

**Maulana Abul Kalam Azad University of Technology, West Bengal**  
*(Formerly West Bengal University of Technology)*  
**Syllabus for B. Tech in Computer Science & Engineering**  
 (Applicable from the academic session 2018-2019)

**Theory of Computation**  
**Code: PEC-IT501A**  
**Contacts: 3L**

Name of the Course:	<b>Theory of Computation</b>		
Course Code: <b>PEC-IT501A</b>	Semester: V		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	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 $\hat{\epsilon}$ transitions - Significance, acceptance of languages. [1L] Conversions and Equivalence: Equivalence between NFA with and without $\hat{\epsilon}$ transitions. NFA to DFA conversion. [2L] Minimization of FSM, Equivalence between two FSM's , Limitations of 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, Regular string 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.

**Course Outcomes:**

On completion of the course students will be able to

1. Define a system and recognize the behavior of a system. They will be able to minimize a system and compare different systems

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2. Convert Finite Automata to regular expression. Students will be able to check equivalence between regular linear grammar and FA.
3. Minimize context free grammar. Student will be able to check equivalence of CFL and PDA. They
4. Will be able to design Turing Machine.
5. Design Turing machine.

**Artificial Intelligence**

**Code: PEC-IT501B**

**Contacts: 3L**

Name of the Course:	<b>Artificial Intelligence</b>		
Course Code: <b>PEC-IT501B</b>	Semester: V		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<p><b>Introduction [2]</b>            Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem.</p> <p><b>Intelligent Agents [2]</b>            Agents &amp; environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.</p> <p><b>Problem Solving [2]</b>            Problems, Problem Space &amp; search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.</p>	6	
2.	<p><b>Search techniques [5]</b>            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.</p> <p><b>Heuristic search strategies [5]</b>            Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms &amp; optimization problems: Hill climbing search, simulated annealing search, local beam search,</p>	13	

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	genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. <b>Adversarial search [3]</b> Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.		
<b>3</b>	<b>Knowledge &amp; reasoning [3]</b> Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.	<b>3</b>	
<b>4</b>	<b>Using predicate logic [2]</b> Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. <b>Probabilistic reasoning [4]</b> Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	<b>6</b>	
<b>5</b>	<b>Natural Language processing [2]</b> Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing. <b>Learning [2]</b> Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. <b>Expert Systems [2]</b> Representing and using domain knowledge, expert system shells, knowledge acquisition.	<b>6</b>	

**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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**Advanced Computer Architecture**  
**Code: PEC-IT501C**  
**Contacts: 3L**

Name of the Course:	<b>Advanced Computer Architecture</b>		
Course Code: PEC-IT501C	Semester: V		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	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

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**Computer Graphics**  
**Code: PEC-IT501D**  
**Contacts: 3L**

Name of the Course:	<b>Computer Graphics</b>
Course Code: PEC-IT501D	Semester: V
Duration: 6 months	Maximum Marks:100
<b>Teaching Scheme</b>	<b>Examination Scheme</b>
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	<b>Introduction to computer graphics &amp; graphics systems [6L]:</b> 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. <b>Scan conversion [8L]:</b> 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	<b>2D transformation &amp; viewing [15L]:</b> 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 <b>3D transformation &amp; viewing [5L]:</b> 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	
	<b>Curves [3L]:</b> 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. <b>Hidden surfaces [3L]:</b> Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry. <b>Color &amp; shading models [2L]:</b> Light & color model; interpolative shading model; Texture. <b>Introduction to Ray-tracing: [3L]</b> 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

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**Constitution of India**

**Code: MC-CS501**

**Contacts: 3L**

Name of the Course:	<b>Constitution of India</b>		
Course Code: MC-CS501	Semester: V		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
Theory:		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance : 5 marks	
Practical: NIL			
Credit Points:	0		

Unit	Content	Hrs/Unit	Marks/Unit
1	<b>Introduction:</b> 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	<b>Union Government and its Administration :</b> 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	

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**Advanced Algorithms**  
**Code: PEC-IT601 A**  
**Contact: 3L**

Name of the Course:	<b>Advanced Algorithms</b>	
Course Code: <b>PEC-IT601A</b>	Semester: VI	
Duration:6 months	Maximum Marks:100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	
<b>Objective:</b>		
1	Introduce students to the advanced methods of designing and analyzing algorithms.	
2	The student should be able to choose appropriate algorithms and use it for a specific problem.	
3	To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.	
4	Students should be able to understand different classes of problems concerning their computation difficulties.	
5	To introduce the students to recent developments in the area of algorithmic design.	
<b>Pre-Requisite:</b>		
1	Algorithm Design and Analysis	

Unit	Content	Hrs/Unit	Marks/Unit
1	<b>Sorting:</b> Review of various sorting algorithms, topological sorting <b>Graph:</b> Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra'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	<b>Matroids:</b> Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to	8	

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	MST. <b>Graph Matching:</b> Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.		
	<b>Flow-Networks:</b> Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. <b>Matrix Computations:</b> 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	<b>Shortest Path in Graphs:</b> Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. <b>Modulo Representation of integers/polynomials:</b> Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. <b>Discrete Fourier Transform (DFT):</b> In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	10	
4.	<b>Linear Programming:</b> Geometry of the feasibility region and Simplex algorithm <b>NP-completeness:</b> Examples, proof of NP-hardness and NP-completeness. <b>One or more of the following topics based on time and interest</b> 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

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**Course Outcomes:**

On completion of the course students will be able to

1. Analyze the complexity/performance of different algorithms.
2. Determine the appropriate data structure for solving a particular set of problems.
3. Categorize the different problems in various classes according to their complexity.
4. Students should have an insight of recent activities in the field of the advanced data structure.

**Distributed Systems**

**Code: PEC-IT601B**

**Contact: 3L**

Name of the Course:	<b>Distributed Systems</b>	
Course Code: <b>PEC-IT601B</b>	Semester: VI	
Duration:6 months	Maximum Marks:100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	
<b>Objective:</b>		
1	To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.	
<b>Pre-Requisite:</b>		
1	Database Management Systems	

Unit	Content	Hrs/Unit	Marks/Unit
1	<b>INTRODUCTION</b> Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts <b>DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE</b> Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues	8	

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2	<b>DISTRIBUTED DATABASE DESIGN</b> Alternative design strategies; Distributed design issues; Fragmentation; Data allocation <b>SEMANTICS DATA CONTROL</b> View management; Data security; Semantic Integrity Control <b>QUERY PROCESSING ISSUES</b> Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	11	
3	<b>DISTRIBUTED QUERY OPTIMIZATION</b> Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms <b>TRANSACTION MANAGEMENT</b> The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models <b>CONCURRENCY CONTROL</b> 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	<b>PARALLEL DATABASE SYSTEMS</b> Parallel architectures; parallel query processing and	6	
6	<b>ADVANCED TOPICS Mobile</b> Databases, Distributed Object Management, Multi-databases	4	

**Text book and Reference books:**

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

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**Course Outcomes:**

On completion of the course students will be able to

1. Design trends in distributed systems.
2. Apply network virtualization.
3. Apply remote method invocation and objects.

**Signals & Systems**

**Code:** PEC-IT601C

**Contacts:** 3L

Name of the Course:	<b>Signals &amp; Systems</b>		
Course Code: PEC-IT601C	Semester: VI		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<p><b>Introduction to Signals and Systems :</b>            Signals and systems as seen in everyday life, and in various branches of engineering and science. Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability.Examples.</p>	3	

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2	<p><b>Behavior of continuous and discrete-time LTI systems (8 hours)</b>          Impulse response and step response, convolution, input-output behavior with periodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.</p>	8	
3	<p><b>Fourier, Laplace and z- Transforms</b>          Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.</p>	10	
4.	<p>The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.</p>	9	

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**Text book and Reference books:**

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “ Signals and systems”, Prentice Hall India, 1997.
2. J. G. Proakis and D. G. Manolakis, “ Digital Signal Processing: Principles, Algorithms, and Applications” , Pearson, 2006.
3. H. P. Hsu, “ Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
4. S. Haykin and B. V. Veen, “ Signals and Systems”, John Wiley and Sons, 2007.
5. A. V. Oppenheim and R. W. Schaffer, “ Discrete-Time Signal Processing”, Prentice Hall, 2009.
6. M. J. Robert “ Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
7. B. P. Lathi, “ Linear Systems and Signals”, Oxford University Press, 2009.
8. A. V. Oppenheim and R. W. Schaffer, “ Discrete-Time Signal Processing”, Prentice Hall, 2009.
9. M. J. Robert “ Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
10. B. P. Lathi, “ Linear Systems and Signals”, Oxford University Press, 2009.
11. R. Anand, “Signals and Systems, Khanna Publishing House, 2018.

**Course Outcomes:**

- On completion of the course students will be able to
- Understand the concepts of continuous time and discrete time systems.
- Analyse systems in complex frequency domain.
- Understand sampling theorem and its implications.
- Understand the concepts of continuous time and discrete time systems.

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**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	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	<b>Introduction [3L]</b> Background, Digital Image	9	
	Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.		
2	<b>Digital Image Formation [4L]</b> A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4	
3	<b>Mathematical Preliminaries[9L]</b> 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 & Sine Transform.	9	

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4.	<b>Image Enhancement [8L]</b> 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	<b>Image Restoration [7L]</b> 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	<b>Image Segmentation [7L]</b> 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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**Syllabus for B. Tech in Computer Science & Engineering**

(Applicable from the academic session 2018-2019)

**Parallel and Distributed Algorithms**

**Code: PEC-IT602A**

**Contacts: 3L**

Name of the Course:	<b>Parallel and Distributed Algorithms</b>		
Course Code <b>PEC-IT602A</b>	Semester: VI		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b>UNIT-I</b> :Basic Techniques, Parallel Computers for increase Computation speed, Parallel & Cluster Computing	8	
2	<b>UNIT-II</b> :Message Passing Technique- Evaluating Parallel programs and debugging, Portioning and Divide and Conquer strategies examples	8	
3	<b>UNIT-III</b> :Pipelining- Techniques computing platform, pipeline programs examples	8	
4.	<b>UNIT-IV</b> :Synchronous Computations, load balancing, distributed termination examples, programming with shared memory, shared memory multiprocessor constructs for specifying parallel sharing data parallel programming languages and constructs, open MP	11	
5	<b>UNIT-V</b> :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.

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**Data Warehousing and Data Mining**

**Code: PEC-IT602B**

**Contacts: 3L**

Name of the Course:	<b>Data Warehousing and Data Mining</b>		
Course Code <b>PEC-IT602B</b>	Semester: VI		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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
	<b>Unit 1:</b>		
1	Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;	8	
2	<b>Unit 2:</b> 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	<b>Unit 3:</b> Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;	8	
4.	<b>Unit 4:</b> 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	

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<b>Unit 5:</b> 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	
<b>Unit 6:</b> 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.

**Course Outcomes:**

After completion of course, students would be:

1. Study of different sequential pattern algorithms
2. Study the technique to extract patterns from time series data and its application in real world.
3. Can extend the Graph mining algorithms to Web mining
4. Help in identifying the computing framework for Big Data

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**Human Computer Interaction**

**Code:PEC-IT602C**

**Contact: 3L**

Name of the Course:	<b>Human Computer Interaction</b>		
Course Code: PEC-IT602C	Semester: VI		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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		
<b>Objective:</b>			
1	Learn the foundations of Human Computer Interaction		
2	Be familiar with the design technologies for individuals and persons with disabilities		
3	Be aware of mobile Human Computer interaction		
4	Learn the guidelines for user interface.		
<b>Pre-Requisite:</b>			
1	Computer Organization &Architecture		

Unit	Content	Hrs/Unit	Marks/Unit
1	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	9	
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	

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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	

**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.

**Course Outcomes:**

On completion of the course students will be able to

1. Differentiate between various software vulnerabilities.
2. Software process vulnerabilities for an organization.
3. Monitor resources consumption in a software.
4. Interrelate security and software development process.

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**Pattern Recognition**

**Code:** PEC-IT602D

**Contact:** 3L

Name of the Course:	<b>Pattern Recognition</b>	
Course Code: <b>PEC-IT602D</b>	Semester: VI	
Duration:6 months	Maximum Marks:100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	<b>Bayesian decision theory 8L</b> Classifiers, Discriminant functions, Decision surfaces Normal density and discriminant functions Discrete features	8	
3	<b>Parameter estimation methods 6L</b> Maximum-Likelihood estimation Gaussian mixture models Expectation-maximization method Bayesian estimation	6	
4.	<b>Hidden Markov models for sequential pattern classification 8L</b> Discrete hidden Markov models Continuous density hidden Markov models	8	
5	<b>Dimension reduction methods 3L</b> 5.1. Fisher discriminant analysis 5.2Principal component analysis. Parzen-window method K-Nearest Neighbour method	3	
6	Non-parametric techniques for density estimation	2	

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7	<b>Linear discriminant function based classifier 5L</b> Perceptron Support vector machines	5	
8	<b>Non-metric methods for pattern classification 4L</b> Non-numeric data or nominal data Decision trees	4	
9	<b>Unsupervised learning and clustering 2L</b> 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.

**Numerical Methods**

**Code: OEC-IT601A**

**Contact: 3L**

Name of the Course:	<b>Numerical Methods</b>		
Course Code: OEC-IT601A	Semester: VI		
Duration:6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	

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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.
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 Behavior**

**Code: OEC-IT601 B**

**Contact: 3L**

Name of the Course:	<b>Human Resource Development and Organizational Behavior</b>		
Course Code: <b>OEC-IT601 B</b>	Semester: VI		
Duration:6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	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 Making. [2] Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2] Leadership: Definition, Importance, Theories of Leadership Styles.	4	
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.

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**SEMESTER – VII**

**Quantum Computing**

**Code:** PEC-CS701A

**Contacts:** 3L

Name of the Course:	<b>Quantum Computing</b>		
Course Code: PEC-CS701A	Semester: VII		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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		
<b>Objective:</b>			
1	The course will provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing		
<b>Pre-Requisite:</b>			
1	Linear Algebra, Theory of Computation		

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 Cauchyschwarz 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	5	

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	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.	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:**

1. 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.

**Course Outcomes:**

On completion of the course students will be able to knowledge of Vector spaces, Matrices, Quantum state, Density operator and Quantum

**Cloud Computing**

**Code:** PEC-CS701B

**Contact:** 3L

Name of the Course:	<b>Cloud Computing</b>		
Course Code: PEC-CS701B	Semester: VII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b><u>Definition of Cloud Computing and its Basics (Lectures )</u></b> . Defining a Cloud, Cloud Types – NIST model, Cloud Cube	9	

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	<p>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</p> <p>SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS)        Compliance as a Service (CaaS)</p>		
2	<p><b>Use of Platforms in Cloud Computing</b>          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 Application Delivery 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,</p>	12	

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	<p>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,</p>		
3	<p><b><u>Cloud Infrastructure:</u></b>  <b>Cloud Management:</b>          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).  <b>Concepts of Cloud Security:</b>          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)</p>	7	
4.	<p><b><u>Concepts of Services and Applications :</u></b></p> <p>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,</p>	8	

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	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		
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**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

Digital Signal Processing  
**Code: PEC-CS701C**  
**Contacts: 3L**

Name of the Course:	<b>Digital Signal Processing</b>		
Course Code: <b>PEC-CS701C</b>	Semester: VII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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		

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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	

**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-CS701D**

**Contacts: 3L**

Name of the Course:	Multi-agent Intelligent Systems		
Course Code: <b>PEC-CS701D</b>	Semester: VII		
Duration:6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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)

**Machine Learning**  
**Code: PEC-CS701E**  
**Contacts: 3L**

Name of the Course:	Machine Learning
Course Code: PEC-CS701D	Semester: VII
Duration: 6 months	Maximum Marks: 100
<b>Teaching Scheme</b>	<b>Examination Scheme</b>
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

<b>COURSE OBJECTIVE</b>		
<input type="checkbox"/> To learn the concept of how to learn patterns and concepts from data without being explicitly programmed		
<input type="checkbox"/> To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.		
<input type="checkbox"/> Explore supervised and unsupervised learning paradigms of machine learning.		
<input type="checkbox"/> To explore Deep learning technique and various feature extraction strategies.		
	<b>Hrs/unit</b>	<b>Marks/unit</b>
<b>Unit 1:</b> <b>Supervised Learning (Regression/Classification)</b> <ul style="list-style-type: none"> <li><input type="checkbox"/> Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes</li> <li><input type="checkbox"/> Linear models: Linear Regression, Logistic Regression, Generalized Linear Models</li> <li><input type="checkbox"/> Support Vector Machines, Nonlinearity and Kernel Methods</li> <li><input type="checkbox"/> Beyond Binary Classification: Multi-class/Structured Outputs, Ranking</li> </ul>	10	

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<b>Unit 2:</b> <b>Unsupervised Learning</b> <input type="checkbox"/> Clustering: K-means/Kernel K-means <input type="checkbox"/> Dimensionality Reduction: PCA and kernel PCA <input type="checkbox"/> Matrix Factorization and Matrix Completion <input type="checkbox"/> Generative Models (mixture models and latent factor models)	7	
<b>Unit 3</b> Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6	
<b>Unit 4</b> Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9	
<b>Unit 5</b> Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9	
<b>Unit 6:</b> Recent trends in various learning techniques of machine learning and classification methods	5	

**References:**

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
4. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018

**Neural Networks and Deep Learning**

**Code: PEC-CS702A**

**Contacts: 3L**

Name of the Course:	<b>Neural Networks and Deep Learning</b>	
Course Code: <b>PEC-CS702A</b>	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
<b>Teaching Scheme</b>	<b>Examination Scheme</b>	
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	

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Unit	Content	Hrs/Unit	Marks/Unit
1	<b>Introduction:</b> Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	3	
2	<b>Feed forward neural network:</b> 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.	<b>Conditional Random Fields:</b> Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	9	
5	<b>Deep Learning:</b> Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	6	
6	<b>Deep Learning research:</b> 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-CS702B**  
**Contacts: 3L**

Name of the Course:	<b>Soft Computing</b>
Course Code: <b>PEC- CS702B</b>	Semester: VII
Duration:6 months	Maximum Marks: 100
<b>Teaching Scheme</b>	<b>Examination Scheme</b>
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	<p>Neural Network</p> <p>Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron.</p> <p>Learning Methods : Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Back-propagation and multi layer networks.</p> <p>Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks. Neuro-Fuzzy modelling: Applications of Neural Networks: Pattern Recognition and classification</p>	10	
4.	<p>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</p>	10	
5	<p><b>PSO:</b>Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).</p>	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-CS702C**  
**Contact: 3L**

Name of the Course:	<b>Adhoc –Sensor Network</b>	
Course Code: <b>PEC-CS702C</b>	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	
<b>Objective:</b>		
1	provide an overview about sensor networks and emerging technologies	
2	To study about the node and network architecture of sensor nodes and its execution environment.	
3	To understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN	
4	To learn about topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control.	
5	To study about sensor node hardware and software platforms and understand the simulation and programming techniques..	

Unit	Content	Hrs/Unit	Marks/Unit
1	<b>Introduction and Overview [4L]</b> :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	<b>Architectures</b> Single-node architecture - hardware components, design constraints, energy consumption of sensor nodes , operating systems and execution environments, examples of sensor nodes,	9	

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	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		
3	<b>Communication Protocols [9L]:</b> 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.	<b>Infrastructure Establishment:</b> 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	<b>Sensor Network Platforms and Tools [9L]:</b> 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.

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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.

**Information Theory and Coding**

**Code: PEC-CS702D**

**Contact: 3L**

Name of the Course:	<b>Information Theory and Coding</b>	
Course Code: <b>PEC-CS702D</b>	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	
<b>Objective:</b>		
1	To develop an understanding of modern network architectures from a design and performance perspective.	
2	To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).	
3	To provide an opportunity to do network programming	
4	To provide a WLAN measurement ideas.	
<b>Pre-Requisite:</b>		
1		
2		
3		

Unit	Content	Hrs/Unit	Marks/Unit
1	<b>Source Coding [7L]</b> Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding	7	

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	theorem, Huffman codes		
2	<b>Channel Capacity And Coding [7L]</b> Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit	7	
3	<b>Linear And Block Codes For Error Correction [8L]</b> Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes	8	
4.	<b>Cyclic Codes [7L]</b> Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes..	7	
5	<b>BCH Codes [8L]</b> Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.	8	
6	<b>Convolutional Codes [8L]</b> 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	

**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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**Cyber Security**  
**Code: PEC-CS702E**  
**Contact: 3L**

Name of the Course:	<b>Cyber Security</b>	
Course Code: <b>PEC-CS702E</b>	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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	
<b>Objective:</b>		
1	To develop an understanding of modern network architectures from a design and performance perspective.	
2	To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).	
3	To provide an opportunity to do network programming	
4	To provide a WLAN measurement ideas.	

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)

**Operation Research**

**Code:** OEC-CS701A

**Contact:** 3L

Name of the Course:	<b>Operation Research</b>
Course Code: OEC-CS701A	Semester: VII
Duration: 6 months	Maximum Marks: 100

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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	<p><b>Basic LPP and Applications; Various Components of LP Problem Formulation.</b></p> <p>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.</p>	17	
2	<p><b>Network Analysis:</b> Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).</p> <p>Inventory Control: Introduction to EOQ Models of Deterministic and Probabilistic ; Safety Stock; Buffer Stock.</p>	9	
3	<p><b>Game Theory:</b> 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</p>	5	
4.	<p><b>Queuing Theory:</b> Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival &amp; Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (<math>\infty</math> / FIFO) and (M/M/1: N / FIFO) and problems.</p>	5	

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**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

**Multimedia Technology**

**Code:** OEC-CS701B

**Contacts:** 3L

Name of the Course:	<b>Multimedia Technology</b>		
Course Code: OEC-CS701B	Semester: VII		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b>Introduction:</b> Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications	2	
2	<b>Text and Audio, Image and Video(14L)</b> 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	14	

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	Computer based Animation.		
3.	<b>Synchronization, Storage models and Access Techniques:</b> 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	
4.	<b>Image and Video Database, Document Architecture and Content Management (17L):</b> 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.	<b>Multimedia Applications(4L):</b> 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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**Introduction to Philosophical Thoughts**

**Code: OEC-CS701C**

**Contact: 3L**

Name of the Course:	Introduction to Philosophical Thoughts		
Course Code: OEC-CS701C	Semester: VII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b>Nature of Indian Philosophy</b> : Plurality as well as common concerns. 2. Basic concepts of the Vedic and Upanisadic views : Atman, Jagrata, Svapna, Susupti, Turiya, Brahman, Karma, Rta,Rna,	17	
2	<b>Carvaka school</b> : its epistemology, metaphysics and ethics. Mukti	9	
3	<b>Jainism</b> : Concepts of sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada, and nayavada ; pramanas, ahimsa, bondage and liberation.		
4	5. Buddhism : theory of pramanas, theory of dependent origination, the four noble truths; doctrine of momentaryness; theory of no soul. The interpretation of these theories in schools of Buddhism : Vaibhasika, Sautrantrika, Yogacara, Madhyamika.	5	
5	6. Nyaya : theory of Pramanas; the individual self and its liberation ; the idea of God and proofs for His existence.	5	

**Text book and Reference books:**

1. M. Hiriyanna : Outlines of Indian Philosophy.

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2. C.D.Sharma : A Critical Survey of Indian Philosophy.
  3. S.N.Das Gupta : A History of Indian Philosophy Vol – I to V.
  4. S.Radhakrishnan : Indian Philosophy Vol – I & II.
  5. T.R.V.Murti : Central Philosophy of Buddhism.
  6. J.N.Mahanty : Reason and Tradition of Indian Thought.
  7. R.D.Ranade : A Constructive Survey of Upanisadic Philosophy.
  8. P.T.Raju : Structural Depths of Indian Thought.
  9. K.C.Bhattacharya : Studies in Philosophy Vol – 1.
  10. Datta and Chatterjee : Introduction of Indian Philosophy
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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	
<b>Teaching Scheme</b>	<b>Examination Scheme</b>	
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]

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**SEMESTER – VIII**

**Signal and Networks**  
**Code: PEC-CS801A**  
**Contact: 3L**

Name of the Course:	<b>Signal and Networks</b>		
Course Code: PEC-CS801A	Semester: VIII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b>Periodic signal analysis:</b> Fourier series and properties; Aperiodic signal analysis : Fourier Transform - its properties and sinusoidal steady state analysis of systems;	7	
3	<b>Elements of electrical network :</b> 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.	<b>One and two port network parameters and functions :</b> 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	

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	Reciprocity Theorems;		
5	<b>Graph theory:</b> Tree, Co-tree, fundamental cut-set, fundamental loop analysis of network; Analog filter design: Butterworth, Sallen Key, frequency transformation and scaling;	6	

**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.

**Cryptography and Network Security**

**Code: PEC-CS801B**

**Contact: 3L**

Name of the Course:	<b>Cryptography and Network Security</b>		
Course Code: PEC-CS801B	Semester: VIII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	Attacks on Computers & Computer Security - Introduction, Need for Security, Security approaches, Principles of Security, Types of attack	5	
2	Cryptography: Concepts & Techniques- Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size	7	

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3	Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, IDEA(International Data Encryption Algorithm) algorithm, RC5(Rivest Cipher 5) algorithm.	8	
4.	Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).	5	
5	Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication.	6	
6	Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME.	4	
7	Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network	3	

**Text book and Reference books:**

1. "Cryptography and Network Security", William Stallings, 2nd Edition, Pearson Education Asia
2. "Cryptography and Network Security" by V.K. Jain, Khanna Publishing House,
3. "Network Security private communication in a public world", C. Kaufman, R. Perlman and M. Speciner, Pearson
4. Cryptography & Network Security: Atul Kahate, TMH.
5. "Network Security Essentials: Applications and Standards" by William Stallings, Pearson.
6. "Designing Network Security", Merike Kaeo, 2nd Edition, Pearson Books
7. "Building Internet Firewalls", Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly .
8. "Practical Unix & Internet Security", Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly

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**Natural Language Processing**  
**Code: PEC-CS801C**  
**Contacts: 3L**

Name of the Course:	<b>Natural Language Processing</b>
Course Code: PEC-CS801C	Semester: VIII
Duration: 6 months	Maximum Marks:100
<b>Teaching Scheme</b>	<b>Examination Scheme</b>
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	<p><b>Regular Expressions and Automata(Recap)</b> - Introduction to NLP, Regular Expression, Finite State Automata [2L]</p> <p><b>Tokenization</b> - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance [5L]</p> <p><b>Morphology</b> - 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]</p>	11	
2	<p><b>Language Modeling</b> 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]</p> <p><b>Hidden Markov Models and POS Tagging</b> Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation. [4L]</p>	8	
3	<p><b>Text Classification</b> Text Classification, Naïve Bayes’ Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. [4L]</p> <p><b>Context Free Grammar</b> Context Free Grammar and Constituency, Some common CFG phenomena for</p>	9	

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	English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing [4L]		
4.	<b>Computational Lexical Semantics</b> Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity [4L] <b>Information Retrieval</b> 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.

**Web and Internet Technology**

**Code: PEC-CS801D**

**Contacts: 3L**

Name of the Course:	<b>Web and Internet Technology</b>		
Course Code: PEC-CS801D	Semester: VIII		
Duration: 6 months	Maximum Marks:100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	6	

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	<p>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.</p>		
2	<p>HTML (3L):          Introduction, Editors, Elements, Attributes, Heading, Paragraph. Formatting, Link, Head, Table, List, Block, Layout, CSS. Form, Iframe, Colors, Colorname, Colorvalue.          Image Maps (1L):          map, area, attributes of image area.          Extensible Markup Language (XML) (4L):          Introduction, Tree, Syntax, Elements, Attributes, Validation, Viewing. XHTML in brief.          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.          JavaScript (4L):          Basics, Statements, comments, variable, comparison, condition, switch, loop, break. Object – string, array, Boolean, reg-ex. Function, Errors, Validation.          Cookies (1L):          Definition of cookies, Create and Store a cookie with example.          Java Applets (2L):          Container Class, Components, Applet Life Cycle, Update method; Parameter passing applet, Applications.</p>	10	
	Client-Server programming In Java (2L):		

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4.	Java Socket, Java RMI. Threats (1L): Malicious code-viruses, Trojan horses, worms; eavesdropping, spoofing, modification, denial of service attacks. Network security techniques (2L): Password and Authentication; VPN, IP Security, security in electronic transaction, Secure Socket Layer (SSL), Secure Shell (SSH). Firewall (1L): Introduction, Packet filtering, Stateful, Application layer, Proxy.	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	

**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-CS801E**

**Contacts: 3L**

<b>Course Code</b>	PEC-CS801 E
<b>Course Name</b>	<b>Internet of Things</b>
<b>Credits</b>	3
<b>Pre-Requisites</b>	Wireless Networks

Total Number of Lectures: 48

<b>COURSE OBJECTIVE</b>
<input type="checkbox"/> Able to understand the application areas of IOT

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<input type="checkbox"/> Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
<input type="checkbox"/> Able to understand building blocks of Internet of Things and characteristics

<b>LECTURE WITH BREAKUP</b>	<b>NO. OF LECTURES</b>
<b>Unit 1:</b> Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	7
<b>Unit 2:</b> 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
<b>Unit 3:</b> 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
<b>Unit 4:</b> 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
<b>Unit 5:</b> 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
<b>Unit 6:</b> Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	5

<b>COURSE OUTCOMES</b>
On completion of the course the student should be able to
<input type="checkbox"/> Understand the vision of IoT from a global context.
<input type="checkbox"/> Determine the Market perspective of IoT.
<input type="checkbox"/> Use of Devices, Gateways and Data Management in IoT.
<input type="checkbox"/> Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
<input type="checkbox"/> Building state of the art architecture in IoT.

**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.

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4. Internet of Things, Arsheep Bahga and Vijay Madiseti

**Big Data Analytics**

**Code:** OEC-CS801A

**Contacts:** 3L

Name of the Course:	<b>Big Data Analytics</b>	
Course Code: OEC-CS801A	Semester: VIII	
Duration: 6 months	Maximum Marks: 100	
<b>Teaching Scheme</b>	<b>Examination Scheme</b>	
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	

Total Number of Lectures: 48

<b>COURSE OBJECTIVE</b>	
<input type="checkbox"/> Understand big data for business intelligence. Learn business case studies for big data analytics. Understand nosql big data management. Perform map-reduce analytics using Hadoop and related tools	
<b>LECTURE WITH BREAKUP</b>	<b>NO. OF LECTUR</b>
<b>Unit 1:</b> 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
<b>Unit 2:</b> 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

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<b>Unit 3:</b> 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 data structures	9
<b>Unit 4:</b> 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
<b>Unit 5:</b> Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	7
<b>Unit 6:</b> 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, HiveOL queries.	6

<b>COURSE OUTCOMES</b>
<b>After completion of course, students would be:</b>
<input type="checkbox"/> Describe big data and use cases from selected business domains <input type="checkbox"/> Explain NoSQL big data management <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Install, configure, and run Hadoop and HDFS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Perform map-reduce analytics using Hadoop <input type="checkbox"/> Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

**References:**

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

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**Cyber Law and Ethics**  
**Code: OEC-CS801B**  
**Contacts: 3L**

Name of the Course:	<b>Cyber Law and Ethics</b>		
Course Code: OEC-CS801B	Semester:VIII		
Duration:6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b>Introduction of Cybercrime:</b> What is cybercrime?, Forgery, Hacking, Software Piracy, Computer Network intrusion[4L]. <b>Category of Cybercrime:</b> how criminals plan attacks, passive attack, Active attacks, cyberstalking. [4L]	8	
2	<b>Cybercrime Mobile &amp; Wireless devices:</b> 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	<b>Tools and Methods used in Cyber crime:</b> Proxy servers, panword checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow. [8L]	8	
4.	<b>Phishing &amp; Identity Theft:</b> Phising methods, ID Theft; Online identity method. [4L] <b>Cybercrime &amp; Cybersecurity:</b> 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

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**Mobile Computing**  
**Code: OEC-CS801C**  
**Contacts: 3L**

Name of the Course:	<b>Mobile Computing</b>	
Course Code: <b>OEC-CS801C</b>	Semester: VIII	
Duration: 6 months	Maximum Marks: 100	
<b>Teaching Scheme</b>		<b>Examination Scheme</b>
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
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	

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**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

**Robotics**

**Code: OEC-IT801D**

**Contacts: 3L**

Name of the Course:	<b>Robotics</b>		
Course Code: OEC-IT801	Semester: VIII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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	<b>Introduction</b> :Introduction -- brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.	1	
2	<b>Elements of robots – links, joints, actuators, and sensors</b> Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link	5	

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	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.		
3	<b>Kinematics of serial robots</b> 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.	<b>Kinematics of parallel robots</b> 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.	<b>Velocity and static analysis of robot manipulators</b> 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	<b>Dynamics of serial and parallel manipulators</b> 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	<b>Motion planning and control</b> Joint and Cartesian space trajectory planning and generation, Classical	6	

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	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	<b>Modeling and control of flexible robots</b> 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	<b>Modeling and analysis of wheeled mobile robots</b> Introduction 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	<b>Selected advanced topics in robotics</b> 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, 2<sup>nd</sup> Edition, McGraw-Hill Higher Education, New Delhi, 2014
3. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.

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**Soft Skill & Interpersonal Communication**

**Code:** OEC-CS801E

**Contact:** 3L

Name of the Course:	<b>Soft Skill &amp; Interpersonal Communication</b>		
Course Code: OEC-CS801E	Semester: VII		
Duration: 6 months	Maximum Marks: 100		
<b>Teaching Scheme</b>		<b>Examination Scheme</b>	
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 Spiritual Intelligence	5	
2	Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types Of Conflicts: Becoming A Conflict Resolution Expert Types Of Stress: Self-Awareness About Stress, Regulating Stress: Making The Best Out Of Stress	5	
3	Habits: Guiding Principles, Habits: Identifying Good And Bad Habits, Habits: Habit Cycle, Breaking Bad Habits, Using The Zeigarnik Effect For Productivity And Personal Growth,	5	

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	Forming Habits Of Success		
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	
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	

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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		
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**TEXT BOOKS AND REFERENCES**

Dorch, Patricia. *What Are Soft Skills?* New York: Execu Dress Publisher, 2013.

Kamin, Maxine. *Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders.* Washington, DC: Pfeiffer & Company, 2013.

Klaus, Peggy, Jane Rohman & Molly Hamaker. *The Hard Truth about Soft Skills.* London: HarperCollins E-books, 2007.

Petes S. J., Francis. *Soft Skills and Professional Communication.* New Delhi: Tata McGraw-Hill Education, 2011.

Stein, Steven J. & Howard E. Book. *The EQ Edge: Emotional Intelligence and Your Success.* Canada: Wiley & Sons, 2006.

**E-Commerce & ERP:**  
**Code: OEC-CS802A**  
**Contacts: 3L**

1. Overview, Definitions, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Managerial Prospective, Rules & Regulations For Controlling E – Commerce, Cyber Laws. [ 3 L ]
2. Technologies : Relationship Between E – Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol : Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E – Commerce . [ 5 L ]
3. Business Models of e – commerce : Model Based On Transaction Type, Model Based On Transaction Party - B2B, B2C, C2B, C2C, E – Governance. [2 L ]
4. E – strategy : Overview, Strategic Methods for developing E – commerce. [2 L ]
5. Four C’s : ( Convergence, Collaborative Computing, Content Management & Call Center ).  
 Convergence : Technological Advances in Convergence – Types, Convergence and its implications, Convergence & Electronic Commerce. Collaborative Computing : Collaborative product development, contract as per CAD, Simultaneous Collaboration, Security. Content Management : Definition of content, Authoring Tools & Content Management, Content – partnership, repositories, convergence, providers, Web Traffic & Traffic Management ; Content Marketing. Call Center : Definition, Need, Tasks Handled, Mode of Operation, Equipment , Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE). [ 6 L ]

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7. Supply Chain Management : E – logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power. [ 3 L ]
8. E – Payment Mechanism : Payment through card system, E – Cheque, E – Cash, E – Payment Threats & Protections. [ 1 L ]
9. E – Marketing :. Home –shopping, E-Marketing, Tele-marketing [ 1 L ]
10. Electronic Data Interchange (EDI) : Meaning, Benefits, Concepts, Application, EDI Model, Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA). [2 L ]
11. Risk of E – Commerce : Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digital signatures. [4 L ]
12. Enterprise Resource Planning (ERP) : Features, capabilities and Overview of Commercial Software, re-engineering work processes for IT applications, Business Process Redesign, Knowledge engineering and data warehouse . Business Modules: Finance, Manufacturing (Production), Human Resources, Plant Maintenance, Materials Management, Quality Management, Sales&Distribution ERPPackage, ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation ERP-Present and Future: Enterprise Application Integration (EAI), ERP and E-Commerce, ERP and Internet, Future Directions in ERP [10]

**Reference :**

1. E-Commerce, M.M. Oka, EPH
2. Kalakotia, Whinston : Frontiers of Electronic Commerce , Pearson Education.
3. Bhaskar Bharat : Electronic Commerce - Technologies & Applications. TMH
4. Loshin Pete, Murphy P.A. : Electronic Commerce , Jaico Publishing Housing.
5. Murthy : E – Commerce , Himalaya Publishing.
6. E – Commerce : Strategy Technologies & Applications, Tata McGraw Hill.
7. Global E-Commerce, J. Christopher & T.H.K. Clerk, University Press
8. Beginning E-Commerce, Reynolds, SPD
9. Krishnamurthy, E-Commerce Mgmt, Vikas

**Micro-electronics and VLSI Design**

**Code:** OEC-CS802B

Contact: 3L

Credits: 3

Allotted Hrs: 39L

Introduction to CMOS circuits: MOS Transistors, MOS transistor switches, CMOS Logic, The inverter, Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers. [6L]

Processing Technology: Silicon Semiconductor Technology- An Overview, wafer processing, oxidation, epitaxy deposition, Ion-implantation and diffusion, The Silicon Gate Process- Basic CMOS Technology, basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator, CMOS process enhancement-Interconnect, circuit elements, 3-D CMOS. Layout Design Rule: Layer Representations, CMOS n-well Rules, Design Rule of background scribe line, Layer Assignment, SOI Rule [10L] .

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Power Dissipation: Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation. Programmable Logic, Programmable Logic structure, Programmable interconnect, and Reconfigurable Gate Array: Xilinx Programmable Gate Array, Design Methods: Behavioural Synthesis, RTL synthesis [8L]

Placement: placement: Mincut based placement – Iterative improvement placement simulated annealing. Routing: Segmented channel routing – maze routing – routability and routing resources – net delays. [5L]

Verification and Testing: Verification Versus Testing, Verification: logic simulation design validation – timing verification – Testing concepts: failures – mechanisms and faults – fault coverage – ATPG methods – types of tests – FPGAs – programmability failures – design for testability. [5L]

Overview of VHDL [5L]

**Text Book:**

1. “Digital Integrated Circuit”, J.M.Rabaey, Chandrasan, Nicolic, Pearson
2. “CMOS Digital Integrated Circuit”, S.M.Kang & Y.Leblebici, TMH
3. “Modern VLSI Design” Wayne Wolf, Pearson
4. “Algorithm for VLSI Design & Automation”, N.Sherwani, Kluwer
5. “VHDL”, Bhaskar, PHI

**References:**

1. “ Digital Integrated Circuits” Demassa & Ciccone, Willey Pub.
2. “Modern VLSI Design: system on silicon” Wayne Wolf; Addison Wesley Longman Publisher
3. “Basic VLSI Design” Douglas A. Pucknell & Kamran Eshranghian; PHI
4. “CMOS Circuit Design, Layout & Simulation”, R.J.Baker, H.W.Lee, D.E. Boyee, PHI

**Economic Policies in India**

**Code: OEC-CS802C**

**Contacts: 3L**

**Economic Development and its Determinants**

Approaches to economic development and its measurement – sustainable development; Role of State, market and other institutions; Indicators of development – PQLI, Human Development Index (HDI), gender development indices.

**Planning in India**

Objectives and strategy of planning; Failures and achievements of Plans; Developing grass-root organizations for development – Panchayats, NGOs and pressure groups.

**Demographic Features, Poverty and Inequality**

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Broad demographic features of Indian population; rural-urban migration; Urbanization and civic amenities; Poverty and Inequality.

**Resource Base and Infrastructure**

Energy; social infrastructure – education and health; Environment; Regional imbalance; Issues and policies in financing infrastructure development.

**The Agricultural Sector**

Institutional Structure – land reforms in India; Technological change in agriculture – pricing of agricultural inputs and output; industry; Agricultural finance policy; Agricultural Marketing and Warehousing; Issues Terms of trade between agriculture and in food security – policies for sustainable agriculture.

**Section – II**

Industrial policy; Public Sector enterprises and their performance; Problem of sick units in India; Privatization and disinvestment debate; Growth and pattern of industrialization; Small-scale sector; Productivity in industrial sector; Exit policy – issues in labour market reforms; approaches for employment generation.

**Public Finances**

Fiscal federalism – Centre-State financial relations; Finances of central government; Finances of state governments; Parallel economy; Problems relating to fiscal policy; Fiscal sector reforms in India.

**Money, Banking and Prices**

Analysis of price behaviour in India; Financial sector reforms; Interest rate policy; Review of monetary policy of RBI; Money and capital markets; Working of SEBI in India.

**External Sector**

Structure and direction of foreign trade; Balance of payments; Issues in export-import policy and FEMA; Exchange rate policy; Foreign capital and MNCs in India; The progress of trade reforms in India.

**Economic Reforms**

Rationale of internal and external reforms; Globalization of Indian economy; WTO and its impact on the different sectors of the economy; Need for and issues in good governance; Issues in competition and safety nets in Indian economy.

**BASIC READING LIST**

1. Ahluwalia, I. J. and I. M. D Little (Eds.) (1999), India's Economic Reforms and Development (Essays in honour of Manmohan Singh), Oxford University Press, New Delhi.
2. Bardhan, P. K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.
3. Bawa, R. s. and P. S. Raikhy (Ed.) (1997), Structural Changes in Indian Economy, Guru Nanak Dev University Press, Amritsar.

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4. Brahmananda, P. R. and V. R. Panchmukhi (Eds.) (2001), Development Experience in the Indian Economy: Inter-State Perspectives, Book well, Delhi.
5. Chakravarty, S. (1987), Development Planning : The Indian Experience, Oxford University Press, New Delhi.
6. Dantwala, M. L. (1996), Dilemmas of Growth : The Indian Experience, Sage Publications, New Delhi.
7. Datt, R. (Ed.) (2001), Second Generation Economic Reforms in India, Deep & Deep Publications, New Delhi.
8. Government of India, Economic Survey (Annual), Ministry of Finance, New Delhi.
9. Jain, a. K. (1986), Economic Planning in India, Ashish Publishing House, New Delhi.
10. Jalan, B. (1992), The Indian Economy – Problems and Prospects, Viking, New Delhi.