

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in CSE (Data Science)
 (Applicable from the academic session 2020-2021)

SEMESTER – III

Analog & Digital Electronics

Code: ESC-301

Contact: 3L

Name of the Course:	Analog & Digital Electronics		
Course Code: ESC-301	Semester: III		
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		
Objective:			
1	To acquire the basic knowledge of different analog components and their applications		
2	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.		
3	To prepare students to perform the analysis and design of various digital electronic circuits		
Pre-Requisite:			
1	Basic Electronics Parts I & II learned in the First year, semesters 1 & 2. Basic BJTs,.		
2	Basic concept of the working of P-N diodes, Schottky diodes,		
3	Basic FETs and OPAMP as a basic circuit component. Concept of Feedback		

Unit	Content	Hrs/Unit	Marks/Unit
1	Different Classes of Amplifiers - (Class-A, B, AB and C - basic concepts, power, efficiency; Recapitulation of basic concepts of Feedback and Oscillation, Phase Shift, Wein Bridge oscillators Astable & Monostable Multivibrators; Schmitt Trigger circuits, 555 Timer.	9	

2	Binary Number System & Boolean Algebra (recapitulation); BCD, ASCII, EBCDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Venn diagram, Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic	11	
	expressions by algebraic method. Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator		
3	Sequential Circuits - Basic Flip-flop & Latch, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), Design of Mod N Counter	10	
4.	A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only [2L] A/D: successive approximation [2L]) Logic families- TTL, ECL, MOS and CMOS - basic concepts. (2L)	6	

Text book and Reference books:

1. Microelectronics Engineering –Sedra & Smith-Oxford.
2. Analog Electronics, A.K. Maini, Khanna Publishing House (AICTE Recommended -2018)
3. Analog Electronics, L.K. Maheswari, Laxmi Publications (AICTE Recommended -2018)
4. Principles of Electronic Devices & circuits—B L Thereja & Sedha—S Chand
5. Digital Electronics – Kharate – Oxford
6. Digital Electronics – Logic & Systems by J.Bigmeil & R.Donovan; Cambridge Learning.
7. Digital Logic and State Machine Design (3rd Edition) – D.J.Comer, OUP
8. Electronic Devices & Circuit Theory – Boyelstad & Nashelsky - PHI
9. Bell-Linear IC & OP AMP—Oxford
10. P.Raja- Digital Electronics- Scitech Publications
11. Morris Mano- Digital Logic Design- PHI
12. R.P.Jain—Modern Digital Electronics, 2/e ,McGraw Hill
13. H.Taub & D.Shilling, Digital Integrated Electronics- McGraw Hill.
14. D.RayChaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
15. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
16. J.Bignell & R.Donovan-Digital Electronics-5/e- Cenage Learning.
17. Leach & Malvino—Digital Principles & Application, 5/e, McGraw Hill
18. Floyd & Jain- Digital Fundamentals-Pearson.

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Course Outcomes:

On completion of the course students will be able to

ESC-301.1 Realize the basic operations of different analog components.

ESC-301.2 Realize basic gate operations and laws Boolean algebra.

ESC-301.3 Understand basic structure of digital computer, stored program concept and different arithmetic and control unit operations.

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Data Structure & Algorithm
Code: PCC-CS301
Contacts: 3L

Name of the Course:	Data Structure & Algorithm	
Course Code: PCC-CS(DS)301	Semester: III	
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	
Objective:		
1	To learn the basics of abstract data types.	
2	To learn the principles of linear and nonlinear data structures.	
3	To build an application using sorting and searching	
Pre-Requisite:		
1	CS 201 (Basic Computation and Principles of C	
2	M101 & M201 (Mathematics), basics of set theory	

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Technique sand their complexity analysis.	10	
2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	9	

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3	Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis	10	
4.	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	9	

Text book and Reference books:

1. “Data Structures and Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Data Structure & Algorithms Using C”, 5th Ed., Khanna Publishing House (AICTE Recommended – 2018)
3. “Fundamentals of Data Structures of C” by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.
4. “Data Structures in C” by Aaron M. Tenenbaum.
5. “Data Structures” by S. Lipschutz.
6. “Data Structures Using C” by Reema Thareja.
7. “Data Structure Using C”, 2/e by A.K. Rath, A. K. Jagadev.
8. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
9. “Data Structures through C” by Yashwant Kanetkar, BPB Publications.
10. “Expert Data Structures with C++” by R.B Patel, Khanna Publishing House

Course Outcomes:

On completion of the course students will be able to

PCC-CS301.1 Differentiate how the choices of data structure & algorithm methods impact the performance of program.

PCC-CS301.2 Solve problems based upon different data structure & also write programs.

PCC-CS301.3 Identify appropriate data structure & algorithmic methods in solving problem.

PCC-CS301.4 Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

PCC-CS301.5 Compare and contrast the benefits of dynamic and static data structures implementations.

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Computer Organization
Code: PCC- CS302
Contacts: 3L

Name of the Course:	Computer Organization	
Course Code: PCC- DS301	Semester: III	
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	Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes. [7L] Commonly used number systems. Fixed and floating point representation of numbers. [1L]	8	
2	Overflow and underflow. Design of adders - ripple carry and carry look ahead principles. [3L] Design of ALU. [1L] Fixed point multiplication -Booth's algorithm. [1L] Fixed point division - Restoring and non-restoring algorithms. [2L] Floating point - IEEE 754 standard. [1L]	8	
	Memory unit design with special emphasis on		

3	implementation of CPU-memory interfacing. [2L] Memory organization, static and dynamic memory, memory hierarchy, associative memory. [3L] Cache memory, Virtual memory. Data path design for read/write access. [5L]	10	
4.	Design of control unit - hardwired and microprogrammed control. [3L] Introduction to instruction pipelining. [2L] Introduction to RISC architectures. RISC vs CISC architectures. [2L] I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA. [3L]	10	

Text book and Reference books:

1. Mano, M.M., “Computer System Architecture”, PHI.
2. Behrooz Parhami “Computer Architecture”, Oxford University Press
3. Hayes J. P., “Computer Architecture & Organisation”, McGraw Hill,
4. Hamacher, “Computer Organisation”, McGraw Hill,
5. N. senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and Microcontrollers” OUP
6. Chaudhuri P. Pal, “Computer Organisation & Design”, PHI,
7. P N Basu- “Computer Organization & Architecture” ,Vikas Pub
8. Rajaraman – “Computer Organization & Architecture”, PHI
9. B.Ram – “Computer Organization & Architecture”, Newage Publications

Course Outcomes:

On completion of the course students will be able to

PCC-CS302.1 Understand basic structure of digital computer, stored program concept and different arithmetic and control unit operations.

PCC-CS302.2 Understand basic structure of different combinational circuits- multiplexer, decoder, encoder etc.

PCC-CS302.3 Perform different operations with sequential circuits.

PCC-CS302.4 Understand memory and I/O operations.

Introduction to Data Science**Code: PCC- DS301****Contacts: 3L**

Name of the Course:	Introduction to Data Science	
Course Code: PCC- DS302	Semester: III	
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	Hours
1	Introduction: Objective, scope and outcome of the course	1
2	Toolboxes: Python, fundamental libraries for data Scientists. Integrated development environment (IDE). Data operations: Reading, selecting, filtering, manipulating, sorting, grouping, rearranging, ranking, and plotting.	7
3	Descriptive statistics, data preparation. Exploratory Data Analysis data summarization, data distribution, measuring asymmetry. Sample and estimated mean, variance and standard score. Statistical Inference frequency approach, variability of estimates, hypothesis testing using confidence intervals, using p-values.	8
4	Supervised Learning: First step, learning curves, training-validation and test. Learning models generalities, support vector machines, random forest. Examples	7
5	Regression analysis, Regression: linear regression simple linear regression, multiple & Polynomial regression, Sparse model. Unsupervised learning, clustering, similarity and distances, quality measures of clustering, case study.	10
6	Network Analysis, Graphs, Social Networks, centrality, drawing centrality of Graphs, PageRank, Ego-Networks, community Detection.	7
7	Total	40

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Mathematics-III (Differential Calculus)

Code: BSC-301

Contacts: 2L

Name of the Course:	Mathematics-III (Differential Calculus)	
Course Code: BSC-301	Semester: III	
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	Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.	8	
2	Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.	7	
3	Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar). Theorems of Green, Gauss and Stokes (Statement only) and related problems.	8	
4.	First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution. [5L] Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation. [4L]	9	
5	Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph. Matrix Representation: Incidence & Adjacency matrix. Tree: Basic Concept of tree, Binary tree, Spanning Tree, Kruskal and Prim's algorithm for finding the minimal spanning tree.	8	

Text book and Reference books:

1. Higher Algebra, S. K. Mapa, Levant Books.
2. Advanced Higher Algebra, Chakravorty and Ghosh, U N Dhar Pvt. Ltd.
3. Co-ordinate Geometry, S. L. Loney
4. Integral Calculus, Das and Mukherjee, U N Dhar Pvt. Ltd.
5. Differential Calculus, Das and Mukherjee, U N Dhar Pvt. Ltd.
6. Advanced Engineering Mathematics, E Kreyszig
7. Advanced Engineering Mathematics, Chandrika Prasad & Reena Garg, Khanna Publishing House (AICTE Recommended Textbook -2018)

Economics for Engineers (Humanities-II)**Code: HSMC-301****Contacts: 3L**

Name of the Course:		Economics for Engineers (Humanities-II)	
Course Code: HSMC-301		Semester: III	
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	1. Economic Decisions Making – Overview, Problems, Role, Decision making process. 2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	9	
2	3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of	9	

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	<p>Money, Debt repayment, Nominal & Effective Interest.</p> <p>4. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods;</p> <p>Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector -Quantifying And Valuing Benefits & drawbacks.</p>		
3	<p>5. Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity</p> <p>Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates.</p> <p>6. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect</p> <p>Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives.</p> <p>7. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability</p> <p>Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.</p>	9	
4.	<p>8. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.</p> <p>9. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems.</p> <p>10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.</p>	9	

Text book and Reference books:

1. James L. Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
3. John A. White, Kenneth E. Case, David B. Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R. Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub
7. Premvir Kapoor, Sociology & Economics for Engineers, Khanna Publishing House (AICTE Recommended Textbook – 2018)

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**PRACTICAL
SYLLABUS
Semester III**

Analog & Digital Electronics Lab

Code: ESC-391

Contacts: 4P

Name of the Course:	Analog & Digital Electronics Lab
Course Code: ESC-391	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:

Analog Electronics

- | | |
|---|---------------------------------------------|
| 1 | Design a Class A amplifier |
| 2 | Design a Phase-Shift Oscillator |
| 3 | Design of a Schmitt Trigger using 555 timer |

Digital Electronics

- | | |
|----|-----------------------------------------------------------------------------------------------------------------------------------------|
| 4 | Design a Full Adder using basic gates and verify its output / Design a Full Subtractor circuit using basic gates and verify its output. |
| 5 | Construction of simple Decoder & Multiplexer circuits using logic gates. |
| 6 | Realization of RS / JK / D flip flops using logic gates |
| 7 | Design of Shift Register using J-K / D Flip Flop |
| 8 | Realization of Synchronous Up/Down counter |
| 9 | Design of MOD- N Counter |
| 10 | Study of DAC |

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

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Data Structure & Algorithm Lab

Code: PCC-CS391

Contacts: 4P

Name of the Course:	Data Structure & Algorithm Lab
Course Code: PCC-CS(DS)391	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:	
Linear Data Structure	
1	Implementation of array operations
2	Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements
3	Merging Problem: Evaluation of expressions operations on Multiple stacks & queues:
4	Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists
5	Polynomial addition, Polynomial multiplication
Non Linear Data Structure	
6	Recursive and Non-recursive traversal of Trees
7	Threaded binary tree traversal. AVL tree implementation
8	Application of Trees. Application of sorting and searching algorithms
9	Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

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Computer Organization Lab

Code: PCC- CS392

Contacts: 4P

Name of the Course:	Computer Organization Lab
Course Code: PCC-CS(DS)392	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:

1	Familiarity with IC-chips: a) Multiplexer, b) Decoder, c) Encoder b) Comparator Truth Table verification and clarification from Data-book.
2	Design an Adder/Subtractor composite unit.
3	Design a BCD adder.
4	Design of a 'Carry-Look-Ahead' Adder circuit.
5	Use a multiplexer unit to design a composite ALU
6	Use ALU chip for multibit arithmetic operation
7	Implement read write operation using RAM IC
8	8. (a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

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Data Science Lab using Python

Code: PCC DS391

Contacts: 4P

Name of the Course:	Data Science Lab using Python
Course Code: PCC-CS(DS)393	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: NIL	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Practical Syllabus

1. Interactive commands in Python, data operations, simple programs for writing into files and reading from files. Data file manipulations programs.
2. Familiarization with IDE in Python.
3. Writing programs for standard algorithms of sorting and searching in Python.
4. Plotting the data using X-Y graph, Bar- chart, and using other plotting techniques.
5. Write programs to perform exploratory data analysis: variance, standard derivation, summarization, distribution, and statistical inference.
6. Plotting the various distributions for given data sets.
7. Classifying and presentation of data using support vector machine.
8. Write programs for k-means clustering and presentation for given data sets.
9. Write programs on graphs of social networks for community detection.
10. Write programs for analysis of graphs to find centrality and page-rank.

Text book and Reference books:

Dr. Jeeva Jose, Begineer's Guide for Data Analysis Using R Programming, Khanna Publishing House, New Delhi

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Semester-IV

Discrete Mathematics

Code: PCC-CS401

Contacts: 3L+1T

Name of the Course:		Discrete Mathematics	
Course Code: PCC-CS401		Semester: IV	
Duration:6 months		Maximum Marks:100	
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: 1 hour/week		Assignment and Quiz : 10 marks	
		Attendance : 5 marks	
Practical: NIL		End Semester Exam :70 Marks	
Credit Points:		4	
Unit	Content		Hrs/Unit
1	Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well- Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.		8
2	Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination		5
3	Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.		8
4.	Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form		7

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5	Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi- connected component and Articulation Points, Shortest distances.	8
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Text book and Reference books:

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
3. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
4. S.B. Singh, Discrete Structures – Khanna Publishing House (AICTE Recommended Textbook – 2018)
5. S.B. Singh, Combinatorics and Graph Theory, Khanna Publishing House (AICTE Recommended Textbook – 2018)
6. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
7. J.K. Sharma, Discrete Mathematics, Macmillan
8. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
9. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
10. Douglas B. West, Introduction to graph Theory, PHI
11. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
12. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
13. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.
14. N. Deo, Graph Theory, Prentice Hall of India, 1974.
15. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
16. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
17. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
18. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
19. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
20. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH

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Database Management Systems
Code: PCC- DS401
Contact: 3L

Name of the Course:		Database Management Systems	
Course Code: PCC- DS401		Semester: IV	
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	Database system architecture: Data Abstraction, Data Independence,Data Definition Language(DDL),Data ManipulationLanguage(DML). Data models: Entity-relationshipmodel, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	9	
2	Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency,Armstrong’s axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions,Query equivalence, Join strategies, Query optimization algorithms.	13	
3	Storage strategies: Indices, B-trees, hashing.	3	
4.	Transaction processing: Concurrencycontrol, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	5	

5	Database Security: Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	3	
6	Advanced topics: Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	3	

Text book and Reference books:

1. “Database System Concepts” , 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.
2. “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer Science Press.
3. Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)
4. “Fundamentals of Database Systems” , 5th Edition by R. Elmasri and S. Navathe,
5. Pearson Education “Foundations of Databases”, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley

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Formal Language & Automata Theory
Code: PCC-CS403
Contacts: 3L

Name of the Course:	Formal Language & Automata Theory	
Course Code: PCC-CS403	Semester: IV	
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
1	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	6
2	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)	7
3	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.	6
4.	Context-sensitive languages: Context-sensitive grammars(CSG) and languages, linear bounded automata and equivalence with CSG.	6
5	Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing- decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators	6
6	Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages	6

Text books/ reference books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

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2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill., PEARSON.
6. Dr. R.B.Patel, Theory of Computation, Khanna Publishing House

Design and Analysis of Algorithms

Code: PCC-CS404

Contacts: 3L

Name of the Course:	Design and Analysis of Algorithms	
Course Code: PCC-CS404	Semester: IV	
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
1	Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion treemethod and Masters' theorem	8
2	Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and- Bound and Backtracking methodologies for the design of algorithms; Illustrations of thesetechniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	8
3	Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm. Tractable and Intractable Problems: Computability	6
4.	of Algorithms, Computability classes – P,NP, NP- complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.	10

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5	Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	4
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Text books/ reference books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
7. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

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Data Mining

Code: PCC-DS 402

Contacts: 3L

Name of the Course:		Data Mining
Course Code: PCC-DS 402		Semester: IV
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	Hours
1	Introduction: Data Mining Concept, Origin, Process, Applications, Techniques, Challenges	3
2	Data Preprocessing: Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Data integration & transform, Data reduction	6
3	Association Rule Mining: Market-basket analysis basics, Naïve algorithm, Apriori algorithm, Direct Hashing and Pruning (DHP), Software for Association Rule Mining, Classification and Prediction: Decision Tree, Classification by decision tree induction, Bayesian classification, Rule-based classification, Prediction – Linear and Nonlinear Regression, Classification software	8
4	Cluster Analysis: Types of data in cluster analysis, Partitioning methods, Hierarchical methods, Density-based methods, Quality & Validity of clustering methods Cluster analysis software	7
5	Web Data Mining: Web content mining, Web usage mining, Web structure mining, Hubs and Authorities, HITS algorithm, Web mining software Text Mining, Support Vector Machine.	7
6	Data Mining Application & Information Privacy: Applications and trends in data mining such as Web, finance, telecommunication, biology and medicine, science and engineering retail industry etc. Social impacts of data mining, information privacy and data security, IT Act overview.	9

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Biology
Code: BSC 401
Contacts: 2L+1T

Name of the Course:		Biology	
Course Code: BSC-401		Semester: IV	
Duration: 6 months		Maximum Marks:100	
Teaching Scheme		Examination Scheme	
Theory: 2hrs./week		Mid Semester exam: 15	
Tutorial: 1 hour		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:		3	
Unit	Content		Hrs/Unit
1	To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18 th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.		2
2	The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c) energy and Carbon utilisation - Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegans, A. Thaliana, M. musculus		3

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3	<p>To convey that “Genetics is to biology what Newton’s laws are to Physical Sciences” Mendel’s laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis brought as a part of genetics.</p> <p>Emphasis to be given not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring.</p> <p>Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans.</p> <p>Discuss the concept of complementation using human genetics.</p>	4
4.	<p>Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures.</p> <p>Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA. Two carbon units and lipids.</p>	4
5	<p>Enzymes: To convey that without catalysis life would not have existed on earth</p> <p>Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.</p>	4
6	<p>Information Transfer: The molecular basis of coding and decoding genetic information is universal</p> <p>Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code.</p> <p>Universality and degeneracy of genetic code.</p> <p>Define gene in terms of complementation and recombination.</p>	4
7	<p>Macromolecular analysis: How to analyse biological processes at the reductionist level Proteins- structure and function.</p> <p>Hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.</p>	5
8	<p>Metabolism: The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems.</p> <p>Exothermic and endothermic versus endergonic and exergonic reactions. Concept of K_{eq} and its relation to standard free energy.</p> <p>Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis).</p> <p>Energy yielding and energy consuming reactions. Concept of Energy charge</p>	4

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9	Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3
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Text books/ reference books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. General Biology, Uma Devi, Khanna Publishing House.
3. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
4. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
5. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
6. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Environmental Sciences

Code: MC-401

Contacts: 1L

Name of the Course:	Environmental Sciences	
Course Code: MC-401	Semester: IV	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory: 1 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:	0	
Unit	Content	Hrs/Unit
1	Basic ideas of environment, basic concepts, man, society & environment, their interrelationship (1L) Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. (2L) Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. (1L) Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. (2L)	6

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2	<p>Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem-components types and function. (1L)</p> <p>Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.(2L)</p> <p>Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L)</p> <p>Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.(2L)</p>	6
3	<p>Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L)</p> <p>Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.(1L)</p> <p>Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L)</p> <p>Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L)</p> <p>Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L)</p> <p>Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L) Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC,destruction of ozone layer by CFC, impact of other green-housegases, effect of ozone modification. (1L)</p> <p>Standards and control measures: Industrial, commercial and residentialair quality standard, control measure (ESP. cyclone separator, baghouse, catalytic converter, scrubber (ventury), Statement with brief reference). (1L)</p>	11

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4.	<p>Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L)</p> <p>River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L)</p> <p>Lake: Eutrophication [Definition, source and effect]. (1L)</p> <p>Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)(1L)</p> <p>Standard and control: Waste water standard [BOD, COD, Oil, Grease],</p> <p>Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L)</p> <p>Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)</p>	9
5	<p>Lithosphere; Internal structure of earth, rock and soil (1L)</p> <p>Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes;</p> <p>Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling.</p> <p>Solid waste management and control (hazardous and biomedical waste).(2L)</p>	3
6	<p>Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] (1L)</p> <p>Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level, L_{10} (18hr Index) , L_d. Noise pollution control. (1L)</p>	3
7	<p>Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/agreement/ protocol. (2L)</p>	2

Text books/ reference books:

1. M.P. Poonia & S.C. Sharma, Environmental Studies, Khanna Publishing House (AICTE Recommended Textbook – 2018)
2. M.P. Poonia, S.C. Sharma, Santosh Sharma, Environmental Engineering, Khanna Publishing House (AICTE Recommended Textbook – 2018)
3. Masters, G. M., “Introduction to Environmental Engineering and Science”, Prentice-Hall of India Pvt. Ltd., 1991.
4. De, A. K., “Environmental Chemistry”, New Age International

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Design & Analysis of Algorithm
LabCode: PCC-CS494
Contact: 4P

Name of the Course:	Design & Analysis Algorithm Lab
Course Code: PCC-CS494	Semester: IV
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:	
Divide and Conquer:	
1	Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach
2	Implement Quick Sort using Divide and Conquer approach Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
3	Find the minimum number of scalar multiplication needed for chain of matrix
4	Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) Implement Traveling Salesman Problem
5	Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm)
Brunch and Bound:	
6	Implement 15 Puzzle Problem
Backtracking:	
7	Implement 8 Queen problem
8	Graph Coloring Problem Hamiltonian Problem
Greedy method	
9	Knapsack Problem Job sequencing with deadlines
10	Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm
Graph Traversal Algorithm:	
11	Implement Breadth First Search (BFS)
	Implement Depth First Search (DFS)

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

Data Mining Lab

Code: PCC- DS492

Contact: 4P

Name of the Course:	Data Mining Lab
Course Code: PCC- DS492	Semester: IV
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

Manipulating strings, Processing Files, Manipulating Lists, Lists and Strings, Dictionary's, Counting with Dictionaries, Dictionaries and Files, Tuples, Tuples and Sorting, Regular Expressions, Networked programs, Sockets and Applications, parsing HTML with Beautiful soup, parsing XML by python, REST,JSON and APIs, Extracting data from JSON, Using database by python, Object oriented python, Geocoding, Page rank and web searching, Gm ,lane.

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Database Management System Lab
Code: PCC- DS491
Contacts: 4P

Name of the Course:	Database Management System Lab
Course Code: PCC- DS491	Semester: IV
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:

Structured Query Language

1. Creating Database

- Creating a Database
- Creating a Table
- Specifying Relational Data Types
- Specifying Constraints
- Creating Indexes

2. Table and Record Handling

- INSERT statement
- Using SELECT and INSERT together
- DELETE, UPDATE, TRUNCATE statements
- DROP, ALTER statements

3. Retrieving Data from a Database

1. The SELECT statement
2. Using the WHERE clause
3. Using Logical Operators in the WHERE clause
4. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause

5. Using Aggregate Functions

6. Combining Tables Using JOINS

- SubqueriesDatabase ManagementCreating ViewsCreating Column Aliases
- Creating Database Users
- Using GRANT and REVOKE

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Cursors in Oracle PL / SQL Writing Oracle PL / SQL Stored Procedures

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

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Semester-V

Software Engineering

Code:ESC501

Contact: 3L

Name of the Course:	Software Engineering	
Course Code: ESC501	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
1	Overview of System Analysis & Design , Business System Concept, System Development Life Cycle,Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost-Benefit Analysis, COCOMO model. [10L]	10
2	System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs.Object- Oriented approach. [5L]	5
3	Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. [4L] Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification	12
	Metrics, Monitoring & Control. [8L]	
4.	Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. [7L]	7
5	Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram. [10 L]	10

Text book and Reference books:

1. Pressman, Software Engineering : A practitioner's approach– (TMH)
2. Pankaj Jalote, Software Engineering- (Wiley-India)
3. N.S. Gill, Software Engineering – (Khanna Publishing House)
4. Rajib Mall, Software Engineering- (PHI)
5. Agarwal and Agarwal, Software Engineering – (PHI)
6. Sommerville, Software Engineering – Pearson
7. Martin L. Shooman, Software Engineering – TMH

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Statistics for DataScience
Code: PCC-DS 501
Contacts: 3L

Name of the Course:	Computer Graphics	
Course Code: PCC-DS 501	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 1: 2L

Introduction: Objective, scope and outcome of the course 1

Unit 2: 4L

Probability models, their properties, combinatorial principle, conditional probability, independence of events.

Unit 3: 6L

Random variable and distributions discrete and continuous distributions, cumulative distribution functions. One dimensional change of variable, joint distributions, joint probability functions, density functions. Conditional independence

Unit 4: 9L

Expectation: Discrete case & continuous case. Variance, covariance and correlation. Generating functions, Conditional expectation. Sampling distribution and limits. Convergence in probability and distribution. Monte Carlo approximations, Normal distribution.

Unit 5: 12L

Statistical inference. Models for inference. Data collection: finite population, simple random sampling, histograms, survey sampling. Some basic inferences. Likely hood inference. Maximum likely hood estimation, inference based on MLE. Bayesian Inference, prior and poster distributions, inference estimation, Baysian computations, optimal inference.

Unit 6:8L

Model checking, sample model, residual probality plots, Chisquare test. Stochastic processes, distribution, Markov chains. Poisson processes.

Text Books:

1. Outline of statistics 1 and 2 by Goon-Gupta-Dasgupta

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2. Fundamentals of mathematical statistics by Gupta and Kapoor
3. Complete Business Statistics Book By Amir Aczel
4. The Practice of Business Statistics, by Manish Sharma (Khanna)

Operating Systems

Code: PCC-CS502

Contacts: 3L

Name of the Course:	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
1	Introduction: Concept of Operating Systems, Generations of Operating systems, Types of	3
	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.	
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, Dining Philosopher Problem etc.	5

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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 and performance. 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 Avi Silberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating System Concepts, Ekta Walia, Khanna Publishing House (AICTE Recommended Textbook – 2018)
4. Operating System: A Design-oriented Approach, 1st Edition by Charles 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 Maurice Bach, Prentice-Hall of India
7. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates

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Object Oriented Programming

Code: PCC-CS 503

Contacts: 3L

Name of the Course:	Computer Organization	
Course Code: PCC-CS503	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
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 Scaleand Swing . The software development process	6

Text book and Reference books:

1. R.S. Salaria, mastering Object-Oriented Programming Using C++, Khanna Publishing.
2. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall, India
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

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Introduction to Industrial Management (Humanities III)

Code: HSMC-501

Contacts: 3L

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: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
1	Introduction System- concept, definition, types, parameters, variables and behavior. Management – definition and functions. Organization structure: i. Definition. ii. Goals. iii. Factors considered in formulating structure. iv. Types. v. Advantages and disadvantages. vi. Applications. Concept, meaning and importance of division of labor, scalar & functional processes, span of control, delegation of authority, centralization and decentralization in industrial management. Organizational culture and climate –meaning, differences and factors affecting them. Moral-factors affecting moral. Relationship between moral and productivity. Job satisfaction- factors influencing job satisfaction. Important provisions of factory act and labor 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

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3	<p>Materials Management:</p> <p>Material management-definition, functions, importance, relationship with other departments.</p> <p>Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department.</p> <p>Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice.</p> <p>Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores.</p> <p>Inventory control:</p> <ol style="list-style-type: none"> 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.). <p>3.6 Material Requirement Planning (MRP)- concept, applications and brief details about software packages available in market.</p>	6
4	<p>Production planning and Control (PPC):</p> <p>Types and examples of production. PPC : i. Need and importance. ii. Functions. iii. Forms used and their importance. iv. General approach for each type of production.</p> <p>Scheduling- meaning and need for productivity and utilisation.</p> <p>Gantt chart- Format and method to prepare.</p> <p>Critical ratio scheduling- method and numeric examples.</p> <p>Scheduling using Gantt Chart (for at least 5-7 components having 5-6 machining operations, with processes, setting and operation time for each component and process, resources available, quantity and other necessary data), At least two examples.</p> <p>4.7 Bottlenecking- meaning, effect and ways to reduce.</p>	8
5	<p>Value Analysis (VA) and Cost Control:</p> <p>5.1 VA-definition, terms used, process and importance. 5.2 VA flow diagram. DARSIRI method of VA.</p> <p>Case study of VA-at least two.</p> <p>Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines.</p>	4
6	<p>Recent Trends in IM:</p> <p>ERP (Enterprise resource planning) - concept, features and applications.</p> <p>Important features of MS Project. Logistics- concept, need and benefits.</p> <p>Just in Time (JIT)-concept and benefits.</p> <p>Supply chain management-concept and benefits.</p>	4

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Text book and Reference books:

1. L.S. Srinath– “CPM & PERT principles and Applications”.
2. Buffa – “Modern Production Management”.
3. N. Nair – “Materials Management”.
4. O. P. Khanna – “ Industrial Engineering & Management”.
5. Mikes – “Value Analysis”.
6. S.C. Sharma, “Engineering Management – Industrial Engineering & Management”, Khanna Book Publishing Company, New Delhi

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Theory of Computation
Code:PEC-DS 501A
Contacts: 3L

Name of the Course:	Theory of Computation	
Course Code: PEC-DS501A	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/U nit
1	Fundamentals: Basic definition of sequential circuit, block diagram, mathematical representation, concept of transition table and transition diagram (Relating of Automata concept to sequential circuit concept) Design of sequence detector, Introduction to finite state model [2L] Finite state machine: Definitions, capability & state equivalent, kth-equivalent concept [1L] Merger graph, Merger table, Compatibility graph [1L] Finite memory definiteness, testing table & testing graph. [1L] Deterministic finite automaton and non deterministic finite automaton.[1L] Transition diagrams and Language recognizers. [1L] Finite Automata: NFA with \hat{I} transitions - Significance, acceptance of languages. [1L] Conversions and Equivalence: Equivalence between NFA with and without \hat{I} transitions. NFA to DFA conversion. [2L] Minimization of FSM, Equivalence between two FSM's , Limitationsof FSM [1L] Application of finite automata, Finite Automata with output- Moore & Melay machine. [2L]	13
2	Regular Languages : Regular sets. [1L] Regular expressions, identity rules. Arden's theorem state and prove[1L] Constructing finite Automata for a given regular expressions, Regularstring accepted by NFA/DFA [1L] Pumping lemma of regular sets. Closure properties of regular sets (proofs not required). [1L] Grammar Formalism: Regular grammars-right linear and left linear	8

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	9grammars. [1L] Equivalence between regular linear grammar and FA. [1L]Inter conversion, Context free grammar. [1L] Derivation trees, sentential forms. Right most and leftmost derivation of strings. (Concept only) [1L]	
3.	Context Free Grammars, Ambiguity in context free grammars. [1L] Minimization of Context Free Grammars. [1L] Chomsky normal form and Greibach normal form. [1L] Pumping Lemma for Context Free Languages. [1L] Enumeration of properties of CFL (proofs omitted). Closure property of CFL, Ogden's lemma & its applications [1L] Push Down Automata: Push down automata, definition. [1L] Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence. [1L] Equivalence of CFL and PDA, interconversion. (Proofs not required).[1L] Introduction to DCFL and DPDA. [1L]	9
4.	Turing Machine : Turing Machine, definition, model [1L] Design of TM, Computable functions [1L] Church's hypothesis, counter machine [1L] Types of Turing machines (proofs not required) [1 L] Universal Turing Machine, Halting problem [2L]	5

Text book and Reference books:

1. "Introduction to Automata Theory Language and Computation", Hopcroft H.E. and Ullman J. D., Pearson education.
2. "Theory of Computation", R.B Patel, Khanna Publishing House, New Delhi
3. "Theory of Computer Science", Automata Languages and computation", Mishra and Chandra shekaran, 2nd edition, PHI.
4. "Formal Languages and Automata Theory", C.K.Nagpal, Oxford
5. "Switching & Finite Automata", ZVI Kohavi, 2nd Edn., Tata McGraw Hill
6. "Introduction to Computer Theory", Daniel I.A. Cohen, John Wiley
7. "Introduction to languages and the Theory of Computation", John C Martin, TMH
8. "Elements of Theory of Computation", Lewis H.P. & Papadimitrou C.H. Pearson, PHI.

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Advanced Computer Architecture
Code: PEC-DS 501C
Contacts: 3L

Name of the Course:	Advanced Computer Architecture	
Course Code: PEC-DS501C	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/U nit
1	Computer Architecture and Organization-Review, Fundamentals of Computer Design, Technology Trends Cost Performance Analysis (3L) Parallel Processing Architectures- Taxonomy- SISD, MISD, SIMD,MIMD, PRAM models (3L)	6
2.	Data and Resource Dependencies, Program Partitioning and Scheduling, Control Flow vs. Data Flow (3L) Network topologies-Static, Dynamic, Types of Networks (3L) RISC vs. CISC, Memory Hierarchy, Virtual Memory (4L)	10
3	Concepts of Pipelining, Instruction Pipelining, dynamic pipelining, arithmetic pipelines. (4L) Multiprocessors- Multistage Networks, Cache Coherence, Synchronization, Message- passing (4L) Vector Processing Principles- Instruction types, Compound, Vector Loops, Chaining (4L)	12
4	Array Processors- Structure, Algorithms (3L) Data Flow Architecture- Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations (4L) Parallel Programming Models, Languages, Compilers (4L)	11

Text book and Reference books:

1. Computer Architecture and Parallel Processing- Kai Hwang and A. .Briggs International Edition, McGraw Hill
2. Advanced Computer Architecture: D. Sima, T. fountain, P. Kacsuk, Pearson
3. Parallel Computer Architecture: D. Culler, J.P.Singh, A.Gupta, Elsevier
4. Advanced Computer Organization and Architecture, Ikvinderpal Singh, Khanna Publishing House.

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Mobile Computing
Code: PEC-DS501B
Contacts: 3L

Name of the Course:		Mobile Computing
Course Code: PEC-DS501B		Semester: V
Duration: 6 months		Maximum Marks: 100
Teaching Scheme		Examination Scheme
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: 3L		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	
Unit	Content	Hrs/Unit
1	Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signalling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Networks signalling.	5
2	General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.	5
3	Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless markup Languages (WML). Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.	7
4.	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G	7
5	Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Bluetooth technology, Bluetooth Protocols.	7
6	Server-side programming in Java, Pervasive web application architecture, Device independent example application	8

Text book and Reference books:

1. "Pervasive Computing", Burkhardt, Pearson
2. "Mobile Communication", J. Schiller, Pearson
3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001
4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.
5. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.
6. "Wireless Web Development", Ray Rischpater, Springer Publishing,
7. "The Wireless Application Protocol", Sandeep Singhal, Pearson .

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8. "Third Generation Mobile Telecommunication systems", by P.Stavronlakis, Springer Publishers,
 9. Brijesh Gupta "Mobile Computing", Khanna Publishing House, New Delhi

Computer Graphics
Code: PEC-DS501D
Contacts: 3L

Name of the Course:		Computer Graphics
Course Code: PEC-DS501D		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/U nit
1	Introduction to computer graphics & graphics systems [6L]: Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software. Scan conversion [8L]: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	14
2	2D transformation & viewing [15L]: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping, Cyrus-beck clipping method 3D transformation & viewing [5L]: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.	20
	Curves [3L]: Curve representation, surfaces, designs, Bezier curves,	

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3.	B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves. Hidden surfaces [3L]: Depth comparison, Z-buffer algorithm, Backface detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry. Color & shading models [2L]: Light & color model; interpolative shading model; Texture. Introduction to Ray-tracing: [3L] Human vision and color, Lighting, Reflection and transmission models.	6
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Text book and Reference books:

1. Hearn, Baker – “Computer Graphics (C version 2nd Ed.)” – Pearson education
2. Z. Xiang, R. Plastock – “Schaum's outlines Computer Graphics (2nd Ed.)” – TMH
3. D. F. Rogers, J. A. Adams – “Mathematical Elements for Computer Graphics (2nd Ed.)” – TMH

Compiler Design

Code: PEC- DS 501E

Contact: 3L

Name of the Course:	Compiler Design	
Course Code: PEC-DS501E	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
1	Introduction to Compiling [3L] Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.	3
2	Lexical Analysis [6L] The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).	6

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3	Syntax Analysis [9L] The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non- recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	9
4	Syntax directed translation [5L] Syntax director definitions, Construction of syntaxtrees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.	5
5	Type checking [4L] Type systems, Specification of a simple type checker, Equivalence of type expressions, Typeconversions	4
6	Run time environments [5L] Source language issues (Activation trees, Controlstack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameterpassing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	5
7	Intermediate code generation [4L] Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	4
8	Code optimization [5L] Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flowgraph, Peephole optimization.	5
9	Code generations [4L] Issues in the design of code generator, a simple code generator, Register allocation & assignment.	4

Text book and Reference books:

1. Aho, Sethi, Ullman - "Compiler Principles, Techniques and Tools" - Pearson Education.
2. Holub - "Compiler Design in C" - PHI.

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Constitution of India
Code: MC-CS501A
Contacts: 3L

Name of the Course:		Constitution of India	
Course Code: MC-CS501		Semester: V	
Duration: 6 months		Maximum Marks:100	
Teaching Scheme		Examination Scheme	
Theory:		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance : 5 marks	
		End Semester Exam:70 Marks	
Practical: NIL			
Credit Points:		0	
Unit	Content		Hrs/U nit
1	Introduction: Constitution’ meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy		3
2	Union Government and its Administration : Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha		6
3.	State Government and its Administration Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions		6
4.	Local Administration District’s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different 4.departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy		8
5.	Election Commission Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women		

Text book and Reference books:

1. 'Indian Polity' by Laxmikanth
2. 'Indian Administration' by Subhash Kashyap
3. 'Indian Constitution' by D.D. Basu
4. 'Indian Administration' by Avasti and Avasti

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Name of the Course:			Essence of Indian Knowledge and Tradition				
Course Code: MC-CS 501 B			Semester: VIII				
Duration: 6 months			Maximum Marks: 70				
Teaching Scheme			Examination Scheme				
Theory: 3 hrs./week			Mid Semester Exam.: 15 Marks				
Tutorial: Nil			Assignment & Quiz: =10(=8+2) Marks				
			Attendance: 5 Marks				
Practical: hr./week			End Semester Exam.: 70 Marks				
Credit Points: 0							
Objective:							
1	The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society andnature.						
2	Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.						
3	The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care system.						
Pre-Requisite:							
1	No						
2							
3							
End Semester Examinations Scheme. Maximum Marks – 70. Time allotted – 3 hrs.							
Groups	Units	Objective Questions (MCQ only with one correct answer)		Subjective Questions			
		No. of questions to be set	Total marks	No. of questions to be set	To answer`	Marks per question	Total marks
A	1 to 4	10	10				
B	1 to 4			6	3	5	15
C	1 to 4			6	3	15	45
<ul style="list-style-type: none">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.							
Unit		Content			Hrs/Unit		Marks/Unit
1		Basic Structure of Indian Knowledge System (i) Veda (ii) Upa-Veda (iii) Vedanga (iv) Upanga					

2	Modern Science and Indian Knowledge System		
3	Yoga and Holistic Health care		
4	Case Studies		
	Total		

Text and reference books:

1. Sivaramakrishna V. (Ed.), Cultural Heritage of India- Course Material, 5th Edition, Bharatiya Vidya Bhavan, Mumbai, 2014.
2. Jitatmanand S., Modern Physics and Vedant, Bharatiya Vidya Bhavan.
3. Capra F., Tao of Physics.
4. Capra F., The wave of Life.
5. Jha V.N., Tarkasangraha of Annam Bhatta (Eng. Trans), International Chinmay Foundation, Velliarnad, Amaku.
6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.
7. Jha G.N. and Jha R.N. (Ed.), Yoga-Darshanam with Vyasa Bhashya (Eng. Trans.), Vidyanidhi Prakasham, Delhi, 2016.
8. Jha R.N., Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.
9. Sharma P.R., Shodashang Hridayam (English translation).

Course Outcome:

After successful completion of this course, the students should be able to

1. To understand, connect up and explain basics of Indian Traditional knowledge from modern scientific perspective.

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Software Engineering Lab
Code: ESC591
Contact: 4P

Name of the Course:	Software Engineering Lab
Course Code: ESC591	Semester: V
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Laboratory Experiments:	
<ul style="list-style-type: none">• Problem Analysis and Project Planning - Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.• Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.• Data Modeling – Use work products – data dictionary.• Software Designing - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.• Prototype model – Develop the prototype of the product. <p>The SRS and prototype model should be submitted for end semester examination.</p>	

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

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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 Assessment: 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 a process 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)

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Object Oriented Programming 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)

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Semester-VI

Artificial Intelligence
Code: PCC-DS 601
Contacts: 3L

Name of the Course:	Artificial Intelligence	
Course Code: PCC-DS 601	Semester: VI	
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	Introduction [2] Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents [2] Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving [2] Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	6	
2.	Search techniques [5] Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Heuristic search strategies [5] Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. Adversarial search [3] Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.	13	

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3	Knowledge & reasoning [3] Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.	3	
4	Using predicate logic [2] Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. Probabilistic reasoning [4] Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	6	
5	Natural Language processing [2] Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. Learning [2] Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. Expert Systems [2] Representing and using domain knowledge, expert system shells, knowledge acquisition.	6	

Text book and Reference books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS
7. M.C. Trivedi, Artificial Intelligence, Khanna Publishing House, New Delhi
(AICTE Recommended Textbook – 2018)

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Data Communication and Computer Networks

Code:PCC- DS602

Contact: 3L

Name of the Course:	Data Communication and Computer Networks		
Course Code: PCC-DS602	Semester: VI		
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	Data communication Components: Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	9	
2	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking,	8	
	Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CD, CDMA/CA		
3	Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	14	

4.	Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	8	
5	Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	8	

Text book and Reference books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

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Name of the Course:	Big Data Technology	
Course Code: PCC- DS603	Semester: VI	
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	

Big data definition, structured and unstructured data. Need for analytics, Big data programming (Hadoop, Map-Reduce), Application Data store (NoSQL), OLAP.

Optimization Techniques, Data flow framework.

Programming Map-Reduce, Best practices.

Text Books: 1. Handbook of big data technology by Zomaya and Sakr.

2. Real time Big Data Analytics Book by Sumit Gupta

3. Big Data and Hadoop, V.K. Jain, Khanna Publishing House

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Advanced Algorithms
Code: PEC-DS601 A
Contact: 3L

Name of the Course:	Advanced Algorithms	
Course Code: PEC-DS601 A	Semester: VI	
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	Sorting: Review of various sorting algorithms, topological sorting Graph: Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkstra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	6	
2	Matroids: Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST.	8	
	Graph Matching: Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.		
	Flow-Networks: Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. Matrix Computations: Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	9	

3	Shortest Path in Graphs: Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. Modulo Representation of integers/polynomials: Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. Discrete Fourier Transform (DFT): In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	10	
4.	Linear Programming: Geometry of the feasibility region and Simplex algorithm NP-completeness: Examples, proof of NP-hardness and NP-completeness. One or more of the following topics based on time and interest Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	10	
5	Recent Trends in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	5	

Text book and Reference books:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.
2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.
3. "Algorithm Design" by Kleinberg and Tardos.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Distributed Systems**Code: PEC-DS601B****Contact: 3L**

Name of the Course:	Distributed Systems	
Course Code: PEC-DS601B	Semester: VI	
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	INTRODUCTION Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues	8	
2	DISTRIBUTED DATABASE DESIGN Alternative design strategies; Distributed design issues; Fragmentation; Data allocation SEMANTICS DATA CONTROL View management; Data security; Semantic Integrity Control QUERY PROCESSING ISSUES Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	11	
3	DISTRIBUTED QUERY OPTIMIZATION Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms TRANSACTION MANAGEMENT The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models CONCURRENCY CONTROL Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management	11	
4.	Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols Algorithm	8	
5	PARALLEL DATABASE SYSTEMS Parallel architectures; parallel query processing and	6	

6	ADVANCED TOPICS Mobile Databases, Distributed Object Management, Multi-databases	4	
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Text book and Reference books:

1. Principles of Distributed Database Systems, M.T. Ozu and PValduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Image Processing**Code:PEC-IT601 D****Contact: 3L**

Name of the Course:	Image Processing		
Course Code: PEC-IT601D	Semester: VI		
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	Introduction [3L] Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	9	
2	Digital Image Formation [4L] A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4	
3	Mathematical Preliminaries[9L] Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & SineTransform.	9	

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4.	Image Enhancement [8L] Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8	
5	Image Restoration [7L] Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.	7	
6	Image Segmentation [7L] Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.	7	

Text book and Reference books:

1. Hearn, Baker – “Computer Graphics (C version 2nd Ed.)” – Pearson education
2. Z. Xiang, R. Plastock – “Schaum’s outlines Computer Graphics (2nd Ed.)” – TMH
3. D. F. Rogers, J. A. Adams – “Mathematical Elements for Computer Graphics (2nd Ed.)” – TMH

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Machine Learning
Code: PEC-DS601 E
Contact: 3L

Name of the Course:	Machine Learning	
Course Code: PEC-DS601E	Semester: VI	
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	

Supervised Learning, Decision Tree, Linear Discriminant Functions (SVM)

Neural Network, Deep belief network, Density elimination Methods

Bayes Decision Theory

Expectation and Minimization

Ensemble Methods

Feature Engineering

Association Rule Mining

Clustering Techniques

Text Books:

1. Machine Learning and Knowledge Discovery edited by Walter Daelemans, Katharina Morik
2. Pattern Recognition and Machine Learning by Christopher Bishop
3. Introduction to Machine learning with python by Andreas C. Müller and Sarah Guido
4. Machine Learning by Rajiv Chopra, Khanna Publishing House
5. Machine Learning using Python, Jeeva Jose, Khanna Publishing House

Parallel and Distributed Algorithms

Code: PEC-DS602A

Contacts: 3L

Name of the Course:	Parallel and Distributed Algorithms	
Course Code PEC-DS602A	Semester: VI	
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	

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Unit	Content	Hrs/Unit	Marks/Unit
1	UNIT-I :Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing	8	
2	UNIT-II :Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples	8	
3	UNIT-III :Pipelining- Techniques computing platform, pipeline programs examples	8	
4.	UNIT-IV :Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallelism sharing data parallel programming languages and constructs, open MP	11	
5	UNIT-V :Distributed shared memory systems and programming achieving constant memory distributed shared memory programming primitives, algorithms – sorting and numerical algorithms.	9	

Text book and Reference books:

1. Parallel Programming, Barry Wilkinson, Michael Allen, Pearson Education, 2nd Edition.
2. Introduction to Parallel algorithms by Jaja from Pearson, 1992.

Data Warehousing and Data Mining**Code: PEC-DS602B****Contacts: 3L**

Name of the Course:	Data Warehousing and Data Mining		
Course Code PEC-DS602B	Semester: VI		
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
	Unit 1:		
1	Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;	8	

2	Unit 2: Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,	8	
3	Unit 3: Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;	8	
4.	Unit 4: Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis; modulation for communication, filtering, feedback control systems.	11	
	Unit 5: Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.	9	
	Unit 6: Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis	5	

Text book and Reference books:

1. Data Warehousing Fundamentals for IT Professionals, Second Edition by Paulraj Ponniah, Wiley India.
2. Data Warehousing, Data Mining, & OLAP – Second Edition by Alex Berson and Stephen J. Smith, Tata McGraw Hill Education
3. Data warehouse Toolkit by Ralph Kimball, Wiley India
4. Data Mining & Warehousing by Ikvinderpal Singh, Khanna Publishing House
5. Jiawei Han and M Kamber, Data Mining Concepts and Techniques,, Second Edition, Elsevier Publication, 2011.
6. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006.
7. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

Human Computer Interaction**Code:PEC-DS602C****Contact: 3L**

Name of the Course:	Human Computer Interaction	
Course Code: PEC-DS602C	Semester: VI	
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	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks;	9	
	Interaction: Models – frameworks – Ergonomics – styles – elements –interactivity- Paradigms.		
2	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules – principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	11	
3.	Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.	8	
4.	Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.	8	
5.	Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Case Studies.	8	
6.	Recent Trends: Speech Recognition and Translation, Multimodal System	3	

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Text book and Reference books:

1. Theodor Richardson, Charles N Thies, Secure Software Design, Jones & Bartlett
2. Kenneth R. van Wyk, Mark G. Graff, Dan S. Peters, Diana L. Burley, Enterprise Software Security, Addison Wesley.

Data Analysis and Modeling Technique**Code:** PEC-DS602D**Contact:** 3L

Name of the Course:	Data Analysis and Modeling Technique
Course Code: PEC-DS602D	Semester: VI
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	Basic probability: Discrete and continuous random variables, independence, covariance, central limit theorem, Chebyshev inequality, diverse continuous and discrete distributions.	6	
2	Statistics, Parameter Estimation, and Fitting a Distribution: Descriptive statistics, graphical statistics, method of moments, maximum likelihood estimation	9	
3	Random Numbers and Simulation: Sampling of continuous distributions, Monte Carlo methods	7	
4.	Hypothesis Testing: Type I and II errors, rejection regions; Z-test, T-test, F-test, Chi-Square test, Bayesian test	9	
5	Stochastic Processes and Data Modeling: Markov process, Hidden Markov Models, Poisson Process, Bayesian Network, Regression, Queuing systems	9	

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Numerical Methods
Code: OEC-DS601A
Contact: 3L

Name of the Course:	Numerical Methods		
Course Code: OEC-DS601A	Semester: VI		
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	Approximation in numerical computation: Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.	2	
2	Interpolation: Newton forward/backward interpolation, Lagrange's and Newton's divided difference Interpolation.	8	
3	Numerical integration: Trapezoidal rule, Simpson's 1/3 rule, Expression for corresponding error terms.	3	
4.	Numerical solution of a system of linear equations: Gauss elimination method, Matrix inversion, LU Factorization method, Gauss-Seidel iterative method.	8	
5	Numerical solution of Algebraic equation: Bisection method, Regula-Falsi method, Newton-Raphson method.	3	
6	Numerical solution of ordinary differential equation: Euler's method, Runge-Kutta methods, Predictor-Corrector methods and Finite Difference method.	2	

Text book and Reference books:

1. R.S. Salaria: Computer Oriented Numerical Methods, Khanna Publishing House
2. C.Xavier: C Language and Numerical Methods.
3. Dutta & Jana: Introductory Numerical Analysis.
4. J.B.Scarborough: Numerical Mathematical Analysis.

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(Applicable from the academic session 2020-2021)

5. Jain, Iyengar , & Jain: Numerical Methods (Problems and Solution).
6. Balagurusamy: Numerical Methods, Scitech.
7. Baburam: Numerical Methods, Pearson Education.
8. N. Dutta: Computer Programming & Numerical Analysis, Universities Press.

Human Resource Development and Organizational Behaviour**Code: OEC-DS601 B****Contact: 3L**

Name of the Course:		Human Resource Development and Organizational Behaviour	
Course Code: OEC-DS601 B		Semester: VI	
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	Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2] Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.	4	
2	Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. [2] 4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory.	8	
3	Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision	4	

	Making. [2] Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2] Leadership: Definition, Importance, Theories of Leadership Styles.		
4.	Organizational Politics: Definition, Factors contributing to Political Behaviour. [2] Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. [2] Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture.	8	

Text book and Reference books:

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.
3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources, PHI, 10th Edn.

Research Methodology**Code: PROJ- DS601****Contact: 3L**

Name of the Course:	Research Methodology		
Course Code: PROJ- CS601	Semester: VI		
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
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Syllabus for B. Tech in CSE (Data Science)*(Applicable from the academic session 2020-2021)*

1	RESEARCH FORMULATION AND DESIGN Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.	9	
2	DATA COLLECTION AND ANALYSIS Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma	9	
	STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.		
3	RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.	9	
4.	INTERPRETATION AND REPORT WRITING Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Project Report, Layout of the Project/Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Project/Research Report, Precautions for Writing Research Reports, Conclusions.	9	

Text book and Reference books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trade marks, copyright designs and geographical indications. Universal Law Publishing.

Additional reading

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992. How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7. Satarkar, S.V., 2000. Intellectual property rights and Copy right. Ess Ess Publications.

Course code	Course Title	L	T	P	Credits
PEC-DS 601C	Information Security	3	0	0	3
Pre- requisite	NIL	Syllabus version			
		v. 1.0			
Course Objectives:					
<div><div>1.</div><div>To study and practice fundamental techniques in developing secure applications</div></div> <div><div>2.</div><div>To understand the policy, procedures and guidelines to protect the computing resources</div></div>					
Expected Course Outcome:					
<div><div>1.</div><div>To understand security parameters and access control methods.</div></div> <div><div>2.</div><div>To understand the fundamental policies and design principle of computing resources</div></div> <div><div>3.</div><div>To recognize system design, logic-based system</div></div> <div><div>4.</div><div>To study the security architecture of database, operating system and associated vulnerabilities</div></div>					
Module:1		4 hours			
Overview of Security Parameters: Confidentiality, integrity and availability; Security violation and threats; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle.					
Module:2		3 hours			

Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.		
Module:3		5 hours
Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-interferenceand policy composition, international standards.		
Module:4		5 hours
Systems Design: Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.		
Module:5		6 hours
Logic-based System: Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, operating system security, user security, program security.Special Topics: Data privacy, introduction to digital forensics, enterprise security specification.		
Module:6		3 hours
Operating Systems Security: Security Architecture, Analysis of Security in Linux/Windows.		
Module:7		2 hours
Database Security: Security Architecture, Enterprise security, Database auditing.		
Module:8	Contemporary issues	2 hours
	Total Lecture hours:	30 hours
Text Book(s)		
1.	Anderson, R. Security engineering. John Wiley & Sons, 2008.	
2.	Bishop, M. Computer Security: Art and Science. Pearson Education, Boston, US, 2003.	
3.	Stamp, M. Information security: principles and practice. John Wiley & Sons, 2014.	
Reference Book(s)		
1.	Pfleeger, C. P., Pfleeger, S. L., and Margulies, J. Security in Computing,ProQuest Safari Tech Books Online, 2017.	
2.	Wheeler, D. A. Secure programming HOWTO, 2017.	
3.	Zalewski, M. Google browser security handbook, 2009.	
4.	Gertz, M., & Jajodia, S. (Eds.). Handbook of database security: applications andtrends. Springer Science & Business Media, 2007.	

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Data Communication and Computer Networks Lab

Code: PCC-DS692

Contacts: 4P

Name of the Course:	Data Communication and Computer Networks Lab
Course Code: PCC-DS692	Semester: VI
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:

- 1) NIC Installation & Configuration (Windows/Linux)
- 2) Understanding IP address, subnet etc
Familiarization with
 - Networking cables (CAT5, UTP)
 - Connectors (RJ45, T-connector)
 - Hubs, Switches
- 3) TCP/UDP Socket Programming
 - Simple, TCP based, UDP based
 - Multicast & Broadcast Sockets
 - Implementation of a Prototype Multithreaded Server
- 4) Implementation of
 - ☐ Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
 - ☐ Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
 - ☐ Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)
- 5) Server Setup/Configuration
FTP, TelNet, NFS, DNS, Firewall

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

Big Data Technology & OLAP Lab

Code: PCC-DS693

Contacts: 4P

Name of the Course:	Big Data Technology and OLAP Lab
Course Code: PCC-DS693	Semester:VI
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

A. NoSQL Lab using (MongoDB/Redis/Cassandra/CouchDB/Hbase using HDFs etc): Introduction to Nosql, Difference between RDBMS to NOSQL,JSON and BSON

documents, Introduction to MongoDB/.. and its Features, Database, Collection and Documents,Various Data Types in MongoDB/...,Introduction to mongo/.. shell, CRUD Operations, Database Operations, Read and Write Operations, Aggregation, Data Modeling Introduction, Data Modeling Concept,Storage Engine,Indexing,Replication Concept, Failover & Recovery

B. Multidimensional Data Modeling using OLAP:

Introduction of Data Warehousing and OLAP, example of a Data Warehouse and Data mart, Data Cleaning

Artificial Intelligence Lab

Code: PCC- DS691

Contacts: 4P

LIST OF EXPERIMENTS:

- 1.Study of Prolog.
2. Write simple fact for the statements using PROLOG.
3. Write predicates One converts centigrade temperatures to Fahrenheit, the other checks if a temperature is below freezing.
4. Write a program to solve the Monkey Banana problem.
5. WAP in turbo prolog for medical diagnosis and show the advantage and disadvantage of green and red cuts.
6. WAP to implement factorial, fibonacci of a given number.
7. Write a program to solve 4-Queen problem.
8. Write a program to solve traveling salesman problem.
9. Write a program to solve water jug problem using LISP Any experiment specially designed by the college.

Any experiment specially designed by the college

(Detailed instructions for Laboratory Manual to be followed for further guidance)

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Semester-VII

Quantum Computing

Code: PEC- DS701A

Contacts: 3L

Name of the Course:	Quantum Computing	
Course Code: PEC-DS701A	Semester: VII	
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	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchy-Schwarz and triangle Inequalities.	3	
2	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators,	10	
3.	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition & singular values, Postulates of Quantum Mechanics.	5	
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	5	

5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.	8	
6.	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	6	

Text book and Reference books:

Quantum Computing without Magic by Zdzislaw Meglicki

2. Quantum Computing Explained By DAVID Mc MAHON

3. Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann

4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.

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Cloud Computing
Code: PEC- DS701B
Contact: 3L

Name of the Course:	Cloud Computing		
Course Code: PEC- DS701B	Semester: VII		
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	<u>Definition of Cloud Computing and its Basics (Lectures)</u> . Defining a Cloud, Cloud Types – NIST model, Cloud Cube model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, 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)	9	

2	Use of Platforms in Cloud Computing Concepts of Abstraction and Virtualization Virtualization technologies : Types of virtualization (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,		

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3	<u>Cloud Infrastructure:</u> 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 computing deployment 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 security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)	7	
4.	<u>Concepts of Services and Applications :</u> Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for 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, Windows Live 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

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Digital Signal Processing

Code: PEC- DS701C

Contacts: 3L

Name of the Course:	Digital Signal Processing		
Course Code: PEC-DS701C	Semester: VII		
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	Module 1: Discrete-time signals and systems (6 hours) Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	6	
2	Module 2: Z-transform (6 hours) z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.	6	
3	Module 2: Discrete Fourier Transform (10 hours) Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	10	
4.	Module 3: Design of Digital filters (12 hours) Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.	12	

	Module 4: Applications of Digital Signal Processing (6 hours) Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	6	
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Text book and Reference books:

1. S. K. Mitra, “Digital Signal Processing: A computer based approach”, McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schaffer, “Discrete Time Signal Processing”, Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, “Digital Signal Processing: Principles, Algorithms And Applications”, Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, “Theory and Application of Digital Signal Processing”, Prentice Hall, 1992.
5. J. R. Johnson, “Introduction to Digital Signal Processing”, Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, “Digital Signal Processing”, John Wiley & Sons, 1988.

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Multi-agent Intelligent Systems

Code: PEC-DS701D

Contacts: 3L

Name of the Course:	Multi-agent Intelligent Systems
Course Code: PEC-DS701D	Semester: VII
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: what is an agent?: agents and objects; agents and expert systems; agents and distributed systems; typical application areas for agent systems.	3	
2	Intelligent Agents: the design of intelligent agents - reasoning agents (eg AgentO), agents as reactive systems (eg subsumption architecture); hybrid agents (eg PRS); layered agents (eg Interrap) a contemporary (Java-based) framework for programming agents (eg the Jack language, the JAM! system).	9	
3	Multi-Agent Systems: Classifying multi-agent interactions - cooperative versus non-cooperative; zero-sum and other interactions; what is cooperation? how cooperation occurs - the Prisoner's dilemma and Axelrod's experiments; Interactions between self-interested agents: auctions & voting systems: negotiation; Interactions between benevolent agents: cooperative distributed problem solving (CDPS), partial global planning; coherence and coordination; Interaction languages and protocols: speech acts, KQML/KIF, the FIPA framework.	12	
4.	Advanced topics: One issue selected from the contemporary research literature, perhaps by guest lecturer.	9	

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Text book and Reference books:

1. An Introduction to Multi Agent Systems - Second Edition. Michael Wooldridge (Wiley, 2009)
2. Programming Multi-agent Systems in Agent Speak Using Jason. Rafael H. Bordini, Jomi Fred Hubner and Michael Wooldridge (Wiley, 2007)

Time Series Analysis and Forecasting

Code: PEC- DS701E

Contacts: 3L

Name of the Course:	Time Series Analysis and Forecasting	
Course Code: PEC-DS701E	Semester: VII	
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	

Different components, illustration, additive and multiplicative models, determination of trend, seasonal and cyclical fluctuations.

Time-series as discrete parameter stochastic process, auto covariance and autocorrelation functions and their properties.

Exploratory time Series analysis, tests for trend and seasonality, exponential and moving average smoothing.

Detailed study of the stationary processes: (1) moving average (MA), (2) auto regressive (AR), (3) ARMA and (4) AR integrated MA (ARIMA) models.

Box-Jenkins models, choice of AR and MA periods.

Discussion (without proof) of estimation of mean, auto covariance and autocorrelation functions under large sample theory, estimation of ARIMA model parameters.

Spectral analysis of weakly stationary process, periodogram and correlogram analyses, computations based on Fourier transform, non stationary process, introduction to forecasting.

Text Books:

1. Introduction to time series and forecasting Book by Rob J. Hyndman
2. Time series analysis, forecasting and control Book by George E.P.Box

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Subject: Data Visualization			
Course Code: PEC-DS-701F			
Duration: 36 Hrs.		Semester: VII	
Teaching Scheme		Maximum Marks: 100	
Theory:3		Examination Scheme	
Tutorial: 0		End Semester Exam:70	
Practical:0		Attendance : 5	
Credit:3		Continuous Assessment: 25	
Aim:			
Sl. No.			
1	Ability to create visualizations from data		
2	Ability to gain a better understanding of data from visualizations		
3	Skill to make sense of trends in data from visualizations		
Objective:			
Sl. No.			
1	To understand the need and benefits of data visualization		
2	To systematically create univariate and bivariate graphs from data		
3	To analyse and draw conclusions from visualizations		
Pre-Requisite:			
Sl. No.			
1	Fundamentals of Python Programming		
Contents			Hrs./week
Chapter	Name of the Topic	Hours	Marks
01	Introduction About data visualization, The need for data visualization, Brief history of data visualization	2	2
02	Statistical Preliminaries Different types of data, Measures of Centrality, Measures of Dispersion, Measures of Association	4	8
03	Univariate Visualizations Stem-and-Leaf Plot, Pie Chart, Bar Graph, Histogram, Line Chart, Box Plot, Analysis and drawing conclusions	6	12
04	Bivariate Visualizations Scatter Plot, Bivariate Line Chart, Hex Plot, Analysis and drawing conclusions	4	8
04	Python NumPy Library NumPy and its advantages, NumPy n-dimensional array (ndarray), Creating ndarrays in NumPy, Slicing ndarrays, ndarray operations, Broadcasting	8	16
05	Data Visualizations in Python Plotting with matplotlib, Univariate graphs using matplotlib, Bivariate graphs using matplotlib, Plotting through pandas, Improving plot aesthetics	12	24
	Sub Total:	36	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	40	100
List of Books:			
Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher

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Sheldon M Ross	Introduction to Probability and Statistics for Engineers and Scientists		Elsevier Academic Press
B. Lubanovic	Introducing Python		O'Reilly
Reference Books:			
Murray R. Spiegel, Larry J. Stephens	Schaum's Outlines on Statistics		McGraw-Hill
Eric Matthes	Python Crash Course		No Starch Press
Ivan Idris	Numpy Beginner's Guide		Packt Publishing

Neural Networks and Deep Learning

Code: PEC-DS702A

Contacts: 3L

Name of the Course:	Neural Networks and Deep Learning		
Course Code: PEC-DS702A	Semester: VII		
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: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	3	
2	Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network, cardinality, operations, and properties of fuzzy relations.	6	
3	Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	6	
4.	Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	9	

5	Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	6	
6	Deep Learning research: Object recognition, sparse coding, computer vision, natural language	6	

Text book and Reference books:

1. Goodfellow, I., Bengio, Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
5. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.
6. Dr. Rajiv Chopra, Deep Learning, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

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Soft Computing
Code: PEC- DS702B
Contacts: 3L

Name of the Course:	Soft Computing	
Course Code: PEC-(DS)702B	Semester: VII	
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, different fuzzification 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	

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3	Neural Network Introduction to Neural Networks: Advent of Modern Neuroscience, 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 and Madaline networks; single layer network; Back-propagation and multi layer networks. Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks. Neuro-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification	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 pattern Recognition	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.

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Adhoc –Sensor Network
Code:PEC- (DS)702C
Contact: 3L

Name of the Course:	Adhoc –Sensor Network	
Course Code: PEC-(DS)702C	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory: 3 hrs		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: 4 hrs		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction and Overview [4L] :Overview of wireless networks, types, infrastructure-based and infrastructure-less, introduction to MANETs (Mobile Ad-hoc Networks), characteristics, reactive and proactive routing protocols with examples, introduction to sensor networks, commonalities and differences with MANETs, constraints and challenges, advantages, applications, enabling technologies for WSNs.	4	
2	Architectures Single-node architecture - hardware components, design constraints, energy consumption of sensor nodes , operating systems and execution environments, examples of sensor nodes,	9	
	sensor network scenarios, types of sources and sinks – single hop vs. multi hop networks, multiple sources and sinks – mobility, optimization goals and figures of merit, gateway concepts, design princip		

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3	Communication Protocols [9L]: Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts - S-MAC, the mediation device protocol, wakeup radio concepts, address and name management, assignment of MAC addresses, routing protocols-classification, gossiping, flooding, energy-efficient routing, unicast protocols, multi-path routing, data-centric routing, data aggregation, SPIN, LEACH, Directed-Diffusion, geographic routing.	9	
4.	Infrastructure Establishment: Topology control, flat network topologies, hierarchical networks by clustering, time synchronization, properties, protocols based on sender-receiver and receiver-receiver synchronization, LTS, TPSN, RBS, HRTS, localization and positioning, properties and approaches, single-hop localization, positioning in multi-hop environment, range based localization algorithms – location services, sensor tasking and control		
5	Sensor Network Platforms and Tools [9L]: Sensor node hardware, Berkeley motes, programming challenges, node-level software platforms, node-level simulators, state-centric programming, Tiny OS, nesC components, NS2 simulator, TOSSIM.		

Text book and Reference books:

1. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
3. REFERENCES
 1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks- Technology, Protocols, and Applications", John Wiley, 2007.
 2. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
 3. Thomas Haenselmann, "Sensor Networks", available online for free, 2008.

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Information Theory and Coding
Code:PEC- (DS)702D
Contact: 3L

Name of the Course:		Information Theory and Coding		
Course Code: PEC-(DS)702D		Semester: VII		
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	Source Coding [7L] Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes		7	
2	Channel Capacity And Coding [7L] Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit		7	
3	Linear And Block Codes For Error Correction [8L] Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes		8	
4.	Cyclic Codes [7L] Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes..		7	
5	BCH Codes [8L] Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.		8	

6	Convolutional Codes [8L] Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding	8	
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Text book and Reference books:

1. Information theory, coding and cryptography - Ranjan Bose; TMH.
2. Information and Coding - N Abramson; McGraw Hill.
3. Introduction to Information Theory - M Mansurpur; McGraw Hill.
4. Information Theory - R B Ash; Prentice Hall.
5. Error Control Coding - Shu Lin and D J Costello Jr; Prentice Hall.

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Surveillance and Cyber Security

Code: PEC-(DS)702E

Contact: 3L

Name of the Course:	Cyber Security		
Course Code: PEC-(DS)702E	Semester: VII		
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	Introduction: Introduction to Cyber Security, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyberwarfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cybersecurity - Organizational Implications.	6	
2	Hackers and Cyber Crimes: Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors.	7	
3	Ethical Hacking and Social Engineering: Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies.	8	

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4.	Cyber Forensics and Auditing: Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013	10	
5	Cyber Ethics and Laws: Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. at Network Layer-IPSec.	5	

Text book and Reference books:

1. Cyber security , Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Information Security and Cyber Laws, Pankaj Agarwal
3. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., Enterprise Cybersecurity -How to Build a Successful Cyberdefense Program Against Advanced Threats, A-press
4. Nina Godbole, SumitBelapure, Cyber Security, Willey
5. Hacking the Hacker, Roger Grimes, Wiley
6. Cyber Law By Bare Act, Govt Of india, It Act 2000.
7. Information Security & Cyber Laws, Gupta & Gupta, Khanna Publishing House, (AICTE Recommended Textbook- 2018)

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Pattern Recognition
Code: PEC-DS-702F
Contact: 3L

Name of the Course:	Pattern Recognition	
Course Code: PEC-DS702F	Semester: VII	
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 5.2 Principal 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	

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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.

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Operation Research
Code: OEC- CS(DS)701A
Contact: 3L

Name of the Course:	Operation Research
Course Code: OEC-(DS)701A	Semester: VII
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	Basic LPP and Applications; Various Components of LP Problem Formulation. Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non- basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex set and explanation with examples Solution of LPP by Simplex Method; Charnes' Big- M Method; Duality Theory. Transportation Problems and Assignment Problems.	17	
2	Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT- CPM (Cost Analysis, Crashing, Resource Allocation excluded). Inventory Control: Introduction to EOQ Models of Deterministic and Probabilistic ; Safety Stock; Buffer Stock.	9	
3	Game Theory: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance	5	
4.	Queuing Theory: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞ / FIFO) and (M/M/1: N / FIFO) and problems.	5	

Text book and Reference books:

1. H. A. Taha, "Operations Research", Pearson
2. P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House
3. Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency
4. Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA

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Multimedia Technology
Code: OEC- (DS)701B
Contacts: 3L

Name of the Course:	Multimedia Technology
Course Code: OEC-(DS)701B	Semester: VII
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

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications	2	
2	Text and Audio, Image and Video(14L) Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI Image: Formats, Image Color Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation.	14	
3.	Synchronization, Storage models and Access Techniques: Temporal relationships, synchronization accuracy specification factors, quality of service, Magnetic media, optical media, file systems (traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, CCD	8	

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4.	Image and Video Database, Document Architecture and Content Management (17L): Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k- d trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing, Content Design and Development, General Design Principles Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document Type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications	17	
5.	Multimedia Applications(4L): Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors	4	

Text book and Reference books:

1. Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications , Pearson Ed.
2. Nalin K. Sharda , Multimedia Information System , PHI.
3. Fred Halsall , Multimedia Communications , Pearson Ed.
4. Koegel Buford , Multimedia Systems , Pearson Ed.
5. Fred Hoffstetter , Multimedia Literacy , McGraw Hill.
6. Ralf Steinmetz and Klara Nahrstedt , Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing , PHI.
7. J. Jeffcoate , Multimedia in Practice: Technology and Application , PHI.
8. V.K. Jain, Multimedia and Animation, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

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Soft Skill & Interpersonal Communication

Code: OEC- DS 701C

Contact: 3L

Name of the Course:	Soft Skill & Interpersonal Communication
Course Code OEC- DS 701C	Semester: VII
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	Introduction: A New Approach To Learning, Planning And Goal-Setting, Human Perceptions: Understanding People, Types Of Soft Skills: Self-Management Skills, Aiming For Excellence: Developing Potential And Self- Actualization, Need Achievement And SpiritualIntelligence	5	
2	Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types Of Conflicts: Becoming AConflict Resolution Expert Types Of Stress: Self-Awareness About Stress, Regulating Stress: Making The Best Out Of Stress	5	
3	Habits: Guiding Principles, Habits: IdentifyingGood And Bad Habits, Habits: Habit Cycle, Breaking Bad Habits, Using The ZeigarnikEffect For Productivity And Personal Growth, Forming Habits Of Success	5	
4.	Communication: Significance Of Listening, Communication: Active Listening, Communication: Barriers To Active Listening, Telephone Communication: Basic Telephone Skills , Telephone Communication: Advanced Telephone Skills, Telephone Communication: Essential Telephone Skills	5	

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5.	Technology And Communication: Technological Personality, Technology And Communication: Mobile Personality?, Topic: Technology And Communication: E-Mail Principles, Technology And Communication: How Not To Send E-Mails!, Technology And Communication: Netiquette, Technology And Communication: E-Mail Etiquette	5	
6	Communication Skills: Effective Communication, Barriers To Communication: Arising Out Of Sender/Receiver's Personality, Barriers To Communication: Interpersonal Transactions, Barriers To Communication: Miscommunication, Non-Verbal Communication: Pre-Thinking Assessment-1, Non-Verbal Communication: Pre-Thinking Assessment-2	5	
7	Nonverbal Communication: Introduction And Importance, Non-Verbal Communication: Issues And Types, Non-Verbal Communication: Basics And Universals, Non-Verbal Communication: Interpreting Non-Verbal Cues, Body Language: For Interviews, Body Language: For Group Discussions	5	
	Presentation Skills: Overcoming Fear,	5	
8	Presentation Skills: Becoming A Professional, Presentation Skills: The Role Of Body Language, Presentation Skills: Using Visuals, : Reading Skills: Effective Reading, Human Relations: Developing Trust And Integrity		

TEXT BOOKS AND REFERENCES

1. Dorch, Patricia. *What Are Soft Skills?* New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine. *Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders.* Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman & Molly Hamaker. *The Hard Truth about Soft Skills.* London: HarperCollins E-books, 2007.
4. Petes S. J., Francis. *Soft Skills and Professional Communication.* New Delhi: Tata McGraw-Hill Education, 2011.
5. Stein, Steven J. & Howard E. Book. *The EQ Edge: Emotional Intelligence and Your Success.* Canada: Wiley & Sons, 2006.

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Project Management and Entrepreneurship

Code: HSMC 701

Contact: 2L+1T

Name of the Course:	Project Management and Entrepreneurship	
Course Code: HSMC 701	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: 1hr		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	

ENTREPRENEURSHIP

1. Introduction: Meaning and Concept of Entrepreneurship, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk-opportunities perspective and mitigation of risks [2L]
2. Entrepreneurship – An Innovation: Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent v/s Convergent Thinking, Qualities of a prospective Entrepreneur [2L]
3. Idea Incubation: Factors determining competitive advantage, Market segment, blue ocean strategy, Industry and Competitor Analysis (market structure, market size, growth potential), Demand-supply analysis [4L]
4. Entrepreneurial Motivation: Design Thinking - Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Achievement motivation theory of entrepreneurship – Theory of McClelland, Harvesting Strategies [2L]
5. Information: Government incentives for entrepreneurship, Incubation, acceleration. Funding new ventures – bootstrapping, crowd sourcing, angel investors, Government of India's efforts at promoting entrepreneurship and innovation – SISI, KVIC, DGFT, SIDBI, Defense and Railways [4L]
6. Closing the Window: Sustaining Competitiveness, Maintaining Competitive Advantage, the Changing Role of the Entrepreneur. [2L]
7. Applications and Project Reports Preparation [4L]
8. PROJECT MANAGEMENT : Definitions of Project and Project Management, Issues and Problems in Project Management, Project Life Cycle - Initiation / Conceptualization Phase, Planning Phase, Implementation / Execution Phase, Closure / Termination Phase [4L]
9. Project Feasibility Studies – Pre-Feasibility and Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis [2L]
10. Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope, Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS), Phased Project Planning [2L]
11. Project Scheduling and Costing – Gantt chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-off

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Analysis, Project Cost Reduction Methods. [6L]

12. Project Monitoring and Control – Role of Project Manager, MIS in Project Monitoring, Project Audit [2L]

13. Case Studies with Hands-on Training on MS-Project [4L]

Text Books and References

1. Innovision, Chelat, Khanna Book Publishing.
2. Innovation and Entrepreneurship by Drucker, P.F.; Harper and Row
3. Business, Entrepreneurship and Management: Rao, V.S.P. ;Vikas
4. Entrepreneurship: Roy Rajeev; OUP.
5. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan
6. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI
7. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.; MGH

Project-II

Code: PROJ-CS781

Contact: 12P

Project work I

The object of Project Work I is to enable the student to take up investigative study in the broad field of Electronics & Communication Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a Supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The assignment to normally include:

Project Work II & Dissertation

The object of Project Work II & Dissertation is to enable the student to extend

further the investigative study taken up under EC P1, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;

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4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

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SEMESTER – VIII

Signal and Networks

Code: PEC- DS801A

Contact: 3L

Name of the Course:	Signal and Networks	
Course Code: PEC-(DS)801A	Semester: VIII	
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	Objective and overview, signal and system types and classifications, step response, impulse response and convolution integral;	3	
2	Periodic signal analysis: Fourier series and properties; Aperiodic signal analysis : Fourier Transform - its properties and sinusoidal steady state analysis of systems;	7	
3	Elements of electrical network : dependent and independent sources, active and passive components; classical differential equations for description of transient conditions of Network; Solutions of linear time invariant networks with initial conditions; Unilateral and Bilateral Laplace Transforms and properties; Transient solutions of networks using Laplace Transform; Network functions: poles, zeros, transfer function, Bode plot;	12	
4.	One and two port network parameters and functions : Z, Y and ABCD parameters, driving point and transfer impedances and admittances; Network Theorems and Formulation of Network equations: generalized formulation of KCL, KVL, State Variable descriptions; Thevenin, Norton, Maximum Power Transfer, Tellegen and	10	
	Reciprocity Theorems;		

5	Graph theory: Tree, Co-tree, fundamental cut-set, fundamental loop analysis of network; Analog filter design: Butterworth, Sallen Key, frequency transformation and scaling;	6	
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Text book and Reference books:

1. Signals and Systems by P. Ramesh Babu & R. Ananda Natarajan, Scitech Publications (India) .
2. Signals & Systems by A. V. Oppenheim, A. S. Willsky and S. H. Nawab, Prentice-Hall India .
3. Networks & Systems by D Roy Choudhury .
4. Networks & Systems by Asfhaq Husain.

Natural Language Processing**Code: PEC-DS801C****Contacts: 3L**

Name of the Course:	Natural Language Processing		
Course Code: PEC-(DS)801C	Semester: VIII		
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	Regular Expressions and Automata(Recap) - Introduction to NLP, Regular Expression, Finite State Automata [2L] Tokenization - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance [5L] Morphology - Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer [4L]	11	

2	Language Modeling Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. [4L] Hidden Markov Models and POS Tagging Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation. [4L]	8	
3	Text Classification Text Classification, Naïve Bayes’ Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. [4L] Context Free Grammar Context Free Grammar and Constituency, Some common CFG phenomena for	9	
	English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing [4L]		
4.	Computational Lexical Semantics Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity [4L] Information Retrieval Boolean Retrieval, Term- document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback [5L]	9	

Text book and Reference books:

1. Speech and Language Processing, Jurafsky and Martin, Pearson Education
2. Foundation of Statistical Natural Language Processing, Manning and Schutze, MIT Press
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.

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Subject: Computer Vision			
Course Code: PEC-DS 801D		Semester: VIII	
Duration: 36 Hrs.		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		End Semester Exam: 70	
Tutorial: 0		Attendance : 5	
Practical:		Continuous Assessment:25	
Credit: 3			
Aim:			
Sl. No.			
1.	Students will learn basic principles of image formation, image processing algorithms and different algorithms for reconstruction and recognition from single or multiple images		
Objective:			
Sl. No.			
1.	To implement fundamental image processing techniques required for computer vision		
2.	Understand Image formation process		
3.	Extract features form Images and do analysis of Images		
	To develop applications using computer vision techniques		
Pre-Requisite:			
Sl. No.			
1.	Programming		
2.	Mathematic course		
Contents			Hrs./week
Chapter	Name of the Topic	Hours	Marks
01	Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	3	10

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02	Edge detection, Edge detection performance, Hough transform, corner detection	6	10
03	Segmentation, Morphological filtering, Fourier transform	3	10
04	Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing	9	10
05	Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.	9	20
06	Recent trends in Activity Recognition, computational photography, Biometrics	6	10
	Sub Total:	36	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	40	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
Richard Szeliski	Computer Vision: Algorithms and Applications		
Goodfellow, Bengio, and Courville	Deep Learning		

Reference Books:

Fisher et al	. Dictionary of Computer Vision and Image Processing		

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Web and Internet Technology

Code: PEC- DS801E

Contacts: 3L

Name of the Course:	Web and Internet Technology	
Course Code: PEC-DS 801D	Semester: VIII	
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	Introduction (1L): Overview, Network of Networks, Intranet, Extranet and Internet. World Wide Web (1L): Domain and Sub domain, Address Resolution, DNS, Telnet, FTP, HTTP. Review of TCP/IP (1L): Features, Segment, Three-Way Handshaking, Flow Control, Error Control, Congestion control, IP Datagram, IPv4 and IPv6. IP Subnetting and addressing (1L): Classful and Classless Addressing, Subnetting. NAT, IP masquerading, IP tables. Internet Routing Protocol (1L): Routing -Intra and Inter Domain Routing, Unicast and Multicast Routing, Broadcast. Electronic Mail (1L): POP3, SMTP.	6	

2	<p>HTML (3L): Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue.</p> <p>Image Maps (1L): map, area, attributes of image area.</p> <p>Extensible Markup Language (XML) (4L): Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.</p> <p>CGI Scripts (1L): Introduction, Environment Variable, GET and POST Methods.</p>	9	
3	<p>PERL (3L): Introduction, Variable, Condition, Loop, Array, Implementing data structure, Hash, String, Regular Expression, File handling, I/O handling.</p> <p>JavaScript (4L): Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation.</p> <p>Cookies (1L): Definition of cookies, Create and Store a cookie with example.</p> <p>Java Applets (2L): Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.</p>	10	
	Client-Server programming In Java (2L):		
4.	<p>Java Socket, Java RMI.</p> <p>Threats (1L): Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks.</p> <p>Network security techniques (2L): Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH).</p> <p>Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.</p>	4	

Internet Telephony (1L): Introduction, VoIP. Multimedia Applications (2L): Multimedia over IP: RSVP, RTP, RTCP and RTSP. Streaming media, Codec and Plugins, IPTV. Search Engine and Web Crawler (2L): Definition, Meta data, Web Crawler, Indexing, Page rank, overview of SEO.	5	
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Text book and Reference books:

1. Web Technology: A Developer's Perspective, N.P. Gopalan and J. Akilandeswari, PHI Learning, Delhi, 2013. (Chapters 1-5,7,8,9).
2. Internetworking Technologies, An Engineering Perspective, Rahul Banerjee, PHI Learning, Delhi, 2011. (Chapters 5,6,12)

Internet of Things**Code: PEC- (DS)801F****Contacts: 3L**

Course Code	PEC- (DS)801 E
Course Name	Internet of Things
Credits	3
Pre-Requisites	Wireless Networks

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	7
Unit 2: Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc	8
Unit 3: Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors	11

Unit 4: Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel	10
Unit 5: Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor	7
Unit 6: Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	5

References:

1. Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing
2. Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L., Smart Sensors and Systems, Springer International Publishing
3. Jeeva Jose, Internet of Things, Khanna Publishing House.
4. Internet of Things, Arsheep Bahga and Vijay Madisetti

Big Data Analytics**Code:** OEC-

(DS)801A

Contacts: 3L

Name of the Course:	Big Data Analytics		
Course Code: OEC-(DS)801A	Semester: VIII		
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		
LECTURE WITH BREAKUP			NO. OF LECTUR

Unit 1: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.	8
Unit 2: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	8
Unit 3: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based datastructures	9
Unit 4: MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats	10
Unit 5: Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	7
Unit 6: Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.	6

References:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging

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2. V.K. Jain, Big Data and Hadoop, Khanna Publishing House, New Delhi (2017).
3. V.K. Jain, Data Analysis, Khanna Publishing House, New Delhi (2019).
4. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
7. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
8. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
9. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
10. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
11. Alan Gates, "Programming Pig", O'Reilley, 2011.

Data Science Ethics

Code: OEC-

(DS)802B

Contacts: 3L

Name of the Course:	Data Science Ethics
Course Code: OEC-(DS)801B	Semester:VIII
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	Intellectual Property: Intellectual property, copyrights, patents, trade secrets and its laws, employees and trade secret, key intellectual property issues, plagiarism, reverse engineering, open source code, competitive intelligence, trademark infringement, cybersquatting.	8	
2	Software Development: Strategies for engineering quality software, importance of software quality, software product liability, software development process, capability maturity model integration, safety critical system, quality management standards.	8	
3	The Impact of Information Technology on Productivity and Quality of Life: Impact of IT, IT investment and productivity, digital divide, impact of it on healthcare	8	

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	cost, electronic health records, use of mobile and wireless technology in healthcare industry, telemedicine, medical information websites.		
4.	Social Networking: Social networking website, business Application of online social networking, social networking ethical issues: cyberbullying, cyber stalking, sexual predators, uploading inappropriate material. Online virtual world: crime in virtual world, educational and business uses.	8	
5	Ethics of IT Organization: Key ethical issues, non-traditional Workers, contingent workers, H-1 B workers, outsourcing, whistle blowing, green computing, ICT industry code of conduct.	8	

Text book and Reference books:

1. “Ethics in Information Technology”, 4th Edition, George Reynolds Strayer University, 2012.
2. “Ethics and Technology: Controversies, Questions, and Strategies for Ethical Computing”, 3rd Edition, Herman T. Tavani, John Wiley & Sons, 2011.
2. “Information Technology Ethics: Cultural Perspectives”, Soraj Hon ladarom, Charles Ess, Idea Group Inc (IGI), 2007.

Mobile Computing

Code: OEC-

(DS)801C

Contacts: 3L

Name of the Course:	Mobile Computing		
Course Code: OEC-(DS)801C	Semester: VIII		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: 3L		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
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1	Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signalling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling.	5	
2	General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.	5	
3	Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML). Wireless Local Loop(WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.	7	
4.	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G	7	
5	Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.	7	
6	Server-side programming in Java, Pervasive web application architecture, Device independent example application	8	

Text book and Reference books:

1. "Pervasive Computing", Burkhardt, Pearson
2. "Mobile Communication", J. Schiller, Pearson
3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001
4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall of India, 2001.
5. "Guide to Designing and Implementing wireless LANs", Mark Ciampa, Thomson learning, Vikas Publishing House, 2001.
6. "Wireless Web Development", Ray Rischpater, Springer Publishing,
7. "The Wireless Application Protocol", Sandeep Singhal, Pearson .
8. "Third Generation Mobile Telecommunication systems", by P.Stavronlakis, Springer Publishers,
9. Brijesh Gupta "Mobile Computing", Khanna Publishing House, New Delhi

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Robotics

Code: OEC- (DS)801D

Contacts: 3L

Name of the Course:	Robotics	
Course Code: OEC-(DS)801D	Semester: VIII	
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	Introduction :Introduction -- brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.	1	
2	Elements of robots – links, joints, actuators, and sensors Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	5	
3	Kinematics of serial robots Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.	4	

4.	Kinematics of parallel robots Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-form and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.	5	
5.	Velocity and static analysis of robot manipulators Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.	5	
6	Dynamics of serial and parallel manipulators Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Commercially available multi-body simulation software (ADAMS) and Computer algebra software Maple.	4	
7	Motion planning and control Joint and Cartesian space trajectory planning and generation, Classical	6	
	control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators. 8 Module 8: Modeling and		
8	Modeling and control of flexible robots Models of flexible links and joints, Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.	4	

9	Modeling and analysis of wheeled mobile robots 3Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR's on uneven terrain, Simulations using Matlab and ADAMS.	3	
10	Selected advanced topics in robotics Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over- constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).	3	

Text book and Reference books:

1. Robotics Process Automation, Khanna Publishing House
2. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014
3. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.

Cyber Law and Ethics**Code: OEC-DS 801B****Contacts: 3L**

Name of the Course:	Cyber Law and Ethics
Course Code: OEC-DS 801B	Semester:VIII
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	Introduction of Cybercrime: What is cybercrime?, Forgery, Hacking, Software Piracy, Computer Network intrusion[4L]. Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cyberstalking. [4L]	8	

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2	Cybercrime Mobile & Wireless devices: Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop [8L]	8	
3	Tools and Methods used in Cyber crime: Proxy servers, password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow. [8L]	8	
4.	Phishing & Identity Theft: Phishing methods, ID Theft; Online identity method. [4L] Cybercrime & Cybersecurity: Legal aspects, Indian laws, IT act, Public key certificate. [4L]	8	

Text book and Reference books:

1. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.
2. Information Security & Cyber laws, Gupta & Gupta, Khanna Publishing House

Subject: Business Analytics	
Course Code: OEC- DS 802A	Semester: 8th
Duration: 36 Hours	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 03	End Semester Exam: 70
Tutorial: 0	Attendance : 5
Practical: 0	Continuous Assessment: 25
Credit: 03	
Aim:	
Sl. No.	
1.	Understand the role of business analytics within an organization.
2.	Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3.	To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4.	To become familiar with processes needed to develop, report, and analyze business data.
5.	Use decision-making tools/Operations research techniques.
6.	Manage business process using analytical and management tools.
7.	Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.
Objective:	
Sl. No.	
1.	Students will demonstrate knowledge of data analytics.
2.	Students will demonstrate the ability to think critically in making decisions based on data and deep analytics.
3.	Students will demonstrate the ability to use technical skills in predictive and prescriptive modelling to support business decision-making.

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4.	Students will demonstrate the ability to translate data into clear, actionable insights.		
Contents		Hrs./week	
Chapter	Name of the Topic	Hours	Marks
01	Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	6	14
02	Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	6	14
03	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	6	14
04	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	6	14
05	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without OutcomeProbabilities,Decision Trees, The Value ofInformation, Utility and Decision Making.	6	10
06	Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	6	4
	Sub Total:	36	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	40	100

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in CSE (Data Science)
 (Applicable from the academic session 2020-2021)

Practical:

Assignments: Based on theory

**List of
BooksText
Books:**

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher

Reference Books:

1.Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey,	Business analytics Principles, Concepts, and Applications		Pearson FT Press.
2.James Evans,	Business Analytics		persons Education.

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

Group	Unit	Objective Questions (MCQ only with the correctanswer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
	ALL			5	3	15	
C							

- Only multiple choice type question (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.