SCHEME OF INSTRUCTION AND EXAMINATION
B.E (AIML)
SEMESTER- V

SNo	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	**PC 501AI**	Automata Languages and Computation	3	0	-		3	40	60	3
2	**PC 502CS**	Database Management Systems	3	0	-		3	40	60	3
3	**PC 503AI**	Design and Analysis of Algorithms	3	0	-		3	40	60	3
4	**PC 504AI**	Machine Learning	3	0	-		3	40	60	3
5	**PC 505AI**	Operating Systems	3	0	-		3	40	60	3
6	**Professional Elective – II**									
	PE 511AI	Number Theory & Cryptography	3	0	-		3	40	60	3
	PE 512AI	Image Processing								
	PE 513AI	Geo Spatial Data Analysis								
	PE 514AI	Data Mining								
Practicals										
7	**PC 552CS**	Database Management Systems Lab	-	-	2x2		3	25	50	2
8	**PC 552AI**	Design and Analysis of Algorithms Lab	-	-	2		3	25	50	1
9	**PC 553AI**	Machine Learning Lab	-	-	2		3	25	50	1
		Total	**18**	**0**	**8**		**27**	**315**	**510**	**22**

PC 501 AI	AUTOMATA LANGUAGES AND COMPUTATION					
Prerequisites	Data Structures		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives	
1	Introduce the concept of formal specification of languages and different classes of formal Languages
2	Discuss automata models corresponding to different levels of Chomsky hierarchy.
3	Understand the concept of computability and decidability

Course Outcomes On completion of this course, the student will be able to	
CO1	Design Finite State Machine, Pushdown Automata, and Turing Machine
CO2	Determine the Chomsky hierarchy and regular, context-free, and recursively enumerable Grammars
CO3	Convert the languages from DFAs, NFAs, and regular expressions, and between PDAs and CFGs.
CO4	Analyze the halting problem, relationships between classes.

UNIT – I

Introduction: Finite state automata, Non-deterministic finite state automata, FA with ε-transitions, Regular expressions, FA with outputs, Applications of FA. Properties of regular sets-Pumping Lemma, Closure properties, Myhill-Nerode Theorem, Minimization of FA, Decision Algorithms.

UNIT – II

Context Free Grammars and Languages: Derivations, Parse-trees, Ambiguity in Grammars and Languages.

Pushdown Automata–Definitions, The languages of PDA, Equivalence of PDAs and CFGs, Deterministic Pushdown Automata (DPDA).

UNIT – III

Properties of CFLs: Normal forms for CFGs, Pumping Lemma, Closure properties, Decision algorithms, Deterministic Context Free Languages, Predicting machines, Decision properties, LR(0) grammars, LR(0) and DPDA, LR(k) grammars.

UNIT – IV

Turing Machines: Introduction, Computational Languages and Functions, Techniques for construction of Turing machines. Modifications of TM, TM as enumerator, Restricted TM.

UNIT – V

Undecidability: Recursive and Recursively enumerable languages, UTM and undecidable problem, Rice Theorem, Post‟s correspondence problem. Chomsky‟s Hierarchy – Regular grammars, Unrestricted grammar, CSL, Relationship between classes of languages.

Suggested Reading:

1	John E. Hopcroft, Jeffrey D. Ullman, *Introduction to Automata Theory, Languages and Computation*, Narosa, 1979.
2	Zvi Kohavi, *Switching and Finite Automata Theory*, TMH, 1976.

PC 502 CS	DATABASE MANAGEMENT SYSTEMS					
Prerequisites	**Data Structures**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives	
1	To introduce three schema architecture and DBMS functional components
2	To learn formal and commercial query languages of RDBMS
3	To understand the principles of ER modeling and theory of normalization
4	To study different file organization and indexing techniques
5	To familiarize theory of serializablity and implementation of concurrency control, and Recovery

Course Outcomes On completion of this course, the student will be able to	
CO1	Understand the mathematical foundations on which RDBMS are built
CO2	Model a set of requirements using the Extended Entity Relationship Model (EER), transform an EER model into a relational model, and refine the relational model using theory of Normalization.
CO3	Develop Database application using SQL and Embedded SQL
CO4	Use the knowledge of file organization and indexing to improve database application Performance.
CO5	Understand the working of concurrency control and recovery mechanisms in RDBMS.

UNIT – I

Introduction: Database System Applications, Purpose of Database Systems, View of Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations Data, Database Languages, Relational Databases, Database Design, Object–based and Semi- structured Databases, Data Storage and Querying, Transaction Management, Data Mining and Analysis, Database Architecture, Database Users and Administrators.

Database Design and the E-R Model: Overview of the Design Process, The Entity- Relationship Model, Constraints, Entity-Relationship Diagrams, Entity – Relationship Design Issues, Weak Entity Sets, Extended E-R Features, Database Design for Banking Enterprise, Reduction to Relational Schemas, Other Aspects of Database Design

UNIT – II

Relational Model: Structure of Relational Databases, Fundamental Relational-Algebra Operations, Additional Relational – Algebra Operations, Extended Relational - Algebra Operations, Null Values, Modification of the Databases.

Structured Query Language: Data Definition, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null.

UNIT – III

Advanced SQL: SQL Data Types and Schemas, Integrity Constraints, Authorization,

Embedded SQL, Dynamic SQL, Functions and Procedural Constructs, Recursive Queries, Advanced

SQL Features. Relational Database Design: Features of Good Relational Design, Atomic Domains and First Normal Form, Functional-Dependency Theory, Decomposition using Functional Dependencies.

UNIT – IV

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-tree Index Files, B-tree Index Files, Multiple Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.

Index Definition in SQL Transactions: Transaction Concepts, Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability.

UNIT – V

Concurrency Control: Lock-based Protocols, Timestamp-based Protocols, Validation-based Protocols, Multiple Granularity, Multi-version Schemes, Deadlock Handling, Insert and Delete Operations, Weak Levels of Consistency, Concurrency of Index Structures.

Recovery System: Failure Classification, Storage Structure, Recovery and Atomicity, Log-Based Recovery, Recovery with Concurrent Transactions, Buffer Management, Failure with Loss of Nonvolatile Storage, Advanced Recovery Techniques, Remote Backup Systems.

Suggested Reading:

1	Abraham Silberschatz, Henry F Korth, S Sudarshan, *Database System Concepts*, McGraw-Hill International Edition, 6th Edition, 2010
2	Ramakrishnan, Gehrke, *Database Management Systems*, McGraw-Hill International Edition, 3rd Edition, 2003.
3	Elmasri, Navathe, Somayajulu, *Fundamentals of Database Systems*, Pearson Education, 4th Edition, 2004.

PC 503 AI	DESIGN AND ANALYSIS OF ALGORITHMS					
Prerequisites	Data Structures		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives	
1	Analyze the asymptotic performance of algorithms.
2	Write rigorous correctness proofs for algorithms
3	Demonstrate a familiarity with major algorithms and data structures.
4	Apply important algorithmic design paradigms and methods of analysis.
5	Synthesize efficient algorithms in common engineering design situations.

Course Outcomes On completion of this course, the student will be able to	
CO1	Analyze the complexity of the algorithm in asymptotic notations.
CO2	Apply the various algorithm approaches based on the complexities and analyze the graph traversal techniques
CO3	Develop the dynamic programming algorithms, and analyze it to determine its computational Complexity

UNIT – I

Introduction: Characteristics of algorithm, Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem

UNIT – II

Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack and Travelling Salesman problem.

UNIT – III

Graph and Tree Algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive Closure, Minimum Spanning Tree, Topological Sorting, Network Flow Algorithm.

UNIT – IV

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-Complete problems and Reduction techniques.

UNIT – V

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE.

Suggested Reading:

1	*Introduction to Algorithms*, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill, 4th Edition, 2002
2	*Fundamentals of Algorithms* – E. Horowitz, Satraj Sahani, Computer Science Press, 1997
3	*Algorithm Design*, First Edition, Jon Kleinberg and ÉvaTardos, Pearson, 2006
4	*Algorithm Design: Foundations, Analysis, and Internet Examples*, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley Publishers, 2006
5	*Algorithms - A Creative Approach*, 3rd Edition, UdiManber, Addison-Wesley, 1995.

PC 504 AI	MACHINE LEARNING					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1	To introduce the basic concepts of machine learning and range of problems that can be handled by machine learning
2	To introduce the concepts of instance based learning and decision tree induction
3	To introduce the concepts of linear separability, Perceptron and SVM
4	To learn the concepts of probabilistic inference, graphical models and evolutionary learning
5	To learn the concepts of ensemble learning, dimensionality reduction and Clustering

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Explain strengths and weakness of different machine learning techniques
CO-2	Select suitable model parameter for different machine learning technique
CO-3	Design & implement various machine learning algorithms to a wide range of real world applications
CO-4	Evaluate available learning methods to develop the research based solutions in different domains.

UNIT – I

Introduction: Learning, Types of Machine Learning, Machine Learning Examples , Decision Tree Learning
Concept learning: Introduction, Version Spaces and the Candidate Elimination Algorithm.
Learning with Trees: Decision Tree Learning, the Big Picture
Linear Discriminants: Learning Linear Separators , The Perceptron Algorithm , Margins

UNIT – II

Estimating Probabilities from Data, Bayes Rule, MLE, MAP
Naive Bayes: Conditional Independence, Naive Bayes: Why and How, Bag of Words Logistic Regression : Maximizing Conditional likelihood , Gradient Descent Kernels: Kernalization Algorithm, Kernalizing Perceptron,
Discriminants: The Perceptron, Linear Separability, Linear Regression
Multilayer Perceptron (MLP): Going Forwards, Backwards, MLP in practices, Deriving back Propagation.

UNIT– III
Support Vector Machines: Geometric margins, Primal and Dual Forms, Kernalizing SVM Generalization & Overfitting: Sample Complexity, Finite Hypothesis classes, VC Dimension Based Bounds 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
Model Selection & Regularization: Structural Risk Minimization, Regularization, k-Fold Cross validation Linear Regression: Linear regression, minimizing squared error and maximizing data Likelihood Neural Networks: Back Propagation, Deep Neural Networks: Convolution, Convolution Neural Networks, LeNet-5 architecture Boosting: Boosting Accuracy, Ada Boosting, Bagging

UNIT –V
Clustering: Introduction, Similarity and Distance Measures, Outliers, Hierarchical Methods, Partitional Algorithms, Clustering Large Databases, Clustering with Categorical Attributes, Comparison. Dimensionality Reduction: Linear Discriminant Analysis, Principal Component Analysis Interactive Learning: Active Learning, Active Learning, Common heuristics, Sampling bias , Safe Disagreement Based Active Learning Schemes Semi-Supervised Learning: Semi-supervised Learning, Transductive SVM, Co-training Reinforcement Learning: Markov Decision Processes, Value Iteration, Q-Learning

Suggested Reading:

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

PC 505 AI	OPERATING SYSTEMS					
Prerequisites	Programming in C and Data Structures		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives	
1	To introduce the concepts of OS structure and process synchronization
2	To study different memory management strategies
3	To familiarize the implementation of file system
4	To understand the principles of system security and protection
5	To discuss the design principles and structure of Windows 7 and Linux

Course Outcomes	
On completion of this course, the student will be able to	
CO1	Evaluate various process scheduling algorithms
CO2	Analyze the steps in address translation and different page replacement strategies
CO3	Compare file allocation methods and choose appropriate allocation strategies for a file.
CO4	Apply the appropriate mechanisms to control access to resources

UNIT – I

Introduction to Operating Systems: OS structure and strategies, Process concepts, Multithreaded Programming, Process scheduling, Process synchronization, Deadlocks.

UNIT – II

Memory management strategies with example architectures: Swapping, Contiguous allocation, Paging, Segmentation, Segmentation with paging, Virtual memory management: Demand paging, Page replacement, Thrashing.

UNIT – III

File system interface: File concepts, Access methods and protection. File system implementation: File system structure, Allocation methods, Directory implementation of file systems, Mass storage structures, I/O systems.

UNIT – IV

System Protection: Principles and Domain, Access Matrix and implementation, Access control and access rights, Capability based systems, Language based Protection.

System Security: Problem, Program threats, cryptography, user authentication, implementing security defenses, Firewalling, Computer security Classification.

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 7 –Design principles, System components, Terminal services and fast user switching File systems, Networking, Programmer Interface.

Suggested Reading:

1	Abraham Silberschatz, Peter B Galvin, *Operating System Concepts*, 9th Edition, Wiley, 2016
2	William Stallings, *Operating Systems-Internals and Design Principles*, 8th Edition, Pearson, 2014
3	Andrew S Tanenbaum, *Modern Operating Systems*, 4th Edition, Pearson, 2016.

	PROFESSIONAL ELECTIVE-II					
PE 511 AI	**NUMBER THEORY AND CRYPTOGRAPHY**					
Prerequisites	Discrete Mathematics		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives	
1	To Learn basics in number theory and cryptology
2	To identify and apply various properties of and relating to the integers and understand the concept of a congruence
3	To impart the knowledge of encryption and decryption techniques and their applications

Course Outcomes On completion of this course, the student will be able to	
CO1	Solve problems in elementary number theory
CO2	Apply elementary number theory to cryptography
CO3	Develop a conceptual understanding of the theoretical basis of number theory and identify how number theory is related to and used in cryptography

UNIT – I

Elementary Number Theory: Time estimates for doing arithmetic, Divisibility and Euclidean algorithm, congruence's, applications to factoring.

UNIT – II

Finite Fields and Quadratic Residues: Finite fields, Legendre symbol, quadratic residues and reciprocity, Jacobi symbol. **Galois field in Cryptography, Chinese Remainder Theorem.**

UNIT – III

Cryptography: Cryptosystems, diagraph transformations, enciphering matrices, Symmetric key cryptosystem, traditional techniques, Key range and size, Deffie-Hellman key exchange, various types of attacks, algorithm types and modes, various symmetric key algorithms (DES, IDEA, RC5, Blowfish).

UNIT – IV

Asymmetric key Cryptography: concept, RSA algorithm, digital envelope, concept of message digest, MD5 algorithm, Authentication requirements, Digital signatures, message authentic codes, Knapsack algorithm.

UNIT – V

Primality and Factoring, Pseudo-primes, Carmichael number, Primality tests, Strong Pseudo-primes, Monte Carlo method, Fermat factorization, Factor base, Implication for RSA, Continued fractionmethod. Elliptic curves - basic facts, Elliptic curve cryptosystems.

Suggested Reading:

1	Neal Koblitz, *A Course in Number Theory and Cryptology*, Graduate Texts in Mathematics, Springer, 1994

2	Williams Stallings, *Cryptography & Network Security*, Pearson Education 3rd Edition, 2004
3	Atul Kahate, *Cryptography & Network Security*, Tata McGraw Hill, New Delhi, 2005.

	PROFESSIONAL ELECTIVE-II					
PE512AI	**IMAGE PROCESSING**					
Prerequisites	**signals and systems**		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives :	
1.	To introduce students to the Basic concepts and analytical methods of analysis of digital images.
2.	To Study fundamental concepts of Digital Image Processing and basic relations among pixels.
3.	To Study different Spatial and Frequency domain concepts.
4.	To understand Restoration process of degraded image and Multi resolution processing.
5.	To understand image compression and Segmentation Techniques.

Course Outcomes : At the end of the course the student will be able to:	
1.	Understand different components of image processing system
2.	Describe various image transforms, enhancement techniques using various processing methods.
3.	Illustrate the compression and segmentation techniques on a given image
4.	Demonstrate the filtering and restoration of images(pixels) with examples
5.	Illustrate the various schemes for image representation and edge detection techniques with examples

UNIT – I

Introduction: Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some basic Relationships between Pixels

UNIT – II

Image Enhancement in the Spatial Domain: Some Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic/Logic Operations, Basics of Spatial Filtering,

Smoothing spatial Filters, Sharpening spatial Filters.
Image Enhancement in the Frequency Domain: Introduction to the Fourier Transform and the Frequency Domain, Smoothing frequency-domain Filters, Sharpening Frequency-domain Filters, Homomorphic Filtering, Implementation.

UNIT – III
Image Restoration: A Model of the Image Degradation/Restoration Process, Linear, Position Invariant Degradations, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering, Constrained Least Squares Filtering. Wavelets and Multi resolution Processing: Multi resolution Expansions, Wavelet Transforms in one Dimension, The Fast Wavelet Transform, Wavelet Transforms in Two Dimensions.

UNIT – IV
Image Compression: Image Compression Models, Error-free Compression, Lossy Compression, Image Compression Standards. Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation

UNIT – V
Representation and Description: Various schemes for representation, boundary descriptors, and regional descriptors.

References:	
1.	Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing. Prentice Hall India/Pearson Education.
2.	A.K.Jain, Fundamentals of Digital Image Processing. Prentice Hall India.

Suggested Readings:	
1.	Madhuri.A.Joshi, Digital Image Processing, PHI.
2.	Sonka, Image Processing, Analysis and Machine Vision. Cengage Publications.

PE 513 AI	GEO-SPATIAL DATA ANALYSIS					
Prerequisites	signals and systems		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	. To introduce the Concepts of GeoSpatial Data Analysis
2.	To introduce the use of various tools for handling large volume of data
3.	To introduce the concepts behind hosting large data on Cloud
4.	To enable students know the details of Implementing various AWS related tools.

Course Outcomes : After completion of course, students will be able to:	
1.	Understand the importance of Geo-spatial Analytics
2.	Use various tools for manipulating large data
3.	Learn use of AWS related tools for data storage
4.	Learn and use AWS for Analyzing and Visualizing Geospatial Data

UNIT – I
An Overview Of Geospatial Analytics, Core Concepts: Key Issues And Extreme Over generalizations, Getting Started With Map Tools And Types

UNIT – II
Mapping Data, More Tools, And Analysis , Innovations: Platforms, IoT, And Mathematics , Big Data Analytics And Systems Of Scale

UNIT – III
Introduction to the Geospatial Data Ecosystem, Introduction to Geospatial Data in the Cloud, Quality and Temporal Geospatial Data Concepts, Geospatial Data Lakes using Modern Data Architecture, Geospatial Data Lake Architecture, Using Geospatial Data with Amazon Redshift .

UNIT – IV
Using Geospatial Data with Amazon Aurora PostgreSQL, Serverless Options for Geospatial, Querying Geospatial Data with Amazon Athena, Analyzing and Visualizing Geospatial Data in AWS, Geospatial Containers on AWS

UNIT – V
Using Geospatial Data with Amazon EMR, Geospatial Data Analysis Using R on AWS, Geospatial Machine Learning with SageMaker, Using Amazon QuickSight to Visualize Geospatial Data, Accessing Open Source and Commercial Platforms and Services

Suggested Readings:	
1.	Geospatial Data and Analysis by Aurelia Moser, Jon Bruner, Bill Day Released February 2017 Publisher(s): O'Reilly Media, Inc. ISBN: 9781491940556
2.	Geospatial Data Analytics on AWS: Discover how to manage and analyze geospatial data in the cloud *ByScott Bateman , Janahan Gnanachandran ,Jeff DeMuth*

	PROFESSIONAL ELECTIVE-II					
PE 514 AI	**DATA MINING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**CIE**	40 Marks	**SEE**		60 Marks	

Course Objectives :	
1	To introduce the basic concepts of data Mining and its applications
2	To understand different data mining techniques like classification, clustering and Frequent Pattern mining
3	To introduce current trends in data mining

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Explain different data mining tasks and the algorithms.
CO-2	Evaluate models/algorithms with respect to their accuracy.
CO-3	Conceptualize a data mining solution to a practical problem
CO-4	Develop hypotheses based on the analysis of the results obtained and test them.

UNIT – I

Introduction: Major issues in Data Mining. Getting to know your data: Data objects and attributed types. Basic statistical descriptions of data. Data visualization, Measuring data similarity and dissimilarity.

UNIT – II

Mining frequent patterns, Associations and correlations, Basic concepts and methods, Basic concepts, Frequent Item set Mining Methods, Which patterns are interesting? Pattern evaluation methods.

UNIT– III

Classification: Basic concepts, Decision tree induction, Bayes classification methods.
Classification: Advance methods, Bayesian Belief Network, Classification by backpropagation, Support vector machine.

UNIT – IV

Cluster Analysis: Concepts and Methods, Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of clustering.

UNIT –V

Data Mining Trends and Research Frontiers, Mining Complex Data Types, Other

Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining trends.

Suggested Reading:

1	Jiawei Han, Micheline Kamber, Jin Pei, Data Mining: Concepts & Techniques, 3rd Edition, Morgon Kauffman, 2011
2	Vikram Pudi, P.Radha Krishna, Data Mining, Oxford University Press, 1st Edition, 2009.
3	Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, Pearson Education, 2008.

PC 552 CS	DATABASE MANAGEMENT SYSTEMS LAB					
Prerequisites	DBMS Theory		**L**	**T**	**P**	**C**
			0	**0**	**4**	**2**
Evaluation	**CIE**	**25 Marks**	**SEE**		**50 Marks**	

Course Objectives	
1	To practice various DDL commands in SQL
2	To write simple and Complex queries in SQL
3	To familiarize PL/SQL

Course Outcomes On completion of this course, the student will be able to	
CO1	Design and implement a database schema for a given problem
CO2	Populate and query a database using SQL and PL/SQL
CO3	Develop multi-user database application using locks.

The list of programs suggested:

Creation of database (exercising the commands for creation).

1. Simple to Complex condition query creation using SQL Plus.
   Usage of Triggers and Stored Procedures.
2. Creation of Forms for Student information, Library information, Pay roll etc.
3. Writing PL/SQL procedures for data validation.
4. Report generation using SQL reports.
5. Creating password and security features for applications.
6. Usage of File locking, Table locking facilities in applications.
7. Creation of small full- fledged database application spreading over3 sessions.

Note:-The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

PC 552 AI	**DESIGN AND ANALYSIS OF ALGORITHMS LAB**					
Prerequisites			**L**	**T**	**P**	**C**
			-	**-**	**2**	**1**
Evaluation	**CIE**	**25 Marks**	**SEE**		**50 Marks**	

Course Objectives	
1	To learn the importance of designing an algorithm in an effective way by consideringspace and time complexity
2	To learn graph search algorithms.
3	To study network flow and linear programming problems
4	To learn the dynamic programming design techniques.
5	To develop recursive backtracking algorithms.

Course Outcomes	
On completion of this course, the student will be able to	
CO1	Design an algorithm in an effective manner
CO2	Apply iterative and recursive algorithms.
CO3	Design iterative and recursive algorithms.
CO4	Implement optimization algorithms for specific applications.
CO5	Design optimization algorithms for specific applications.

List of Programs
1. Write a program to find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm. .
2. Write a program to find the shortest path in graph using Dijkstra's algorithm.
3. Write a program that implements N Queen's problem using backtracking algorithm.
4. Write a program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.
5. Write a program to implement dynamic programming algorithm to solve all pairs shortest path problem.
6. Write a program to solve 0/1 knapsack problem using Greedy algorithm.
7. Write a program to solve 0/1 knapsack problem using Dynamic programming algorithm.
8.Write a program to solve 0/1 knapsack problem using Backtracking algorithm
9.Write a program to solve 0/1 knapsack problem using Branch and bound algorithm.
10.Write a program that uses dynamic programming algorithm to solve the optimal binary search tree
11.Write a program for solving traveling sales persons problem using Dynamic programming algorithm.
12. Write a program for solving traveling sales persons problem using The back tracking algorithm.
13. Write a program for solving traveling sales persons problem using Branch and Bound.
14. Write a program to obtain the Topological ordering of vertices in a given digraph using Warshall's Algo.
15.Write a program to compute the transitive closure of a given directed graph using Warshall's algorithm.
16.Write a program to print all the nodes reachable from a given starting node in a digraph using BFS.
17. Write a program to check whether a given graph is connected or not using DFS method.
18. Write a program to find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.

PC 553 AI	**MACHINE LEARNING LAB**					
Prerequisites			**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**
Evaluation	**CIE**	**25 Marks**	**SEE**		**50 Marks**	

Course Objectives	
1	Demonstration of different classifiers on different data
2	Demonstrate ensembling of classifiers for solving real world problems
3	Make use of real world data to implement machine learning models.

Course Outcomes On completion of this course, the student will be able to	
CO1	Apply machine learning algorithms: dataset preparation, model selection, model building
CO2	Evaluate various Machine Learning approaches.
CO3	Use scikit-learn, Keras and Tensorflow to apply ML. techniques. 5. Design and develop solutions to real world problems using ML. techniques.
CO4	Apply unsupervised learning and interpret the results.

List of Experiments

1. Basic Data Preprocessing
   a. Installation of python environment/Anaconda IDE for machine learning installing python modules/Packages like scikit-learn, Keras and Tensorflow.
   b. Programs involving pandas, Numpy and Scipy libraries.
2. Programs for classification
   a. Build models using linear regression and logistic regression and apply it to classify a new instance.
   b. Write a program to demonstrate the following classifiers. Use an appropriate data set for building the model. Apply the model to classify a new instance.
      i) Decision tree
      ii) K nearest neighbour
      iii) Naïve bayes
      iv) Support vector machine
3. Demonstration of Clustering algorithms using
   a. K-means
   b. Hierarchical algorithms
4. Demonstrate ensemble techniques like boosting, bagging, random forests
5. Build a classifier, compare its performance with an ensemble technique like random forest.

6. Evaluate various classification algorithms performance on a dataset using various measures like True Positive rate, False positive rate, precision, recall.
7. Demonstrate GA for optimization (minimization or maximization problem)
8. Case study on supervised/unsupervised learning algorithm: a) Handwritten digits classification using CNN b) Text classification using python libraries.

SCHEME OF INSTRUCTION AND EXAMINATION

B.E (AIML) SEMESTER- VI

S.No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Examination			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	**PC 602 CS**	Computer Networks	3	0	-		3	40	60	3
2	**PC 601 AI**	Web Programming	3	0	-		3	40	60	3
3	**PC 603 CS**	Distributed Systems	3	0	-		3	40	60	3
4	**PC 604 CS**	Deep Learning	3	0	-		3	40	60	3
5	***Professional Elective – III***									
	PE 611 AI	Programming for Big Data Systems	3	0	-		3	40	60	3
	PE 612 AI	Interpretable Machine Learning								
	PE 613 AI	Virtual & Augmented Reality								
	PE 614 AI	AI For Gaming								
	PE 615 AI	Cloud Computing								
6	***Open Elective –I***									
	OE601BM	Engineering Applications in Medicine	3	0	-	-	3	40	60	3
	OE602BM	Human Assistive Technologies								
	OE601CE	Disaster Management								
	OE602CE	Road Safety Engineering								
	OE601CS	Python Programming								
	OE602CS	Cyber Security								
	OE601EC	Verilog HDL								
	OE602EC	Principles of Electronic Communication Systems								
	OE601EE	Applications of Electrical Energy								
	OE602EE	Electrical Safety Management								
	OE601ME	3D Printing Technology								
	OE602ME	Finite Element Methods								
Practicals										
7	**PC 652 CS**	Computer Networks Lab	-	-	2		3	25	50	1
8	**PC 653 CS**	Deep Learning Lab	-	-	2		3	25	50	1
9	**PC 651 AI**	Web Programming Lab	-	-	2		3	25	50	1
10	**PW 661 AI**	Mini-Project	-	-	6		-	50	-	3
11	**PW 961 AI**	Summer Internship Six Weeks during summer vacation	Evaluation will be done in VII-Semester							
		Total	**18**	**0**	**12**		**27**	**365**	**510**	**24**

PC 602 CS	COMPUTER NETWORKS					
Prerequisites	Data Structures and Programming Concepts		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

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

Course Outcomes On completion of this course, the student will be able to	
CO1	Apply the function of each layer of OSI and trace the flow of information from one node to another node in the network
CO2	Understand the principles of IP addressing and internet routing
CO3	Analyze the working of networked applications such as DNS, mail file transfer and www
CO4	Implement client-server socket-based networked applications.

UNIT – I

Data Communications: Components, analog and digital signals and Encoders, Modems, RS232 Interfacing.
Switching: Circuit Switching, Message Switching and Packet Switching.
Topologies – Concept of layering.-Protocols and Standards – ISO / OSI model, TCP/IP.

UNIT – II

Data Link Layer: Error Control: Error detection and correction (CRC and Hamming code for singlebit correction)
Flow Control: stop and wait – - sliding window protocols-go Back-N ARQ – selective repeat ARQ
MAC LAYER: Ethernet IEEE 802.3LAN, Manchester encoding, Binary exponential algorithm, Efficiency calculation, ARP and RARP.

UNIT – III

Network Layer : Internetworks – virtual circuit and Datagram approach Routing – Distance Vector Routing ,Link State Routing , OSPF and BGP IPv4 , addressing, Subnetting, IPv6, CIDR, ICMP and IGMP protocols.

UNIT – IV

Transport Layer: Services of transport layer, Multiplexing and crash recovery
Transmission Control Protocol (TCP) – TCP window management Congestion Control, timer management and User Datagram Protocol (UDP).

UNIT – V
Socket Programming: Primitive and advanced system calls, client/server iterative and concurrent programs IO multiplexing, Asynchronous IO and select system call. APPLICATION LAYER : Domain Name Space (DNS) – SMTP – FTP – HTTP.

Suggested Reading:

1	*Computer Networks*, 5th Edition, Andrew S. Tanenbaum , David J. Wetherall , Pearson Education, 2021
2	*Computer Networks: A Systems Approach*, Larry Peterson and Bruce Davie, Elsevier , 5th Edition, 2021
3	*Computer Networking: A Top-Down Approach*, 6th Edition, James F. Kurose , Keith W. Ross , Pearson , 2022

PC 601 AI	WEB PROGRAMMING					
Prerequisites	Databases		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To learn HTML5 and JavaScript.
2.	To familiarize the tools and technologies to process XML documents.
3.	To learn various server-side and database connectivity technologies.
4.	To gain knowledge on Sevlets .
5.	To work wirh PHP.

Course Outcomes : At the end of the course the student will be able to:	
1.	Design a website with static and dynamic web pages.
2.	Develop a web application with session tracking and client side data validations.
3.	Develop web content publishing application that accesses back-end data base and publishes data in XML format.
4.	Build an application with PHP.
5.	Understand database design.

UNIT – I

Introduction to World Wide Web, Web Browsers, Web Servers, Uniform Resource Locators,

HTTP. HTML5: Introduction, Links, Images, Multimedia, Lists, Tables, Creating Forms, Styling Forms.

UNIT – II

Introduction to XML, XML document structure, Document Type Definition, Namespaces, XML Schemas, Displaying XML documents with CSS, XPath Basics, XSLT, XML Processors.

UNIT – III
Introduction to Java script, Java Script and Forms Variables, Functions, Operators, Conditional Statements and Loops, Arrays DOM, Strings, Event and Event Handling, Java Script Closures. Introduction to Ajax, Pre-Ajax Java Script Communication Techniques, XML HTTP Request Object, Data Formats, Security Concerns, User Interface Design for Ajax.

UNIT – IV
Java Servlets: Java Servlets and CGI Programming, Benefits of Java Servlet, Life Cycle of Java Servlet, Reading data from client, HTTP Request Header, HTTP Response Header, working with Cookies, Tracking Sessions. Introduction to MERN stack and LAMP stack, React JS.

UNIT – V
Introduction to PHP: Overview of PHP, General Syntactic Characteristics, Primitives, Operations, Expressions, Control Statements, Arrays, Functions, Pattern matching, Form handling, Files, Cookies, Session Tracking. **Database access through Web:** Architectures for Database Access- **Database access with Mongo DB** - Database access with PHP-Database access with JDBC.

References:	
1.	Robert W.Sebesta, Programming the World Wide Web, 3rd Edition, Pearson Education, 2006.
2.	Wendy Willard, HTML5, McGraw Hill Education (India) Edition, 2013

Suggested Readings:	
1.	Thomas Powell, The Complete Reference: Ajax, Tata-McGraw-Hill, 2011.
2.	John Pollock, Java Script, 4th Edition, McGraw Hill Education (India) Edition, 2013.
3.	Jim Keogh, J2EE : The Complete Reference, Tata-McGraw-Hill, 2002.

PC603CS	DISTRIBUTED SYSTEMS					
Prerequisites	Operating Systems		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To acquire an understanding of the issues in distributed systems.
2.	To study architectures and working of distributed file systems.
3.	To expose the students to distributed transaction management, security issues and eplication.
4.	To explore knowledge on Distributed fault tolerant Systems
5.	To understand map-reduce algorithms.

Course Outcomes : At the end of the course the student will be able to:	
1.	Describe the problems and challenges associated with distributed systems.
2.	Implement small scale distributed systems.
3.	Understand design tradeoffs in large-scale distributed systems.
4.	Gain knowledge on Consistency and Replication
5.	Familiar with Distributed Fault Tolerant systems

UNIT – I

Introduction: From networked systems to distributed systems , Design goals, A simple classification of distributed ystems , Pitfalls

Architectures: Architectural Styles, Middleware and distributed systems, Layered-system architectures, Symmetrically distributed system architectures , Hybrid system architectures

Processes: Threads, Virtualization, Clients, Servers, and Code Migration.

Communication: Foundations, Remote Procedure Call, Message-Oriented Communication, Stream-Oriented Communication, and Multicast Communication.

UNIT – II

Coordination : Clock Synchronization, Logical Clocks, Mutual Exclusion, Election Algorithms, Gossip based Coordination, Distributed Event Matching, Location Systems.

Transactions- The Slippery Concept of a Transaction, Weak Isolation Levels, serializability

Naming: Names, Identifiers and Addresses, Flat Naming, Structured Naming, and Attribute-Based Naming, Named Data Networking

UNIT – III
Consistency and Replication: Introduction, Data-Centric Consistency Models, Client-Centric Consistency Models, Replica Management, and Consistency Protocols. **Replication-** Leaders & Followers, Problems with Replication Lag, Multi-Leader Replication, Leaderless Replication **Partitioning** - Partitioning and Replication, Partitioning of Key- Value Data, Partiotining and Secondary Indexes, Rebalancing Partitions, Request Routing **Consistency And Consensus**- Consistency Guarantees, Linearizability, Ordering Guarantees, Distributed Transactions and Consensus

UNIT – IV
The Trouble with Distributed Systems- Faults and Partial Failures, Unreliable Networks, Unreliable Clocks, Knowledge, Truth and Lies **Fault Tolerance:** Introduction to Fault Tolerance, Process Resilience, Reliable Client-Server Communication, Reliable Group Communication, Distributed Commit, and Recovery.

UNIT – V
Map-Reduce and Distributed File Systems : Example, Scaling, programming model, Apache Hadoop, Amazon Elastic Map Reduce, Mapreduce.net, Pig and Hive. **Beyond Map Reduce**

References:	
1.	Maarten Van Steen, and Andrew S. Tanenbaum, *Distributed Systems*, PHI 4nd Edition, 2023
2.	Martin Kleppman , Designing Data Intensive Systems, O'Reilly, 2017

Suggested Readings:	
1.	R.Hill, L.Hirsch, P.Lake, S.Moshiri, *Guide to Cloud Computing, Principles and Practice*, Springer, 2013.

PC 604 CS	DEEP LEARNING					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
1	To introduce basic concepts of artificial neural networks and multilayer perceptrons
2	To introduce basic concepts of CNN and VGG
3	To introduce recurrent neural networks and LSTM's
4	To introduce auto encoders and GAN's

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understand the problem of XOR seperability and activation functions in ANN's
CO-2	Understand the problem of over fitting, under fitting, Gradient Descent and Stochastic Gradient Descet
CO-3	Demonstrate understanding of CNN's and VGG's
CO-4	Demonstrate understanding of RNN's and LSTM's
CO-5	Use auto encoders and GAN's

UNIT – I

Artificial Neural Networks: Introduction, Perceptron, XOR Gate, Perceptron Training Rule, Activation Functions

Linear Neural Networks: Linear Regression, Implementation of Linear Regression, Softmax Regression, The Image Classification Dataset , Implementation of Softmax Regression

UNIT – II

Multilayer Perceptrons: Multilayer Perceptrons, Implementation of Multilayer Perceptrons, Model Selection, Under fitting and Over fitting, Weight Decay, Dropout, Forward Propagation, Backward Propagation, and Computational Graphs, Numerical Stability and Initialization, Considering the Environment, Predicting House Prices.

Optimization Algorithms: Optimization and Deep Learning, Convexity, Gradient Descent, Stochastic Gradient Descet, Minibatch Stochastic Gradient Descent, Momentum, Adagrad, RMSProp, Adadelta, Adam, Learning Rate Scheduling

UNIT – III

Introduction to Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters

Modern Convolutional Neural Networks: Deep Convolutional Neural Networks (AlexNet), Networks Using Blocks (VGG), Network in Network (NiN), Networks with Parallel Concatenations (GoogLeNet), Batch Normalization, Residual Networks (ResNet), Densely Connected Networks (DenseNet)

UNIT – IV
Recurrent Neural Networks: Sequence Models, Text Preprocessing, Language Models and the Dataset, Recurrent Neural Networks, Implementation of Recurrent Neural Networks from Scratch, Concise Implementation of Recurrent Neural Networks, Back propagation Through Time. **Modern Recurrent Neural Networks:** Gated Recurrent Units (GRU),Long Short Term Memory (LST), Deep Recurrent Neural Networks, Bidirectional Recurrent Neural Networks, Machine Translation and the Dataset, Encoder-Decoder Architecture, Sequence to Sequence, Beam Search

UNIT –V
Auto encoders: Types of Auto Encoders and its applications **Generative Adversarial Networks:** Generative Adversarial Network, Deep Convolutional Generative Adversarial Networks

Suggested Reading:

1	Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016. Link:https://www.deeplearningbook.org
2	Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, Dive into Deep Learning, 2020
3	Dive into Deep Learning — Dive into Deep Learning 0.16.6 documentation (d2l.ai)

PE 611 AI	PROGRAMMING FOR BIG DATA SYSTEMS					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
1	Learn business case studies for big data analytics
2	Understand nosql big data management
3	Perform map-reduce analytics using Hadoop and related tools

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Describe big data and use cases from selected business domains
CO-2	Explain NoSQL big data management
CO-3	Install, configure, and run Hadoop and HDFS
CO-4	Perform map-reduce analytics using Hadoop
CO-5	Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

UNIT – I

What is big data, why big data, convergence of key trends, unstructured data, industry examples ofbig data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.

UNIT – II

Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer to peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map reduce calculations.

UNIT – III

Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDF Sconcepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures

UNIT – IV

Map Reduce workflows, unit tests with MR Unit, test data and local tests, anatomy of Map Reducejob run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats

UNIT –V
Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration. Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Suggested Reading:

1	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging
2	Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence",
3	Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
4	Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
5	Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
6	E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012
7	Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
8	Eben Hewitt, "Cassandra: The Definitive Guide",

PE 612 AI	INTERPRETABLE MACHINE LEARNING					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives :	
1	To introduce the concepts of Interpretation, Interpretability, and Explainability
2	To learn the importance of features and Global Model-Agnostic Interpretation Methods
3	To explore counterfactual explanations and Visualiz Convolutional Neural Networks
4	To study Interpretation Methods for Multivariate Forecasting , Feature Selection and Engineering for Interpretability
5	To introduce the concepts of Bias Mitigation , Causal Inference , Model Tuning for Interpretability

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understand the methods of traditional model interpretation and challenges of machine learning interpretability
CO-2	Measuring the impact of a feature on the outcome and use Local Model-Agnostic Interpretation Methods
CO-3	Understand Anchor and Counterfactual Explanations, visualize CNN and evaluate misclassifications
CO-4	Understand the effect of irrelevant features and Asses time series models and LSTM with interpretation methods
CO-5	Detect and mitigate Bias, create casual models, tune models for fairness

UNIT – I

Interpretation, Interpretability, and Explainability: Technical requirements, machine learning interpretation, Interpretability, Explainability, A business case for interpretability

Key Concepts of Interpretability: Preparations, Learning about interpretation method types and scopes, Appreciating what hinders machine learning interpretability

Interpretation Challenges: Reviewing traditional model interpretation methods, Predicting minutes delayed with various regression methods, Generalized Linear Models (GLMs).

UNIT – II

Fundamentals of Feature Importance and Impact: Technical requirements, The mission, The preparations, Measuring the impact of a feature on the outcome, Practicing PFI, Interpreting PDPs, Explaining ICE plots.

Global Model-Agnostic Interpretation Methods: The preparations, Learning about Shapley values, Interpreting SHAP summary and dependence plots, Accumulated Local Effects (ALE) plots, Global surrogates. Local Model-Agnostic Interpretation Methods: Leveraging SHAP's Kernel Explainer for local interpretations with SHAP values, Employing LIME, Using LIME for NLP, Trying SHAP for NLP

UNIT– III

Anchor and Counterfactual Explanations: Unfair bias in recidivisim risk assessments, Understanding anchor explanations, Exploring counterfactual explanations, Comparing with CEM

Visualizing Convolutional Neural Networks: Preparations, Loading the CNN model, Visualizing the learning process with activation-based methods, Evaluating misclassifications with gradient-based attribution methods, Saliency maps, Grad-CAM, Creating Grad Cam++ maps, Understanding classifications with perturbation-based attribution methods, LIME's Image Explainer, CEM, Bonus method: SHAP's Deep Explainer.

UNIT – IV

Interpretation Methods for Multivariate Forecasting and Sensitivity Analysis: Loading the LSTM models, Assessing time series models with traditional interpretation methods,
Generating LSTM attributions with integrated gradients, Computing global and local attributions with SHAP's Kernel Explainer, Identifying influential features with factor prioritization, Computing Morris sensitivity indices, Quantifying uncertainty and cost sensitivity with factor fixing, Generating and predicting on Salteli samples.

Feature Selection and Engineering for Interpretability: The preparations, Understanding the effectof irrelevant features, Creating a base model, Reviewing filter-based feature selection methods, Basic filter-based methods, Correlation filter-based methods, Ranking filter-based methods, Comparing filter-based methods, Exploring embedded feature selection methods, Discovering wrapper, hybrid, and advanced feature selection methods, Wrapper methods, Hybrid methods, Advanced methods,
Evaluating all feature-selected models, Considering feature engineering.

UNIT –V

Bias Mitigation and Causal Inference Methods: Detecting bias, Mitigating bias, Pre-processing bias mitigation methods, In-processing bias mitigation methods, Creating a causal model, Understanding heterogeneous treatment effects, Testing estimate robustness.

Monotonic Constraints and Model Tuning for Interpretability: Placing guardrails with feature engineering, Tuning models for interpretability, Tuning a Keras neural network, Tuning other popular model classes, Optimizing for fairness with Bayesian hyper parameter tuning and custom metrics, Constraints for XGBoost, Constraints for Tensor Flow Lattice.

Suggested Reading:

1	Interpretable Machine Learning with Python by Serg Masis, Released March 2021

PE 613 AI	VIRTUAL & AUGMENTED REALITY					
Prerequisites	Mathematics, Programming		L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	Learn the fundamental Computer Vision, Computer Graphics and Human-Computer interaction Techniques related to VR/AR.
2.	Review the Geometric Modeling Techniques
3.	Discuss and Examine VR/AR Technologies.
4.	Use of various types of Hardware and Software in Virtual Reality systems.
5.	Simulate and Apply Virtual/Augmented Reality to varieties of Applications

Course Outcomes : At the end of the course the student will be able to:	
1.	Understand fundamental Computer Vision, Computer Graphics and HumanComputer Interaction Techniques related to VR/AR.
2.	Understand Geometric Modeling Techniques.
3.	Understand the Virtual Environment.
4.	Apply various types of Hardware and Software in Virtual Reality systems.
5.	Design and Formulate Virtual/Augmented Reality Applications.

UNIT – I

Introduction to Virtual Reality (VR)

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

UNIT – II

Computer Graphics and Geometric Modelling

The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, Color theory, Conversion From 2D to 3D, 3D space curves, 3D boundary representation, Simple 3D modelling, 3D clipping, Illumination models, Reflection models, Shading algorithms, Geometrical Transformations: Introduction, Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection.

UNIT – III

Virtual Environment

Input/Output Devices: Input (Tracker, Sensor, Digital Gloves, Movement Capture, Videobased Input, 3D Menus & 3D Scanner, etc.), Output (Visual/Auditory/Haptic Devices) Generic VR system: Introduction, Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems, Animating the Virtual Environment: Introduction, The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in between, free from deformation, particle system Physical Simulation: Introduction, Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

UNIT – IV

Augmented Reality (AR)

Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments, Evaluating ARsystems

UNIT – V

Development Tools and Frameworks

Human factors: Introduction, the eye, the ear, the somatic senses Hardware: Introduction, sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems Software: Introduction, Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

AR / VR Applications.

Introduction, Engineering, Entertainment, Science, Training, Game Development.

References:

1.	Coiffet, P., Burdea, G. C., (2003), "Virtual Reality Technology," Wiley-IEEE Press, ISBN: 9780471360896.
2.	Schmalstieg, D., Höllerer, T., (2016), "Augmented Reality: Principles & Practice," Pearson, ISBN: 9789332578494.

Suggested Readings:	
1.	Norman, K., Kirakowski, J., (2018), " Wiley Handbook of Human Computer Interaction," Wiley-Blackwell, ISBN: 9781118976135.
2.	LaViola Jr., J. J., Kruijff, E., McMahan, R. P., Bowman, D. A., Poupyrev, I., (2017), "3D User Interfaces: Theory and Practice," Pearson, ISBN: 9780134034324.

PE 614 AI	AI FOR GAMING					
Prerequisites	Artificial Intelligence		**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives:	
1.	Gain a solid understanding of core AI techniques in gaming, including decision-making, pathfinding, and behavior modeling, and explore their applications in game development.
2.	Learn advanced AI concepts such as procedural content generation, adaptive AI, and machine learning, and apply them to create dynamic and engaging gaming experiences.
3.	Develop skills in designing and implementing AI systems for games, focusing on performance optimization, enhancing gameplay, and addressing challenges in game AI development.

Course Outcomes:	
1.	Understand the basic concepts of Artificial Intelligence (AI) in games, including the differences between academic AI and game AI, and the role of AI in game design and mechanics.
2.	Analyze the fundamental principles and challenges of game AI, focusing on balancing complexity, performance, and memory constraints in AI engines.
3.	Develop an understanding of AI movement algorithms and pathfinding techniques, including steering behaviors, and the use of algorithms like Dijkstra and A* for efficient navigation.
4.	Implement decision-making techniques such as decision trees, state machines, and behavior trees, and explore advanced AI methods like fuzzy logic and rule-based systems in game environments.
5.	Explore tactical and strategic AI systems, and understand various learning algorithms, including reinforcement learning and neural networks, to create adaptive and intelligent game agents.

Unit-1

Introduction to Artificial Intelligence (AI) in Games: What is AI? Academic AI vs. Game AI, Model of Game AI: Movement, Decision Making, Strategy, Infrastructure, Agent-Based AI, Algorithms and Data Structures for AI: Common algorithms and their implementations**,** Data structures for AI models, AI Development and Design in Games: The role of AI in game design**,** Case studies on AI use in game mechanics

Unit-2

Game AI Fundamentals and Challenges: The Complexity Fallacy: The perception of complexity in game AI**,** Simple vs. complex AI behaviors, Types of AI in Games: Hacks, Heuristics, and Algorithms in AI, Speed and Memory Constraints: Balancing AI performance with processor and memory limitations, The AI Engine: Structure, tools, and implementation of AI engines**,** Building and integrating AI engines into games.

Unit-3
Movement and Pathfinding in AI: Movement Algorithms: 2D movement: Kinematics and statics**,** Kinematic movement algorithms (Seek, Wander)**,** Steering behaviors (Seek, Flee, Arrive, Collision Avoidance), Combining Steering Behaviors: Blending, arbitration, and coordination of multiple behaviors, Pathfinding Basics: Graphs, Dijkstra, and A* algorithms, Advanced Pathfinding: Hierarchical pathfinding, dynamic pathfinding, and continuous-time pathfinding.

Unit-4
Decision-Making Techniques in AI: Overview of Decision Making: Role of decision-making systems in games, Decision Trees, State Machines, and Behavior Trees: Implementing decision-making algorithms in AI**,** Combining state machines and behavior trees for complex decision-making**,** Fuzzy Logic and Markov Systems**:** Fuzzy logic in decision-making processes**,** Markov processes and state machines, Rule-Based Systems and Blackboard Architectures: Structure and implementation of rule-based AI, Blackboard systems for managing shared knowledge among agents.

Unit-5
Tactical, Strategic AI and Learning: Tactical AI: Waypoint tactics and tactical analyses (terrain, influence maps), Tactical pathfinding and coordinated actions, Learning Basics : Types of learning: online, offline, intra- and inter-behavior learning**,** Learning algorithms: Hill Climbing, Reinforcement Learning, Naive Bayes Classifiers, Deep Learning and Neural Networks: Introduction to deep learning in AI, Applying neural networks and reinforcement learning in game AI, Procedural Content Generation: Pseudorandom number generation, landscape creation, and dungeon generation techniques.

Suggested Reading:
1. Ian Millington and John Funge, AI for Games, CRC Press, 3rd edition (2019)
2. Georgios N. Yannakakis and Julian Togelius , Artificial Intelligence and Games, Springer, 1st edition (2018)
3. Mat Buckland, Programming Game AI by Example, Jones & Bartlett Learning, 1st edition (2005)

PE 615 AI	CLOUD COMPUTING					
Pre-requisites			L	T	P	C
			3	-	-	3
Evaluation	SEE	60 Marks	CIE		40 Marks	

Course Objectives :	
1	To introduce basic concepts cloud computing and enabling technologies
2	To learn about Auto-Scaling, capacity planning and load balancing in cloud
3	To introduce security, privacy and compliance issues in clouds
4	To introduce cloud management standards and programming models

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understand the basic approaches and Core ideas of Cloud Computing.
CO-2	Understand the Challenges and approaches in the management of the Cloud environments.
CO-3	Familiarize with advanced paradigms and solutions necessary for building and managing modern Cloud environments.
CO-4	Envision use of Cloud environment in Enterprise.

UNIT– I
Introduction, Benefits and challenges, Cloud computing services, Resource Virtualization, Resource pooling sharing and provisioning.

UNIT – II
Scaling in the Cloud, Capacity Planning, Load Balancing, File System and Storage,

UNIT – III
Multi-tenant Software, Data in Cloud, Database Technology, Content Delivery Network, Security Reference Model, Security Issues, Privacy and Compliance Issues

UNIT – IV
Portability and Interoperability Issues, Cloud Management and a Programming Model Case Study, Popular Cloud Services

UNIT –V
Enterprise architecture and SOA, Enterprise Software , Enterprise Custom Applications, Workflow and Business Processes, Enterprise Analytics and Search, Enterprise Cloud Computing Ecosystem.

Suggested Reading:

1	Cloud Computing - Sandeep Bhowmik, Cambridge University Press, 2017.
2	Enterprise Cloud Computing - Technology, Architecture, Applications by Gautam Shroff, Cambridge University Press, 2016.
3	Kai Hwang, Geoffrey C.Fox, Jack J.Dongarra, ―Distributed and Cloud Computing From Parallel Processing to the Internet of Things‖, Elsevier, 2012.

OE601BM	ENGINEERING APPLICATIONS IN MEDICINE					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To make the students gain basic knowledge of Human Physiology.
2.	To make the students learn the applications of various branches of engineering in Medicine.
3.	**To gain skills in Solid mechanics.**
4.	**To work with brain computer interface.**
5.	**To impart knowledge on** Types of Biomaterials.

Course Outcomes : At the end of the course the student will be able to:	
1.	Describe the major organ systems of the human body
2.	Understand the concepts of bioelectricity and medical instruments
3.	Apply solid and fluid mechanics principles to joints and blood flow respectively
4.	Learn the need and applications of BCI
5.	Analyze and choose proper biomaterial for various applications

UNIT – I
Evolution of Modern healthcare, Major organ systems- Cardiovascular, Respiratory, Nervous, Skeletal, Muscular. Homeostasis. Physiological signals and their diagnostic importance.

UNIT – II
Bioelectricity-Excitable cells, Resting potential, Action potential, Accommodation, Strength-Duration Curve, Propagation of impulses in myelinated and unmyelinated nerves. Medical Instrumentation System-Functions, Characteristics, Design Challenges. Signal Processing-QRS detection.

UNIT – III

Solid mechanics-Analysis of muscle force and joint reaction force for the limb joints.

Fluid mechanics-Factors governing and opposing blood flow, Wind-Kessel model, Application of Hagen-Poiseuille flow to blood flow.

UNIT – IV

Brain-Computer Interface: Brain signals for BCIs, Generic setup for a BCI, Feature extraction and Feature translation involved in BCIs. Typical applications-Word forming, Device control.

UNIT – V

Materials and Tissue Replacements-Types of Biomaterials- Metals, Polymers, Ceramics and Composites and their applications in Soft and Hard tissue replacements. Implants- Manufacturing process, Design, fixation.

References:

1.	John Enderle, Susan M. Blanchard and Joseph Bronzino, Introduction to Biomedical Engineering, Second Edition, Elsevier, 2005.
2.	Ozkaya, Nordin. M, Fundamentals of Biomechanics, Springer International Publishing, 4th Edition, 2017.

Suggested Readings:

1.	John Enderle, Susan M. Blanchard and Joseph Bronzino, Introduction to Biomedical Engineering, Second Edition, Elsevier, 2005.
2.	Ozkaya, Nordin. M, Fundamentals of Biomechanics, Springer International Publishing, 4th Edition, 2017.
3.	Khandpur R.S., Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2016.
4.	John G.Webster, Medical Instrumentation: Application and Design, John Wiley and Sons Inc., 3rd Ed., 2003.

OE602BM	HUMAN ASSISTIVE TECHNOLOGIES					
Prerequisites			**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives :	
1.	To extend knowledge of the amputee, of lost and remaining functions affecting locomotion, and to collect information on the best possible medical treatment.
2.	To improve fitting techniques and practices, including training, so that existing devices might be used with greater comfort and function.
3.	To develop improved lower-extremity devices.
4.	**To impart knowledge on orthotic devices.**
5.	**To do real time applications.**

Course Outcomes : At the end of the course the student will be able to:	
1.	Apply fundamental knowledge of engineering in rehabilitation.
2.	Apply analytical skills to assess and evaluate the need of the end-user.
3.	Develop self-learning initiatives and integrate learned knowledge for problem solving.
4.	Understand the basics of robotics and apply their principles in developing prosthetics.
5.	Apply the knowledge of computers in solving rehabilitation problems.

UNIT – I

Introduction to Rehabilitation Engineering, Definition of Rehabilitation Engineering, Scope and importance of the field, Historical perspective. Interdisciplinary nature and collaboration with healthcare professionals. Physical disabilities: mobility impairments, spinal cord injuries. Cognitive disabilities: learning disabilities, traumatic brain injuries. Psychosocial aspects of disability.

UNIT – II

Assistive Technology, Human Factors and Ergonomics in Assistive Technology Design. Mobility Aids, Types of Wheelchairs and design aspects: Manual wheelchairs, Powered wheelchairs, Customizable features and design considerations, Auxiliary devices and systems. Human-Centered Designing

UNIT – III
Sensory disabilities: visual and hearing impairments. Sensory augmentation and substitution: Visual system: Visual augmentation. Tactual vision substitution, Auditory vision substitution; Auditory system: Auditory augmentation. Cochlear implantation, Visual auditory substitution, Tactual auditory substitution, Tactual system: Tactual augmentation. Tactual substitution. Assessment and Outcome Measurement

UNIT – IV
Rehabilitation Robotics, Exoskeletons, Major Limb Prosthetic Devices, Orthotic Devices, Types of orthotics and prosthetics, Intelligent prosthetic Knee, Prosthetic Hand, Controlled orthotics and prosthetics Materials and fabrication techniques, Functional and cosmetic considerations. FES system, Restoration of Hand function, Restoration of standing and walking, Myo-electric Hand.

UNIT – V
Case Studies and Real-World Applications. Augmentative and Alternative communications, Software tools for simulation and testing. Virtual reality applications in rehabilitation. Machine learning applications in assistive technology. Predictive analytics for personalized rehabilitation

References:	
1.	Robinson C.J., *Rehabilitation Engineering*, CRC Press, 1995.
2.	Ballabio E., et al., *Rehabilitation Technology*, IOS Press, 1993.

Suggested Readings:	
1.	Rory A Cooper, Hisaichi Ohnabe, Douglas A. Hobson, *Series in medical physis and biomedical engineering: An introduction to rehabilitation engineering*, Taylor and Francis Group, London, 2007.
2.	Joseph D. Bronzino *The biomedical engineering handbook -biomedical engineering fundamentals*, 3rd Ed., CRC Press, Taylor & Francis Group, London, 2006.

OE601CE	DISASTER MANAGEMENT					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To introduce basic conceptual understanding of natural & man-made hazards and different contextual aspects.
2.	To develop the knowledge and understanding of the International and national strategy for disaster reduction (UN-ISDR).
3.	To ensure skills and abilities to analyze potential effects of disasters.
4.	To promote the use of science and technology for implementing the disaster risk reduction (DRR) plans and policies.
5.	To understand the strategies and methods to deliver public health response to avert these effects.

Course Outcomes : At the end of the course the student will be able to:	
1.	Aptitude to link hazards, risk, vulnerability, differential impacts and capacity building to the life and property loss during disasters and its impacts on the society and sustainability.
2.	Ability to understand various aspects of natural and man-made hazards and emerging trends.
3.	Acquaintance with different steps involved in disaster risk reduction (DRR) and international initiatives for prevention, mitigation and preparedness.
4.	Knack to appreciate the national policy and role of individuals, communities, and government organizations in disaster management.
5.	Capacity to identifying current technological constraints and hazard specific solutions, particularly construction codes etc.

UNIT – I

Understanding the Concepts, Definitions and Terminologies used in the field of Disaster Management (i.e. Hazard, Risk, Vulnerability, Resilience, and Capacity Building).

Differential impacts of Disasters in terms of Gender, Age, Social Status, Location, Prosperity, Disabilities.

Disaster- Development Nexus.

UNIT – II

Classification, Causes, Consequences and Controls of Geophysical hazards-Earthquakes, Landslides, Tsunami Weather related hazards- Meteorological (Cyclones, Storm-surge and Lighting) Hydrological (Floods, Droughts, Avalanches) Climatological (Wildfire, Cold & Heat Waves)

Biological hazards-Epidemic & Pandemics, Technological hazards-Chemical, Industrial, Nuclear

Man-made hazards-Structural Failure, Fire, Transportation accidents, Terrorism and Wars Emerging Disasters- Urban Areas, Climate Change. Regional and Global Trends-loss of life & Property in various hazards.

UNIT – III

DISASTER MANAGEMENT CYCLE AND INTERNATIONAL FRAMEWORK

Disaster Management Cycle Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue– Emergency Operation Centre – Incident Command System – Relief and Rehabilitation Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment Paradigm Shift in Disaster Management: International Decade for Natural Disaster Reduction; Yokohama Strategy; Hyogo Framework of Action

UNIT – IV

DISASTER RISK MANAGEMENT IN INDIA

Disaster Profile of India – Mega Disasters of India and Lessons Learnt**,** Disaster Management Act 2005 – Institutional and Financial Mechanism**,** National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter- governmental Agencies**.**

UNIT – V

TECHNOLOGICAL APPROACHES TO DISASTER RISK REDUCTION

Geo-informatics in Disaster Management (RS, GIS, GPS and RS)**,** Disaster Communication System (Early Warning and Its Dissemination)**,** Land Use Planning and Development Regulations**,** Disaster Safe Designs and Constructions**,** Structural and Non Structural Mitigation of Disasters**,** Science &Technology Institutions for Disaster Management in India**.**

References:	
1.	Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2.	Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi.

Suggested Readings:	
1.	World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland.

OE602CE	ROAD SAFETY ENGINEERING					
Prerequisites			**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives :	
1.	To introduce the fundamentals of road safety and road safety audit
2.	To get familiarized with various road safety techniques, measures and their applications
3.	To be able to understand and evaluate various traffic control devices
4.	Familiarize with traffic management techniques
5.	To examine and analyze the incident management process

Course Outcomes : At the end of the course the student will be able to:	
1.	Analyze Accident data
2.	Plan and design of road safety improvement programs
3.	Apply the principles of road safety in urban transport
4.	Apply traffic management techniques
5.	Able to plan effective incident management program

UNIT – I

Road accidents: Causes, scientific investigations and data collection, analysis of individual accidents to arrive at real causes, statistical methods of analysis of accident data, Basic concepts of road accident statistics, safety performance function: The empirical Bayes method identification of hazards road location. Application of computer analysis of accident data.

UNIT – II

Safety in Road Design: Operating the road network for safety, highway operation and counter measures, road safety audit, principles-procedures and practice, code of good practice and checklists, vehicle design factors & driver characteristics influencing road safety.

UNIT – III

Road Signs and Traffic Signals: Classification, Location of signs, measures of sign effectiveness,

Types of visual perception, sign regulations, sign visibility, sign variables, Text versus symbols, Road marking: Role of road marking, classification, visibility. Traffic signals: Need, Signal face illumination and location of signals, factors affecting signal design, pedestrian's safety, fixed and vehicle actuated signals. Design of signals, area traffic control, Delineators, traffic impact attenuators, road side rest areas, safety barriers, traffic aid posts.

UNIT – IV

Traffic Management Techniques: Integrated safety improvement and traffic calming schemes, speed and load limit, traffic lights, safety cameras, tests on driver and vehicles, pedestrian safety issues, parking, parking enforcement and its influence on accidents, travel demand management, methods of traffic management measures: restriction of turning movements, One way streets, tidal flow operation methods, exclusive bus lanes and closing side-streets; latest tools and techniques used for road safety; legislation, enforcement, education and propaganda.

UNIT – V

Incident Management: Introduction, characteristics of traffic incidents types of incidents, impacts, incident management process, incident traffic management; application of ITS: Motorist information, equipment used; planning effective incident management program, best practice in incident management programs. National importance of survival of transpiration systems during and after all natural disasters especially cyclones, earthquakes, floods etc and manmade disasters like sabotage, terrorism etc.

References:

1.	Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017.
2.	KadiyaliL.R, Lal, N.B., 'Principles and Practices of Highway Engineering' Khanna Publishers, 7e, 2017.

Suggested Readings:

1.	IRC 93 ' Guidelines for the design of road traffic signals' IRC, New Delhi.

OE601EC	Verilog HDL					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To familiarize with various modeling styles: structural, dataflow and behavioral of Verilog HDL.
2.	To develop combinational and sequential circuits using various modeling styles of Verilog HDL.
3.	To design and develop Verilog HDL models of combinational and sequential circuits.
4.	To learn Synthesis and FPGA design flo To design and develop real time applications: Booth‘s multiplier, Divider, hardwired control for basic CPU, FIR filter.
5.	To design and develop real time applications: Booth‘s multiplier, Divider, hardwired control for basic CPU, FIR filter.

Course Outcomes : At the end of the course the student will be able to:	
1.	Implement and distinguish different Verilog HDL modeling styles.
2.	Construct and analyze Verilog HDL models of combinational and sequential circuits
3.	Design and develop Verilog HDL modeling and test bench for digital systems for the given specifications.
4.	Outline FPGA design flow and timing analysis.
5.	Understand implementation of real time applications.

UNIT – I

Introduction to HDL: Overview and Importance of HDLs, Differences between HLL, HDL and ALP. Design methodologies, Modules, Lexical Conventions, Number Specifications, Strings, Identifiers and Keywords Data types, System task and compiler Directives, Port declaration and port connection rules.

UNIT – II

Structural and Dataflow modeling: gate-level modeling, delays, hazards, dataflow modeling: Continuous Assignments, Delays, Expressions, Operators and Operands, Operator Types 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 Simulation: Types of Simulation, Event driven Simulation and Cycle Based Simulation; design examples.

UNIT – IV
Synthesis and Verification: Tasks and Functions: Differences between Tasks and Functions, Tasks and Functions. Verilog HDL synthesis, 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.

References:	
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.

Suggested Readings:	
1.	Bhasker, ―A Verilog HDL Primer, 2nd Edition, BS Publications, 2001.

OE602EC	PRINCIPLES OF ELECTRONIC COMMUNICATION SYSTEMS					
Prerequisites			**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives :	
1.	Provide an introduction to fundamental concepts in the understanding of Electronic communications systems
2.	Provide an introduction to network model and some of the network layers including physical layer, data link layer, network layer and transport layer
3.	Provide an introduction to the evolution of wireless systems and current wireless technologies
4.	Provide an introduction to fundamental concepts in the understanding of Telecommunication and optical communications systems
5.	Provide an introduction to fundamental concepts in Analog and Digital Communications

Course Outcomes : At the end of the course the student will be able to:	
1.	Understand the working of analog and digital communication systems.
2.	Understand the Data Communication and Networking
3.	Understand the concepts of modulation and demodulations
4.	Understand the evolution of communication technologies from traditional telephony systems to modern wireless communication systems
5.	Understand the principles of optical communications systems

UNIT – I

Introduction to communication systems: Electromagnetic Frequency Spectrum, Signal and its representation, Elements of Electronic Communications System, Types of Communication Channels, Signal Transmission Concepts-Baseband transmission and Broadband transmission, Communication parameters-Transmitted power, Channel bandwidth and Noise, Need for modulation Signal Radiation and Propagation-Principle of electromagnetic radiation, Types of Antennas, Antenna Parameters and Mechanisms of Propagation.

UNIT – II

Analog and Digital Communications: Amplitude modulation and demodulation, FM modulation

and demodulation, Digital converters, Digital modulation schemes – ASK, FSK, PSK, QPSK, Digital demodulation.

UNIT – III
Data Communication and Networking: Network Models, OSI Model, Data Link Layer – Media Access control, Ethernet, Network Layer – Internet Protocol (IPv4/IPv6), Transport Layer – TCP, UDP.

UNIT – IV
Telecommunication Systems: Telephones, Telephone system, Paging systems, Internet Telephony. Optical Communications: Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

UNIT – V
Wireless Communications: Evolution of Wireless Systems: AMPS, GSM, CDMA, WCDMA, And OFDM. Current Wireless Technologies: Wireless LAN, Bluetooth, PAN and ZigBee, Infrared wireless, RFID communication, UWB, Wireless mesh networks, Vehicular adhoc networks.

References:	
1.	Louis E. Frenzel, "Principles of Electronic Communication Systems", 3e, McGraw Hill publications, 2008.
2.	Behrouz A. Forouzan,"Data Communications and Networking", 5e TMH, 2012.

Suggested Readings:	
1.	Kennady, Davis, "Electronic Communications systems", 4e, TMH, 1999.

OE601ME	3D PRINTING TECHNOLOGY					
Prerequisites			**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives :	
1.	To understand the fundamental concepts of 3D Printing, its advantages and limitations.
2.	To know the working principle, advantages, disadvantages and applications of liquid, solid and Powder based 3D Printing Technologies.
3.	To know the various types of STL file errors and other data formats used in 3D Printing Technology.
4.	To know the features of various 3D Printing software's.
5.	To know diversified applications of 3D Printing Technologies

Course Outcomes : At the end of the course the student will be able to:	
1.	Interpret the features of 3D Printing and compare it with conventional methods.
2.	Illustrate the working principle of liquid, solid and powder based 3D Printing Technologies.
3.	Identify various types of errors in STL file and other data formats used in 3D Printing Technology.
4.	Select suitable software used in 3D Printing Technology.
5.	Apply the knowledge of various 3D Printing technologies for developing innovative applications.

UNIT – I

Introduction: Prototyping fundamentals: Need for time compression in product development, Historical development, Fundamentals of 3D Printing, 3D Printing Process Chain, Advantages and Limitations of 3D Printing, 3D Printing wheel, Commonly used Terms, Classification of 3D printing processes, Fundamental Automated Processes: Distinction between 3D Printing and Conventional Machining Processes.

UNIT – II

Liquid-based 3D Printing Systems: Stereo Lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Polyjet: Models and specifications, Process, working principle, Applications, Advantages and

Disadvantages, Case studies Solid-based 3D Printing System: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT – III

Powder Based 3D Printing Systems: Working principle, Specifications, Materials used, Process, Applications, Advantages and Disadvantages, Case studies of the following 3D Printing Technologies like Selective laser sintering (SLS), Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS), Laser Engineered Net Shaping (LENS), Electron Beam Melting (EBM).

UNIT – IV

3D Printing Data Formats & Software: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. 3D Printing Software's Features: Magics, Mimics, Solid View, View Expert, 3 D Rhino, 3 D doctor, Flash Print, Object Studio, Cura, ITK Snap, 3-matic, Simplant, 3-matic, Simplant, MeshLab, Ansys for Additive Manufacturing.

UNIT – V

Applications of 3D Printing : Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Electronic Industry, Jewellery Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules. Biopolymers, Packaging, Disaster Management, Entertainment and Sports industry.

References:

1.	Chee Kai Chua and Kah Fai Leong, "3D Printing and Additive Manufacturing Principles and Applications" Fifth Edition, World scientific
2.	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing- Ian Gibson, David W Rosen, Brent Stucker, Springer, Second Edition, 2010.

Suggested Readings:

1.	Rapid Prototyping & Engineering Applications – Frank W.Liou, CRC Press, Taylor & Francis Group, 2011.

OE602ME	FINITE ELEMENT METHODS					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To understand the theory and application of the finite element method for analyzing structural systems.
2.	To learn Approximation theory for structural problems as the basis for finite element methods.
3.	To learn formulations for a variety of elements in one, two, and three dimensions.
4.	Implementations of element formulations will be examined using Matlab.
5.	

Course Outcomes : At the end of the course the student will be able to:	
1.	Demonstrate a basic understanding of the concepts, mathematical formulation and numerical implementation.
2.	Demonstrate the ability to invoke appropriate assumptions, select proper elements and develop FEA models that adequately and efficiently represent physical systems.
3.	Underlying the FEA as applied to solid mechanics.
4.	Solve 2D vector variable problems and analyze higher order elements and its applications.
5.	Create his/her own FEA computer programs using Matlab to solve simple engineering problems.

UNIT – I

Introduction

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT – II

One-Dimensional Problems

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices – Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes.

UNIT – III

Two Dimensional Scalar Variable Problems

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems – Torsion of Non circular shafts – Quadrilateral elements – Higher Order Elements.

UNIT – IV

Two Dimensional Vector Variable Problems

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations – Plate and shell elements.

UNIT – V

Isoparametric Formulation

Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques – Solutions Techniques to Dynamic problems – Introduction to Analysis Software.

References:

1.	Tirupathi R. Chandraputla and Ashok, D. Belgundu" Introduction to Finite Elements in Engineering", Pearson Education, 2002, 3rd Edition.
2.	Rao S.S., "The Finite Element Methods in Engineering", pergamon Press, 1989.

Suggested Readings:

1.	Segerlind, L.J. "Applied Finite Element Analysis", Wiley Publication, 1984.

OE601EE	APPLICATIONS OF ELECTRICAL ENERGY					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To introduce the students and understand Utilization of electrical energy for various applications like industrial heating.
2.	To understand various techniques of electric welding and types of batteries.
3.	To understand the concept of illumination and study about the laws of illumination.
4.	To know the applications of various lamps to factory lighting, street lighting etc.
5.	To understand the concept of electric traction including speed – time curves of different traction services.

Course Outcomes : At the end of the course the student will be able to:	
1.	Identify a suitable heating scheme for a given application.
2.	Identify proper welding technique and various characteristics of batteries.
3.	Study the nature and production of light and laws related to illumination.
4.	Classify types of electric light sources based on nature and operation and their objectives, performance and reliability.
5.	Determine the speed-time characteristics of various traction services and also estimate the energy consumption levels at various modes of operation.

UNIT – I

Industrial Heating: Advantages and methods of electric heating. Description, operation and performance of resistance ovens, Design of heating element. High frequency heating, Induction Heating, Induction furnaces, Core type, Coreless furnaces, Dielectric heating. Electric Arc furnaces, Direct Arc furnace, Indirect Arc furnaces

UNIT – II

Electric welding: Classification of electric welding, welding transformer and its rating, various types of Electric arc welding and electric resistance welding.

Batteries: Lead acid batteries, SMF batteries, Construction and maintenance, Charging and rating of batteries.

UNIT – III

Illumination: Introduction, nature and production of light, Sensitivity of the eye, Units of light. The inverse square law and cosine law, Solid angle, Lighting calculations, Determination of M.S.C.P, Rousseau‟s construction.

UNIT – IV

Types of lamps - Discharge lamps, Sodium vapour lamps, Mercury vapour lamps, Fluorescent lamp. Starting and power factor corrections, stroboscopic effects, Neon signs, Application to factory lighting, Street lighting and Flood lighting.

UNIT – V

Electric Traction: System of Electric Traction, Transmission of drive, Systems of track electrification, Traction mechanics, Speed time curves, Tractive effort, Power of Traction motor, Specific energy consumption, Mechanics of train movement, Coefficient of adhesion.

References:

1.	Partab H, Art and Science of Utilization of Electric Power, Dhanpat Rai & Sons, 1997.
2.	K.B. Raina & S.K. Bhattacharya, Electrical Design, Estimating 1. and Costing, Wiley Eastern Ltd., 1991.

Suggested Readings:

1.	Partab H, Modern Electric Traction, Dhanpat Rai & Sons, 2000.

OE602EE	ELECTRICAL SAFETY MANAGEMENT					
Prerequisites			**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Evaluation	**CIE**	**40 Marks**	**SEE**		**60 Marks**	

Course Objectives :	
1.	Understand electrical safety measures, the hazards associated with electric current, and voltage identify different types of electrical shocks
2.	Understand installation work of electrical plant and equipment. Safety during installation of outdoor switchyard equipment, safety during installation of electrical rotating machines.
3.	Understand procedure of domestic wirings, to handle different domestic electrical appliances, Procedure of Agricultural pump installation
4.	Identifies different hazardous zones, classification of equipment enclosure for various hazardous gases, importance of earthing system. Understand Management Safety Policy
5.	Understand standards on electrical safety, different IE Rules and Acts

Course Outcomes : At the end of the course the student will be able to:	
1.	Explain the objectives and precautions of Electrical safety, effects of shocks and their prevention.
2.	Summarize the safety aspects during installation of plant and equipment.
3.	Describe the electrical safety in residential, commercial and agricultural installations.
4.	Describe the various Electrical safety in hazardous areas, Equipment earthing and system neutral earthing.
5.	State the electrical systems safety management and IE rules.

UNIT – I

INTRODUCTION TO ELECTRICAL SAFETY, SHOCKS AND THEIR PREVENTION:

Terms and definitions, objectives of safety and security measures, Hazards associated with electric current, and voltage, who is exposed, principles of electrical safety, Approaches to prevent Accidents, scope of subject electrical safety. Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash

shocks, burns, residential buildings and shops.

UNIT – II

SAFETY DURING INSTALLATION OF PLANT AND EQUIPMENT:

Introduction, preliminary preparations, preconditions for start of installation work, during, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines, drying out and insulation resistance measurement of rotating machines.

UNIT – III

ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS: Wiring and fitting – Domestic appliances – water tap giving shock – shock from wet wall – fan firing shock – multi-storied building – Temporary installations – Agricultural pump installation – Do's and Don'ts for safety in the use of domestic electrical appliances.

UNIT – IV

ELECTRICAL SAFETY IN HAZARDOUS AREAS: Hazardous zones – class 0,1 and 2 – spark, flashovers and corona discharge and functional requirements – Specifications of electrical plants, equipment for hazardous locations – Classification of equipment enclosure for various hazardous gases and vapours – classification of equipment/enclosure for hazardous locations.

UNIT – V

SAFETY MANAGEMENT OF ELECTRICAL SYSTEMS: Principles of Safety Management, Management Safety Policy, Safety organization, safety auditing, Motivation to managers, supervisors, employees.

REVIEW OF IE RULES AND ACTS AND THEIR SIGNIFICANCE:

Objective and scope – ground clearances and section clearances – standards on electrical safety - safe limits of current, voltage –Rules regarding first aid and firefighting facility.

The Electricity Act, 2003, (Part1, 2, 3, 4 & 5).

References:

1.	S.Rao, Prof. H.L.Saluja, "Electrical safety, fire safety Engineering and safety management", 1st edition
2.	Khanna Publishers. New Delhi, 2016 Reprint.

Suggested Readings:	
1.	Pradeep Chaturvedi, "Energy management policy, planning and utilization", Concept Publishing company, New Delhi, 1997.

OE601CS	PYTHON PROGRAMMING					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To know the basics of Programming.
2.	To convert an algorithm into a Python program.
3.	To construct Python programs with control structures.
4.	To structure a Python Program as a set of function.
5.	To use Python data structures-lists, tuples, dictionaries.

Course Outcomes : At the end of the course the student will be able to:	
1.	Develop algorithmic solutions to simple computational problems.
2.	Develop and execute simple Python programs.
3.	Develop simple Python programs for solving problems.
4.	Structure a Python program into functions.
5.	Represent compound data using Python lists, tuples, dictionaries.

UNIT – I

Introduction to Computing and Problem Solving: Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudo Code and Flowcharts – Instructions – Algorithms Building Blocks of Algorithms.

Introduction to Python Programming: Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

Control Flow Statements: The if, The if…else, The if…elif…else Decision Control Statements, Nested if Statement, The while Loop, The for Loop, The continue and break Statements.

UNIT – II

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default

Parameters, Keyword Arguments, Command Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters;

Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

UNIT – III

Files and Exception: Text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file. Strings: Basic String Operations, String Slicing, Testing, Searching, and Manipulating Strings Dictionaries and Sets: Dictionaries, Sets, Serializing Objects.

UNIT – IV

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Classes with Multiple Objects, Class Attributes versus Data Attributes, Encapsulation, Inheritance The Polymorphism.

Functional Programming: Lambda. Iterators, Generators, List Comprehensions

UNIT – V

GUI Programming: Graphical User Interfaces, Using the tkinter Module, Display text with Label Widgets, Organizing Widgets with Frames, Button Widgets and Info Dialog Boxes, Getting Input with Entry Widget, Using Labels as Output Fields, Radio Buttons, Check Buttons.

References:

1.	Richard L. Halterman, "Learning To Program With Python", Copyright © 2011.
2.	Dr. Charles R, "Python for Everybody, Exploring Data Using Python 3", Severance. 2016.

Suggested Readings:

1.	Gowrishankar S., Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.

OE602CS	CYBER SECURITY					
Prerequisites			L	T	P	C
			3	0	0	3
Evaluation	CIE	40 Marks	SEE		60 Marks	

Course Objectives :	
1.	To learn the various threats in networks and security concepts.
2.	To apply authentication applications in different networks.
3.	To understand security services for email.
4.	To awareness of firewall and IT laws and policies.
5.	**To understand different IT Policies.**

Course Outcomes : At the end of the course the student will be able to:	
1.	Understand the various network threats.
2.	Analyze the forensic tools for evidence collection.
3.	Apply the firewalls for threat analysis.
4.	Understand OS artifact.
5.	Evaluate Different IT Acts.

UNIT – I

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering.

UNIT – II

Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis

UNIT – III
Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, search and seizure of computer systems, password cracking.

UNIT – IV
Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrieval, Email analysis from mobile phones.

UNIT – V
Ethics, Policies and IT Act. Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, E Commerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems Indian Laws, Information Technology Act 2000, Indian Evidence Act, India Technology Amendment Act 2008, Indian Penal Code, Computer Security Act 1987, National Information Infrastructure Protection Act 1996, Fraud Act 1997, Children Online Protection Act 1998, Computer Fraud and Abuse Act 2001, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship, ,Introduction to Cyber Ethics, rights over intellectual property, Corporate IT Policy Formulations, Compliance Auditing.

References:	
1.	Charles P. Fleeger, "Security in Computing", Prentice Hall, New Delhi, 2009.
2.	BehrouzA.Forouzan, “Cryptography & Network Security”, Tata McGraw Hill, India, New Delhi, 2009.

Suggested Readings:	
1.	William Stallings, “Cryptography and Network Security”, Prentice Hall, New Delhi, 2006.

PC 652 CS	COMPUTER NETWORKS LAB					
Prerequisites			**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**
Evaluation	**CIE**	**25 Marks**	**SEE**		**50 Marks**	

Course Objectives	
1	To familiarize POSIX: IPC
2	To use socket interface to write client-server network applications
3	To effectively use sockets to write simple network monitoring tools

Course Outcomes On completion of this course, the student will be able to	
CO1	Write concurrent programs using message queues and semaphores
CO2	Use connection-oriented , connectionless and Asynchronous sockets
CO3	Implement networked applications in TCP/IP protocol Suite

List of Programs

1. Examples using IPC
2. Echo Server using TCP (Concurrent or Iterative) and UDP
3. Time of the day server
4. Talker and Listener
5. Ping routine
6. Trace route
7. Mini DNS

Note: The above experiments [2-7] have to be carried out using socket programming interface. Multi-threading has to be employed wherever it is required.

PC 653 CS	Deep Learning Lab					
Prerequisites			L	T	P	C
			0	0	2	1
Evaluation	CIE	25 Marks	SEE		50 Marks	

List of Programs	
1. Build a deep neural network model start with linear regression using a single variable	
2. Build a deep neural network model start with linear regression using multiple variables.	
3. Write a program to convert speech into text.	
4. Write a program for Time-Series Forecasting with the LSTM Model.	
5. Write a program to predict a caption for a sample image using LSTM.	
6. Write a program for character recognition using CNN.	
7. Write a program to predict a caption for a sample image using CNN	
8. Write a program for character recognition using RNN and compare it with CNN.	
9. Write a program to detect Dog image using YOLO Algorithm.	
10. Write a program to develop a GAN for Generating MNIST Handwritten Digits.	
11. Write a Program for Use of Vision Transformer for image tagging	

PC 651 AI	WEB PROGRAMMING LAB					
Prerequisites	HTML, JAVA		L	T	P	C
			0	0	2	1
Evaluation	CIE	25 Marks	SEE		50 Marks	

Course Objectives :	
1.	To develop an ability to design and implement static and dynamic website
2.	**To understand, analyze and create XML documents and XML Schema**
3.	**To understand, analyze and build web applications using PHP**

Course Outcomes : At the end of the course the student will be able to:	
1.	Create web pages using HTML and Cascading Styles sheets
2.	Create dynamic web pages using JavaScript
3.	Understand, analyze and apply the role of languages like HTML, CSS, XML, JavaScript, PHP, SERVLETS, JSP and protocols in the workings of the web and web applications
4.	Build web applications using PHP
5.	Analyze a web page and identify its elements and attributes

1. Develop and demonstrate the usage of inline, internal and external style sheet using CSS
2. Write JavaScript to validate the following fields of the Registration page.
    a. First Name (Name should contains alphabets and the length should not be less than 6 characters).
    b. Password (Password should not be less than 6 characters length).
    c. E-mail id (should not contain any invalid and must follow the standard pattern name@domain.com)
    d. Mobile Number (Phone number should contain 10 digits only).
    e. Last Name and Address (should not be Empty).
3. Create an XML document that contains 10 users information. Write a Java Program, which takes User Id as input and returns the user details by taking the user information from XML document using DOM parser or SAX parser.
4. Write an HTML page including any required JavaScript that takes a number from text field in the range of 0 to 999 and shows it in words. It should not accept four and above digits, alphabets and special characters.
5. Implement the web applications with Database using
    (a) PHP
    (b) Servlets and
    (c) JSP
6. Develop and demonstrate PHP Script for the following problems:
    a) Write a PHP Script to find out the Sum of the Individual Digits.

b) Write a PHP Script to check whether the given number is Palindrome or not

7. Write an HTML page including any required JavaScript that takes a number from one text field in the range of 0 to 999 and shows it in another text field in words. If the number is out of range, it should show "out of range" and if it is not a number, it should show "not a number" message in the result box.

8. Write a HTML page that has one input, which can take multi-line text and a submit button. Once the user clicks the submit button, it should show the number of characters, words and lines in the text entered using an alert message. Words are separated with white spaces and lines are separated with new line character.

9. Write an HTML page that contains a selection box with a list of 5 countries. When the user selects a country, its capital should be printed next to the list. Add CSS to customize the properties of the font of the capital (color, bold and font size).

10. Create and save an XML document at the server, which contains 10 users information. Write a program which takes User Id as input and returns the user details by taking the user information from the XML document.

Install the following on the local machine: Apache Web Server, Tomcat Application Server locally, Install MySQL and install PHP and configure it to work with Apache web server and MySQL.

Implement the following web applications using (a) PHP, (b) Servlets and (c) JSP.

i) A user validation web application, where the user submits the login name and password to the server. The name and password are checked against the data already available in Database and if the data matches, a successful login page is returned. Otherwise a failure message is shown to the user.

ii) Modify the above program to use an XML file instead of database.

iii) Modify the above program using AJAX to show the result on the same page below the submit button.

iv) A simple calculator application that takes two numbers and an operator (+,-,*,/,%) from an HTML page and returns the result page with the operation performed on the operands.

v) A web application takes a name as input and on submit it shows a hello<name>page where <name> is taken from the request. It shows the start time at the right top corner of the page and provides the logout button. On clicking this button, it should show a logout page with Thank You<name> message with the duration of

usage.(Use session to store name and time).

PW 661 AI	MINI PROJECT					
Pre-requisites	-		**L**	**T**	**P**	**C**
			-	-	6	3
Evaluation	**SEE**	-	**CIE**	50 Marks		

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	To review available literature and formulate structural engineering problems
2	To learn the technique of writing reports and prepare presentation

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Identify engineering problems reviewing available literature
CO-2	Understand of contemporary / emerging technology for various processes and systems.
CO-3	Share knowledge effectively in oral and written form and formulate documents
CO-4	Present solution by using his/her technique applying engineering principles.
CO-5	Prepare technical report and presentation

Guidelines:

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

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Semester and End Semester will be monitored by the departmental committee.

PW 961 AI	SUMMER INTERNSHIP					
Prerequisites			L	T	P	C
			-	-	-	-
Evaluation	SEE	-	CIE		-	

Course Objectives:	
1.	To train and provide hands-on experience in analysis, design, and programming of information systems by means of case studies and projects.
2.	To expose the students to industry practices and team work.
3.	To provide training in soft skills and also train them in presenting seminars and technical report writing.

Course Outcomes:

After completion of this course student will be able to do:

CO-1	Get Practical experience of software design and development, and coding practices within Industrial/R&D Environments.
CO-2	Gain working practices within Industrial/R&D Environments.
CO-3	Prepare reports and other relevant documentation

Summer Internship is introduced as part of the curricula of encouraging students to work on problems of interest to industries. A batch of three students will be attached to a person from the Computer Industry/Software Companies/R&D Organization for a period of 8 weeks.

This will be during the summer vacation following the completion of the III year Course. One faculty coordinator will also be attached to the group of Three (3) students to monitor the progress and to interact with the industry co-ordinate (person from industry). After the completion of the project, student will submit a brief technical report on the project executed and present the work through a seminar talk to be organized by the Department.

Award of sessionals are to be based on the performance of the students, to be judged by a committee constituted by the department. One faculty member will co-ordinate the overall activity of Industry Attachment Program.

Students have to undergo summer internship of Six Weeks duration at the end of semester VI and the credits will be awarded after evaluation in VII semester.