Maharshi Dayanand University, Rohtak
SCHEME OF STUDIES AND EXAMINATION

B.Tech (Artificial Intelligence & Machine Learning)
B.Tech (Computer Science and Engineering-Artificial Intelligence & Machine Learning)
3rd Year

Semester 5th & 6th
Scheme Effective From 2022-23

COURSE CODE AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional Core Courses
PEC	Professional Elective Courses
LC	Laboratory Courses
MC	Mandatory Courses
PT	Practical Training
S	Seminar

Scheme of Studies and Examination
B. TECH. (Artificial Intelligence & Machine Learning) -5th Semester
B. TECH. (Computer Science and Engineering- Artificial Intelligence & Machine Learning)-5th Semester
w.e.f. 2022-23

Sr. No.	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Internal Assessment	Theory	Practical	Total	
1	PCC-CSE-303G (Common with CSE)	Computer Networks	3	0	0	3	3	25	75	-	100	3
2	PCC-CSE-307G (Common with CSE)	Design and Analysis of Algorithms	3	0	0	3	3	25	75	-	100	3
3	PCC-DS-306G	Big Data & Analytics	3	0	0	3	3	25	75	-	100	3
4	PCC-DS-305G	Automata Theory & Compiler Design	3	0	0	3	3	25	75	-	100	3
5	PCC-AI-301G	Neural Networks Fundamentals	3	0	0	3	3	25	75	-	100	3
6	Professional Elective Course	Professional Elective-I	3	0	0	3	3	25	75	-	100	3
7	LC-CSE-325G	Algorithms Design using C++ Lab	0	0	3	3	1.5	25	-	25	50	3
8	LC-DS-346G	Data Analytics Lab	0	0	3	3	1.5	25	-	25	50	3
9	LC-AI-341G	Neural Computing Lab	0	0	3	3	1.5	25	-	25	50	3
10	LC-AI-343G	Programming Lab-I	0	0	2	2	1	25	-	25	50	3
11.	PT-CSE-329G (Common with CSE)	Practical Training -I	Refer Note-1 Below									
Total			18	0	11	29	23.5	250	450	100	800	

Note-1: Practical Training I: The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students will be awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

Grades : Excellent: A, Good : B, Satisfactory: C, Not Satisfactory: F

Professional Electives Courses

Chose any one from the list:

Professional Electives-I		
	Course Code	**Course title**
Professional Elective -I	PEC-DS-309G	DevOps Overview
	PEC-DS-311G	Advance Java Programming
	PEC-DS-313G	Data Analytics Basics
	PEC-CSE-311G	Software Engineering

Scheme of Studies and Examination
B. TECH. (Artificial Intelligence & Machine Learning) -6th Semester
B. TECH. (Computer Science and Engineering- Artificial Intelligence & Machine Learning)-6th Semester
w.e.f. 2022-23

Sr. No	Course Code	Course Title	Hours per week			Total Contact Hrs. per week	Credit	Examination Schedule (Marks)				Duration of Exam (Hours)
			L	T	P			Internal Assessment	Theory	Practical	Total	
1	PCC-AI-302G	Statistical Machine Learning	3	0	0	3	3	25	75		100	3
2	PCC-AI-304G	Principles of Artificial Intelligence	3	0	0	3	3	25	75		100	3
3	PCC-DS-303G	Data Mining and Analytics	3	0	0	3	3	25	75		100	3
4	PCC-AI-306G	Data Science with R Programming	3	0	0	3	3	25	75		100	3
5	Professional Elective Course	Professional Elective-II	3	0	0	3	3	25	75	-	100	3
6	Professional Elective Course	Professional Elective-III	3	0	0	3	3	25	75	-	100	3
7	LC-AI-342G	Project-I	0	0	4	4	2	25	-	25	50	3
8	LC-AI-344G	Statistical Machine Learning Lab	0	0	3	3	1.5	25	-	25	50	3
9.	LC-AI-346G	Artificial Intelligence Lab	0	0	3	3	1.5	25	-	25	50	3
10	LC-AI-348G	Programming Lab-II	0	0	2	2	1	25	-	25	50	3
11.	MC-317G*	Constitution of India	2	0	0	2	0	-	-	-	-	-
Total			20		12	32	24	250	450	100	800	

The evaluation of Constitution of India (MC-317G) will be based on grades A, B, C, F. The student who is awarded 'F' grade is required to repeat the subject.

NOTE: At the end of 6th semester each student has to undergo Practical Training of 4/6 weeks in an Industry/ Institute/ Professional Organization/ Research Laboratory/ training center etc. and submit typed report along with a certificate from the organization & its evaluation shall be carried out in the 7th Semester.

Professional Electives Courses

Chose any one from the list:

Professional Electives		
	Course Code	**Course title**
Professional Elective -II	PEC-DS-310G	Advanced Programming Practice
	PEC-DS-312G	Business Intelligence & Analytics
	PEC-AI-308G	Nature Inspired Computing Techniques
Professional Elective – III	PEC-DS-315G	Predictive Analytics Essentials
	PEC-DS-316G	UI/UX Design
	PEC-AI-310G	Intelligent Machining

Computer Networks				
Course code	PCC-CSE-303G			
Category	Professional Core Course			
Course title	Computer Networks			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Classwork	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Course Objectives:

1. To develop an understanding of modern network architectures from a design and
2. Performance perspective.
3. To introduce the student to the major concepts involved in wide-area networks(WANs), local area networks (LANs) and Wireless LANs (WLANs).
4. To provide an opportunity to do Network programming
5. To provide a WLAN measurement idea.

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit: 1

Introduction: Data communication, Components, Computer networks and its historical development, distributed processing, Internet

Network Models: OSI model and TCP/IP Model

Physical Layer – physical layer functions, Data Representation, Simplex, Half Duplex and Full Duplex Transmission, Modulation and Multiplexing, Packet and circuit switching, Transmission media, Topologies, connectionless and connection-oriented services.

Data Link Layer : Data link layer functions and services, MAC Addressing, Framing, Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window Protocol.

Unit: 2

Medium Access Control: MAC layer functions, Random access, Controlled Access and channelization protocols.

Network Layer: Network layer functions and services, Logical addressing, IPv4 classful and classless addressing, subnetting, NAT, IPv4, ICMPv4, ARP, RARP and BOOTP, IPv6, IPv6 addressing, DHCP.

Network Devices: Repeater, hub, switch, router and gateway.

Unit: 3

Routing Algorithms: introduction to routing, Shortest Path Algorithm, Flooding, Hierarchical Routing, Link State and Distance Vector Routing

Transport Layer: Transport layer functions and services, Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), TCP connection management

Application Layer: Application layer functions and services, Domain Name Space (DNS), EMAIL, File Transfer Protocol (FTP), HTTP, SNMP

Unit: 4

Congestion Control, Quality of Service, QoS Improving techniques.

LAN: Ethernet, Token Bus, Token Ring, MAN Architecture- DQDB, WAN Architectures- FrameRelay, ATM, SONET/SDH

Network Security: Firewalls, security goals, types of attack, Introduction to cryptography, Types of ciphers: symmetric and asymmetric key ciphers.

Suggested books:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.
2. Data and Computer Communication, 8th Edition, William Stallings, Pearson PrenticeHall India.

Suggested reference books:

1. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New InternationalEdition.
2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall ofIndia.
3. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States ofAmerica.

Course Outcomes:

1. Explain the functions of the different layer of the OSI Protocol.
2. Draw the functional block diagram of wide-area networks (WANs), local areanetworks (LANs) and Wireless LANs (WLANs) and describe the function of each.
3. Identify and connect various connecting components of a computer network.
4. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP,SNMP, Bluetooth, Firewalls using open source available software and tools.

Design and Analysis of Algorithms

Course code	PCC-CSE-307G				
Category	Professional Core Course				
Course title	Design and Analysis of Algorithms				
Scheme and Credits	L	T	P	Credits	Remarks: Common With CSE
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note:Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

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.

Unit 1

Introduction to Algorithms: Algorithm, Performance Analysis (Time and Space complexity), Asymptotic Notation (Big OH, Omega and Theta)-best, average and worst-case behavior. Elementary Data Structures (Basic terminology of Stacks and Queues, Tree, Graph), Sets and Disjoint Set Union.

Divide and Conquer: General method, Binary Search, Merge Sort, Quick Sort, and other sorting algorithms with divide and conquer strategy, Strassen's Matrix Multiplication algorithms and analysis of these problems.

Unit 2

Greedy Method: General method, Fractional Knapsack problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Single source shortest paths.
Dynamic Programming: General method, Optimal Binary Search Trees, 0/1 knapsack, The Traveling Salesperson problem.

Unit 3

Back Tracking: General method, The 8-Queen's problem, Sum of subsets, Graph Colouring, Hamiltonian Cycles.
Branch and Bound: The method, 0/1 knapsack problem, Traveling Salesperson problem, Efficiency considerations.

Unit 4

NP Hard and NP Complete Problems: Basic concepts, Cook's theorem, NP hard graph problems, NP hard scheduling problems, NP hard code generation problems, and Some simplified NP hard problems.

Suggested books:

1. Fundamental of Computer algorithms, Ellis Horowitz and Sartaj Sahni, 1978, Galgotia Publication
2. Introduction to Algorithms, Thomas H Cormen, Charles E Leiserson and Ronald Lrivest: 1990, TMH

Suggested reference books:

1. The Design and Analysis of Computer Algorithm, Aho A.V. Hopcroft J.E., 1974, Addison Wesley.
2. Algorithms-The Construction, Proof and Analysis of Programs, Berlion, P.Bizard, P., 1986. Johan Wiley & Sons,
3. Writing Efficient Programs, Bentley, J.L., PHI 4. Introduction to Design and Analysis of Algorithm, Goodman, S.E. &Hedetnieni, 1997, MGH.
4. Introduction to Design and Analysis of Algorithm, Goodman, S.E. &Hedetnieni, 1997,MGH.

5. Introduction to Computers Science- An algorithms approach, Jean Paul Trembley, Richard B.Bunt, 2002, T.M.H.
6. Fundamentals of Algorithms: The Art of Computer Programming Vol Knuth, D.E.: 1985, Naresh Publication.

Course outcomes

1. To identify and justify correctness of algorithms and to analyse running time of algorithms based on asymptotic analysis.
2. To understand when an algorithmic design situation calls for the divide-and-conquer paradigm. Synthesize divide-and-conquer algorithms.
3. Describe the greedy paradigm and dynamic-programming paradigm. Explain when an algorithmic design situation calls for it.
4. Developing greedy algorithms/dynamic programming algorithms, and analyze it to determine its computational complexity.
5. To write the algorithm using Backtracking and Branch and Bound strategy to solve the problems for any given model engineering problem.

Big Data & Analytics					
Course code	PCC-DS-306G				
Category	Professional Core Course				
Course title	Big Data & Analytics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To provide an overview of an emerging field of big data analytics.
2. To make students familiar with the tools required to manage and analyze big data like Hadoop, No SQL, Map-Reduce.
3. To teach the fundamental techniques and principles in achieving analytics with scalability and streaming capability on both structured and unstructured data.
4. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

UNIT -I

Introduction to Big Data: Types of Digital Data-Characteristics of Data, Evolution of Big Data, Definition of Big Data, Characteristics, Applications & Challenges with Big Data, 3Vs of Big Data, Non-Definitional traits of Big Data, Big Data workflow Management, Business Intelligence vs. Big Data, Data science process steps, Foundations for Big Data Systems and Programming, Distributed file systems, Data warehouse and Hadoop environment, Coexistence.

UNIT -II

Big Data Analytics: Classification of analytics, Data Science, Terminologies in Big Data, CAP Theorem, BASE Concept. **NoSQL:** Types of Databases, Advantages, NewSQL, SQL vs. NoSQL vs NewSQL.

Introduction to Hadoop: Features, Advantages, Versions, Overview of Hadoop Eco systems, Hadoop distributions, Hadoop vs. SQL, RDBMS vs. Hadoop, Hadoop Components, Architecture, HDFS.

UNIT -III

Map Reduce: Mapper, Reducer, Combiner, Partitioner, Searching, Sorting, Compression. **Hadoop 2 (YARN):** Architecture, Interacting with Hadoop Eco systems.

No SQL databases: Mongo DB: Introduction, Features, Data types, Mongo DB Query language, CRUD operations, Arrays. Functions: Count, Sort, t – Limit, Skip, Aggregate, Map Reduce. Cursors: Indexes, Mongo Import, Mongo Export.

UNIT -IV

Cassandra: Introduction, Features, Data types, CQLSH, Key spaces, CRUD operations, Collections, Counter, TTL, alter commands, Import and Export, Querying System tables. **Hadoop Eco systems:** Hive, Architecture, data type, File format, HQL, SerDe, User defined functions.

Suggested books:

1. T. Erl , W.Khattak and P. Buhler., *Big Data Fundamentals, Concepts, Drivers & Techniques* (1e), The Prentice Hall Service Technology Series, 2016.
2. S. Acharya, *Big Data and Analytics*, Wiley India Pvt. Ltd., 2015
3. V. Prajapati, *Big Data Analytics with R and Hadoop*, Packt Publishing Ltd., 2013.
4. A. Holmes, *Hadoop in Practice*, (2e), Manning Publications, 2015
5. S. Ryza, *Advanced Analytics with Spark: Patterns for Learning from Data at Scale*, (2e), O'Reilly, 2017

Course Outcomes:

1. Understand the key issues in big data management and its associated applications for business decisions and strategy.
2. Develop problem solving and critical thinking skills in fundamental enabling techniques like Hadoop, MapReduce and NoSQL in big data analytics.
3. Collect, manage, store, query and analyze various forms of Big Data.
4. Interpret business models and scientific computing paradigms and apply software tools for big data analytics.
5. Adapt adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Automata Theory & Compiler Design					
Course code	PCC-DS-305G				
Category	Professional Core Course				
Course title	Automata Theory & Compiler Design				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To get familiar with regular expressions to describe a language using automata.
2. Usage of context free grammars to describe the syntax of a language.
3. To learn different parsing techniques.
4. To provide techniques for syntactic, semantic language analysis, intermediate code Generation and optimization.

Unit: 1

Formal Language And Regular Expressions : Languages, Operations On Languages, Regular Expressions, Identity Rules For Regular Expressions, Finite Automata – DFA, NFA, Conversion Of Regular Expression to NFA, NFA To DFA.

Introduction to Compilers: Phases of the Compiler.

Syntax Analysis: Chomsky hierarchy of languages, Context Free Grammars, CNF, GNF, Top-Down Parsing, Recursive Descent Parsers: LL (K) Parsers. Bottom-Up Parsing: Shift Reduces Parser, LR Parsers: SLR, CLR, LALR.

UNIT- 2

Syntax Directed Translation: Syntax Directed Definition, Construction of Syntax Trees, L-Attributed Definitions. Intermediate Code Generation: Intermediate Languages, Translation of Assignment Statements and Boolean Expressions;

Push Down Automata**:** Introduction to PDA, Deterministic and Non-Deterministic PDA, Design of PDA: Transition table, Transition diagram and acceptability of strings by designed PDA; Turing Machine- basic model, Design, Transition table and diagram, Halting problem

UNIT- 3

Type Checking: Specification of Simple Type Checker, Equivalence of Type Expressions, Type Conversions Runtime Environments: Storage Organization, Storage Allocation Strategies, Access to Non Local Names, Parameter Passing, Symbol Table, Dynamics Storage Allocation Techniques.

UNIT- 4

Code Optimization: Principal Sources Of Optimization, Optimization Of Basic Blocks, Loops In Flow Graphs, Global Data Flow Analysis, Peephole Optimization.

Code Generation: Issues in Design of Code Generator, Simple Code Generator, Register Allocation and Assignment, DAG Representation of Basic Block, Generating Code from DAGs.

Suggested books:

1. Compilers Principle, Techniques & Tools – Alfread V. AHO, Ravi Sethi & J.D. Ullman; 1998 Addison Wesley.
2. Introduction to Automata Theory Languages & Computation, 3rd Edition, Hopcroft, Ullman, PEA

Suggested reference books

1. Theory and practice of compiler writing, Tremblay & Sorenson, 1985, Mc. Graw Hill.
2. System software by Dhamdhere, 1986, MGH.

3. Principles of compiler Design, Narosa Publication
4. Elements compiler Design, Dr. M. Joseph, University Science Press

Course Outcomes

1. Read and write finite automata and grammars for programming language constructs.
2. Understand the functionality of parsing mechanisms.
3. Construct syntax trees and generate intermediate code.
4. Understand the concepts of storage administration for different programming environments.
5. Understand the concepts of optimization and generate the machine code.

Neural Networks Fundamentals					
Course code	PCC-AI-301G				
Category	Professional Core Course				
Course title	Neural Networks Fundamentals				
Scheme and Credits	L	T	P	Credits	
	3	0		3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To understand the different issues involved in the design and implementation of a Neural Networks.
2. To study the basic of neural network and its activation functions.
3. To understand and use of perceptron and its application in real world
4. To develop an understanding of essential NN concepts such as: learning, feed forward and feed backward
5. To design and build a simple NN model to solve a problem

Unit-I

Overview of biological neurons: Structure of biological neuron, neurobiological analogy, Biological neuron equivalencies to artificial neuron model, Evolution of neural network.

Activation Functions: order of activation, synchronous activation, asynchronous activation Threshold functions, Signum function, Sigmoid function, Tan - hyperbolic function, Stochastic function, Ramp function, , Linear function, Identity function.

ANN Architecture: Various network topologies & learning strategies, Feed forward network, Feed backward network, single and multi-layer network, fully recurrent network

Unit-II

McCulloch and Pits Neural Network (MCP Model): Architecture, Solution of AND, OR function using MCP model, Hebb Model: Architecture, training and testing, Hebb network for AND function.

Perceptron Network: Architecture, training, Testing, single and multi-output model, Perceptron for AND function, Linear function, application of linear model, linear seperatablity, solution of OR function using liner seperatablity model.

Unit-III

Learning: Supervised, Unsupervised: SOM, Topology, function, variations, Neural Gas, Multi SOM, resonance, ART, ART Task & Structure, ART Learning Process; reinforcement learning, Gradient Decent algorithm, generalized delta learning rule, Habbian learning, Competitive learning, Back Propagation Network: Architecture, training and testing, Variations in Back propagation

Unit-IV

Associative memory: Auto associative and Hetro associative memory and their architecture, training (insertion) and testing (Retrieval) algorithm using Hebb rule and Outer Product rule. Storage capacity, Testing of associative memory for missing and mistaken data, Bidirectional memory

Reference Books:

1. David Kriesel, A Brief Introduction to Neural Networks, dkriesel.com, 2005
2. Gunjan Goswami, Introduction to Artificial Neural Networks, S.K. Kataria& Sons, 2012
3. Raul Rojas, Neural Networks: A Systematic Introduction, 1996.
4. S. Sivanandam, Introduction to Artificial Neural Networks, 2003
5. Introduction to artificial Neural systems by Jacek M. Zurada, 1994, Jaico Publ. House.

6. Principles of Soft Computing by S.N. Deepa, S.N. Sivanandam., Weley publication

Course Outcomes

1. Know the purpose of Artificial Neural Networks
2. Apply the concepts of activation, propagation functions
3. Work with supervised learning network paradigm
4. Work with unsupervised learning network paradigm
5. Know the purpose and working of Neural Networks memory concepts

Algorithms Design Using C++ Lab					
Course code	LC-CSE-325G				
Category	Laboratory Course				
Course title	Algorithms Design Using C++ Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Objectives:

1. Implementation of various algorithms and to analyze the performance of algorithms.
2. Demonstrate a familiarity with major algorithms and data structures.
3. Apply important algorithmic design paradigms and methods of analysis.
4. Synthesize efficient algorithms in common engineering design situations.

List of programs:

1. Write a Program for iterative and recursive Binary Search.
2. Write a Program to sort a given set of elements using the Quick Sort/Merge Sort/Selection Sort method and determine the time required to sort the elements.
3. Write a Program for implementation of Fractional Knapsack problem using Greedy Method and 0/1 Knapsack problem using Dynamic Programming.
4. Write a Program to find the shortest path from a given vertex to other vertices in a weighted connected graph using Dijkstra's algorithm.
5. Write a Program to find the minimum cost spanning tree (MST) of a given undirected graph using Kruskal's algorithm/Prim's Algorithms.
6. Write a Program to implement N-Queens problem using back tracking.
7. Write a Program to check whether a given graph is connected or not using DFS method.
8. Write a program to implement the Travelling Salesman Problem (TSP).

Note: At least 5 to 10 more exercises to be given by the faculty concerned.

Course Outcomes:

1. The course will help in improving the programming skills of the students.
2. The design of algorithms for any problem will inculcate structured thinking process in the students and improve the analytical power.

Data Analytics Lab					
Course code	LC-DS-346G				
Category	Laboratory Course				
Course title	Data Analytics Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	
Classwork	25Marks				
Exam	25Marks				
Total	50Marks				
Duration of Exam	03Hours				

NOTE: Minimum 15 Lab activities / programs related to the course contents of Big Data & Analytics can be designed and developed by the subject faculty using Hadoop Tools/Hadoop Eco System/Python / any suitable Open Source tools/ software.

Neural Computing Lab				
Course code	LC-AI-341G			
Category	Laboratory Course			
Course title	Neural Computing Lab			
Scheme and Credits	L	T	P	Credits
	0	0	3	1.5
Branches (B. Tech.)	Computer Science and Engineering			
Class work	25 Marks			
Exam	25 Marks			
Total	50 Marks			
Duration of Exam	03 Hours			

NOTE: Minimum 15 Lab activities / programs related to the course contents of Soft Computing Methods can be designed and developed by the subject faculty using MATLab/Python / any suitable Open Source tools/ software.

Practice of Neural Network tool for : Simple Logic functions , XOR problem, Delta rule, Pattern Classification, Pattern Clustering, Learning Algorithms.

Tentative List of Experiments is-

1. Introduction to Matlab/Python in context with NN.
2. Plotting of Activation Functions: Threshold functions, Signum function, Sigmoid
3. function, Tan-hyperbolic function, Ramp function, Identity function using matlab/Python
4. Implementation of some basic model like MCP with suitable example.
5. Implementation of Hebb model with suitable example.
6. How the weights and bias values affect the output of a neuron.
7. How the choice of activation function (or transfer function) affects the output of a
8. neuron. Experiment with
9. Implementation of linearly separable concept for a problem.
10. To study some basic neuron models and learning algorithms by using Matlab's neural network toolbox or Python's Library.

Programming Lab-I					
Course code	LC-AI-343G				
Category	Laboratory Course				
Course title	Artificial Programming Lab-I				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE: Hands-on Lab activities related to the course contents of Professional Elective can be designed and developed by the subject faculty using suitable Open Source tools/ software.

Practical Training-I					
Course code	PT-CSE-329G				
Category	Laboratory Course				
Course title	Practical Training				
Scheme and Credits	L	T	P	Credits	Remarks-
	0	0	0	0	
Branches (B. Tech.)	Computer Science and Engineering				
Class work	-				
Exam	-				
Total	-				
Duration of Exam	-				

The evaluation of Practical Training-I will be based on seminar, viva-voce, report submitted by the students. According to performance, the students are awarded grades A, B, C, F. A student who is awarded 'F' grade is required to repeat Practical Training.

Grades :

Excellent: A

Good : B

Satisfactory: C

Not Satisfactory: F

Statistical Machine Learning					
Course code	PCC-AI-302G				
Category	Professional Core Course				
Course title	Statistical Machine Learning				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions fromeach unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand the statistical machine learning techniques.
2. Gain knowledge on linear regression models, Random Forests
3. Gain knowledge on the basics of probabilistic approaches like Naïve Bayes, Bayes Theorem, KNN classifier
4. Acquire knowledge on Support Vector machines
5. Introduce the working principle of Artificial Neural networks
6. Understand the K-means clustering techniques, PCA and SVD

Unit-I

Statistical terminology for model building and validation -Machine Learning, Major differences between statistical modeling and machine learning, Steps in machine learning model development and deployment Statistical fundamentals and terminology for model building and validation, Bias versus variance trade-off, Train and test data, Linear regression versus gradient descent, Machine learning losses, When to stop tuning machine learning models, Train, validation, and test data Cross-validation, Grid Search, Machine learning model overview.

Unit-II

Comparison between regression and machine learning models, Compensating factors in machine learning Models, Assumptions of linear regression, Steps applied in linear regression modeling, Example of simple linear regression from first principles, Machine learning models - ridge and lasso regression, Example of ridge regression machine learning, Example of lasso regression machine learning model, Logistic Regression Versus Random Forest-Maximum likelihood estimation, Terminology involved in logistic regression, Applying steps in logistic regression modeling, Random forest – Example of random forest using German credit data, Grid search on random forest, Variable importance plot, Comparison of logistic regression with random forest

Unit-III

K-nearest neighbors – KNN voter example, Curse of dimensionality -Curse of dimensionality with 1D, 2D, and 3D Example, Curse of dimensionality with 3D example, KNN classifier with breast cancer, Wisconsin data example, Naive Bayes, Probability fundamentals-Joint probability, Understanding Bayes theorem with conditional probability, Naive Bayes classification, Laplace estimator, Naive Bayes SMS spam classification example; Support Vector Machines and Neural Networks Support vector machines working principles, Maximum margin classifier, Support vector classifier, Support vector machines, Kernel functions

Unit-IV

Artificial neural networks – ANN, Forward propagation and backpropagation, Optimization of neural networks-Stochastic gradient descent – SGD; Introduction to deep learning - Solving methodology, Deep learning software; K-means clustering- K-means working methodology from first principles, Optimal number of clusters and cluster evaluation, The elbow method, K-means clustering with the iris data example, Principal component analysis – PCA, PCA working methodology from first principles, PCA applied on handwritten digits using scikit-learn, Singular value decomposition – SVD, SVD applied on handwritten digits using scikit-learn.

Suggested References Books:

1. Pratap Dangeti,"Statistics for Machine Learning",Packt Publishing Ltd,2017.
2. Masashi Sugiyama," Introduction to Statistical Machine Learning", Elsevier, 2016
3. Gareth James, Daniela Witten,Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2015
4. Hastie Trevor, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer-Verlag New York Inc, February2009

Course outcomes:

1. Acquire the knowledge on Statistical machine learning techniques.
2. Acquire the ability to build model based on logistic regression and random forest techniques
3. Understand the basic ideas of probability and work on probabilistic approaches like Naïve Bayes, Bayes Theorem
4. Apply the knowledge of Kernel functions in practical applications
5. Apply the knowledge of K- means clustering on real world examples
6. Acquire the knowledge on using PCA and SVD with Scikit-learn

Principles of Artificial Intelligence					
Course code	PCC-AI-304G				
Category	Professional Core Course				
Course title	Principles of Artificial Intelligence				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Provide a broad understanding of the basic techniques for building intelligent computer systems and an understanding of how AI is applied to problems.
2. Gain knowledge in problem formulation and building intelligent agents
3. Understand the search technique procedures applied to real world problems
4. Understand the types of logic and knowledge representation schemes
5. Acquire knowledge in planning and learning algorithms
6. Gain knowledge in AI Applications and advances in Artificial Intelligence

Unit 1

Introduction to AI-AI techniques, Problem solving with AI, AI Models, Data acquisition and learning, aspects in AI,
Problem solving- Problem solving process, Formulating problems, Problem types and characteristics , Problem space and search ; Intelligent agent, Rationality and Rational agent with performance measures Flexibility and Intelligent agents, Task environment and its properties , Types of agents, Other aspects of agents ; Constraint satisfaction problems(CSP), Crypto arithmetic puzzles, CSP as a search problem-constrains and representation, CSP-Backtracking, Role of heuristic CSP-Forward checking and constraint propagation, CSP-Intelligent backtracking

Unit 2

Searching techniques- Uniformed search- General search Algorithm, Uniformed search Methods-Breadth first
Search, Depth first search, Depth limited search , Iterative Deepening search, Bi-directional search
Informed search- Generate and test, Best First search, A* Algorithm, AO* research,
Local search Algorithms-Hill Climbing, Simulated Annealing, Local Beam Search , Genetic Algorithms ;
Adversarial search Methods-Game playing- Important concepts, Game playing and knowledge structure, Game as a search problem-Minimax approach , Minimax Algorithm , Alpha beta pruning, Game theory problems

Unit 3

Knowledge and reasoning-Approaches and issues of knowledge reasoning, Knowledge base agents-Logic Basics
Logic-Propositional logic-syntax ,semantics and inferences, Propositional logic- Reasoning patterns, Predicate logic – Syntax and semantics, instance and is relationship, Unification and Resolution
Knowledge representation using- rules, semantic nets, frames, Inferences ; Uncertain Knowledge and reasoning-
Methods, Bayesian probability and belief network, Probabilistic reasoning, Probabilistic reasoning over time, Forward and backward reasoning, Other uncertain techniques-Data mining , Fuzzy logic, Dempster -shafer theory ;
Planning- Planning problems, Simple planning agent, Planning languages, Blocks world, Goal stack planning, Mean Ends Analysis, Non-linear Planning, Conditional planning, Reactive planning

Unit4

Learning- Machine learning , Goals and Challenges of machine learning, Learning concepts, models, Artificial neural network based learning- Back propagation, Support vector machines, Reinforcement learning, Adaptive learning, Multi-agent based

learning , Ensemble learning, Learning for decision making, Distributed learning, Speedup learning; Expert system and its types; Natural language processing-Levels of NLP, Syntactic and Semantic Analysis, Information retrieval, Information Extraction, Machine translation , NLP Applications ; Advance topics in Artificial Intelligence-
Cloud Computing and intelligent agent, Business intelligence and analytics, Sentiment Analysis, Deep learning Algorithms, Planning and logic in intelligent agents.

Suggested Reference Books:

1. Parag Kulkarni, Prachi Joshi, Artificial Intelligence –Building Intelligent Systems, 1st ed., PHI learning,2015
2. Deepak Kemhani, First course in Artificial Intelligence, McGraw Hill PvtLtd,2013
3. Stuart J. Russell, Peter Norwig , Artificial Intelligence –A Modern approach, 3rd Pearson Education, 2016
4. Prateek Joshi, Artificial Intelligence with Phython, 1st ed. Packet Publishing,2017
5. Denis Rothman, Artificial Intelligence by Example, Packt, 2018

Course outcomes

1. Formulate a problem and build intelligent agents
2. Apply appropriate searching techniques to solve a real world problem
3. Analyze the problem and infer new knowledge using suitable knowledge representation schemes
4. Develop planning and apply learning algorithms on real world problems
5. Design an expert system and implement natural language processing techniques
6. Implement advance techniques in Artificial Intelligence

Data Mining and Analytics				
Course code	PCC-DS-303G			
Category	Professional Core Course			
Course title	Data Mining and Analytics			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions fromeach unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Understand the concepts of Data Mining
2. Familiarize with Association rule mining
3. Familiarize with various Classification algorithms
4. Understand the concepts of Cluster Analysis
5. Familiarize with Outlier analysis techniques
6. Familiarize with applications of Data mining in different domains

Unit 1

What is Data mining ? Kinds of data meant for mining , Kinds of patterns that can be mined, Applications suitable for data mining, Issues in Data mining, Data objects and Attribute types, Statistical descriptions of data, Need for data preprocessing and data quality, Data cleaning, Data integration, Data reduction, Data transformation, Data cube and its usage

Unit 2

Mining frequent patterns: Basic concepts , Market Basket Analysis, Frequent itemsets, Closed itemsets, Association rules-Introduction, Apriori algorithm-theoritical approach, Apply Apriori algorithm on datasets Generating Association rules from frequent itemsets, Improving efficiency of Apriori, Pattern growth approach, Mining frequest itemsets using Vertical data format, Strong rules vs. weak rules, Association analysis to Correlation, analysis Comparison of pattern evaluation measures.

Unit 3

Classification: Basic concepts , General approach to Classification, Decision tree induction, Algorithms and numerical examples for Decision tree induction, Attribute selection measure, Tree pruning, Scalability and Decision tree induction; Bayes' Theorem Naïve Bayesian Classification , IF-THEN rules for classification, Rule extraction from a decision tree, Metrics for evaluating classifier performance, Cross validation, Bootstrap,
Ensemble methods-Introduction, Bagging and Boosting

Unit 4

Cluster Analysis: Introduction, Requirements and overview of different, categories, Partitioning method: Introduction, k-means, k-medoids, Hierarchical method: Introduction, Agglomerative vs. Divisive method, Distance measures in algorithmic methods, BIRCH technique, DBSCAN technique, STING technique, CLIQUE technique, Evaluation of clustering techniques;
Outliers: Introduction, Challenges of outlier detection, Outlier detection methods: Introduction, Supervized and Semi-

supervized methods, Unsupervized methods, Statistical approaches, Statistical data mining methods, Data mining and

recommender systems , Statistical and Proximity based methods, Data mining for financial data analysis, Data mining for Intrusion detection

Suggested books:

1. Jiawei Han and Micheline Kamber, " Data Mining: Concepts and Techniques", 3rd Ed, Morgan Kauffman Publishers, 2011.
2. L. Bing *Web Data Mining* Springer-Verlag,2017.
3. P. Ponniah, *Data Warehousing*, (2e), Wiley India Pvt. Ltd., 2011
4. A.K. Pujari, *Data Mining Techniques* (4e), Orient Black Swan/ Universities Press 2016.
5. N.T. Pang, M. Steinbach, K. Anuj and V. Kumar., *Introduction to Data Mining*, Pearson Education 2nd Ed, Pearson 2018

Course outcomes

1. Gain knowledge about the concepts of Data Mining
2. Understand and Apply Association rule mining techniques
3. Understand and Apply various Classification algorithms
4. Gain knowledge on the concepts of Cluster Analysis
5. Gain knowledge on Outlier analysis techniques
6. Understand the importance of applying Data mining concepts in different domains

Data Science with R Programming				
Course code	PCC-AI-306G			
Category	Professional Core Course			
Course title	Data Science with R Programming			
Scheme and Credits	L	T	P	Credits
	3	0	0	3
Class work	25 Marks			
Exam	75 Marks			
Total	100 Marks			
Duration of Exam	03 Hours			

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Able to apply fundamental algorithmic ideas to process data
2. Understand the Data Analytics lifecycle
3. Able to construct predictive models to classify new data set
4. Learn to apply hypotheses and data into actionable predictions
5. Document and communicate the results effectively to different stakeholders
6. Effectively communicate the findings using visualization techniques

Unit-I

Data science process: The roles in a data science project, Stages in data science project, Define, Collect, Build, Evaluate, Present and Deploy, Working with data from files, Structured data, other data formats and Transforming data in R, Working with relational databases and NoSQL databases, Staging and Curating the data, Exploring data, sing summary statistics to spot problems, Managing data, Cleaning data, Sampling for modeling and validation, Training and test set split, Sample group column, Record grouping, Data provenance, Data Structures- Structured, Semi-structured, Quasi-structured and Unstructured data, Drivers of big data, Devices – Mobile, smart devices

Unit-II

Approaching Analytics Problems: Key roles for successful Analytics project, Discovery, Business domain, Resources, Problem framing, Key stakeholders, Analytics sponsors, Initial hypotheses, Data sources, Data Preparation, Learning about the data, conditioning, Model Planning, Data exploration, Model selection, Model Building, Common tools for model building, Communicate Results, Analysis over the different models, Operationalize, Moving the model to deployment, environment Analytics Plan , Key deliverables of analytics project , Presentation: Project sponsors, Analysts, Code, Technical specifications

Unit-III

Introduction to R, R Graphical user interfaces , Data Import and Export, Attributes and Data Types, Vectors, Arrays and Matrices, Data Frames, Lists, Factors, Contingency Tables, Descriptive statistics, Model building, Evaluation a Deployment, Hypotheses Testing, Null hypotheses and Alternative hypotheses, Difference of means Student t-test, Welch's t-test, Wilcoxon Rank-Sum test, Type I and II errors, Choosing and evaluating models, Schematic model construction and evaluation, Mapping problems to machine learning, Evaluating classification models,

Solving classification problems, working without known targets Accuracy, precision, Recall, sensitivity and specificity, Evaluating clustering models Intracluster distance, cross cluster distance

Unit-IV

Validating models: Overfitting, Quantifying model soundness, Ensuring model quality Memorization methods Using single variable and multi variable, Linear regression, Building a linear regression model and predicting, Logistic regression , Building a logistic regression model and predicting, Unsupervised methods, Cluster analysis.

Documentation, Deploying models, Knitr package, Deploying R HTTP services and exporting, Presenting your results to the project sponsor , Summarizing the project goals and stating the results , Presenting your model to end user, Presenting your work to other data scientist, Introduction to data analysis, Dirty data , Visualization before Analysis , Visualizing a single variable, Examining multiple variables, Box and Whisker plot, Scatterplot matrix, Dotchart and Barplot , Hexbinplot for large datasets, Analyzing a variable over time

Reference Books:

1. David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics" , EMC Education Services,2015
2. Nina Zumel, John Mount,"Practical Data Science with R",Manning Publications,2014
3. Jure Leskovec, Anand Rajaraman, Jeffrey D.Ullman,"Mining of Massive Datasets", Cambridge University Press,2014
4. Mark Gardener,"Beginning R- The Statistical Programming Language", John Wiley & Sons, Inc,2012
5. W.N.Venables, D.M.Smithandthe R Core Team,"An Introduction to R", 2013
6. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd.,2014

Course Outcomes

The students will learn

1. Able to comprehend basic methods of processing data from real world problems
2. Able to convert data into actionable insights
3. Build clustering and classification models using R environment
4. Apply statistical techniques for evaluation
5. Analyze and validate the models using appropriate performance metrics
6. Present the results using effective visualization techniques

Project-I					
Course code	LC-AI-342G				
Category	Laboratory Courses				
Course title	Project-I				
Scheme and Credits	L	T	P	Credits	
	0	0	4	2	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

Course Objectives:

1. To prepare the student to gain major design and or research experience as applicable to the profession
2. Apply knowledge and skills acquired through earlier course work in the chosen project.
3. Make conversant with the codes, standards, application software and equipment
4. Carry out the projects within multiple design constraints
5. Incorporate multidisciplinary components
6. Acquire the skills of comprehensive report writing

Students will be assigned projects(Applications/Research based) individually or in a group of not more than 3 students depending on the efforts required for completion of project in the subject(s)/area/ skills delivered in this semester using current tools/technology(ies) .

The project will have 4 stages:
(*Marks for internal evaluation are given in brackets)

1. Synopsis submission (5 marks),
2. 1st mid-term progress evaluation (Literature Survey in case of research project) (5 marks)
3. 2nd mid-term progress evaluation (Paper Publishing/acceptance in a reputed Journal or Conference acceptance/ Presenting) (5 marks)
4. Final submission evaluation (10 marks).

The external examiner will evaluate the project on the basis of idea/quality of project, implementation of the project, project report and/or publication and viva.

Course Outcomes:

Design a system / process or gain research insight into a defined problem as would be encountered in engineering practice taking into consideration its impact on global, economic, environmental and social context.

Statistical Machine Learning Lab				
Course code	LC-AI-344G			
Category	Laboratory Course			
Course title	Statistical Machine Learning Lab			
Scheme and Credits	L	T	P	Credits
	0	0	3	1.5
Class work	25 Marks			
Exam	25 Marks			
Total	50 Marks			
Duration of Exam	03 Hours			

NOTE:

1. **Minimum 15 Lab programs/activities can be designed and developed by the subject faculty using Python, Python Library/suitable Open Source tools/ software.**
2. **Lab activities will be carried out from the offered course contents of Statistical Machine Learning in the semester.**

In this course, various experiments will be performed, covering Statistical Machine Learning techniques. Experiments covering pre-processing of data, various classifiers such as Bayesian, Decision Trees, Support Vector Machines, k-nearest neighbour; Regression Models, and data sets will be described in the laboratory manual. Measures of classification precision, enhancement of classifier efficiency by the assembly, boosting, PCA, SVD on handwritten digits using Scikit-learn etc.

Artificial Intelligent Lab					
Course code	LC-AI-346G				
Category	Lab Course				
Course title	Artificial Intelligent Lab				
Scheme and Credits	L	T	P	Credits	
	0	0	3	1.5	
Classwork	25Marks				
Exam	25Marks				
Total	50Marks				
Duration of Exam	03Hours				

Implementation / development of programs using Python/ any suitable Programming Language for following Tentative List of Experiments:

Lab 1: Implementation of toy problems

Lab 2: Developing agent programs for real world problems

Lab 3: Implementation of constraint satisfaction problems

Lab4: Implementation and Analysis of DFS and BFS for an application

Lab 5: Developing Best first search and A* Algorithm for real world problems

Lab 6: Implementation of minimax algorithm for an application

Lab 7: Implementation of unification and resolution for real world problems.

Lab 8: Implementation of knowledge representation schemes - use cases

Lab 9: Implementation of uncertain methods for an application

Lab 10: Implementation of block world problem

Lab 11: Implementation of learning algorithms for an application

Lab12: Development of ensemble model for an application

Lab13: Expert System case study

Lab 14: Implementation of NLP programs

Lab 15: Applying deep learning methods to solve an application.

NOTE: More programs related to the course contents of Principles Artificial Intelligent can be designed and developed by the subject faculty.

Programming Lab-II					
Course code	LC-AI-348G				
Category	Laboratory Course				
Course title	Artificial Programming Lab-II				
Scheme and Credits	L	T	P	Credits	
	0	0	2	1	
Class work	25 Marks				
Exam	25 Marks				
Total	50 Marks				
Duration of Exam	03 Hours				

NOTE: Minimum 25 Lab activities/Programs related to the course contents of Data Mining and Analytics & Professional Electives (PE-II and PE-III) opted can be designed and developed by the subject teachers using suitable Open Source tools/ software.

Constitution of India				
Course code	MC-317G			
Category	Mandatory Course			
Course title	**Constitution of India**			
Scheme and credits	L	T	P	Credits
	2	0	0	0

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution**.**

Unit – I

Philosophy of Indian Constitution: Salient features of Indian Constitution, Preamble, and Nature of Indian Constitution, Procedure for amendment of the Constitution.

Unit – II

Federal structure and distribution of legislative and financial powers between the Union and the States

Unit – III

Organs of Governance: President – Qualification and Powers of the President, Governor- Qualification and Powers of Governor, Parliament: Composition, Qualifications and Disqualifications, Judiciary: Appointment, Tenure and Removal of Judges.

Unit – IV

Fundamental Rights: Origin and development of Fundamental rights, Need for fundamental rights. Introduction to Right to equality , Right to freedom, Right against exploitation, Right to freedom of religion, Cultural and Education rights and Fundamental duties.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S.N. Busi, Dr. B.R. Ambedkar framing of Indian Constitution, latest Edition
3. M.P. Jain, Indian Constitution Law, Lexis Nexis, latest edition
4. D.D. Basu, Introduction to Constitution of India, Lexis Nexis, latest edition.

NOTE: The evaluation of Constitution of India (MC-317G) will be based on grades A, B, C, F.

The student who is awarded 'F' grade is required to repeat the subject.

Professional Elective

DevOps Overview					
Course code	PEC-DS-309G				
Category	Professional Elective Course				
Course title	DevOps Overview				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Understand DevOps as a practice, methodology and process for fast collaboration, integration and communication between Development and Operations team.
2. Understand the principles and fundamentals Master Continuous Integration, Continuous Deployment, Continuous Delivery, Configuration Management and Continuous Monitoring
3. Learn the fundamentals & various technologies such as GIT. Maven, Chef, Puppet & more.
4. Understand the Automation and increase the speed of productivity with reliability

Unit-I

Traditional Software development Processes- The Advent of Software Engineering, Waterfall model and other development models, Developers vs IT Operations conflict

Unit-II

AGILE Methodologies- Agile movement in 2000 - Agile Vs Waterfall Method - Iterative Agile Software Development - Individual and team interactions over processes and tools - Working software over - comprehensive documentation - Customer collaboration over contract negotiation - Responding to change over following a plan

Unit-III

DevOps Overview, Definition and Introduction to DevOps - DevOps and Agile ,
PURPOSE OF DEVOPS- Minimum Viable Product, Application Deployment, Continuous Integration, Continuous Delivery

Unit-IV

CAMS (CULTURE, AUTOMATION, MEASUREMENT AND SHARING) CAMS – Culture – CAMS, Automation - CAMS – Measurement - CAMS – Sharing Test-Driven Development - Configuration Management - Infrastructure Automation - Root Cause Analysis – Blamelessness - Organizational Learning, REST API, GraphQL, HTTP/2, Application Containerization, DevOps Tools, Monitoring Tools; Recent applications / Case Studies of DevOps

Suggested References Books:

1. The DevOps Handbook,Gene Kim, Jez Humble, Patrick Debois, and Willis Willis , O'Rielly Publishers
2. What is DevOps? - by Mike Loukides
3. Effective DevOps: Building a Culture of Collaboration, Affinity, and Tooling at Scale, Jennifer Davis and Ryn Daniels, O'Rielly Publishers
4. Practical DevOps, Joakim Verona, O'Rielly Publishers
5. M. Walls, *Building a Dev Ops Culture*, O'Reilly Publications, 2013.
6. J. Joyner, *Dev Ops for Beginners, Dev Ops Software Development Method guide for software developers and IT professionals,* Mihails Konoplovs, 2015.
7. Online Resources on DevOps

Course outcomes:

On completion of this course, the students will be able to-

1. Get thru the traditional software development process.
2. Learn the Agile methodologies and its Developments.
3. Make a way to DevOps as a practice, methodology and process for fast collaboration, integration and communication between Development and Operations team.
4. Master in Continuous Integration, Continuous Deployment, Continuous Delivery, Configuration Management and Continuous Monitoring

Advance Java Programming					
Course code	PEC-DS-311G				
Category	Professional Elective Course				
Course title	Advance Java Programming				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To demonstrate the use of Object Oriented Programming and threads concepts in Java.
2. To familiarize students with Graphical user interface, distributed application, web development using Servlets and JSP.
3. To impart the core features of Spring and hibernate framework.

Unit-I

Core Java and Multithread: Class and object - Packages and sub packages– Abstract class and Interface. Multithreading: thread creation, thread priorities, synchronization and Inter thread communication.

Abstract Window Toolkit and Swing: Abstract Window Toolkit(AWT): AWT classes, Window fundamentals - Frame Windows - creating a frame window in applet, Creating a Windowed Program. Event Handling: Event Classes – Sources of Events – Event Listener Interfaces. Swing: Icons and Labels – Text Fields –Buttons – Combo Boxes – Tabbed Panes – Scroll Panes – Trees – Tables.

Unit-II

Applications in Distributed Environment: Java Remote Method Invocation – Invocation concept – Remote Interface – Passing Objects – Client Side and Server side RMI Process. Java Interface Definition Language and CORBA – The Concept of Object Request Brokerage – IDL and CORBA – Client side and Server side IDL Interface.

Servlets with Database Connectivity: Java Servlets – MVC Architecture – Container Architecture – Controller Components – Dynamic Forms – Servlet Context - The JDBC API: The API components, database operations like creating tables, CRUD(Create, Read, Update, Delete) operations using SQL – JDBC Drivers

Unit-III

Java Server Pages and Enterprise JavaBeans: JSP Scripting Elements – Tags - Variables and Objects – Methods – Control Statements – User Sessions – Cookies – Session Objects – JSTL and Servlets with JSP. Enterprise JavaBeans: Deployment Descriptors – Session JavaBean – Entity JavaBean – Message and Driven Bean.

Unit-IV

Spring Framework : Introduction to Spring – Bean scope and lifecycle – Inversion of control – Dependency injection – Spring MVC: Building spring web Apps – Creating controllers and views – Request params and request mapping – Form tags and data binding.

Hibernate Framework: Introduction to Hibernate – Hibernate CURD features – Advanced mappings – Hibernate Query Languages and Transactions. Spring Hibernate Integrations: Hibernate DAO implementation using Spring Framework. Recent trends.

Reference Books:

1. Herbert Schildt, "Java: The Complete Reference", McGraw-Hill Publishers, 11th Edition, 2019.
2. Mahesh P. Matha "JSP and SERVLETS: A Comprehensive Study", PHI publication, 2015
3. D.T. Editorial Services "Java 8 Programming Black Book", Wiley, 2015
4. Santosh Kumar K "Spring and Hibernate", Mc.Graw Hill Education, 2013

Course Outcomes

After successfully completing the course the student should be able to

1. Choose the appropriate OOP technique for solving the given problem and use multithreads when required.
2. Design Graphical User Interface using AWT and Swing.
3. Build and Deploy distributed applications using RMI and CORBA.
4. Design, Develop and Deploy dynamic web applications using Servlets with JDBC.
5. Design and Develop applications using JSP and Enterprise Java Bean.
6. Recognize the capabilities of java framework to facilitate solving industrial applications using Spring framework.

Data Analytics Basics					
Course code	PEC-DS-313G				
Category	Professional Elective Course				
Course title	Data Analytics Basics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. To understand the Data analytics tasks, methods and process
2. To understand the concepts of data exploratory analysis
3. To familiarize students with data interaction and visualization techniques .
4. To impart the major simulation and visualization trends of volumetric data.

Unit-I

Steps in Data Analytics Projects, Data Analytics tasks and methods, Data Gathering and Preparation: Data Formats, Parsing and Transformation, Scalability and Real-time Issues; Data Cleaning: Consistency Checking, Heterogeneous and Missing Data, Data Transformation and Segmentation;

Unit-II

Exploratory Analysis: Descriptive and comparative statistics, Hypothesis testing, Statistical Inference. Association rule mining, Clustering. Visualization: Visual Representation of Data, Gestalt Principles, Information Overloads; Creating Visual Representations: Visualization Reference Model, Visual Mapping, Visual Analytics, Design of Visualization Applications;

Unit-III

Classification of Visualization Systems: Interaction and Visualization Techniques, Visualization of One, Two and Multi-Dimensional Data, Text and Text Documents; Visualization of Groups: Trees, Graphs, Clusters, Networks, Software, Metaphorical Visualization;

Unit-IV

Visualization of Volumetric Data: Vector Fields, Processes and Simulations, Visualization of Maps, Geographic Information, GIS systems, Collaborative Visualizations, Evaluating Visualizations; Recent Trends in Various Perception Techniques: Various Visualization Techniques, Data Structures used in Data Visualization.

Reference Books:

1. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining, 2nd Edition, John Wiley & Sons Publication, 2014.
2. Glenn J. Myatt, Wayne P. Johnson, Making Sense of Data II: A Practical Guide to Data Visualization, Advanced Data Mining Methods, and Applications, John Wiley & Sons Publication, 2009.
3. E. Tufte. The Visual Display of Quantitative Information, (2e), Graphics Press, 2007.
4. Jules J., Berman D., Principles of Big Data: Preparing, Sharing, and Analyzing Complex Information, (2e), 2013.
5. Matthew Ward and Georges Grinstein, Interactive Data Visualization: Foundations, Techniques, and Applications, (2e), A K Peters/CRC Press, 2015.
6. Jurgen Kai-Uwe Brock, Data Design: The Visual Display of Qualitative and Quantitative Information, (1e), Consulting Press, 2017.
7. Edward R. Tufte, The Visual Display of Quantitative Information, (2e), Graphics Press USA, 2001.
8. Cole Nussbaumer Knaflic, Storytelling With Data: A Data Visualization Guide for Business Professionals, (1e), John Wiley and Sons, 2015.

Course Outcomes

After successfully completing the course the student should be able to

1. Get through the Data analytics tasks, methods and process in real world
2. Well familiar brief concepts of data exploratory analytics
3. Design, Develop and Deploy the dashboard with data interaction and visualization techniques.
4. Choose the appropriate simulation and visualization trends for its volumetric data.

Advanced Programming Practice					
Course code	PCC-DS-310G				
Category	Professional Core Course				
Course title	Advanced Programming Practice				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

COURSE OBJECTIVES:

1. Create Real-time Application Programs using structured, procedural and object oriented programming paradigms
2. Create Real-time Application Programs using event driven, declarative and imperative programming paradigms
3. Create Real-time Application Programs using parallel, oncurrent and functional programming paradigms.
4. Create Real-time Application Programs using logic, dependent type and network programming paradigms
5. Create Real-time Application Programs using symbolic, automata based and graphical user interface program paradigm
6. Create Real-time Application Programs using different programming paradigms using python language

Unit-I

Introduction to Programming Language, Characteristics, classifications, types, various programming paradigm, programs, sub-programs, function, sub function, function types, routine, co-routine, sub-routine, virtual machines, platform independency. Various Programming paradigms and their implementation in Python -

Overview of Structured Programming Paradigm, Programming Language Theory, structured programming features and languages examples like C, C++, Java, C#, Ruby; Structured Programing in Python.

Overview of Procedural Programming Paradigm, features, various programming aspects and languages examples- Bliss, ChucK, Matlab ; creating routines and subroutines using functions in Python.

Overview of Object Oriented Programming Paradigm, features, various programming aspects and languages examples- BETA, Cecil, Lava; OOPs in Python

Unit-II

Overview of Event Driven Programming Paradigm, Concepts, features, various programming aspects and languages examples- Algol, Javascript, Elm; Event Driven Programming in Python.

Overview of Declarative Programming Paradigm, basic concepts , features, various programming aspects and languages examples; Declarative Programming in Python.

Overview of Imperative Programming Paradigm, basic concepts , features, various programming aspects and languages examples- PHP, Ruby, Perl, Swift; Imperative Programming in Python.

Parallel Programming Paradigm: Multi-threading, Multi-Processing, Serial Processing, Parallel Processing, Multiprocessing module in Python, Process class, Pool class; Parallel Programming in Python

Unit-III

Concurrent Programming Paradigm: Parallel Vs Concurrent Programming, threading, multiprocessing, concurrent. Futures, gevent, greenlets, celery, Other languages: ANI, Plaid; Concurrent Programming in Python
Functional Programming Paradigm: Sequence of Commands- map(), reduce(), filter(), lambda, partial, functools, Other languages: F#, Clojure, Haskell ; Functional Programming in Python.
Logic Programming Paradigm: First-class function, Higher-order function, Pure functions, Recursion, Packages: Kanren, SymPy , PySWIP, PyDatalog, Other languages: Prolog, ROOP, Janus; Logic Programming in Python.
Dependent Type Programming Paradigm: Logic Quantifier: for all, there exists, Dependent functions, dependent pairs
Relation between data and its computation, Other Languages: Idris, Agda, Coq; Dependent Type Programming in Python.

Unit-IV

Network Programming Paradigm: Socket Programming: TCP & UDP, Connection oriented, connectionless, Sock_Stream, Sock_Dgram, socket(), bind(), recvfrom(), sendto(), listen() , Server-Client; send(), recv(), connect(), accept(), read(), write(), close(), Other languages: PowerShell, Bash, TCL; Socket Programming in Python.
Symbolic Programming Paradigm : Symbolic Maths, algebraic manipulations, limits, differentiation, integration, series SymPy usage for symbolic maths Equation Solving, Matrices, Other languages: Aurora, LISP, Wolfram; Symbolic Programming in Python
Automata Based Programming Paradigm: Finite State Machine, deterministic finite State transitions using python-automaton automation (dfa), nfa , Initial state, destination state, event(transition), Other languages: Forth, Ragel, SCXML; Automata Based Programming in Python
GUI Programming Paradigm: Graphical User Interface (GUI) , Tkinter, WxPython, Jpython, WxWidgets, PyQT5, Other languages: GTK, java-gnome; GUI Programming in Python

Suggested References Books:

a. Elad Shalom, A Review of Programming Paradigms throughout the History: With a suggestion Toward a Future
Approach, Kindle Edition, 2018
b. John Goerzen, Brandon Rhodes, Foundations of Python Network Programming: The comprehensive guide to building network applications with Python, 2nd ed., Kindle Edition, 2010
c. Elliot Forbes, Learning Concurrency in Python: Build highly efficient, robust and concurrent applications, Kindle Edition, 2017
4. Amit Saha, Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus and More, Kindle Edition, 2015
5. Alan D Moore, Python GUI Programming with Tkinter: Develop responsive and powerful GUI applications with Tkinter, Kindle Edition, 2018
6. https://www.scipy-lectures.org/

Course outcomes:

1. Create Programs using structured, procedural and object oriented programming paradigms
2. Create Programs using event driven, declarative and imperative programming paradigms
3. Create Programs using parallel, concurrent and functional programming paradigms
4. Create Programs using logic, dependent type and network programming paradigms
5. Create Programs using symbolic, automata based and graphical user interface programming paradigms
6. Create Programs using different programming paradigms using python language

Business Intelligence & Analytics					
Course code	PCC-DS-312G				
Category	Professional Elective Course				
Course title	Business Intelligence & Analytics				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

1. Introduce the Business intelligence concepts ,techniques and models
2. Understand the modeling process behind business analytics
3. To analyze different data analysis tools and techniques

Unit-I

Introduction: Introduction to Business Intelligence – Designing Business Intelligence Application- Requirements Gathering, Establishing the Technical Architecture, Designing a Business Intelligence Solution , Designing Dimensional Models , Designing the Physical Databases ;

Predictive Analytics: Data Mining Concepts- Definitions, Characteristics, and Benefits - How Data Mining Works - Data Mining Versus Statistics Data Mining Process - Data Mining Methods - Data Mining and Privacy Issues - Regression – Classification –Association Rules – clustering -Techniques for Predictive Modeling – ANN- SVM

Unit-II

Text Analytics, Text Mining, And Sentiment Analysis: Text Analytics, Text Mining, and Sentiment Analysis - Natural Language Processing - Text Mining Process- tools - Sentiment Analysis -Overview, Process, Applications - Speech Analytics – Rule based, Multi, Layer, Hybrid Sentimental analysis – Machine Learning in Sentimental analysis

Web Analytics and Web Mining : Web Mining Overview - Web Content and Web Structure Mining - Search Engines - Search Engine Optimization - Web Analytics Technologies, metrics - Web Analytics Maturity Model and Web Analytics Tools

Unit-III

Prescriptive Analytics: Decision Support Systems Modeling - Mathematical Models for Decision Support - Certainty, Uncertainty, and Risk- Decision Modeling with Spreadsheets - Mathematical Programming Optimization, - Decision Analysis with Decision Tables and Decision Trees - Problem-Solving Search Methods - Problem-Solving Search Methods

Unit-IV

Knowledge Management and Big Data Analytics : Knowledge Management –Concepts, Definitions , Approaches, tools and techniques - Big Data and Analytics- Fundamentals of Big Data Analytics – Technologies - Data Scientist - Big Data and Data Warehousing - Automated Decision Systems and Expert Systems - Business Analytics: Emerging Trends and Future Impacts, Recent Trends

Reference Books:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Business Intelligence and Analytics", 10th Edition, Pearson , 2015.
2. S. Christian Albright, Wayne L. Winston, Business Analytics: Data Analysis & Decision Making, 6th Edition, CENGAGE INDIA , 2017
3. Dinabandhu Bag, Business Analytics, Routledge, 1st edition, 2016
4. Rick Sherman, Business Intelligence Guidebook: From Data Integration to Analytics, Morgan Kaufmann, 1st edition 2014

Course Outcomes:

After successfully completing the course the student should be able to

1. Understand the fundamental of Business Intelligence and to design a customized solution.
2. Familiarize on the concepts, techniques and reporting methods of descriptive analytics and predictive analytics
3. Explore the methods used to analyze speech and text and implement optimized search engines
4. Design and implement Decision Support systems
5. Familiarize on the processes needed to develop, report, and analyze business data.

Nature Inspired Computing Techniques					
Course code	PEC-AI-308G				
Category	Professional Elective Course				
Course title	Nature Inspired Computing Techniques				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To Understand the basics of Natural systems
2. To appreciate the concepts of Natural systems and its applications
3. To understand new Basic Natural systems functions(operations)
4. To understand the fundamentals of nature inspired techniques which influence computing
5. To understand an Integration of Hardware and software in Natural applications.
6. *To Understand* practical implementation of Natural design considerations.

Unit-I

Introduction, Overview of Philosophy, Nature to Nature Computing , A Brief Overview of Three Branches, Individuals, Entities and agents, Parallelism and Distributivity Interactivity, Adaptation- Feedback, Self-Organization, Complexity, Emergence , Bottom-up Vs Top-Down Approach, Determination, Chaos and Fractals

Unit-II

Evolutionary Computing, Hill Climbing, Simulated Annealing, Simulated Annealing, Genetics Principles, Standard Evolutionary Algorithm, Genetic Algorithms, Reproduction, Crossover Mutation, Evolutionary Programming, Genetic Programming,

Unit-III

Swarm Intelligence – Introduction, Ant Colony Optimization, Ant Foraging Behavior, Ant Colony Optimization, SACO algorithm, Ant Colony Algorithm (ACA), Scope of ACO algorithms, Swarm Robotics, Social Adaptation of Knowledge, Particle Swarm Optimization.
Immune System-Introduction to Immune System, Physiology and main components, Pattern Recognition and Binding, Immune Network Theory, Danger Theory, Immune Algorithms, Genetic algorithms, Bone Marrow Models, Forest's Algorithm, Artificial Immune Networks

Unit-IV

DNA Computing, DNA Molecule, Adleman's experiment, PAM Model, Splicing Systems, From Classical to DNA Computing, Universal DNA Computers, Scope of DNA Computing, Lipton's Solution to SAT Problem
Recent Trends and real world applications

References Books:

1. Leandro Nunesde Castro," Fundamentals of Natural Computing, Basic Concepts, Algorithms And Applications",Chapman &Hall/CRC, Taylorand Francis Group,2007.
2. FloreanoD.and MattiussiC.,"Bio- Inspired Artificial Intelligence: Theories, Methods and Technologies", MIT Press, Cambridge, MA,2008.
3. AlbertY.Zomaya,"Handbook of Nature-Inspired and Innovative Computing",Springer,2006
4. Marco Dorrigo,Thomas Stutzle,” Ant Colony Optimization”, PHI,2005

Course Outcomes:

After successfully completing the course the student should be able to

1. Illustrate the basic concepts of Swarm Intelligence processes
2. Examine the principle of Immuno computing techniques
3. Skills for planning, estimating, and resourcing for Natural design considerations
4. Manage the scope changes of nature inspired techniques which influence computing
5. Ability to identify optimization Techniques as a means to provide functionality and value to apply context in specific case studies
6. Ability to understand the needs and familiarize the DNA Computing

Predictive Analytics Essentials					
Course code	PEC-DS-315G				
Category	Professional Elective Course				
Course title	Predictive Analytics Essentials				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. To provide the knowledge of various quantitative and classification predictive models based on various regression and decision tree methods.
2. To provide the knowledge to select the appropriate method for predictive analysis
3. To provide the understanding of how to search, identify, gather and pre-process data for the analysis.
4. To provide the understanding of how to formulate predictive analytics questions.

Unit-I

Introduction: The Analytics Life Cycle, Introduction to Predictive Analytics, Matrix Notation, Basic Foundations, Model, Method and Feature Selection.
Regression: Covariance, Correlation and ANOVA review; Simple Linear Regression, OLS Model Diagnostics, Dummy Variables, Multivariate Regression, OLS Assumptions ,Weighted Least Squares (WLS), Generalized Linear Models (GLM).

Unit-II

Classification Models: Introduction, Binomial Logistic Regression, Multinomial Logistic Regression, Linear Discriminant Analysis, Quadratic Discriminant Analysis.
Decision Trees: Introduction Regression Trees, Regression Tree Issues, Classification Trees, Pruning Trees, Bootstrap Aggregation (Bagging), Random Forest Models.

Unit-III

Data Pre-Processing: Overview, Variable Types, Introduction to Data Transformations, Data Transformations: Categorical to Dummy Variables, Polynomials, Box-Cox Transformation, Log & Elasticity Models, Logit Transformation, Count Data Models, Centering, Standardization, Rank Transformations, Lagging Data (Causal Models), Data Reduction.
Variable Selection: Dimensionality Issues, Multi-Collinearity, Variable Selection Methods, Step Methods.

Unit-IV

Dimensionality: Regularization (Penalized or Shrinkage Models, Ridge Regression, LASSO, Dimension Reduction Models, Principal Components Regression (PCR), Partial Least Squares(PLS).
Machine Learning: Machine Learning Overview, Bias vs. Variance Trade-off, Error Measures, Cross-Validation.
Deep Learning: Machine Learning Overview, architecture, techniques and applications.
Recent trends and contemporary issues.

References Books:

1. An Introduction to Statistical Learning: with Applications in R, James, Witten, Hastie and Tibshirani, Springer, 1st Edition, 2013.
2. The Elements of Statistical Learning-Data Mining, Inference, and Prediction, Trevor Hastie, Robert Tibshirani, Jerome Friedman , Second Edition , Springer Verlag, 2009.
3. Predictive & Advanced Analytics (IBM ICE Publication)

Course Outcomes:

After successfully completing the course the student should be able to

1. Ability to develop and use various quantitative and classification predictive models based on various regression and decision tree methods.
2. Ability to select the appropriate method for predictive analysis
3. Ability to search, identify, gather and pre-process data for the analysis.
4. Ability to formulate predictive analytics questions.

UI/UX Design					
Course code	PEC-DS-316G				
Category	Professional Elective Course				
Course title	UI/UX Design				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Understand the concepts of design; Utilize by learning various color models
2. Gain knowledge on the basics of various law in UX
3. Construct the task for requirement gathering
4. Gain knowledge on how to Design for various domains or applications
5. Introduce tools for designing various applications
6. Utilise different types of design for real-time programming applications

Unit-I

What is typography-type properties, baseline, cap height, X-height, ascenders, Descenders and weight, Type classification-Serif **,**sans serif fonts, monospace, handwriting and Display, Readability, letter spacing, line height with an example, Paragraph spacing, power of alignment, Leading and Kerning, Fundamentals of color, Color Models Introduction, RGB, CMYK, Color harmony: monochromatic, analogous, Complementary, triadic, double-complementary, Meaning of colors, The power of Contrast

Unit-II

Laws of UX designing **,** Hicks law, example of hicks law with an application Jakob‘s law, example of jakob‘s law with an application, Fitts‘s Law, example of Fitts‘s law with an application, Ockham‘s Razor **,** example of Ockham‘s law with an application, Pareto Principle, example of Pareto principle with an application, Weber‘s law, example of Weber‘s law with an application, Tesler‘s law, example of Tesler‘s law with an application, Law of proximity, example of proximity, Law of similarity and human eye

Unit-III

Introduction to Interaction Design **,** Task analysis, Data collection for gathering user **,** Data for task requirements, Requirements gathering, Eliciting Qualitative data, analyzing qualitative data, Qualitative metrics, User narratives, Scenario implementation and its challenges, Wireframes, Example on wireframes.

Prototypes **:** Introduction, Implementation of Prototypes, UX design for mobile application, Application design example , Responsive Design, Adaptive design and difference with Responsive design. Culture in usability, Universal usability, Inclusive interaction, Importance of accessibility, principles of accessibility, Universal design, Accessibility design, Font weight, color, Contrast, Screen readers, Alt text using a tool

Unit-IV

Introduction to Multifaceted Users, Designing for Multifaceted Users, Design guidelines, Guidelines for helping adults, Application example, Virtual third eye simulator introduction, Web accessibility guide, Virtual third eye simulator web accessibility.

Importance of case studies and guidelines: Tracking APP Introduction, Tracking APP Design guidelines, Tracking APP demo, Designing UI, Redesigning Gmail and making it flash, Design principles, Redesigning Gmail and making it flash Demo.

Introduction of how to Design a new UX concept to reduce driver distraction, Designing concepts of Driver distraction Demo, Importance of User data in UX designing, Approach to design without user data, Designing concept **,** Implementation problems without data, Dynamic webpages, Demo, Perform UI Case study

Reference Books:

1. Jeff Johnson, Kate Finn, Designing user Interfaces for an aging population towards Universal design, Morgan Kauffman publishers, Elseiver-2017
2. Elvis Canziba, Hands-on UX Design for Developers, Packt Birminiham,mumbai-2018
3. Andrew Rogerson, User Experience Design, Smashin media 2012, Freiburg,Germany
4. Barbara Ballard, Designing the mobile user experience, Wiley publications, 2007
5. https://uxdesign.cc/tagged/case-study

Course Outcomes:

After successfully completing the course the student should be able to

1. Identify various color models for design
2. Create the design as per the design law
3. Construct the task for requirement gathering
4. Create wire frames and prototypes
5. Create the usability constraints and accessibility
6. Construct real-time applications using real -time programming applications

Intelligent Machining					
Course code	PEC-AI-310G				
Category	Professional Elective Course				
Course title	Intelligent Machining				
Scheme and Credits	L	T	P	Credits	
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Objectives of the course:

The objective of this course are:

1. Understand the fundamentals of Artificial Intelligence
2. Learn basics of Intelligent machining, sensors and machining process
3. Understand the design of Intelligent Systems - RTOS
4. Understand the computational methods, optimization and reasoning about physical system
5. Understand implications of Artificial Intelligence in various real time applications

Unit-I

Introduction to Artificial Intelligence and it's techniques, Problem Solving with Artificial Intelligence AI Models, Data acquisition and learning aspects of AI, Problem Solving - Problem Solving Process, Formulating Problems, Problem types and Characteristics, Problem Space and Search, Intelligent Agent Rationality and Rational agent with performance measures, Flexibility and Intelligent Agents, Task Environment and its Properties, Types of Agents, Other aspects of agents, Constraint satisfaction problem (CSP), Crypto Arithmetic puzzles, CSP as a search problem-constraints and representation, CSP-backtracking and Role of heuristic, CSP - Froward Checking and constraint propagation, CSP-Intelligent backtracking.

Unit-II

Introduction Intelligent Machining, Basics Open Architecture Machine Control, Manufacturing Automation Protocol, The Evolution of Intelligent Machining, MOSAIC – NGC, OSACA – SERCOS, Components of Intelligent Machining, Introduction sensors – Machining Process, Sensing and Monitoring , Signal Processing, Transforming Data into Information – Examples, Machining Process Control Practical Uses of Machine Learning, Machine Learning Process Control Strategies, Programmable Logic Controllers (PLC), Closed Loop Process Control Systems, Introduction to Adaptive Control, Commercially Available Software

Unit-III

Representation of Intelligent systems, Control for the Evolution of VLSI Designs, An Object-Oriented Approach, Tools and Techniques for Conceptual Design , Design Compilers, Labelled Interval Calculus, Knowledge Representations for Design Improvisation, A knowledge-based Framework for
Design, Introduction to RTOS - Hardware Components, Design Principles of RTOS - Interrupt , Processing - task Management, Task Scheduling -Synchronization tools, Task Communication - Memory Management, File System, Tracing and Debugging

Unit-IV

Computational methods and optimization, Neural Network Modelling, Fuzzy set theory, Machining Optimization, Objective Functions and Constraints, Optimization Techniques, Reasoning about physical system, Temporal Qualitative Analysis, Reasoning about Geometry, Study of Heuristic knowledge for automatic configuration Generation and Innovation;
Case Study - Autonomous Vehicle (Driver Less Car), Flying Drones, Cogito, Alexa , SIRI, Defect Prediction , Wear and Tear Prediction in Mechanical devices, Smarter Home robots, Application of AI in CAD/CAM, Streamlining Drug Discovery, Betterment (Financial Advisor)

References Books:

1. Farid Meziane, Sunil Vadera, Khiary Kobbacy and Nathan Proudlove, "Intelligent Systems in Manufacturing:Current Developments and Future Prospects", (unit 1)
2. How Netflix Uses Analytics To Select Movies, Create Content, and Make Multimillion Dollar Decisions Author: Zach Bulygo(unit 1)
3. Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith (unti 2)
4. Artifical Intelligent in Engineering Design: Volume 1 , Gerard Meurant, Springer (Chapter 2,3,5,6,9 -unit3)
5. K.C.Wang, " Embedded and Real-Time Operating Systems (Chapter 10.6- Unit 3)
6. Sam Siewert, John Pratt," Real-Time Embedded Components and Systems with Linux and RTOS", David Pallai Publisher, 2016. (Chapter 8- Unit 3)
7. Machining: Fundamentals and Recent Advances, J. Paulo Davim, Springer. (Chapter 12-unit 4)
8. Artifical Intelligent in Engineering Design: Volume 2 , Gerard Meurant, Springer (Chapter 10-14 - unit 5)

Course Outcomes:

After successfully completing the course the student should be able to

1. Acquire the knowledge on the fundamentals of Artificial intelligence and its problem solving approaches
2. Acquire the knowledge on fundamentals of Intelligent Machining and machining process
3. Acquire knowledge on the design of Intelligent Systems and RTOS
4. Acquire knowledge on computational methods and optimization
5. Apply the knowledge on Real time applications

SOFTWARE ENGINEERING

Coursecode	PEC CSE-311G				
Category	Professional Elective Course				
Coursetitle	Software Engineering				
Scheme and Credits	L	T	P	Credits	Semester 5
	3	0	0	3	
Class work	25 Marks				
Exam	75 Marks				
Total	100 Marks				
Duration of Exam	03 Hours				

Objectives of the course

- Be successful professionals in the field with solid fundamental knowledge of software engineering
- Utilize and exhibit strong communication and interpersonal skills, as well as professional and ethical principles when functioning as members and leaders of multi-disciplinary teams
- Apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles and processes

Note: Examiner will set nine questions in total. Question one will be compulsory. Question one will have 6 parts of 2.5 marks each from all units and remaining eight questions of 15 marks each to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each unit.

Unit: 1

Introduction: The process, software products, emergence of software engineering, evolving role of software, software life cycle models, Software Characteristics, Applications, Software crisis.

Software project management: Project management concepts, software process and project metrics Project planning, project size estimation metrics, project estimation Techniques, empirical estimation techniques, COCOMO- A Heuristic estimation techniques, staffing level estimation, team structures, staffing, risk analysis and management, project scheduling and tracking

Unit: 2

Requirements Analysis and specification requirements engineering, system modeling and simulation Analysis principles modeling, partitioning Software, prototyping: , Prototyping methods and tools; Specification principles, Representation, the software requirements specification and reviews Analysis Modeling: Data Modeling, Functional modeling and information flow: Data flow diagrams, BehavioralModeling; The mechanics of structured analysis: Creating entity/ relationship diagram, data flow model, control flow model, the control and process specification; The data dictionary; Other classical analysis methods.

System Design: Design concepts and principles: the design process: Design and software quality, design principles; Design concepts: Abstraction, refinement, modularity, software architecture, control hierarchy, structural partitioning, data structure, software procedure, information hiding; Effective modular design: Functional independence, Cohesion, Coupling;

Unit: 3

Architectural Design: Software architecture, Data Design: Data modeling, data structures, databases and the data warehouse, Analyzing alternative Architectural Designs, architectural complexity; Mapping requirements into a software architecture; Transform flow, Transaction flow; Transform mapping: Refining the architectural design.

Testing and maintenance: Software Testing Techniques, software testing fundamentals: objectives, principles, testability; Test case design, white box testing, basis path testing: Control structure testing: Black box testing, testing for specialized environments, architectures and applications. Software Testing Strategies: Verification and validation, Unit testing, Integration testing, Validation testing, alpha and beta testing; System testing: Recovery testing, security testing, stress testing, performance testing; The art of debugging, the debugging process debugging approaches. Software re-engineering, reverse engineering, restructuring, forward engineering.

Unit: 4

Software Reliability and Quality Assurance :Quality concepts, Software quality assurance , SQA activities; Software reviews: cost impact of software defects, defect amplification and removal; formal technical reviews: The review meeting, review reporting and record keeping, review guidelines; Formal approaches to SQA; Statistical software quality assurance; software reliability: Measures of reliability and availability ,The ISO 9000 Quality standards: The ISO approach to quality assurance systems, The ISO 9001 standard, Software Configuration Management. Computer Aided software Engineering: CASE, building blocks, integrated case environments and architecture, repository.

Suggested books:

- Software Engineering – A Practitioner's Approach, Roger S. Pressman, 1996, MGH.

Suggested reference books

- Fundamentals of software Engineering, Rajib Mall, PHI Software Engineering by Nasib Singh Gill, Khanna Book Publishing Co (p) Ltd
- Software Engineering by Ian Somerville, Pearson Edu, 5 edition, 1999, AW,
- Software Engineering – David Gustafson, 2002, T.M.H
- Software Engineering Fundamentals Oxford University, Ali Behforooz and Frederick J. Hudson 1995 JW&S,
- An Integrated Approach to software engineering by Pankaj jalote , 1991 Narosa,

Course Outcomes

1. How to apply the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment
2. An ability to work in one or more significant application domains
3. Work as an individual and as part of a multidisciplinary team to develop and deliver quality software
4. Demonstrate an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle
5. Demonstrate an ability to use the techniques and tools necessary for engineering practice