Area Networks: Overview, The SAN and Its Evolution, Components of FC SAN, FC Connectivity, Switched Fabric Ports, Fibre Channel Architecture, Zoning, FC SAN Topologies, Virtualization in SAN. IP SAN and FCoE: iSCSI, FCIP, FCoE. Network-Attached Storage: General-Purpose Servers versus NAS Devices, Benefits of NAS, File Systems and Network File Sharing, Components of NAS, I/O Operation, Implementations, File-Sharing Protocols, Factors Affecting NAS Performance, FileLevel Virtualization. Object-Based and Unified Storage: Object-Based Storage Devices, Content Addressed Storage, CAS Use Cases.

UNIT-IV

Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Life Cycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Architecture, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments. Local Replication: Replication Terminology, Uses of Local Replicas, Replica Consistency, Local Replication Technologies. Remote Replication: Modes of Remote Replication, Remote Replication Technologies, Three- Site Replication.

UNIT-V

Cloud Computing: Cloud Enabling Technologies, Characteristics of Cloud Computing, Benefits of Cloud Computing Cloud Service Models, Cloud Deployment Models, Cloud Computing Infrastructure, Cloud Challenges. Securing the Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Storage Security Domains. Managing the Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Infrastructure Management Activities, Storage Infrastructure Management Challenges, Developing an Ideal Solution, Information Lifecycle Management.

Suggested Readings:

EMC Corporation, Information Storage and Management, Wiley India, 2nd Edition, 2011.
Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, Osborne, 2003.
Marc Farley, Building Storage Networks, Tata McGraw Hill, Osborne,2nd Edition, 2001.
Meeta Gupta, Storage Area Network Fundamentals, Pearson Education Limited, 2002.

Course Code	Course Title						Core/Elective
OE601CE	**DISASTER MANAGEMENT**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

Course Outcomes

Student will be able to

- Understand impact on Natural and manmade disasters.
- Classify disasters and destructions due to cyclones
- Understand disaster management applied in India

UNIT – I

Introduction to Disasters: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks. Natural and Manmade disasters, impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic. political, environmental, health, psychosocial, etc.).

UNIT – II

Disaster: Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc.

Differential Impacts - in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change.

Cyclones and Floods: Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India.

UNIT – III

Approaches to Disaster Risk Reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural-nonstructural sources, roles and responsibilities of community, Panchayati Raj Institutions/Urban Local Bodies (PRis/ULBs), states, Centre, and other stake-holders.

UNIT – IV

Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of development projects such as darns, embankments, changes in Land-use etc. Climate Change Adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT – V

Disaster Risk Management in India: Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, OM Act and Policy, other related policies, plans, programmes and legislation)

Field Work and Case Studies: The field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.

Suggested Reading

1 Sharma V. K. (1999). Disaster Management, National Centre for Disaster Management, IIPE, Delhi.
2. Gupta Anil K, and Sreeja S. Nair. (2011). Environmental Knowledge for Disaster Risk Management,NIDM, New Delhi.
1. Nick. (1991). Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila Philippines.
2. Kapur, et al. (2005). Disasters in India Studies of grim reality, Rawat Publishers, Jaipur.
3. Pelling Mark, (2003). The Vulnerability of Cities: Natural Disaster and Social Resilience Earthscan publishers, London.

Course Code	Course Title						Core/Elective
OE602CE	**GEO SPATIAL TECHNIQUES**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- Description about various spatial and non-spatial data types, and data base management techniques
- Development of the concepts and professional skills in utility of geospatial techniques
- Enhancement of knowledge of geospatial techniques to field problems

Course Outcomes

Student will be able to

- Understand and apply GIS tools
- Analyse and process data to apply to the GIS tools.
- Assimilate knowledge on field problems using remote sensing

UNIT – I

Introduction: Basic concepts, socioeconomic challenges, fundamentals of geographical information systems (GIS), history of geographical information system, components of geographical information systems. Projections and Coordinate Systems: Map definitions, representations of point, line, polygon, common coordinate system, geographic coordinate system, map projections, transformations, map analysis.

UNIT –I I

Data Acquisition and Data Management: data types, spatial, non spatial (attribute) data, data structure and database management, data format, vector and raster data representation, object structural model filters and files data in computer, key board entry, manual digitizing, scanner, aerial photographic data, remotely sensed data, digital data, cartographic database, digital elevation data, data compression, data storage and maintenance, data quality and standards, precision, accuracy, error and data uncertainty. Data Processing: Geometric errors and corrections, types of systematic and non systematic errors, radiometric errors and corrections, internal and external errors.

UNIT –III

Data Modeling: Spatial data analysis, data retrieval query, simple analysis, recode overlay, vector data model, raster data model, digital elevation model, cost and path analysis, knowledge based system. GIS Analysis and Functions: Organizing data for analysis, analysis function, maintenance and analysis of spatial data, buffer analysis, overlay analysis, transformations, conflation, edge matching and editing, maintenance and analysis of spatial and non spatial data

UNIT– IV

Applications of GIS: Environmental and natural resource management, soil and water resources, agriculture, land use planning, geology and municipal applications, urban planning and project management, GIS for decision making under uncertainty, software scenario functions, standard GIS packages, introduction to Global Positioning Systems (GPS) and its applications.

UNIT– V

Introduction to Remote Sensing: General background of remote sensing technology, objectives and limitations of remote sensing, electro-magnetic radiation, characteristics, interaction with earth surface and atmosphere, remote sensing platforms and sensors, satellite characteristics, digital image processing, IRS series and high resolution satellites, software scenario functions, remote sensing applications to watershed modeling, environmental modeling, urban planning and management.

Suggested Reading

1. Burrough, P. A., and McDonnell R. A. (1998), 'Principles of Geographical Information Systems',
2. Oxford University Press, New York
3. Choudhury S., Chakrabarti, D., and Choudhury S. (2009), 'An Introduction to Geographic Information Technology', I.K. International Publishing House (P) Ltd, New Delhi
4. Kang-tsung Chang. (2006), 'Introduction to Geographical information Systems', Tata McGraw-Hill Publishing Company Ltd., Third Edition, New Delhi
5. Lilysand T.M., and Kiefer R.W. (2002), 'Remote Sensing and Image Interpretation', John Wiley and Sons, Fourth Edition, New York

Course Code	Course Title						Core/Elective
OE601EE	**RELIABILITY ENGINEERING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To understand the concepts of different types of probability distributions.
- Importance of reliability evaluation of networks.
- To make the students understand about Reliability, availability model of Power Systems and Markov modeling of Power Plants with identical and no identical units.

Course Outcomes:

Student will be able to:

- Analyze various types of probability disseminations.
- Significance of consistency assessment of networks.
- Applicability of Markov modeling of Power Plants with matching and no similar entities.

UNIT- I

Discrete and Continuous random variables, probability density function and cumulative distribution function. Mean and Variance. Binomial, Poisson, Exponential and Weibull distributions.

UNIT - II

Failure and causes of failure. Failure rate and failure density. Reliability function and MTTF. Bath tub curve for different systems. Parametric methods for above distributions. Non - Parametric methods from field data.

UNIT- III

Reliability block diagram. Series and parallel systems. Network reduction technique, Examples. Evaluation of failure rate, MTTF and reliability, Active and Standby Redundancy, r out of n configuration. Non-series - parallel systems. Path based and cut set methods.

UNIT- IV

Availability, MTTR and MTBF, Markov models and State transition matrices. Reliability models for single component. two components, Load sharing and standby systems. Reliability and availability models of two unit parallel system with repair and standby systems with repair.

UNIT- V

Repairable Systems. maintainability. Preventive maintenance, Evaluation of reliability and J1TTF. Overhauling and replacement. Optimum maintenance policy. Markov model of a power plant with identical units and non-identical units. Capacity outage probability table. Frequency of failures and Cumulative frequency.

Suggested Reading

1. Charles E. Ebeling, Reliability and Maintainability Engineering,Mc Graw Hill Inetrnational Edition, 1997.
2. Balaguruswamy, Reliability Engineering, Tata McGraw Hill Publishing company Ltd,1984.
3. R.N.Allan. Reliability Evaluation of Engineering Systems, Pitman Publishing,1996.
4. Endrenyi. Reliability Modelling in Electric Power Systems. John Wiley & Sons,1978.

Course Code	Course Title						Core/Elective
OE601ME	**INDUSTRIAL ROBOTICS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To familiarize the student with the anatomy of robot and their applications.
- To provide knowledge about various kinds of end effectors usage.
- To equip the students with information about various sensors used in industrial robots.
- To make the student understand the importance of spatial transformation of robots using forward and inverse kinematics.
- To specify and provide the knowledge of techniques involved in robot vision in industry.
- To equip students with latest robot languages implemented in industrial manipulators.

Course Outcomes:

Student will be

- Able to demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics and Have an understanding of the functionality and limitations of robot actuators and sensors.
- Able to demonstrate an ability to apply spatial transformation to obtain forward/Inverse kinematics equation of robot manipulators using analytical/numerical/simulation tools.
- Able to apply knowledge and choose the best & economically suitable sensors/end effectors required for specific applications.
- Able to understand the importance of robot vision and apply the learnt techniques to get the required information from input images.
- Able to design and develop a industrial robot for a given purpose economically.
- Appreciate the current state and potential for robotics in new application areas.

UNIT – I

Introduction to Robotics: Basic structure of Robots. Degree of freedom of Robots. Work envelope. Classification of Robots based on Drive Technology, Work-Envelope and motion control methods. Application of Robots in Industry, Repeatability, Precision and Accuracy as applied to Robots, Specifications of robots used for various applications.

End effectors – Grippers: Mechanical grippers, pneumatic and hydraulic grippers, magnetic grippers, vacuum grippers, RCC grippers – Two fingered and three fingered grippers – Internal grippers and external grippers – Selection and design considerations.

UNIT – II

Requirements of a sensor, principles and applications of the following types of sensors – Position of sensors (Piezo electric sensor, LVDT, Resolvers, Optical encoders, Pneumatic

position sensors) – Range sensors (Triangulation principle, Structured, Lighting approach, Time of flight range finders, Laser range meters) – Proximity sensors (Inductive, Hall effect, Capacitive, Ultrasonic and Optical proximity sensors) – Touch sensors (Binary sensors, Analog sensors) – Wrist Sensors – Compliance Sensors – Slip Sensors.

UNIT- III

Kinematic Analysis of robots: Rotation matrix. Homogeneous transformation matrix, Denavit&Hartenbergrepresentation, Euler and RPY angles representation. Representation of absolute position and orientation in terms of joint parameters, Direct Kinematics of manipulators, Inverse kinematics of Robot arm for position and orientation. Redundancy in Robots. Static force analysis

UNIT-IV

Introduction to techniques used in Robot vision. Image acquisition, illumination techniques, imaging geometry, basic relationship pixels, pre-processing, segmentation & description of 3 dimensional structures, their recognition and interpretation

Types of Camera, frame grabbing , sensing and digitizing image data – Signal conversion – Image Storage – Lighting techniques – Image processing and analysis – Data reduction – Segmentation – Feature extraction – Object recognition – and various algorithms – Applications – Inspection, identification, visual serving and navigation.

UNIT-V

Robot programming languages: Characteristics of robot level languages, task level languages Teach pendant programming – Lead through programming – Robot programming languages – VAL programming – Motion commands – Sensor commands – End effecter commands – Simple programs.

RGV – AGV – Implementation of robots in industries – Various steps - Safety considerations for robot operations.Economic analysis of robots – Pay back method, EUAC method and Rate of return method.

Suggested Readings

1. Groover M P, "Industrial Robotics", McGraw Hill Publications, 1999.
2. Fu. K.S., GonZalez R.C., Lee C.S.G. "Robotics, Control-sensing vision and Intelligence", McGraw Hill,Int. Ed., 1987.
3. Spong and Vidyasagar, "Robot Dynamics & Control", John Wiley and Sons, Ed.,1990
4. Mittal and Nagrath, "Industrial Robotics", Tata McGraw Hill Publications, 2004.
5 Saha&Subirkumarsaha, ‘robotics’, tmh, india

Course Code	Course Title						Core/Elective
OE602ME	**MATERIAL HANDLING**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To know about the working principle of various material handling equipments
- To understand the Material handling relates to the loading, unloading and movement of all types of materials
- To understand the estimation of storage space and maintenance of material handling equipments

Course Outcomes:

Student will be able to

- Understand various conveying systems that available in industry
- Understand various bulk solids handling systems and their design features
- Understand and various modern material handling systems and their integration.
- Calculate number of MH systems required, storage space, cost and maintenance.

UNIT – I

Mechanical Handling Systems: Belt Conveyors and Desing, Bucket Elevators, Package conveyors, Chain and Flight Conveyors, Screw Conveyors, Vibratory Conveyors, Cranes and Hoists.

UNIT – II

Pneumatic and Hydraulic Conveying Systems: Modes of Conveying and High pressure conveying systems, Low Velocity Conveying System. Components of Pneumatic Conveying Systems: General Requirements, Fans and Blowers, Boots-Type Blowers, Sliding-Vane Rotary Compressors, Screw Compressors, Reciprocating Compressors, Vacuum Pumps.

UNIT- III

Bulk Solids Handling: Particle and Bulk Properties. Adhesion, Cohesion and Moisture Content. Gravity Flowof Bulk Solids: Static and Dynamic Pressure Distribution in Bulk Solids. Modes of Flow: Mass Flow, Funnel Flow and Expanded Flow from Hoppers, Bins and Silos.

UNIT- IV

Modern Material Handling Systems: Constructional features of (i) AGV (ii) Automated storage and retrieval systems. Sensors used in AGVs and ASRS.Bar code systems and RFID systems: Fundamentals and their integration with computer-based information systems.

UNIT-V

Total MH Throughput: Calculation for no. of MH systems; storage space estimation based on no of aisles. Maintenance of MH equipment, spare parts management, cost of materials handling, cost per unit load computations.

Suggested Readings

1. Dr. Mahesh Varma, "Construction Equipment and its Planning & Application", Metropolitan Book
2. Co.(P) Ltd., New Delhi, India 1997.
3. James M. Apple, "Material Handling Systems Design", The Ronald Press Company, New York, USA, 1972.
4. Woodcock CR. and Mason J.S., "Bulk Solids Handling: An Introduction to Practice Technology", Leonard Hill USA, Chapman and Hall, New York.
5. M P Grooveretal, "Industrial Robotics", Me Graw Hill, 1999.

Course Code	Course Title						Core/Elective
OE602EC	**DIGITAL SYSTEMS DESIGN using VERILOG HDL**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To familiarize with various modeling styles: structural, dataflow and behavioral of Verilog HDL.
- To develop combinational and sequential circuits using various modeling styles of Verilog HDL.
- To design and develop Verilog HDL models of data path and control units of Central Processing Unit (CPU).
- To learn Synthesis and FPGA design flow.
- To design and develop real time applications: Booth's multiplier, Divider, hardwired control for basic CPU and FIR filter.

Course Outcomes

Student will be able to

- Able to implement and distinguish different Verilog HDL modeling styles.
- Able to construct and analyze Verilog HDL models of combinational and sequential circuits.
- Able to design and develop Verilog HDL modeling and test bench for digital systems for the given specifications.
- Able to outline FPGA design flow and timing analysis.

UNIT – I

Structural modeling: Overview of Digital Design with Verilog HDL, Basic concepts, modules and ports, gate-level modeling, hazards and design examples

UNIT – II

Dataflow and Switch level modeling: dataflow modeling, operands and operators. Switch Level Modeling: CMOS switches and bidirectional switches and design examples

UNIT – III

Behavioral Modeling: Structured Procedures, Procedural Assignments, Timing Controls, Conditional Statements, multi-way branching, Loops, Sequential and Parallel blocks, Generate blocks. Combinational, sequential logic modules and design examples.

UNIT –IV

Synthesis and Verification: Tasks and Functions: Differences between Tasks and Functions. Verilog HDL synthesis, Application Specific IC (ASIC) and Field Programmable Gate Array (FPGA) design flow. Verification: Timing analysis and Test bench design. Design examples.

UNIT – V

Real time implementations: Fixed-Point Arithmetic modules: Addition, Multiplication, Division, Arithmetic and Logic Unit (ALU), Timer, Universal Asynchronous Receiver and Transmitter (UART), DSP modules: FIR and IIR filters, CPU design: Data path and control units.

Suggested Readings

1. Samir Palnitkar, "Verilog HDL A Guide to Digital Design and Synthesis," 2nd Edition, Pearson Education, 2006.
2. Ming-Bo Lin, Digital System Designs and Practices: Using Verilog HDL and FPGA," Wiley India Edition, 2008.
3. J. Bhasker, "A Verilog HDL Primer," 2nd Edition, BS Publications, 2001.

Course Code	Course Title						Core/Elective
OE601CS	**OPERATING SYSTEMS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To understand CPU, Memory, File and Device management
- To learn about concurrency control, protection and security
- To gain knowledge of Linux and Windows NT internals

Course Outcomes

Student will be able to

- Explain the components and functions of operating systems
- Analyze various Scheduling algorithms
- Apply the principles of concurrency
- Compare and contrast various memory management schemes
- Perform administrative tasks on Linux Windows Systems

UNIT-I

Introduction to Operating Systems: OS structure and strategies, Process concepts, Threads, Inter process communication. CPU scheduling algorithms, Process synchronization, Critical section problem, Semaphores, Monitors.

UNIT-II: Memory management, Swapping, Contiguous allocation, Paging, Static and Dynamic partitions, Demand paging, Page replacement algorithms, Thrashing, Segmentation, Segmentation with paging. File system interface: File concepts, Access methods and protection. File system implementation: File system structure, Allocation methods, Directory implementation.

UNIT-III

Deadlocks: Necessary conditions, Resource allocation graph, Methods for handling deadlocks, Prevention, Avoidance, Detection and Recovery. Protection: Goals, Domain of protection, Access matrix. Security: Authentication, Threat monitoring, Encryption.

UNIT-IV Device Management: Disk scheduling methods, Disk management, Device drivers and interfaces, CPU- Device interactions, I/O optimization.

UNIT-V: Case Studies:

The Linux System–Design principles, Kernel modules, Process management, Scheduling, Memory management, File systems, Input and Output, Inter process communication

Windows NT – General Architecture, The NT kernel, The NT executive

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Suggested Reading

1. Abraham Silberschatz, Peter B Galvin, Operating System Concepts, Addison Wesley, 2006
2. William Stallings, Operating Systems-Internals and Design Principles, 5th edition, PHI, 2005
3. Andrew S Tanenbaum, Modern Operating Systems, 4th edition, Pearson, 2016

Course Code	Course Title						Core/Elective
OE602CS	**OOP Using JAVA**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives

- To introduce fundamental object oriented concepts of Java programming Language - such as classes, inheritance, packages and interfaces
- To introduce concepts of exception handling and multi-threading
- To use various classes and interfaces in java collection framework and utility classes
- To understand the concepts of GUI programming using AWT controls
- To introduce Java I/O streams and serialization

Course Outcomes

Student will be able to

- Develop java applications using OO concepts and packages
- Write multi threaded programs with synchronization
- Implement real world applications using java collection frame work and I/O classes
- Write Event driven GUI programs using AWT/Swing

UNIT – I

Object Oriented System Development: understanding object oriented development, understanding object oriented concepts, benefits of object oriented development.

Java Programming Fundamentals: Introduction, overview of Java, data types, variables and arrays, operators, control statements.

UNIT – II

Java Programming OO concepts: classes, methods, inheritance, packages and interfaces.Exceptional Handling, Multithreaded Programming

UNIT – III

I/O Basics, Reading Console Input and Output, Reading and Writing Files, Print Writer Class, String Handling

Exploring Java.Lang, Collections Overview, Collection Interfaces, Collection Classes, Iterators, Random Access Interface, Maps, Comparators, Arrays, Legacy Classes and Interfaces, String Tokenizer

UNIT – IV

Introducing AWT working With Graphics: AWT Classes, Working with Graphics

.Event Handling: Two Event Handling Mechanisms, The Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces

AWT Controls: Control Fundamentals, Labels, Using Buttons, Applying Check Boxes, CheckboxGroup, Choice Controls, Using Lists, Managing Scroll Bars, Using TextField, Using TextArea, Understanding Layout Managers, Menu bars and Menus, Dialog Boxes, FileDialog,Handling events by Extending AWT Components, Exploring the controls, Menus and Layout Managers.

UNIT – V

Java I/O Classes and Interfaces, Files, Stream and Byte Classes, Character Streams, Serialization.

Suggested Readings

1. Herbert Schildt, The Complete Reference JAVA, Tata McGraw Hill, 7thEdition, 2005
2. James M Slack, Programming and Problem Solving with JAVA, Thomson learning, 2002
3. C.Thomas Wu, An Introduction to Object-Oriented Programming with Java, Tata McGraw Hill, 5thEdition, 2005.

Course Code	Course Title						Core/Elective
OE601LA	**INTELLECTUAL PROPERTY RIGHTS**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To create awareness on Engineering Ethics providing basic knowledge about ethics, moral issues & moral dilemmas and professional ideals.
- To understanding, define and differentiate different types of intellectual properties (IPs) and their roles in contributing to organizational competitiveness.
- To expose to the Legal management of IP and understanding of real life practice of Intellectual Property Management.

Course Outcomes:

Student will able be

- Able to identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.
- Able to recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.
- Able to identify activities and constitute IP infringements and the remedies available to the IP owner and describe the precautious steps to be taken to prevent infringement of proprietary rights and duties in products and technology development.

UNIT –I

Introduction: Meaning of Intellectual Property- Nature of I.P- Protection of I.P. Rights-kinds of Intellectual Property Rights –International Conventions of Intellectual Property Rights-patent Traty 1970, GATT 1994, TRIPS & TRIMS – International Organization for Protection of IPR – WTO, WIPRO, UNESCO.

UNIT –II

Patents: Meaning of Patent- Commercial Significance – Obtaining of Patent – patentable Subject – matter – rights and obligations of Patentee – specification – Registration of patents – Compulsory licensing and licenses of rights – Revocation.

UNIT –III

Industrial Designs : Definitions of Designs – Registration of Designs – Rights and Duties of Proprietor of Design – Piracy of Registered Designs.

UNIT –IV

Trade Marks : Meaning of trademark – purpose of protecting trademarks Registered trade mark – procedure – passing off – Assignment and licensing of trade marks – Infringement of trademarks.

UNIT – V

Nature, scope of copyright – Subject matter of copy right – Right conferred by copyrightPublication – Broad – casting, telecasting – computer programme – Database right – Assignment – Transmission of copyright – Infringement of copy right.

Suggested Reading

1.Cornish W.R, "Intellectual Property Patents", Copyright, Trademarks and Allied Rights, Sweet & Maxwell 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern law House 2nd Edn. 1997.
3. Robin Jacob & Daniel Alexander, "A Guide Book to Intellectual Property Patents, Trademarks, Copyrights and designs", Sweet and Maxwell, 4th Edn.,1993.

Course Code	Course Title						Core/Elective
OE601IT	**DATABASE SYSTEMS (open Elective)**						Elective
Prerequisite	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
-	3	-	-	-	**30**	**70**	**3**

Course Objectives:

- To introduce E-R Model and Normalization
- To learn formal and commercial query languages of RDBMS
- To understand the process of database application development
- To study different database architectures
- To introduce security issues in databases

Course Outcomes:

Student will be able to:

- Understand the mathematical foundations of Database design
- Model a set of requirements using the Entity Relationship (E-R)Model , transform an E-R model into a relational model ,and refine the relational model using theory of Normalization
- Understand the process of developing database application using SQL
- Understand the security mechanisms in RDBMS

UNIT I

Design: Conceptual design (E-R modeling), the relational model, normalization

UNIT II

Queries: algebra and logic (relational algebra and calculus), relational query languages and queries (namely SQL),select, project, join, union, intersection, except, recursion, aggregation, data manipulation

UNIT III

Applications: application development, database application interfaces (e.g., JDBC), internet applications, proper database application paradigms, transactions, transaction management, concurrency control, crash recovery

UNIT IV

Distributed DB, Architecture, Query processing and Optimization in Distributed DB, Introduction to NoSQL Databases , Graph databases, Columnar Databases

UNIT V

Introduction to Database Security Issues, Security mechanism, Database Users and Schemas, Privileges

Suggested Books

1. Jim Melton and Alan R. Simon.SQL 1999: Understanding Relational Language Components.First Edition, 1999.Morgan Kaufmann Publishers.

2. Don Chamberlin.Using the New DB2: IBM's Object-Relational Database System.First Edition, 1996.Morgan Kaufmann Publishers.
3. Database System Concepts Sixth Edition, by Abraham Silberschatz , Henry F Korth, S Sudarshan,Mc Graw-Hill Education
4. Fundamentals of Database Systems , Elmasri, Navathe, Sixth Edition , Addison-Wesley

Course Code	Course Title						Core/Elective
	Introduction to Data Structures						**Open Elective**
Prerequisites	Contact Hours per Week				CIE	SEE	Credits
	L	T	D	P			
PPS	3	-	-	-	30	70	03

Course Objectives:

- To develop basic understanding of time and space complexity of an algorithm
- To understand need of data structures for efficient storage and easy access of data.
- To introduce basic linear data structures and operations on them.
- To introduce non-linear data structures and their representations.
- To understand various sorting and searching techniques and their efficiency.

Course Outcomes:

After completing this course, students will be able to:

- Emphasize on need of data structure in writing efficient algorithms.
- Distinguish between linear and non-linear data structures and their applications in real world problems.
- Explain representation of different data structures in computer systems.
- Explain different operations on data structures and write algorithms for them.
- Explain different sorting techniques and write algorithms for them.

Unit – I:

Algorithms: Definition, Algorithm Specifications, Performance Analysis of an Algorithm – Time and Space Complexity, Asymptotic Notations.

Introduction to Data Structures – Definition, Basic Concepts, Implementation of Data Structures.

Arrays: Definition, Terminology, One-Dimensional Arrays, Memory Allocation and Basic Operations on arrays.

Unit – II:

Stacks: Introduction, Definition, Representation of a Stack, Operations on a Stack, Applications of a Stack: Recursion, and Evaluation of an Arithmetic Expression.

Queues: Introduction, Definition, Representation of a Queue, Various Queue Structures: Circular Queue, Deque.

Unit – III:

Linked Lists: Definition, Single Linked List – Representation and basic Operations, Circular Linked List, Double Linked List, Implementing Stack and Queue using Linked List.

Unit – IV:

Trees – Basic Terminologies, Definition, Representation of Binary Trees, Operations on Binary Trees, Binary Search Trees.

Graphs: Introduction, Terminology, Representation of Graphs, Graph Traversal Techniques, Minimum Spanning Cost Trees.

Unit – V:

Searching and Sorting: Linear Search, Binary Search, and its complexity analysis, Sorting Algorithms: Selection Sort, Bubble Sort, Insertion Sort, and Merge Sort – and their complexity analyses.

Suggested Readings:

1. Classic Data Structures, Debasis Samanta, SecondEdition, PHI, 2006.
2. Fundamentals of Data structures in C, Second Edition, E. Horowitz, S. Sahni and Susan, Anderson-Freed, Universities Press, 2007.