SEMESTER –V

Name of the Course: B. Tech in AI & DS **Subject:** Probability & Statistics	
Course Code: PCCAIDS 501	**Semester: V**
Teaching Scheme	**Maximum Marks: 100**
Theory: 3 hrs./week	**Examination Scheme**
Tutorial:	End Semester Exam: 70
Practical:0	Attendance: 5
Credit:3	Continuous Assessment: 25

Aim:

Sl. No.	
1.	The aim of this course is to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling various problems in the discipline.
2.	The objective of this course is to familiarize the students with statistical techniques.

Objective: Throughout the course, students will be expected to demonstrate their understanding of probability & statistics by being able to learn each of the following

Sl. No.	
1.	The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
2.	The basic ideas of statistics including measures of central tendency, correlation and regression.
3.	The statistical methods of studying data samples.

Pre-Requisite:

Sl. No.	
1.	Knowledge of basic algebra, calculus.
2.	Ability to learn and solve mathematical model.

Contents		**Hrs./week**	**Contents**
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and nonhomogeneous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.	**16**	**20**
02	Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.	**16**	**25**
03	Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	**16**	**25**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**

Assignments:

Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Erwin Kreyszig	Advanced Engineering Mathematics	9 th Edition	John Wiley & Sons
N. G. Das	Statistical Methods	0070083274, 9780070083271	Tata Mc.Graw Hill
Reena Garg	Advanced Engineering Mathematics | AICTE Recommended	First Edition	Khanna Publishing
Reference Books:			
P. G. Hoel, S. C. Port and C. J. Stone	Introduction to Probability Theory		Universal Book Stall
W. Feller	An Introduction to Probability Theory and its Applications	3rd Ed.	Wiley
Manish Sharma, Amit Gupta	The Practice of Business Statistics| AICTE Recommended	First Edition	Khanna Publishing

Operating Systems
Code: PCC- CS502
Contacts: 3L

Name of the Subject:	**Operating Systems**		
Course Code: PCC-CS502	Semester: V		
Duration: 6 months	Maximum Marks:100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance : 5 marks	
Practical: hrs./week		End Semester Exam :70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/ Unit
1	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	3	
2	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	10	
3.	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problemetc.	5	
4.	**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	5	

5.	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).	8	
6.	I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency andperformance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	6	

Text book and Reference books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia StudentEdition.
2. Operating Systems: Internals and Design Principles, 5th Edition,William Stallings, Prentice Hall of India.
3. Operating System Concepts, Ekta Walia, Khanna PublishingHouse (AICTE Recommended Textbook – 2018)
4. Operating System: A Design-oriented Approach, 1st Edition byCharles Crowley, Irwin Publishing
5. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt,Addison- Wesley
6. Design of the Unix Operating Systems, 8th Edition by MauriceBach, Prentice-Hall of India
7. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet,Marco Cesati, O'Reilly and Associates

Operating System Lab
Code: PCC- CS592
Contacts: 4P

Name of the Course:	Operating System Lab
Course Code: PCC- CS592	Semester: V
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

1 1. **Managing Unix/Linux Operating System [8P]:**

Creating a bash shell script, making a script executable, shell syntax (variables, conditions,control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks,Making file systems, Superblock, I-nodes, File system checker, Mounting file systems,
Logical Volumes, Network File systems, Backup schedules and
methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Password
security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and
permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users &user groups.
2. **Process [4P]**: starting new process, replacing a process image, duplicating aprocess image, waiting for a process,
zombie process.
3. **Signal [4P]**: signal handling, sending signals, signal interface, signal sets.
4. **Semaphore [6P]**: programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads [6P]**: programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit,
pthread_attr_init, pthread_cancel)
6. **Inter-process communication [6P]**: pipes(use functions pipe, popen, pclose), named pipes(FIFOs, accessing FIFO),
message passing & shared memory(IPC version V).

Any experiment specially designed by the college
(Detailed instructions for Laboratory Manual to be followed for further guidance)

Object Oriented Programming
Code: PCC-CS503
Contacts: 3L

Name of the Subject:	**Object Oriented Programming**
Course Code: PCC-CS 503	Semester: V
Duration:6 months	Maximum Marks:100

Teaching Scheme	**Examination Scheme**
Theory:3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz : 10 marks
	Attendance: 5 marks
Practical: hrs./week	End Semester Exam:70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Abstract data types and their specification.How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementingoperations, illustrated by the Text example.	8	
2	Features of object-oriented programming. Encapsulation, object identity, polymorphism –but not inheritance.	8	
3	Inheritance in OO design. Design patterns. Introduction and classification. Theiterator pattern.	6	
4	Model-view-controller pattern. Commands as methods and as objects. ImplementingOO language features. Memory management.	6	
5	Generic types and collections GUIs. Graphical programming with Scale and Swing . The software development process	6	

Text book and Reference books:

1. R.S. Salaria, Mastering Object-Oriented Programming Using C++, Khanna Publishing House
2. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – PrenticeHall,
3. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
4. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
5. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING
6. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
7. Ivor Horton's Beginning Java 2 SDK – Wrox
8. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Object Oriented Programming & Java Lab
Code: PCC-CS593
Contacts: 4P

Name of the Course:	Object Oriented Programming Lab
Course Code: PCC-CS593	Semester:V
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

Laboratory Experiments:

1. Assignments on class, constructor, overloading, inheritance, overriding
2. Assignments on wrapper class, arrays
3. Assignments on developing interfaces- multiple inheritance, extending interfaces
4. Assignments on creating and accessing packages
5. Assignments on multithreaded programming
6. Assignments on applet programming

Note: Use Java for programming

Any experiment specially designed by the college
(Detailed instructions for Laboratory Manual to be followed for further guidance)

Introduction to Industrial Management (Humanities III)

Code: HSMC-501

Contacts: 2L

Name of the Course:	**Introduction to Industrial Management (Humanities III)**
Course Code: HSMC-501	Semester: V
Duration:6 months	Maximum Marks:100

Teaching Scheme	**Examination Scheme**
Theory:2 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz : 10 marks
	Attendance: 5 marks
Practical: NIL	End Semester Exam:70 Marks
Credit Points: 2	

Unit	Content	Hrs/Unit	Marks/Unit
1	**Introduction** System- concept, definition, types, parameters, variables and behavior. Management – definition andfunctions. Organization structure: i. Definition. ii. Goals. iii. Factors considered in formulatingstructure. iv. Types. v. Advantages and disadvantages. vi. Applications. Concept, meaning and importance of division of labor, scalar & functional processes, span of control, delegation ofauthority, centralization and decentralization in industrial management. Organizational culture and climate –meaning, differences and factors affecting them. Moral-factors affecting moral. Relationship between moral andproductivity. Job satisfaction- factors influencing jobsatisfaction. Important provisions of factory act andlabor laws.	6	

2	**Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT):** 2.1 CPM & PERT-meaning, features, difference, applications. 2.2 Understand different terms used in network diagram. Draw network diagram for a real life project containing 10-15 activities, computation of LPO and EPO.(Take minimum three examples). Determination of critical path on network. Floats, its types and determination of floats. Crashing of network, updating and its applications.	8	
3	**Materials Management:** Material management-definition, functions, importance, relationship with other departments. Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department. Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice. Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores. Inventory control: i. Definition. ii. Objectives. iii. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. iv. ABC analysis and other modern methods of analysis. v. Various types of inventory models such as Wilson's inventory model, replenishment model and two bin model. (Only sketch and understanding, no derivation.). 3.6 Material Requirement Planning (MRP)- concept, applications and brief details about software packages available in market.	6	

4	**Production planning and Control (PPC):** Types and examples of production. PPC : i. Need and importance. ii. Functions. iii. Forms used and their importance. iv. General approach foreach type of production. Scheduling- meaning and need forproductivity and utilisation. Gantt chart- Format and method toprepare. Critical ratio scheduling-method andnumeric examples. Scheduling using Gantt Chart (for at least 5-7 components having 5-6	8	
	machining operations, with processes, setting and operation time for each component and process, resources available, quantity and other necessarydata), At least two examples. 4.7 Bottlenecking- meaning, effect andways to reduce.		
5	**Value Analysis (VA) and Cost Control:** 5.1 VA-definition, terms used, process and importance. 5.2 VA flow diagram. DARSIRI method of VA. Case study of VA-at least two. Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines.	4	
6	**Recent Trends in IM:** ERP (Enterprise resource planning) - concept, features and applications. Important features of MS Project. Logistics- concept, need and benefits. Just in Time (JIT)-concept and benefits. Supply chain management-concept and benefits.	4	

Text book and Reference books:

1. S.C. Sharma, "Engineering Management – Industrial Engineering &Management" (AICTE Recommended Textbook), Khanna Book Publishing Company, New Delhi

2. L.S. Srinath– "CPM & PERT principles and Applications".
3. Buffa – "Modern Production Management".
4. N. Nair – "Materials Management".
5. O. P. Khanna – " Industrial Engineering & Management".
6. Mikes – "Value Analysis".

Cloud Computing

Code: PECAIDS 501B
Contact: 3L

Name of the Course:	**Cloud Computing**		
Course Code: **PECAIDS 501B**	Semester: V		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical:		End Semester Exam: 70 Marks	
Credit Points:	3		

Unit	Content	Hrs/ Unit	Marks/Unit
1	**Definition of Cloud Computing and itsBasics (Lectures)**. Defining a Cloud, Cloud Types – NIST model, Cloud Cube	9	
	model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software asa Service with examples of services/ serviceproviders, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing, A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients, IaaS –Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics,Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) Compliance as a Service (CaaS)		

2	**Use of Platforms in Cloud Computing** Concepts of Abstraction and Virtualization Virtualization technologies : Typesofvirtualization (access, application, CPU,storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including ApplicationDelivery Controller and Application Delivery Network),Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance, Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks,	12	
	Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service., Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service, Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services,		

3	**Cloud Infrastructure**: Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computingdeployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle). Concepts of Cloud Security: Cloud security concerns, Security boundary,Security service boundary Overview of securitymapping Security of data: Brokered cloudstorage access, Storage location and tenancy,encryption, and auditing and compliance Identity management (awareness of Identityprotocol standards)	7	
4.	**Concepts of Services and Applications :** Service Oriented Architecture: Basic conceptsof message-based transactions, Protocol stackfor an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs, Applications in the Cloud: Concepts of cloud transactions, functionality mapping,	8	

	Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs Cloud-based Storage: Cloud storage definition – Manned and Unmanned Webmail Services: Cloud mail services including Google Gmail, Mail2Web, WindowsLive Hotmail, Yahoo mail, concepts of Syndication services		

Text book and Reference books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd, 2013
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited,2013
3. Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill
4. Cloud Computing, Miller, Pearson
5. Building applications in cloud:Concept, Patterns and Projects, Moyer, Pearson
6. Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

Pattern Recognition
Code: PECAIDS 501C
Contact: 3L

Name of the Subject:	**Pattern Recognition**	
Course Code: **PECAIDS 501C**	Semester: V	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam:70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	Basics of pattern recognition	2	
2	**Bayesian decision theory 8L** Classifiers, Discriminant functions, Decision surfaces Normal density and discriminant functions Discrete features	8	
3	**Parameter estimation methods 6L** Maximum-Likelihood estimation Gaussian mixture models Expectation-maximization method Bayesian estimation	6	
4.	**Hidden Markov models for sequential pattern classification 8L** Discrete hidden Markov models Continuous density hidden Markov models	8	
5	**Dimension reduction methods 3L** 5.1. Fisher discriminant analysis 5.2Principal component analysis. Parzen-window method K-Nearest Neighbour method	3	
6	Non-parametric techniques for density estimation	2	
7	**Linear discriminant function based classifier 5L** Perceptron Support vector machines	5	

8	**Non-metric methods for pattern classification 4L** Non-numeric data or nominal data Decision trees	4	
9	**Unsupervised learning and clustering 2L** Criterion functions for clustering Algorithms for clustering: K-means, Hierarchical and other methods	2	

Text book and Reference books:

1. R. O. Duda, P. E. Hart and D. G. Stork: Pattern Classification, John Wiley, 2001.
2. S. Theodoridis and K. Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Subject: Graph Theory	
Course Code: PECAIDS 501D	**Semester: V**
	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	**End Semester Exam: 70**
Tutorial:	**Attendance : 5**
Practical: 0	**Continuous Assessment: 25**
Credit: 3	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Aim:	
Sl. No.	
1.	Understand the basic of graph theory.
2.	Understand path, walks and cycle
3.	Understand set covering and matches.
4.	Understand vertex coloring.

Objective:	
Sl. No.	
1.	To learn about the vertex, edge, path and cycle.
2.	To learn about connected graph.
3.	To learn about shortest path.
4.	To learn about set covering and matching.
5.	To learn about vertex coloring.

Pre-Requisite:	
Sl. No.	
	None

Contents		**4 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction** Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion, Realization of a graphic sequence.	**7**	**14**
02	**Connected graphs and shortest paths** Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm.	**7**	**14**
03	**Trees** Definitions and characterizations, Number of trees, Cayley's formula, Kircho-matrix-tree theorem, Minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Fleury's algorithm, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions.	**7**	**14**
04	**Independent sets coverings and matchings** Introduction, Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall's Theorem, K¨onig's Theorem, Perfect matchings in graphs, Greedy and approximation algorithms.	**8**	**14**
05	**Vertex Colorings** Basic definitions, Cliques and chromatic number, Mycielski's theorem, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class-1 and Class-2 graphs, Edge-coloring of bipartite graphs, Class-2 graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring.	**7**	**14**
	Sub Total:	**36**	**70**

	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
J. A. Bondy and U. S. R. Murty	Graph Theory	1st edition	Springer
Richard J. Trudeau	Introduction to Graph Theory	2nd edition	Dover Publications
S.B. Singh	Combinatorics and Graph Theory	Third Edition	Khanna Publishing
Reference Books:			
Chartrand and Zhang	A First Course in Graph Theory	ISBN-10: 0486483681 ISBN-13: 978-0486483689	Dover Publications
Maarten van Steen	Graph Theory and Complex Networks: An Introduction	ISBN-10: 9081540610 ISBN-13: 978-9081540612	Maarten van Steen

End Semester Examination Scheme. Maximum Marks-70. Time allotted-3hrs.

Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)		**Subjective Questions**			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1 to 5**	**10**	**10**				
B	**1 to 5**			**5**	**3**	**5**	**60**
C	**1 to 5**			**5**	**3**	**15**	

- Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	**Chapter**	**Marks of each question**	**Question to be set**	**Question to be answered**
A	**All**	**1**	**10**	**10**

B	**All**	**5**	**5**	**3**
C	**All**	**15**	**5**	**3**

Soft Computing
Code: PEC-AIDS 501A
Contacts: 3L

Name of the Course:	**Soft Computing**
Course Code: **PEC-AIDS 501A**	Semester: V
Duration:6 months	Maximum Marks: 100

Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz : 10 marks
	Attendance: 5 marks
Practical:	End Semester Exam: 70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm	8	
2	Fuzzy sets and Fuzzy logic systems: Classical Sets and Fuzzy Sets and Fuzzy relations : Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations. Membership functions : Features of membership functions, standard forms and boundaries, differentfuzzification methods. Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods. Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models – Sugeno Fuzzy Models. Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting	10	

3	Neural Network Introduction to Neural Networks: Advent of ModernNeuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron. Learning Methods : Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline andMadaline networks; single layer network; Back-propagation and multi layer networks. Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks. Neuo-Fuzzy modelling:Applications of Neural Networks: Pattern Recognition andclassification	10	
4.	Genetic Algorithms: Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA). Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and patternRecognition	10	
5	**PSO:**Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	4	

Text book and Reference books:

1. Fuzzy logic with engineering applications, Timothy J. Ross, John Wiley and Sons.
2. S. Rajasekaran and G.A.V.Pai, "Neural Networks,Fuzzy Logic and Genetic Algorithms", PHI
3. Principles of Soft Computing , S N Sivanandam, S. Sumathi, John Wiley & Sons
4. Genetic Algorithms in search, Optimization & Machine Learning by David E.Goldberg
5. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, PHI
6. Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH,
7. Genetic Algorithms in search, Optimization & Machine Learning by David E.Goldberg, Pearson/PHI
8. A beginners approach to Soft Computing, Samir Roy & Udit Chakraborty, Pearson
9. Fuzzy Sets and Fuzzy Logic: Theory and Applications, George J. Klir and Bo Yuan,Prentice Hall
10. Neural Networks: A Comprehensive Foundation (2nd Edition), Simon Haykin,Prentice Hall.

Data Science & Data Science Lab
Code: PCCAIDS 502 & 592
Contacts: 3L+4P

Name of the Course:	**Data Science**
Course Code: **PCCAIDS 502**	Semester: V
Duration:6 months	Maximum Marks: 100 +100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz : 10 marks
Practical: 4 hrs./week	Attendance: 5 marks
Credit Points: 3+2	End Semester Exam: 70 Marks
	Practical Sessional internal continuous evaluation: 40
	Practical Sessional external examination: 60

PRE-REQUISITES

- Introduction to Programming
- Probability

OBJECTIVES

The objective of this course is to impart necessary knowledge of the mathematical foundations needed for data science and develop programming skills required to build data science applications.

LEARNING OUTCOMES

At end of this course, the students will be able to:

- Demonstrate understanding of the mathematical foundations needed for data science.
- Collect, explore, clean, munge and manipulate data.
- Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
- Build data science applications using Python based toolkits.

Unit	Content	Hrs/Unit
1	Introduction to Data Science Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting	(4 Hours)
2	Introduction to Programming Tools for Data Science 2.1 Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK 2.2 Visualizing Data: Bar Charts, Line Charts, Scatterplots 2.3 Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction	(6 Hours)
3	Mathematical Foundations 3.1 Linear Algebra: Vectors, Matrices, 3.2 Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation 3.3 Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem	(12 Hours)

	3.4 Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, Phacking, Bayesian Inference	
4	Machine Learning Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural NetworksLearning And Generalization, Overview of Deep Learning.	(16 Hours)
5	Case Studies of Data Science Application Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.	(6 Hours)

LIST OF PRACTICALS

1. Write a programme in Python to predict the class of the flower based on available attributes.
2. Write a programme in Python to predict if a loan will get approved or not.
3. Write a programme in Python to predict the traffic on a new mode of transport.
4. Write a programme in Python to predict the class of user.
5. Write a programme in Python to indentify the tweets which are hate tweets and which are not.
6. Write a programme in Python to predict the age of the actors.
7. Mini project to predict the time taken to solve a problem given the current status of the user.

LIST OF SUGGESTED BOOKS

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
3. Jain V.K., “Data Sciences”, Khanna Publishing House, Delhi.
4. Jain V.K., “Big Data and Hadoop”, Khanna Publishing House, Delhi.
5. Jeeva Jose, “Machine Learning”, Khanna Publishing House, Delhi.
6. Chopra Rajiv, “Machine Learning”, Khanna Publishing House, Delhi.
7. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press
http://www.deeplearningbook.org
8. Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers
9. Chopra Rajiv, Questions & Answers in AI, DS, ML, Khanna Book Publishing