65401

LINUX PROGRAMMING

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To develop the skills necessary for systems programming.
2. To model asynchronous event handling.
3. To establish efficient communication between two asynchronous processes.
4. To design various client & server communication models.

UNIT I - Korn Shell Programming, Text Processing Utilities and Files

Basic Script Concepts, Expressions, Decisions: Making Selections, Repetition, Special Parameters and Variables, Changing Positional Parameters, Argument Validation, Control Structures and select. Text Processing Utilities – grep, make utility.

Files: Files concept, File System Structure, I-nodes, File Attributes, File types, kernel support for files, file descriptors, low level file Access- File structure related system calls (File APIs), Directory file APIs.

UNIT II – Process and Signals

Process: Process concept, Kernel support for process, process attributes, process control - process creation, waiting for a process, process termination, zombie process, orphan process APIs.

Signals: Introduction to signals, Signal generation and handling, Kernel support for signal, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, and abort and sleep functions.

UNIT III - IPC, Message Queues, Semaphores and Shared Memory

IPC: Introduction to IPC, Pipes, FIFOs. Message Queues - Kernel support for messages, Unix System V APIs for messages, client/server example. Semaphores - Kernel support for semaphores, Unix System V APIs for semaphores. Shared Memory - Kernel support for shared memory, Unix system V APIs for shared memory, semaphore and shared memory example.

UNIT IV – Socket Programming

Sockets: Introduction to Sockets, Socket Addresses, Socket system calls for connection oriented protocol and connectionless protocol, example, client/server programs.

UNIT V – Multithreaded Programming and Advanced I/O

Multithreaded Programming: Differences between threads and processes, Thread structure and uses, Threads and Lightweight Processes, POSIX Thread APIs, Creating Threads, Thread Attributes, Thread Synchronization with semaphores and with Mutexes, Example programs.
Advanced I/O: Introduction, Non-Blocking I/O, Record Locking, I/O Multiplexing, select and pselect functions, Poll Function, Asynchronous I/O, POSIX Asynchronous I/O readv and writev functions, readn and writen-functions, Memory-Mapped I/O.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Make use of well-defined Korn shell utilities and develop menu driven Text processing Application.
CO 2 : Appreciate process abstraction and asynchronous event handling using signals.

CO 3 : Implement IPC Mechanisms, Messages Queues and synchronize the access patterns as a shared memory.
CO4 : Design concurrent server programs based on various design alternatives.
CO5 : Implement multi-threaded based server and I/O Multiplexing mechanisms.

Text Books:

1. Behrouz A. Forouzan, Richard F. Gilberg, *UNIX and shell Programming*, Cengage Learning.
2. W Richard Stevens and Stephen A Rago, *Advanced Programming in the UNIX Environment*, 3rd Edition, Addison Wesley / Pearson Education Inc., 2013.
3. T.Chan, *Unix System Programming using C++*, PHI.

References:

1. W R Stevens, *Unix Network Programming*, PHI.
2. Uresh Vahalia, *Unix Internals: The New Frontiers*, Pearson Education.
3. Graham Glass and King Ables, *Unix for Programmers and Users*, 3rd Edition, Pearson Education.

65402

DATA WAREHOUSING AND DATA MINING

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To demonstrate the value of Data mining in solving real-world problems.
2. Demonstrate Understanding of foundational concepts underlying Data mining.
3. Demonstrate Understanding of algorithms commonly used to perform various Data mining tasks.

UNIT I – Introduction to Data Mining and Data Warehouse

Fundamentals of Data mining, Data Mining Functionalities, Classification of Data Mining systems, Data Mining task Primitives, Data Warehouse, Integration of a Data Mining System with a Database or a Data Warehouse System, Multidimensional Data Model, A three tier Data Warehouse Architecture, OLAP Technology for Data Mining.

UNIT II – Association Rule Mining

Data Characterization, Data Discrimination, Attribute-Oriented Induction.
Association Rule Mining: Basic Concepts, Efficient and Scalable Frequent Itemset Mining methods. Mining various kinds of Association rules, from Association Analysis to Correlation Analysis, Constraint-based Association Mining.

UNIT III - Classification and Prediction

Classification**:** Introduction to Classification and Prediction, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule based classification, Support Vector Machines, Associate Classification, Lazy Learners, and Other Classification Methods.

Accuracy and Error measures: Evaluating the accuracy of a classifier or a predictor, Ensemble Methods.

UNIT IV – Cluster Analysis

Introduction to Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Classical Partitioning methods: K-Means and K-Medoids, Hierarchical Method-BIRCH, Density-Based Methods: DBSCAN and DENCLUE, Grid-Based Methods: STING, Model-Based Clustering Methods-Expectation Maximization, Clustering High-Dimensional Data: PROCLUS, Outlier Analysis.

UNIT V – Time Series, Text and Web Mining

Mining Time-series data, Mining sequence patterns in Transactional Databases, Text Mining, Mining the World Wide Web, VIPS and HITS algorithms.

Applications and Trends in Data Mining: Data Mining Applications, Major issues and challenges in Data Mining, Social Impacts of Data Mining.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Understand different data mining tasks and apply the algorithms most appropriate for addressing them.
CO 2 : Discover and Analyze interesting patterns from different kinds of databases.
CO 3 : Apply the techniques of classification and prediction to build and use supervised learning from datasets.

CO4 : Apply the techniques of clustering to implement unsupervised learning systems.
CO5 : Understand nature of time-series, web and text data to develop methodologies and application for such data analysis and mining.

Text Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, *Data Mining Concepts and Techniques*, 3rd Edition, Morgan Kaufmann Publishers/Elsevier, 2011.

References:

1. Arun K Pujari, *Data Mining Techniques*, 2nd Edition, University Press, 2013.
2. Pang Ning Tan, Michael Steinbach and Vipin Kumar, *Introduction to Data Mining,* Pearson Education, 2007.
3. Sam Anahory and Dennis Murray, *Data Warehousing in the Real World*, Pearson Education Asia, 2011.

65403

DEEP LEARNING

(Professional Elective II)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To know the Characteristics and principles of deep neural networks and CNN.
2. To model building through different learning techniques
3. To know the Vectorization Deep models and Feature Engineering

UNIT I - Foundations of Neural Networks and Deep Learning

Neural Networks, activation function, loss function, hyper parameters, Definition-Deep learning, Architectural Principles, Building blocks of Deep networks, RBMs, Auto encoders.

UNIT II - **Architectures of deep Networks**

Unsupervised pretrained Networks, Deep Belief Networks, Generative Adversial Networks, CNN, Architecture, Input layer, Convolutional Layers, Recurrent Neural networks, Recursive Neural Networks, Modeling CSV data with Multilayer Perceptron, Modeling Handwritten images using CNN.

UNIT III - Concepts of Tuning Deep Networks

An Intuition for Building Deep Networks, Matching Input data and Network Architectures, Relating Model Goal and Output layers, Weight Initialization, Loss Function, Learning rates and Recommendations, Optimization methods, How to use Regularization.

UNIT IV - Tuning Specific Deep Network Architectures

Common Convolutional Architectural Patterns, Configuring Convolutional Layers, Configuring Pooling Layers, Transfer Learning, Network Input Data and Input Layers, Output Layers and RNN Output Layer, Training the Network, Padding and Masking.

UNIT V - Vectorization

Introduction to vectorization, Why do we need to vectorize Data, Feature Engineering and Normalization techniques, Vectorizing Image data, Image data Representation, Working with sequential data, Working with Text in Vectorization.

Course Outcomes: At the end of the course, the student should be able to

CO1	:	Use Deep networks for solving different problems related to data visualization.
CO2	:	Formalize tasks in terms of Computational Complexity via neural networks and Deep Learning architectures.
CO3	:	Design deep learning models to solve data-rich tasks.
CO4	:	Build datasets, tune and train deep learning models with deep learning libraries.
CO5	:	Understand the inner mechanisms of Deep learning neural techniques during training process and Vectorization.

Text Books:

1. Josh Patterson and Adam Gibson "*Deep Learning- A Practitioners approach*, O'reilly 2017.
2. Nikhil Budum, Nicholas Locascio, *Fundamentals of Deep learning*, 2017.

References:

1. Jacek M. Zurada, *"Introduction to Artificial Neural Systems"*, Jacek M. Zurada, PWS Publishing Company, 1995.
2. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc., 2015.
3. Yoshua Bengio, Learning Deep Architectures for AI, Foundations and Trends in Machine Learning, Yoshua Bengio, Now Publishers, 2009.

65404

VIRTUAL REALITY

(Professional Elective II)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To understand Virtual reality concepts
2. To Demonstrate understanding of the classic components of a VR system, Human Factors, Applications.
3. Understanding how to do Modeling, model management, VR programming.

UNIT I - Introduction

The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.
(1.1, 1.3 and 1.5 of TextBook (1))

UNIT II - Input Output Devices

Trackers, Navigation, and Gesture Interfaces – Three dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. Graphics displays, sound displays and haptic feedback.
(2.1, 2.2 and 2.3, 3.1,3.2 & 3.3 of Text Book (1)).

UNIT III - Modeling

Geometric modeling, kinematics modeling, physical modeling, behavior modeling, model management.
(5.1, 5.2 and 5.3, 5.4 and 5.5 of Text Book (1)).

UNIT IV - Human Factors and Applications

Methodology and terminology, user performance studies, VR health and safety issues. Medical applications, military applications, robotics applications
(7.1, 7.2, 7.3, 8.1, 8.3 and 9.2 of Text Book (1)).

UNIT V - VR Programming

Introducing Java 3D, loading and manipulating external models, using a lathe to make shapes. 3D Sprites, animated 3D sprites, particle systems
(Chapters 14, 16 and 17, 18, 19 and 21 of Text Book (2))

Course Outcomes: At the end of the course, the student should be able to

CO1 : Know the fundamentals of Virtual Reality
CO2 : Understanding the components of VR
CO3 : Can exhibit proficiency with Modeling, types, Model management
CO4 : Applications of VR and their Issues to be concentrated.
CO5 : Understand the Java 3D

Text Books:

1. Gregory C. Burdea and Philippe Coiffet, *Virtual Reality Technology*, John Wiley and Sons, Inc (Wiley Inter Science), Second Edition, 2006.
2. Andrew Davison, *Killer Game Programming in Java*, Oreilly-SPD, 2005.

References:

1. William R.Sherman, Alan Craig, *Understanding Virtual Reality, interface, Application and Design*, Morgan Kaufmann, 2008.
2. Bill Fleming, *3D Modeling and surfacing*, 1st Edition, Morgan Kauffman, 2019.
3. David H.Eberly, *3D Game Engine Design*, 1st Edition, Elsevier, 2006.

65405

SEMANTIC WEB AND SOCIAL NETWORKS

(Professional Elective II)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To learn Web Intelligence
2. To learn Knowledge Representation for the Semantic Web
3. To learn Ontology Engineering
4. To learn Semantic Web Applications, Services and Technology
5. To learn Social Network Analysis and semantic web

UNIT I: Web Intelligence

Thinking and Intelligent Web Applications, The Information Age ,The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

UNIT II: Knowledge Representation for the Semantic Web

Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework(RDF) / RDF Schema, Ontology Web Language(OWL), UML, XML/XML Schema.

UNIT III: Ontology Engineering

Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

UNIT IV: Semantic Web Applications, Services and Technology

Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base ,XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

UNIT V: Social Network Analysis and semantic web

What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Course Outcomes: At the end of the course, the student should be able to

CO1 : Understand the basics of Semantic Web and Social Networks.
CO2 : Understand and knowledge representation for the semantic web.
CO3 : Create ontology.
CO4 : Develop social-semantic applications.
CO5 : Build blogs and social networks.

Text Books:

1. Berners Lee, Godel and Turing, *Thinking on the Web*, Wiley inter science, 2008.
2. Peter Mika, *Social Networks and the Semantic Web*, Springer, 2007.

References:

1. J. Davies, R. Studer, P. Warren, *Semantic Web Technologies*, Trends and Research in Ontology Based Systems, John Wiley & Sons. 2006.
2. Heiner Stuckenschmidt, Frank Van Harmelen*, Information sharing on the semantic Web*, Springer Publications. 2005 Edition.
3. T. Segaran, C. Evans, J. Taylor, *Programming the Semantic Web*, O'Reilly, SPD. 2009

65406

VISUAL PROGRAMMING

(Professional Elective II)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To know the elements of the .NET Framework and work effectively with Visual Studio.NET
2. To develop applications for the .NET Framework using C# and deploy C# Applications
3. Use C# debugging techniques.

UNIT I – Introduction to .NET Framework and Visual Studio.NET

Introduction to .NET Framework – The .Net Framework, C# language.

Visual Studio.NET - using the Visual Studio IDE.C# Language and Syntax – Data Types, Variables, Constants, Operators, Casting, Control Structures, Conditionals, Loops, Namespaces, Preprocessor Directives, Keywords, Strings and Regular Expressions.

UNIT II – Overview of Object Oriented Programming for C#

Classes and Objects – Constructing and Initializing objects, Properties, Indexers, Methods and Constructors, Parameter Passing to Methods and Constructors, Abstraction, Encapsulation, Static fields and methods. Inheritance – Overview, Controlling accessibility, Overloading, Method Hiding. Interfaces – Overview, Using .NET provided interfaces, Writing and using your own interfaces. Polymorphism – Overview, Dynamic vs. Static Binding, Abstract Classes, Generics – Generic Features, Generic Methods, Arrays and Tuples, Delegates and Events.

UNIT III – Reflection, Web application Development

Reflection, Assemblies – Features, Structure, Types – Shared and Private, C# Collections introduction Collections, List<T>, HashSet<T>, SortedSet<T> , Stack<T> , Queue<T>, LinkedList<T> Web Application Development – Getting Started with ASP.NET 4.5.1, Building ASP.NET Website, Designing your Webpage, Working with ASP.NET Server Controls-Types.

UNIT IV – Creating consisting looking websites, Databases, LINQ

Creating consisting looking websites – Master Page, Content Page, Page Life cycle, Navigation – Navigation Controls, Routing & Redirection, Validating User Input, Processing data at server, Databases – Installation of Server 2012, Retrieving and manipulating data with SQL, LINQ – Language Integrated Query.

UNIT V – ADO.NET

ADO.NET – Overview of ADO.NET, Evolution from ADO, Concepts, Using Database Connections. Working with Stored Procedures, Data Reader, Managing Data and Relationships, Datasets – Structure, Using a Datasets, Typed Datasets, Populating the Datasets, Persisting Dataset changes. Deploying the website –Preparing for deployment, Running under IIS.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Understand basics of .Net Framework and using Visual studio.Net.
CO 2 : Create Object Oriented Programs using C#

CO 3 : Work with public, private libraries and build web applications using ASP.Net
CO 4 : Create Websites and understand the Language Integrated Query (LINQ) database.
CO 5 : Understand terminology and providers associated with ADO.NET

Text Books:

1. Christian Nagel, Jay Glynn and Morgan Skinner, *Professional C# 5.0 and .NET 4.5.1*, John Wiley & Sons Inc., 2014.
2. Imar Spaanjaars, *Beginning ASP.net 4.5.1in C# and VB*, Wrox Publication, 2014.

References:

1. John Sharp, *Microsoft Visual C# Step by Step*, O'Reilly Media, Inc., 2013.
2. Randal Root and Mary Romero Sweeney, *A Tester's Guide to .NET Programming*, Apress, 2006.

65407

WIRELESS NETWORKS AND MOBILE COMPUTING

(Professional Elective II)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To provide an introduction to mobile and wireless computing.
2. To provide a basic understanding of how the communication networks are planned, Managed, administered and operated.
3. To understand Communication management networks, protocols, modeling, network management applications such as configuration, fault and performance management.

UNIT I - Introduction to Network Technologies and Cellular Communications:

Infrared vs. Radio Transmission, Infrastructure and Ad Hoc Networks, GSM - Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. Mobile Computing (MC) - Introduction to MC, novel applications, limitations, and architecture, Bluetooth - User Scenarios, Physical Layer, MAC layer, Networking, Security, Link Management.

UNIT II - Medium Access Control

Motivation for a specialized MAC (Hidden and exposed terminals, near and far terminals), SDMA, FDMA, TDMA, CDMA, MAC protocols for GSM, Wireless LAN (IEEE802.11), collision Avoidance (MACA, MACAW) protocols.

UNIT III - Mobile IP Network Layer:

IP and Mobile IP Network layers, Packet Delivery and Handover Management, Location Management Registration, tunneling and encapsulation, Dynamic Host Configuration Protocol (DHCP).

UNIT IV - Mobile Transport Layer

Conventional TCP/IP Protocols, Indirect TCP, Snooping TCP, Mobile TCP, Other transport Protocols for Mobile Networks

UNIT V – Mobile Ad hoc Networks (MANETs):

Introduction, applications and challenges of a MANET, applications. Classification of Routing algorithms, algorithms such as DSR, AODV, DSDV, etc., Mobile agents and service discovery

Course Outcomes: At the end of the course, the student should be able to

CO1 : Apply advanced data communication methods and networking protocols for wireless and mobile environment.
CO2 : Utilize and employ application frame works for developing mobile applications including under disconnected and weakly connected environment.
CO3 : Select components and networks for particular application.
CO4 : Understand issues related to client server computing with adaptation, power aware and context aware computing and MANET Protocols.
CO5 : Have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support.

Text Books:

1. Jochen Schiller, *Mobile Communications*, 2nd Edition, Addison-Wisley, 2004
2. Reza Behravanfar, *Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML*, Cambridge University Press, October 2004.

References:

1. RajKamal, *Mobile Computing*, Oxford University Press, 2007.
2. William Stallings, Wireless Communication and Networking, PHI, 2003.

65408

DIGITAL IMAGE PROCESSING AND PATTERN RECOGNITION

(Professional Elective III)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To impart adequate background knowledge about image processing and pattern recognition.
2. To demonstrate knowledge and skills required for image processing and pattern recognition tools.
3. To offer necessary knowledge to design and implements a prototype of an image processing and pattern recognition application.

UNIT I - Fundamental of Digital Image Processing

Fundamental steps of image processing, components of an image processing of system. The image model and image acquisition, sampling and quantization, relationship between pixels, distance functions, Statistical and spatial operations, Intensity functions transformations, histogram processing, smoothing & sharpening – spatial filters. Frequency domain filters, homomorphic filtering, image filtering & restoration. Inverse and Weiner filtering, FIR Weiner filter.

UNIT II - Image Segmentation

Morphological and other area operations, basic morphological operations, opening and closing operations, dilation erosion, Hit or Miss transform, morphological algorithms, extension to grey scale images. Segmentation and Edge detection region operations, basic edge detection, second order detection, crack edge detection, gradient operators, compass and Laplace operators, edge linking and boundary detection, thresholding, region-based segmentation, segmentation by morphological watersheds.

UNIT III – Image Compression and Security

Image compression: Types and requirements, statistical compression, spatial compression, contour coding, quantizing compression, image data compression-predictive technique, pixel coding, transfer coding theory, lossy and lossless predictive type coding, Digital Image Water marking.

UNIT IV – Image Representation and Description

Representation and Description: Chain codes, Polygonal approximation, Signature Boundary Segments, Skelton's, Boundary Descriptors, Regional Descriptors, Relational Descriptors, Principal components for Description, Relational Descriptors.

UNIT V - Pattern Recognition and Classification

Pattern Recognition Fundamentals: Basic Concepts of pattern recognition, Fundamental problems in pattern recognition system, design concepts and methodologies, example of automatic pattern recognition systems, a simple automatic pattern recognition model

Pattern classification: Pattern classification by distance function: Measures of similarity, Clustering criteria, K-Means algorithm, Pattern classification by likelihood function: Pattern classification as a Statistical decision problem, Bayes classifier for normal patterns.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Apply pixel relationship and color model to images
CO 2 : Outline the basics of filtering for image enhancement in the spatial and frequency domain.
CO 3 : Summarize the procedure for restoring degraded images and segmentation.
CO 4 : Do image representation and description.
CO 5 : Perform the classification of patterns

Text Books:

1) Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Third edition, Pearson Education, 2017.
2) Julus T. Tou, and Rafel C. Gonzalez, *Pattern recognition Principles*, 1st Edition, Addision-Wesley Publishing Company, 1974.

References:

1) Anil K. Jain, *Fundamentals of digital image processing*, 1st Edition, Prentice Hall of India, 2004.
2) Richard Duda, Hart and David Strok, *Pattern classification*, 2nd Edition, John Wiley publishers, 2001.
3) S.Jayaraman, S. Esakkirajan and T.Veerakumar, *Digital Image Processing*, 1st Edition, TMH, 2016.

65409

CYBER SECURITY

(Professional Elective III)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. Appraise the current structure of cyber security roles across the DoD enterprise, including the roles and responsibilities of the relevant organizations.
2. Evaluate the trends and patterns that will determine the future state of cyber security

UNIT I – Digital Securities

Introduction, Types of Attacks, Digital Privacy, Online Tracking, Privacy Laws, Types of Computer Security risks (Malware, Hacking, Pharming, Phishing, Ransomware, Adware and Spyware, Trojan, Virus, Worms, WIFI Eavesdropping, Scareware, Distributed Denial-Of-Service Attack, Rootkits, Juice Jacking), Antivirus and Other Security solution, Password, Secure online browsing, Email Security, Social Engineering, Secure WIFI settings, Track yourself online, Cloud storage security, IOT security, Physical Security Threads.

UNIT II - Online Anonymity

Anonymous Networks, Tor Network, I2P Network, Freenet, Darknet, Anonymous OS – Tails, Secure File Sharing, VPN, Proxy Server, Connection Leak Testing, Secure Search Engine, Web Browser Privacy Configuration, Anonymous Payment

UNIT III - Cryptography and Secure Communication

The Difference Between Encryption and Cryptography, Cryptographic Functions, Cryptographic Types, Digital Signature, The Difference Between Digital Signatures and Electronic Signatures, Cryptographic Systems Trust Models, Disk Encryption Using Open Source Tools, Multitask Encryption Tools, Attacking Cryptographic Systems, Countermeasures Against Cryptography Attacks, Securing Data in Transit, Cloud Storage Encryption, Encrypt DNS Traffic and Email Communication

UNIT IV - Cyber Crime

Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: Social Engineering, Categories of Cyber Crime, Property Cyber Crime.

UNIT V - Digital Forensics

Introduction to Digital Forensics, Forensic Software and Hardware, Analysis and Advanced Tools, Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Identify security risks and take preventive steps
CO 2 : Apply the security tools and analysis of attacks in the network.
CO 3 : Exploring different security solution to counter the attacks in Internet.
CO 4 : Investigate cybercrime and collect evidences
CO 5 : Use knowledge of forensic tools and software

Text Books:

1. Nihad Hassan and Rami Hijazi, *Digital Privacy and Security Using Windows: A Practical Guide*, Apress, 2015.

References:

1. Nasscom, *Digital Forensics*, DSCI, 2012.
2. Nasscom, *Cyber Crime Investigation*, DSCI, 2013.

65410

MINING MASSIVE DATASETS

(Professional Elective III)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To get know the latest technologies and algorithms for mining massive data sets.
2. To impart knowledge about big data processing, the purpose of map reduce in scaling data mining applications and problems inherent to handle massive data sets.
3. To expose similarity and dissimilarity measures, stream data processing and machine learning models to extract knowledge from massive data sets.

UNIT I – MapReduce

Introduction to distributed file systems, Map-reduce, Algorithms using MapReduce Extension to MapReduce, Communication cost model, Complexity theory for MapReduce.

UNIT II – Similarity Measures

Finding similar items, Page rank, Matrix factorization, Shingles, Minhashing, Locality Sensitive Hashing families. Dissimilarity Measures - Distance Measures, Theory of Locality-Sensitive Functions, Methods for High Degrees of Similarity.

UNIT III – Stream Processing

Motivation, Sampling, Bloom filtering, Count-distinct using FM sketch, Estimating moments using AMS sketch. Dimensionality Reduction **-** Linear dimensionality reduction, PCA, SVD. Random projections, Johnson-Lindenstrauss lemma, JL transforms, sparse JL-transform. Random hashing, Clarkson-Woodruff algorithm.

UNIT IV – Large Scale machine learning

Machine learning model, perceptrons, support vector machines, and learning from nearest neighbor. Advertising on the web - issues in on-line advertising, on-line algorithms, and content based recommendations.

UNIT V – Mining Social Network Graphs

Introduction to social network graphs, clustering social network graphs, partitioning graphs, finding overlapping communities.

Course Outcomes: At the end of the course, the student should be able to

CO 1	:	Understand the concept data mining, Map reduce framework for Big data processing.
CO 2	:	Use the different similarity and dissimilarity measures while extracting the knowledge from massive data sets
CO 3	:	Identify algorithms for stream data analytics, and dimensionality reduction techniques
CO 4	:	Design algorithms to mine data using perceptrons, support vector machines, and also understand the concept of advertising on web
CO 5	:	Construct algorithms to extract data from social network graphs

Text Books:

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, *Mining of Massive Datasets*, 2nd edition, Cambridge University Press, 2014.
2. S. Boyd, N. Parikh, E. Chu, B. Peleato, and J. Eckstein, *Distributed optimization and statistical learning via the alternating direction method of multipliers*, 2011.

References:

1. Jimmy Lin and Chris Dyer. Morgan and Claypool, *Data Intensive Text Processing with MapReduce*, Morgan and Claypool publishers, 2010.
2. Tom White, *Hadoop: The definitive Guide*, 4th edition, O'reilly Press, 2015.

67407

SOFTWARE TESTING METHODOLOGIES

(Professional Elective – III)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
			Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Prerequisites:

1. Software Engineering

Course Objectives:

1. To acquire knowledge on basic principles, concepts on different testing techniques and methodologies and to demonstrate how they can uncover different errors (bugs).
2. To understand the taxonomy of bugs & testing and the stages at which different tests are to be performed.
3. To design the test cases and execute to uncover errors related to internal processing logic within modules, interfacing, and functionality of software.
4. To gain theory and knowledge to design and & implement testing tools with an aim to enhance the performance of testing.

Unit I – Introduction and Overview of Testing

Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs. Overview of Unit & integration testing, and white box & black box testing.

Unit II - Flow Graphs, Path Testing, Paths, Path Products and Regular Expressions

Flow Graphs, Path Testing: Basic concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.
Paths, Path Products and Regular Expressions: Path products and path expression, reduction procedure, applications, regular expressions and flow anomaly detection.

Unit III - Dataflow Testing and Domain Testing

Dataflow Testing: Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

Domain Testing: Domains and paths, domain testing, domains and interface testing, domains and testability.

Unit IV – Logic Based Testing, States, State Graphs and Transition Testing

Logic Based Testing: Overview, decision tables, path expressions, kv charts, specifications.
States, State Graphs and Transition Testing: Overview, state bugs, transition bugs, state testing.

Unit V - Graph Matrices and Application

Integration Testing, Graph Matrices and Application: Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools.

System and Acceptance Testing: Functional system testing, Non-functional system testing, Acceptance testing.

Testing Object Oriented Systems: Introduction to Object Oriented testing concepts, Differences in OO Testing.

Course outcomes: At the end of the course, the student will be able to

CO 1 : Apply basic concepts of testing, path testing, path expression, flow graph and predicate testing for testing code.
CO 2 : Acquire knowledge of domain errors, type's domain bugs and sources of domain errors.
CO 3 : Appreciate the purpose of logic-based testing using decision tables, reduction using KV charts and integration testing as a phase of testing.
CO 4 : Represent a problem using graph matrices, node reduction algorithm, understand the functional and non- functional system testing techniques.
CO 5 : Select test cases for Acceptance testing based on required criteria, and understand different concepts of Object Oriented testing.

Text Books:

1. Boris Beizer, Software Testing Techniques, 2nd Edition, Dreamtech, 2009.
2. Srinivasan D and Gopalaswamy R, Software Testing: Principles and Practices, Pearson Education, 2008.

References:

1. Sagar Naik, Software Testing and Quality Assurance: Theory and Practice, Wiley, 2008.
2. Edward Kit, Software Testing in Real World, Pearson Education, 2008.
3. E. William Perry, Effective methods of Software Testing, 3rd Edition, John Wiley, 2006.

65411

WEB SERVICES AND CLOUD COMPUTING

(Professional Elective III)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. This course aims to provide conceptual understanding of Service Oriented Architecture, its implementation using Web Services - SOAP & ReST, fundamentals of Cloud Computing, it's delivery models, Virtualization, Federation, Presence and various pressing issues related to Cloud Computing such as Security and Privacy.
2. It provides a deep drill down of all the critical concepts using a variety of case studies.
3. It provides an evaluation of various pros and cons of cloud computing technology and examines it's future direction, opportunities, risks and challenges.

UNIT I - SOA and Web Services

Overview of Service Oriented Architecture – SOA concepts, Key Service Characteristics, Technical Benefits of SOA. Introduction to Web Services– The definition of web services, basic operational model of web services, basic steps of implementing web services. Core fundamentals of SOAP – SOAP Message Structure, SOAP encoding, SOAP message exchange models. Describing Web Services –Web Services life cycle, anatomy of WSDL. Introduction to Axis– Installing axis web service framework, deploying a java web service on axis.

UNIT II – ReST based Web Services

Overview of Representational State Transfer (ReST) – URIs, Statelessness, Resource Oriented Architecture, Designing read-only ReST web service, Designing read-write ReST web service, ReST Benefits and Limitations.

UNIT III - Cloud Computing

Principles of Parallel and Distributed Computing, Introduction to cloud computing, Cloud computing architecture, cloud concepts and technologies, Cloud benefits and challenges, Cloud service delivery models – Infrastructure as a Service, Platform as a Service, Software as aService, Cloud deployment models – public, private, hybrid. Case Study: Amazon cloud and its ReST web services, Google App Engine, Microsoft Azure.

UNIT IV – Virtualization

Virtualization- Characteristic features, Taxonomy, Hypervisors, Virtualization and Cloud Computing, Pros and Cons of Cloud Computing. Case Studies: Xenpara-virtualization, VMWare full virtualization.

UNIT V - Federation, Presence, Security and Privacy in the Cloud

Federation in the cloud, Presence in the cloud, Privacy and its relation to cloud based information system, Cloud security challenges, Software-as-a-Service security.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Acquire the basic knowledge on Service Oriented Architecture and fundamentals of SOAP & WSDL in defining Web Services.
CO 2 : Learn about ROA and ReST based Web Services.
CO 3 : Understand the basics of Cloud Computing and explore case studies like Amazon Cloud, Google App Engine, and Micosoft Azure.

CO 4 : Learn about Virtualization and case studies like Xen-Para Virtualization, VMWare Full Virtualization.
CO 5 : Learn about Federation, Presence, Security and Privacy in the Cloud and also know about the challenges faced in the Cloud.

Text Books:

1. R. Nagappan, R. Skoczylas and R.P. Sriganesh, *Developing Java Web Services*, Wiley India, 2008**.**
2. Raj Kumar Buyya, James Broberg and Andrzej M Goscinski, *Cloud Computing: Principles and Paradigms*, Wiley, 2013.

References:

1. Michael P. Papazoglou, *Web Services & SOA: Principles and Technology*, 2nd Edition, Pearson, January, 2012.
2. Leonard Richardson and Sam Ruby, *ReSTful Web Services*, 1st Edition, O'Reilly, July, 2011.
3. Raj Kumar Buyya, Christian Vecchiola and S Thamarai Selvi, *Mastering Cloud Computing*, McGraw-Hill, February, 2013.
4. John W. Rittinghouse, and James F. Ransome, *Cloud Computing: Implementation Management and Security*, 1st Edition, CRC Press, August, 2009.

65431

LINUX AND SHELL PROGRAMMING LAB

Instruction	:	2 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	1	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To make the students to learn Linux shell programming
2. To realize the operating system principles and abstractions.

LIST OF EXPERIMENTS:

1. Write a shell script that accepts a file name, starting and ending line numbers as arguments and displays all the lines between the given line numbers.
2. Write a shell script that deletes all lines containing a specific word in one or more files supplied as arguments to it.
3. Write a shell script that displays a list of all files in the current directory to which the user has read, write and execute permissions.
4. Write a C program to implement "ls –ls" command.
5. Write a C program which creates a child process and the parent waits for child's exit.
6. Write a C program to demonstrate the difference between the fork and vfork system calls.
7. Write a C program in which main process creates a child process and registers a signal handler to get the exit status of the child asynchronously.
8. Implement ` ls|wc -l -c –w ' command using pipe and exec functions.

9. Establish bidirectional communication between sender program and receiver program using multiple FIFO's.
10. Implement SVR based Message Queue IPC mechanism to establish asynchronous communication between two communicating processes.
11. Implement the following communication model:
    a) Process 1 creates a Message Queue resource.
    b) Process 2 enacts the server role
    c) Process 3 and 4 are clients
    d) Process 3 seeks 'isprime' service from the server by inserting the payload in the message queue
    e) Process 4 seeks 'iseven' service form the server by inserting the payload in the message queue
    f) Server retrieves the service request from the Message queue and inserts the reply
    g) Intended Client retrieves the response.

12. Implement client/server model using socket API
13. Implement a concurrent server using fork based model while avoiding the zombie state of the client.
14. Implement a concurrent server model using pthread API
15. Solve the producer consumer problem using pthread API

Course Outcomes: At the end of the course, the student should be able to

CO1 : Develop and implement Linux shell programs
CO2 : Write programs to implement shell commands and use IPC mechanisms for realizing scalable applications.
CO3 : Model the process abstraction and process control.
CO4 : Implement and deploy client-server applications while utilizing relevant System calls.
CO5 : Implement concurrent programs using process and thread API and establish communication among them.

65432

DATA MINING LAB

Instruction	:	2 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	1	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To make the students to learn and use Data Mining tools.
2. To impart skill to build Machine Learning Models using Python libraries.

List of Tasks:

1. Implement the following subtasks on the German Credit Data set.
   a) List all the categorical (or nominal) attributes and the real-valued attributes separately.
   b) Identify missing values in a given data set.
   c) Identify Null values in a given data set.
2. Implement Discretization Concept on Numerical Attribute.
3. Discuss about Filters on Supervised and Unsupervised Learning.
4. Apply Apriori Frequent Item Set Mining Algorithm on Weather nominal dataset.
   a) List the top 10 Association rules. (Check the results for different support and confidence threshold values) using Weka.
5. Apply FP-growth Frequent Item Set Mining Algorithm on Super Market dataset.
   a) List the top 10 Association rules. Check the results for different support and confidence threshold values using Weka.
6. Construct a Naïve Bayesian Classifier Model on IRIS Data set. Test the build Classification Model Using 10-fold cross validation. Comment on the performance of the Constructed Classification Model using Weka.
7. Construct a Decision Table for Rule based Classifier on Soybean Data set. Test the build Classification Model Using 10-fold cross validation. Comment on the performance of the Constructed Classification Model using Weka.
8. Construct an EM Model on Diabetes Data set. Comment on the performance of the Clustering Model using Weka.
9. Construct a Simple K-Means Model on Vote Data set. Comment on the performance of Clustering Model using Weka.
10. Construct a Naïve Bayesian Classifier Model on Vote Data set. Test the build Classification Model Using 5-fold cross validation using Python Scikit Learn.
11. Apply the Hierarchical Clustering Technique on Weather dataset and comment on the performance of the algorithm using Python Scikit Learn.
12. Create a Data Set of 30 instances characterized by four attributes (income, age, expenditure, assets) in arff format. Apply K-Means Clustering technique on the generated Data set. Compute the performance of K-Means algorithm against hierarchal Clustering algorithm using Python Scikit Learn.
13. Apply the Decision Table Rules Classification Technique on Soybean dataset and comment on the performance of the algorithm using Python Scikit Learn.
14. Construct a J48 Trees Classifier Model on Weather Numeric Data set. Test the build Classification Model Using 10-fold cross validation. Comment on the performance of the Constructed Classification Model using Python Scikit Learn.
15. Construct a EM Model on Diabetes Data set. Comment on the performance of the Clustering Model using Python Scikit Learn.
16. Construct a Cobweb Model on IRIS Data set. Comment on the performance of the Clustering Model using Python Scikit Learn.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Pre-process the dataset for data analysis and mining.
CO 2 : Use WEKA tools for discovering various types of knowledge such as Association rules, Classification and clustering models.
CO 3 : Build Machine Learning Models in Python using libraries such as Scikit learn.

65451

NATURAL LANGUAGE PROCESSING

(Professional Elective IV)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To show how language related algorithms and techniques can be applied to important real-world problems (Spell Checking, Text Document Search, Part-of-Speech Tagging).
2. To introduce to some of the problems and solutions of NLP and their relation to linguistics and statistics.

UNIT - I

Finding the Structure of Words: Words and Their Components, Issues and Challenges, Morphological Models Finding the Structure of Documents: Introduction, Methods, Complexity of the Approaches, Performances of the Approaches.

UNIT - II

Syntax Analysis: Parsing Natural Language, Treebanks: A Data-Driven Approach to Syntax, Representation of Syntactic Structure, Parsing Algorithms, Models for Ambiguity Resolution in Parsing, Multilingual Issues.

UNIT - III

Semantic Analysis: Introduction, Meaning Representation, Lexical Semantics, Ambiguity, Word Sense Disambiguation.

UNIT - IV

Discourse Processing: Cohesion, Reference Resolution, Discourse Cohesion and Structure. **Language Modeling:** Introduction, N-Gram Models, Language Model Evaluation, Parameter Estimation, Language Model Adaptation, Types of Language Models, Language-Specific Modeling Problems.

UNIT - V

Natural Language Generation: Introduction, Architectures of NLG systems, Generation tasks and Representations, Applications of NLG.

Machine Translation: Introduction, Problems in Machine Translation, Characteristics of Indian Languages, Machine Translation approaches, Direct Machine Translation**,** Rule-Based Machine Translation, Corpus-based Machine Translation, Knowledge-based Machine Translation systems.

Course Outcomes: After completion of course, students will be able to

CO 1	:	Understand parts- of- speech tagger based on HMMs and transformation based learning.
CO 2	:	Able to construct statistical models over strings and trees using supervised and unsupervised training methods.
CO 3	:	Able to design, implement, and analyze NLP algorithms.
CO 4	:	Understand how a system would able to communicate with humans via language.
CO 5	:	Able to design different language modeling Techniques

Test Books:

1. Daniel Jurafsky & James H Martin, *Speech and Natural Language Processing*, 2nd Edition, Pearson Publications, 2008.
2. Tanvier Siddiqui, U.S. Tiwary, *Natural Language Processing and Information Retrieval*, Oxford University Press, 2008.

References:

1. Steven Biord, Ewan Klein and Edward Loper, "*Natural Language Processing with Python" Analyzing text with Natural Language Toolkit*", O'Reilly Media, Inc, June 2009.

65452

ETHICAL HACKING

(Professional Elective IV)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

2. To understand numerous methods of real-world information intelligence.
3. To learn about vulnerability scanners.
4. To understand techniques used to sniff traffic across a network.
5. To familiarize with the methodologies that can be used to hack into a target.
6. To appreciate the wide variety of attacks that can be performed against a wireless network

UNIT I - Introduction To Hacking

Terminologies, Categories of Penetration Test, Writing Reports, Structure of a Penetration Testing Report, Vulnerability Assessment Summary, Risk Assessment, Methodology.

UNIT II - Information Gathering Techniques

Active, Passive and Sources of information gathering, Copying Websites Locally, NeoTrace, Cheops-ng, Intercepting a Response, WhatWeb, Netcraft, Basic Parameters, Xcode Exploit Scanner, Interacting with DNS Servers, Fierce, Zone Transfer with Host Command and Automation, DNS Cache Snooping- Attack Scenario, Automating Attacks, SNMP - Problem, Sniffing Passwords.

UNIT III - Network Sniffing

Introduction to Vulnerability Assessment - Pros and Cons, NMap, Updation of database, Testing SCADA Environments with Nmap, Nessus, Sniffing: Types, Hubs versus Switches, Modes, MITM Attacks, ARP Protocol Basics- working, Attacks, DoS Attacks, Dsniff tool, Using ARP Spoof to Perform MITM Attacks, Sniffing the Traffic with Dsniff, Sniffing Pictures with Drifnet, Urlsnarf and Webspy, Sniffing with Wireshark, Ettercap- ARP Poisoning, Hijacking Session with MITM Attack, ARP Poisoning with Cain and Abel, Sniffing Session Cookies with Wireshark, Hijacking the Session

UNIT IV - Basics Of Exploitation

Remote Exploitation: Understanding Network Protocols, Attacking Network Remote Services, Common Target Protocols, tools for cracking network remote services, Attacking SMTP, Attacking SQL Servers

UNIT V – Wireless Hacking

Wireless Hacking : Requirements , Aircracking , Hidden SSIDs , Monitor Mode , Monitoring Tool-Beacon Frames on Wireshark ,Airodump-ng , Wireless Adapter in Monitor Mode , Determining the Target , Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng , Capturing Packets and Four-Way

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Understand the core concepts related to malware, hardware and software vulnerabilities and their causes.
CO 2 : Understand ethics behind hacking and vulnerability disclosure

CO 3 : Appreciate the Cyber Laws and impact of hacking
CO 4 : Exploit the vulnerabilities related to computer system and networks using state of the art tools and technologies.
CO 5 : Analyze and trouble shoot the problems related to system or network security issues.

Text Books:

1. Rafay Baloch, *Ethical Hacking and Penetration Testing Guide*, CRC Press, 2015.

References:

2. Patrick Engebretson, *The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy*, Syngress Media, Second Revised Edition, 2013.
3. Michael T. Simpson, Kent Backman and James E. Corley, *Hands On Ethical Hacking and Network Defense*, Cengage Learning, 2012.

65453

SOFT COMPUTING

(Professional Elective IV)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To enable students to understand and use soft computing Techniques for problem solving.
2. To understand hybrid systems that use combination of soft computing techniques and apply them to solve complex problems. tothe working of fuzzy sets and fuzzy logic.

Unit I - Introduction to Soft Computing

What is Soft Computing, Fuzzy Systems, Genetic Algorithms, Fundamentals of Artificial Neural Networks: Model of an Artificial Neuron, Neural Network Architectures, and characteristics, Learning Methods, Taxonomy of Neural Network Architectures, History of Neural Network Research, Early Neural Network Architectures, Some Application Domains. Rough sets: Information Systems and Decision Systems, Indiscernibility, Set approximations, Properties of Rough Sets, Rough membership, Reducts, Applications.

Unit II - Associative Memory

Associative Memory: Autocorrelators, Hetrocorrelators: Kosko's discrete BAM, Wang et al's Multiple training encoding strategy, Exponential BAM, Associative memory for real-coded pattern pairs, applications of Associative memory. Adaptive Resonance Theory: Introduction: Cluster structure, vector Quantization, classical ART Network, Simplified ART architecture. ART1: architecture, special features, ART1 algorithm, illustration. ART2: architecture, ART2 algorithm, illustration, applications, sensitivities of ordering of data.

Unit III - Fuzzy Logic

Fuzzy Set Theory: Fuzzy versus Crisp, Crisp sets - Operations on crisp sets, properties of crisp sets, partition and covering, Fuzzy sets - membership functions, basic fuzzy set operations, properties of fuzzy sets, Crisp relations - Cartesian product, other crisp relations, operations on crisp relations, Fuzzy relations - fuzzy cartesian product, operations on fuzzy relations. Fuzzy systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy rule base system, Defuzzification Methods, Applications.

Unit IV - Genetic Algorithm

Fundamentals of Genetic Algorithms: History, Basic concepts, Creation of Offsprings, Working Principle, Encoding, Fitness function, Reproduction. Genetic Modelling: Inheritance Operators, Cross Over, Inversion and Deletion, Mutation operator, Bit-wise operators, Bit-wise operators used in GA, Generation cycle, Convergence of Genetic Algorithm, Multilevel optimization, Real life problems, Differences and similarities between GA and other traditional methods, Advances in GA.

Unit V - Hybrid Systems

Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms: Hybrid systems, Neural Networks, Fuzzy Logic and Genetic algorithms Hybrids, Preview of the Hybrid systems to be discussed. Genetic algorithm based Backpropagation Networks: GA based weight determination, Applications. Fuzzy Backpropagation Networks: LR-type Fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BP, Inference by Fuzzy BP, Applications.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Understand Soft Computing Techniques such as Neural Networks and Rough Sets
CO 2 : Understand and use Associative Memory and Adaptive Resonance Theory.
CO 3 : Use Fuzzy Set Theory and develop Fuzzy systems and applications.
CO 4 : Understand and apply Genetic Algorithms and Modeling for finding solutions real life problems.
CO 5 : Understand Hybrid systems that use combination of soft computing techniques.

Text Books:

1. S. Rajasekaran, G.A.Vijayalakshmi Pai, "*Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthesis and Applications*", Sixteenth printing, PHI, 2012.
2. Samir Roy and Udit Chakraborty, "Introduction *to Soft Computing, Neuro Fuzzy and Genetic Algorithm*", 1st Edition, Pearson India, 2013.

References:

1. M. Panda, M.R. Patra, *Soft Computing: Concepts and Techniques*, Laxmi Publications, 1st Edition, Universal Science Press, New Delhi, 2014.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, *Neuro Fuzzy and Soft Computing*, Fifth Reprint, Pearson, 2017.
3. Prof. Debasis Samanta, "*NPTEL Video Lectures on Introduction to Soft Computing*", Dept. of CSE IIT Kharagpur.

65454

HUMAN COMPUTER INTERACTION

(Professional Elective IV)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To learn the foundation of Human Computer Interaction
2. To be familiar with the design technologies for individuals and persons with disabilities
3. To be aware of mobile human computer interaction

Unit I - Human :I/O channels –Memory

Reasoning and problem solving ; The computer; Devices-Memory-Processing and networks; Interaction; Models-frameworks- Ergonomics-Styles-Elements Interactivity Paradigms

Unit II - Interactive Design Basics

Process-scenarios-navigation-screen design-Iteration and Prototyping, HCI in software process-software life cycle-usability engineering-prototyping in practice-design rationale.

Design Rules-principles , standards, guidelines, rules. Evaluation Techniques-Universal Design

Unit III - Cognitive models

Socio- Organizational issues and stake holder requirements-communication and collaboration models- Hypertext, multimedia and WWW.

Unit IV - Mobile Ecosystem

Platforms, Application frameworks-Types of Mobile Applications; Widgets, Applications, Games-Mobile Information Architecture, Mobile 2.0.

Mobile Design: Elements of Mobile Design, Tools.

Unit V - Designing Web Interfaces

Drag and Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual pages, Process flow.

Case-studies. Recent Trends: Speech Recognition and Translation, Multi modal System

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Understand the guidelines influencing human computer interaction
CO 2 : Design an interactive web interface on the basis of models studied
CO 3 : Understand the structure of models of vision
CO4 : Describe typical Human Computer Interaction(HCI) models
CO5 : Analyze and identify stakeholder requirements of HCI systems

Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, *Human Computer Interaction*, 3rd Edition, Peraon Education, 2004.
2. Brian Fling, *Mobile Design and Development*,1st Edition, Oreilly Media Inc.,2009

References:

1. Yvonne Rogers, Helen Sharp, Jenny Preece, *Interaction Design: Beyond Human Computer interaction*, 3rd Edition, Wiley, 2011.
2. Mackenzie, *Human-Computer Interaction :An Emperical Research Perspective*, Morgan Kaufmann Elsevier Science and Technology Books, 2012
3. Bill Scott and Theresa Neil, *Designing Web Interfaces*, 1st Edition, O'Reilly,2009

67451

WIRELESS AD-HOC AND SENSOR NETWORKS

(Professional Elective –IV)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
			Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Prerequisites:

1. Computer Networks

Course Objectives:

1. To understand the applications of ad hoc and sensor networks
2. To understand the MAC and transport protocols for ad hoc networks
3. To understand the concepts of sensor networks
4. To understand the security of sensor networks

Unit I - Introduction to Ad Hoc Wireless Networks

Introduction to Ad Hoc Wireless Networks: Characteristics of MANETs, Applications of MANETs, Challenges.

Routing in MANETs: Topology-based versus Position-based approaches, Topology based routing protocols, Position based routing, Other Routing Protocols.

Unit II - Data Transmission in MANETs

Data Transmission in MANETs: The Broadcast Storm, Multicasting, Geocasting
TCP over Ad hoc Networks: TCP Protocol overview, TCP and MANETs, Solutions for TCP over Ad hoc networks

Unit III - Basics of Wireless Sensors and Applications

Basics of Wireless Sensors and Applications: introduction, The Mica Mote, Sensing and Communication Range, Design issues, Energy consumption, Clustering of Sensors, Applications of WSNs.

Data Retrieval in Sensor Networks: Classification of WSNs, MAC layer, Routing layer, Highlevel application layer support, Adapting to the inherent dynamic nature of WSNs.

Unit IV – Security

Security: Security in Ad hoc Wireless Networks, Key Management, Secure Routing, Cooperation in MANETs, Intrusion Detection Systems.

Sensor Network Platforms and Tools: Sensor Network Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms.

Unit V – Operating System

Operating System —TinyOS Imperative Language: nesC, Dataflow style language: T1nyGALS, Node- Level Simulators, ns-2 and its sensor network extension, TOSSIM.

Course outcomes: At the end of the course, the student will be able to

CO 1 : Understand basics of MANETs and routing protocols
CO 2 : Understand how TCP modified for wireless networks
CO 3 : Design of different layers of WSN
CO 4 : Understand issues and challenges of security in WSNs
CO 5 : Design and implement sensor network protocols in the NesC/TinyOS

Text Books:

1. Carlos De Morais Cordeiro and Dharma Prakash Agrawal, Ad Hoc and Sensor Networks: Theory and Applications, World Scientific Publications /Cambridge University Press, March 2006.
2. Feng Zhao and Leonidas Guibas , Wireless Sensor Networks: An Information Processing Approach, Elsevier Science imprint, Morgan Kauffman Publishers, Reprint 2009.

References:

1. C.Siva Ram Murthy and B.S.Murthy, Ad hoc Wireless Networks: Architectures and Protocols, Pearson Education, 2004.
2. Fei Hu, XiaojunCao, Wireless Sensor Networks: Principles and Practice, Auerbach / CRC Press, Taylor & Francis Group, 2010.
3. Subir Kumar Sarkar et al. Wireless Ad hoc Mobile Wireless Networks: Principles, Protocols and Applications, Auerbach Publications, Taylor & Francis Group, 2008.
4. Charles E.Perkins, Ad hoc Networking, Pearson Education, 2001.
5. Shih-Liri Wu and Yu-Chee Tseng, Wireless Ad hoc Networking, Auerbach Publications, Taylor & Francis Group, 2007

65455

COMPUTER VISION

(Professional Elective V)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To review image processing techniques for computer vision.
2. To perform feature analysis, 3D image analysis
3. To explore the concept of Hough Transform and its applications.

UNIT I - Image filters and Operations

Image Processing Operations, Convolutions and Point Spread Functions, Noise Suppression by Gaussian Smoothing, Median Filters, Mode Filters, Rank Order Filters, Sharp Unsharp Masking, Shifts Introduced by Median Filters, Discrete Model of Median Shifts, Shifts Introduced by Mode Filters , Mean and Gaussian Filters, Rank Order Filters, Shifts in Rectangular Neighborhoods.

UNIT II - Thresholding Techniques and Feature Detection

Region-Growing Methods, Thresholding, Adaptive Thresholding, More Thoroughgoing Approaches to Threshold Selection, The Global Valley Approach to Thresholding, Basic Theory of Edge Detection, The Template Matching Approach, Theory of 3x3 Template Operators, Design of Differential Gradient Operators, The Concept of a Circular Operator and implementation, The Canny Operator, The Laplacian Operator.

UNIT III - Corner and Interest Point Detection

Template Matching, Second-Order Derivative Schemes, A Median Filter-Based Corner Detector, The Harris Interest Point Operator, Local Invariant Feature Detectors and Descriptors. Binary Shape Analysis: Object Labeling and Counting, Size Filtering, Distance Functions and Their Uses, Skeletons and Thinning.

UNIT IV - Boundary Analysis:

Centroidal Profiles, Problems with the Centroidal Profile Approach, (s, ψ) Plot, Tackling the Problems of Occlusion, Accuracy of Boundary Length Measures, Line Detection: Application of the Hough Transform to Line Detection, The Foot-of-Normal Method, Application of the Foot-of-Normal Method, Longitudinal Line Localization, Final Line Fitting, Using RANSAC for Straight Line Detection, Circle and Ellipse Detection : Hough-Based Schemes for Circular Object Detection, The Problem of Unknown Circle Radius, Ellipse Detection.

UNIT V - Three-Dimensional World

3-D Vision—the Variety of Methods, Projection Schemes for Three-Dimensional Vision, Shape from Shading, Photometric Stereo, The Assumption of Surface Smoothness, Shape from Texture, Three-Dimensional Object Recognition Schemes. Ambiguity of Pose under Weak Perspective Projection, Obtaining Unique Solutions to the Pose Problem.

Course Outcomes: At the end of the course, the student should be able to

CO 1 : Understand fundamental image processing techniques required for computer vision.
CO 2 : Implement Thresholding Techniques and edge detection methods
CO 3 : Implement Corner and Intersect point Detection.
CO 4 : Apply Hough Transform for line, circle, and ellipse detections.
CO 5 : Design 3D object recognition schemes.

Text Books:

1. Davies E.R., *Computer and Machine Vision, Theory, Algorithms, Practicalities*, Academic Press, in print of Elsevier, 4th Edition, 2012.

References:

1. Jan Erik Solem, *Programming Computer Vision with Python: Tools and algorithms for analyzing images*, 1st Edition, O'Reilly Media, 2012.
2. Mark Nixon and Alberto S. Aquado, *Feature Extraction & Image Processing for Computer Vision*, 3rd Edition, Academic Press, 2012.
3. R. Szeliski, *Computer Vision: Algorithms and Applications*, 1st Edition, Springer, 2011.

67455

BLOCK CHAIN TECHNOLOGY

(Professional Elective –V)

(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
			Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Prerequisites:

1. Object Oriented Programming through Java
2. Cryptography and Network Security
3. Web Technologies

Course Objectives:

1. This course aims to provide conceptual understanding of the function of Blockchains as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
2. It covers the technological underpinnings of blockchain operations as distributed data structures and decision-making systems, their functionality and different architecture types.
3. It provides a critical evaluation of existing "smart contract" capabilities and platforms, and examines their future directions, opportunities, risks and challenges.

Unit I - Introduction to Blockchain

Introduction to Blockchain: The growth of Blockchain technology, Distributed systems, The history of Blockchain and Bitcoin, Types of Blockchain, Consensus, CAP theorem and Blockchain

Decentralization: Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization

Unit II – Bitcoins

Bitcoins: Introducing Bitcoin, Digital keys and addresses, Transactions, Blockchain: The structure of a block, Mining.

Bitcoin Network and Payments: The Bitcoin network, Wallets, Bitcoin payments: Innovation in Bitcoin, Bitcoin Clients and APIs: Bitcoin installation, Alternative Coins, Bitcoin limitations.

Unit III - Smart Contracts

Smart Contracts: History, Definition, Ricardian contracts, Introduction to Ethereum, Components of the Ethereum ecosystem, Further Ethereum, Programming languages.

Unit IV - Ethereum Development Environment

Ethereum Development Environment: Test networks, setting up a private net, Starting up the private network, Development Tools and Frameworks, Compilers, Solidity compiler (solc), Installation on Linux, Installation on macOS, Integrated Development Environments (IDEs)
Solidity language: Solidity language, Types, Value types, Literals, Enums, Function types, Reference types, Global variables, Control structures, Layout of a Solidity

Unit V - Hyper Ledger

Hyperledger: Projects under Hyperledger, Hyperledger as a protocol, The reference architecture, Requirements and design goals of Hyperledger Fabric, Hyperledger Fabric, Membership services, Blockchain services, Consensus services, Distributed ledger

Beyond Cryptocurrency: applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms, Limitations of blockchain as a technology, and myths vs. reality of blockchain technology.

Course Outcomes: At the end of the course, the student will be able to

CO 1 : Understand the structure of a blockchain and why/when it is better than a simple distributed database.
CO 2 : Evaluate the setting where a blockchain based structure may be applied, its potential and its limitations.
CO 3 : Understand what constitutes a "smart" contract, what are its legal implications and what it can and cannot do, now and in the near future.
CO 4 : Attain awareness of the new challenges that exist in monetizing businesses around blockchains and smart contracts.
CO 5 : Describe and understand the differences between the most prominent blockchain structures and permissioned blockchain service providers, as well as rising alliances and networks.

Text Books:

1. Imran Bashir, Mastering Blockchain, Second Edition, Packt Publishing, March 2018.
2. Andreas M. Antonopoulos, Mastering Bitcoin Programming the Open Blockchain, 2nd Edition, "O'Reilly Media, Inc.", June,2017.

References:

1. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric
2. Publisher: https://www.packtpub.com/big-data-and-business-intelligence/hands-blockchain-hyperledger
3. Public github repository with code samples: https://github.com/HyperledgerHandsOn/trade-finance-logistics

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SPATIAL INFORMATICS

(Professional Elective V)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To identify, store, manipulate and analyze spatial data using state-of-the-art software.
2. To understand and interpret data in different ways, that reveal relationships.
3. To explore the commercial trends in the form of tools.

UNIT I – Introduction

Application domains, Compare a SDBMS with a GIS, Categories of Users, An example of an SDBMS application, Spatial concepts, Models of Spatial Information, Three-Step Database Design, Extending ER with Spatial Concepts, Spatial query languages: Standard Database Query Languages, Relational Algebra, Basic SQL Primer, Extending SQL for Spatial Data, Example Queries that emphasize spatial aspects, Trends: Object-Relational SQL. (Textbook 1).

UNIT II - Spatial Data Management

Storage: Disk and Files, Spatial Indexing, Trends, Evaluation of Spatial Operations, Query Optimization, Analysis of Spatial Index Structures, Distributed Spatial Database Systems, Parallel Spatial Database Systems (Textbook 1).

UNIT III - Spatial Networks

Example Network Databases, Conceptual, Logical and Physical Data Models, Query Language for Graphs, Graph Algorithms, Trends: Access Methods for Spatial Networks (Textbook 1).

UNIT IV - Spatial Data Analysis

Understanding the Context and Relevance of Spatial Analysis, Spatial Analysis Using a GIS Timeline, Geographic Data: Properties, Strengths, and Analytical Challenges, Making Scientific Observations and Measurements in Spatial Analysis, Using Statistical Measures to Analyze Data Distributions, Descriptive Statistics, Deriving a Weighted Mean Using the Frequency Distributions in a Set of Observations, Spatial Statistics: Measures for Describing Basic Characteristics of Spatial Data, Spatial Measures of Central Tendency, Spatial Measures of Dispersion (Text book 2).

UNIT V - Commercial Systems (Tools)

Interacting with a GIS or with a Spatial DBMS, ArcInfo, ArcView GIS, ArcView Spatial Model, Smallworld Oracle Extension for Handling Spatial Data, PostgreSQL. (Text book 3)

Course Outcomes: At be the end of the course, the student should able to

CO 1 : Understand spatial concepts, spatial data models and spatial query languages.
CO 2 : Implement the spatial operations, spatial queries and query optimization.
CO 3 : Design data models with networks. Implement accessing methods.
CO 4 : Analyze the spatial data using GIS timeline, and also perform statistical analysis on spatial data.
CO 5 : Work on Commercial software or tools and can analyze the commercial trend in spatial information industry.

Text Books:

1. Shashi Shekhar, Sanjay Chawla, *Spatial Databases- A Tour*, P.H, 2003.
2. Margai, Florence M Oyana, Tonny J, *Spatial analysis - statistics, visualization, and computational methods*-CRC Press, 2015.
3. Philippe Rigaux, Michel Scholl and Agn`es Voisard, *Spatial DBs With Application to GIS*, Morgan Kaufman Publishers, 2002.

References:

1. Jingxiong Zhang, Peter Atkinson, Michael Goodchild, *Scale in Spatial Information and Analysis*-CRC Press Taylor and Francis, 2014.
2. Ian Heywood, Sarah Cornelius, Steve Carver, *An Introduction to Geographical Information Systems*, Prentice Hall 2006.
3. Atsuyuki Okabe, Kokichi Sugihara, *Spatial Analysis along Networks-Statistical and Computational Methods,* Wiley Publications, 2012.

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DESIGN PATTERNS

(Professional Elective –V)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
			Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Prerequisites:

1. Object Oriented Programming through Java
2. Software Engineering

Course Objectives:

1. To make the students understand the basic concepts of Design patterns.
2. To understand the various Design patterns.
3. To understand the importance of design patterns for development of a reusable product.

Unit I – Introduction

Introduction: What Is a Design Pattern? Design Patterns in Smalltalk MVC, Describing Design Patterns, The Catalog of Design Patterns, Organizing the Catalog, How Design Patterns Solve Design Problems, How to Select a Design Pattern, How to Use a Design Pattern.

Unit II – A Case Study

A Case Study: Designing a Document Editor: Design Problems, Document Structure, Formatting, Embellishing the User Interface, Supporting Multiple Look-and-Feel Standards, Supporting Multiple Window Systems, User Operations Spelling Checking and Hyphenation, Summary What to Expect from Design Patterns.

Unit III – Creational Patterns

Creational Patterns: Abstract Factory, Builder, Factory Method, Prototype, Singleton, Discussion of Creational Patterns.

Unit IV – Structural Patterns

Structural Patterns: Adapter, Bridge and Composite, Decorator, façade, Flyweight, Proxy.

Unit V – Behavioral Patterns

Behavioral Patterns: Chain of Responsibility, Command, Interpreter, Iterator, Mediator, Memento, Observer, State, Strategy, Template Method, Visitor, Discussion of Behavioral Patterns.

Course outcomes: At the end of the course, the student will be able to

CO 1 : Appreciate the basic concepts of design patterns and able to know how to selectand use the design patterns.
CO 2 : Identify the design pattern in the existing code and use of creational patterns.
CO 3 : Apply and use the structural patterns
CO 4 : Identify and use the behavioral patterns
CO 5 : Find and catalog patterns in the object-oriented software

Text Books:

1. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley, 1995.
2. James W. Cooper, Java™ Design Patterns: A Tutorial**,** Addison Wesley, 2000.

References:

1. Mark Grand, Patterns in Java: A Catalog of Reusable Design Patterns Illustrated with UML, Volume 2, Wiley DreamTech.
3. Mark Grand, Patterns in Java, Volume 2, Wiley DreamTech, 2008.
4. Mark Grand, Java Enterprise Design Patterns, Wiley DreamTech, 2006.

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REAL TIME SYSTEMS

(Professional Elective V)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:		Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To discuss the characteristics and elements of real time systems
2. To introduce the task abstraction and the scheduling models
3. To model the fault tolerance problems

Unit – I: Introduction to Real Time Systems

Introduction: Applications, Characteristics of Real Time Systems, Basic Model, Types of Real time Tasks, Timing constraints and modeling.

Unit- II: Real Time Task Scheduling

Types of Task Scheduling, Clock Driven Scheduling -Table Driven Scheduling, Cyclic Scheduling, Event Driven Scheduling - EDF and RMA.

Unit –III: Resource Sharing and Scheduling Real Time tasks in Distribute Systems

Priority Inversion, PIP, HLP, PCP, Different Types of Priority Inversions under PCP, Issues in Resource Sharing Protocol.
Dynamic Allocation of Tasks, Fault Tolerant Scheduling of Tasks, Clock Synchronization.

Unit-IV: Real Time Communication and Real Time Databases

Real time communication in a LAN, Soft and Hard Real Time Communication in LAN, Bounded Access Protocols in LAN, Real Time Routing, Resource Reservation, Rate Control, QoS Models
Real Time Databases, Characteristics of Temporal Data, Concurrency Control in Real Time Databases.

Unit- V: Fault Tolerance Techniques and Commercial RTOS

Fault tolerance: Introduction, Types of Faults, Fault Detection, Redundancy, Byzantine Failures
Real Time Operating System, Unix as RTOS, VxWorks, RT Linux.

Course Outcomes: At the end of the course, the student should be able to

CO 1	:	Characterize the real time systems and understand the criticalities in design an embedded system.
CO 2	:	Implement real time task scheduling algorithms
CO 3	:	Extend the scheduling algorithms to distributed environment.
CO 4	:	Implement real time routing protocols and consistency models in data bases
CO 5	:	Model fault tolerance algorithms and gain insight into various real time operating systems.

Text Books:

1. Rajib Mall, *Real Time Systems: Theory and Practice*, Pearson Education, 2007
2. C.M Krishna and Kang G. Shin, *Real Time Sytems*, McGraw-Hill, 1997

References:

1. Jane W.S. Liu, *Real-Time Systems*, Pearson, 2005
2. Quing Li, *Real Time concepts for Embedded Systems*, Elsevier, 2011.

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COMPUTER GRAPHICS

(Professional Elective V)
(Common to CSE & IT)

Instruction	:	3 Periods / week	Continuous Internal Evaluation	:	30 Marks
Tutorial	:	-	Semester End Examination	:	70 Marks
Credits	:	3	Semester End Exam Duration	:	3 Hours

Course Objectives:

1. To enable the students to learn basic and fundamental computer graphics and image synthesis techniques.
2. To expose the students to the current and emerging technologies such as OpenGL and visualize 2D and 3D objects.

UNIT I

Introduction: Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and workstations and input devices

Output primitives: Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms

UNIT II

OpenGL: Introduction, The OpenGl API, Primitives and attributes, Color, Viewing, Control Functions, Sample Program, 3D APIs, Graphics Architecture.
Geometric objects and Transformations I: Scalars, point and Vectors, Coordinate Systems and Frames, frames in OpenGl, Translation, Rotation and Scaling.

UNIT III

Geometric objects and Transformations II: Transformations in Homogenous coordinates, Concatenation of Transformations, OpenGl Transformation Matrices.
Viewing: Classical and Computer Viewing, Positioning of the camera, Simple projections, Projections in OpenGl, Parallel projection matrices, Perspective projection matrices, projects and shadows.

UNIT IV

Lighting and Shading: Light and Matter, Light sources, the phone lighting Model, Computation of Vectors, Polygonal shading, Light sources in OpenGL, Specifications of material in OpenGl, shading of the sphere model.

UNIT V

From Vertices to Fragments: Basic implementation strategies, Four major tasks, Clipping - Line segment, Polygon, 3D, Rasterization – polygon, Bresenham's algorithm, Hidden surface removal.
Computer animation: Design of animation sequence, raster animation, computer animation languages, key frame systems, motion specifications.

Course Outcomes: At the end of the course, the student should be able to

CO1: Know the application areas of computer graphics, overview of graphics systems and output primitives.
CO2: Understand OpenGL as a cross platform application programming interface (API)
CO3: Apply 2D geometric transforms, 2D viewing using OpenGl transformation matrices.
CO4: Create programs using OpenGL APIs for rendering 2D and 3D vector graphics.
CO5: Use visible surface detection methods and computer animation.

Text Books :

1. Donald Hearn and M. Pauline Baker "*Computer Graphics C version*", 2nd edition, Pearson Education, 2002.
2. Edward Angel, "*Interactive Computer Graphics: A Top Down Approach Using OpenGL*", 5th edition Pearson 2012.

References:

1. Marschner, Steve Shirley, Peter, *Fundamentals of Computer Graphics*, 4th Edition-A K Peters, Limited, Taylor & Francis Group, 2016.
2. Steven Harrington," *Computer Graphics*", Tata McGraw-Hill, 2008.
3. Hearn, Baker & Carithers, *Computer Graphics with OpenGL*, 4th Edition., Pearson New International, 2013.