Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Artificial Intelligence

(Applicable from the academic session 2023-2024)

Curriculum Structure

Semester-III							
Sl No.	Category	Subject Code	Subject Name	Total Number of Contact hours			Credits
				L	T	P	
Theory							
1	Engineering Science Course	ESC301	Analog and Digital Electronics	3	0	0	3
2	Professional Core Courses	PCC-CS301	Data Structure & Algorithms	3	0	0	3
3	Professional Core Courses	PCC-CS302	Computer Organization	3	0	0	3
4	Basic Science course	BSC-AI301	Discrete Mathematics	2	0	0	2
5	Humanities &Social Sciences including Management Courses	HSMC 301	Economics for Engineers (Humanities-II)	3	0	0	3
		Total Theory		14	0	0	14
Practical							
1	Professional Core Courses	PCC-CS391	Data Structure & Algorithms Lab	0	0	4	2
2	Engineering Science Course	ESC391	Analog and Digital Electronics Lab	0	0	4	2
3	Professional Core Courses	PCC-CS392	Computer Organization	0	0	4	2
4	Professional Core Courses	PCC- CS393	IT Workshop(Python I)	0	0	4	2
		Total Practical		0	0	16	8
		Total Credit for Third Semester		22			

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Semester-IV								
Sl No		**Type of Course**	**Code**	**Course Title**	**Hours per week**			**Credits**
					L	T	P	
1	**THEORY**	Professional Core Course	PCC-AI401	Artificial Intelligence	3	0	0	3
2		Professional Core Course	PCC-AI402	Optimization Techniques	3	0	0	3
3		Professional Core Course	PCC-CS403	Formal Language & Automata Theory	3	0	0	3
4		Professional Core Course	PCC-CS404	Design andAnalysis of Algorithm	3	0	0	3
5		Basic Science Course	BSC-401	Biology	2	0	0	2
6		Mandatory Course	MC-401	EnvironmentalScience	2	0	0	2
7	**PRACTICAL**	Professional Core Course	PCC-AI491	Artificial Intelligence Lab	0	0	4	2
8		Professional Core Course	PCC-CS494	Design andAnalysis of Algorithm Lab	0	0	4	2
9		Professional Core Course	PCC-AI492	Python II / R Programming Language Lab	0	0	4	2
TOTAL CREDITS								**22**

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Semester V								
Sl No		**Type of Course**	**Code**	**Course Title**	**Hours per week**			**Credits**
					L	T	P	
1	**THEORY**	Professional Core Course	PCC-AI501	Probability and Statistics	3	0	0	3
2		Professional Core Course	PCC-CS502	Operating System	3	0	0	3
3		Professional Core Course	PCC-CS503	Object Oriented Programming	3	0	0	3
4		Professional Core Course	PCC-AI 502	Machine Learning	3	0	0	3
5		Humanities and Social Sciences including Management	HSMC501	Introduction to Industrial Management	2	0	0	2
6		Professional Elective	PECAI501(A/ B /C)	Cloud Computing /IoT / Graph Theory	3	0	0	3
7	**PRACTICAL**	Professional Core Course	PCC-CS592	Operating System Lab	0	0	4	2
8		Professional Core Course	PCC-CS593	Object Oriented Programming Lab	0	0	4	2
9		Professional Core Course	PCC-AI592	Machine Learning Lab	0	0	4	2
TOTAL CREDITS								**23**

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Semester VI								
Sl No		**Type of Course**	**Code**	**Course Title**	**Hours per week**			**Credits**
					L	T	P	
1	**THEORY**	Professional Core Course	PCC-AI601	Data Base Management System	2	0	0	2
2		Professional Core Course	PCC-AI602	Deep Learning	3	0	0	3
		Professional Core Course	PCC-AI603	Soft Computing	3	0	0	3
3		Professional Core Course	PCC-CS602	Computer Networks	3	0	0	3
4		Professional Elective	PEC-AI601 (A/B/C)	Big Data Analytics /Data Mining/Game Theory	3	0	0	3
5		Open Elective	OEC-AI601 (A/B)	Human Computer Interaction/Cryptography and Network Security	3	0	0	3
6	**PRACTICAL**	Professional Core Course	PCC-AI691	Data Base Management System lab	0	0	4	2
7		Professional Core Course	PCC-AI603	Soft Computing Lab	0	0	4	2
8		Professional Core Course	PCC-CS692	Computer Networks Lab	0	0	4	2
TOTAL CREDITS								**23**

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(Applicable from the academic session 2023-2024)

Semester VII							
Sl No	**Type of Course**	**Code**	**Course Title**	**Hours perweek**			**Credits**
				L	T	P	
1	Professional Elective Course	PEC-AI701 (A/B/C/D)	*Computer Graphics/ Computer Vision/ Quantum Computing/ Multi Agent Intelligent System	3	0	0	3
2	Professional Elective Course	PEC-AI702 (A/B/C/D)	*Robotics/ Information Theory and Coding/Computer Aided Design/Digital Signal Processing	3	0	0	3
3	Open Elective Course	OEC-AI701 (A /B/ C / D)	*Social Network Analysis /Bio-Informatics/*E-commerce and ERP/*Optical Networking	3	0	0	3
4	Humanities andSocial Sciences including Management	HSMC701	Project Management and Entrepreneurship	2	0	0	2
	Project	PROJ-AI781	Project I	0	0	12	6
TOTAL CREDITS				**17**			

Semester VIII							
Sl No	**Type of Course**	**Code**	**Course Title**	**Hours perweek**			**Credits**
				L	T	P	
1	Professional Elective Course	PEC-AI801 (A/B/C)	Natural language Processing/Cyber Law and Ethics/Mobile Computing	3	0	0	3
2	Open Elective Course	OEC-AI801 (A/B/C)	Economic Policies in India/ Microelectronics and VLSI/Software Engineering	3	0	0	3
3	Open Elective Course	OEC-AI802 (A/B/C)	Human Resource Development & Organization Behaviour/ Research Methodology/ Soft skill and InterpersonalCommunication	3	0	0	3
4	Project	PROJ-AI881	Project II	0	0	12	6
TOTAL CREDITS				**15**			

Semester-III

Analog & Digital Electronics
Code: ESC-301
Contact: 3L

Name of the Course:	**Analog & Digital Electronics**	
Course Code: ESC-301	Semester: III	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: hrs./week		End Semester Exam : 70 Marks
Credit Points:	3	

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

Unit	Content	Hrs/Unit	Marks/Unit
1	Different Classes of Amplifiers - (Class-A, B, AB and C - basic concepts, power, efficiency; Recapitulation of basic concepts of Feedback and Oscillation, Phase Shift, Wein Bridge oscillators Astable & Monostable Multivibrators; Schimtt Trigger circuits, 555 Timer.	9	
2	Binary Number System & Boolean Algebra (recapitulation); BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic, Venn diagram, Boolean algebra (recapitulation); Representation in SOP and POS forms; Minimization of logic expressions by algebraic method. Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator	11	

3	Sequential Circuits - Basic Flip-flop & Latch, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), Design of Mod N Counter	10	
4.	A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only [2L] A/D: successive approximation [2L]) Logic families- TTL, ECL, MOS and CMOS - basic concepts. (2L)	6	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

ESC-301.1 Realize the basic operations of different analog components.ESC-301.2 Realize basic gate operations and laws Boolean algebra.

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

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

Name of the Course:		**Data Structure & Algorithm**	
Course Code: PCC-CS301		Semester: III	
Duration: 6 months		Maximum Marks:100	
Teaching Scheme			**Examination Scheme**
Theory: 3 hrs./week			Mid Semester exam: 15
Tutorial: NIL			Assignment and Quiz: 10 marks
			Attendance : 5 marks
Practical: hrs./week			End Semester Exam :70 Marks
Credit Points:		3	
Objective:			
1	To learn the basics of abstract data types.		
2	To learn the principles of linear and nonlinear data structures.		
3	To build an application using sorting and searching		
Pre-Requisite:			
1	CS 201 (Basic Computation and Principles of C		
2	M101 & M201 (Mathematics), basics of set theory		

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

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

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

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

PCC-CS301.2 Solve problems based upon different data structure & also write programs. PCC-CS301.3 Identify appropriate data structure & algorithmic methods in solving problem.

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

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

Computer Organization

Code: PCC- CS302

Contacts: 3L

Name of the Course:	**Computer Organization**	
Course Code: PCC- CS302	Semester: III	
Duration:6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz : 10 marks
		Attendance: 5 marks
Practical: hrs./week		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes. [7L] Commonly used number systems. Fixed and floating point representation of numbers.[1L]	8	
2	Overflow and underflow. Design of adders - ripple carry and carry look ahead principles. [3L] Design of ALU. [1L] Fixed point multiplication -Booth's algorithm. [1L] Fixed point division - Restoring and non-restoring algorithms. [2L] Floating point - IEEE 754 standard. [1L]	8	
	Memory unit design with special emphasis on		
3	implementation of CPU-memory interfacing. [2L] Memory organization, static and dynamic memory, memory hierarchy, associative memory. [3L] Cache memory, Virtual memory. Data path design for read/write access. [5L]	10	
4.	Design of control unit - hardwired and microprogrammed control. [3L] Introduction to instruction pipelining. [2L] Introduction to RISC architectures. RISC vs CISC architectures. [2L] I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA. [3L]	10	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

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

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

PCC-CS302.3 Perform different operations with sequential circuits.PCC-CS302.4 Understand memory and I/O operations.

Discrete Mathematics
Code: BSC-AI301
Contacts: 3L

Name of the Course:	**Discrete Mathematics**	
Course Code: BSC-AI301	Semester: III	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial:		Assignment and Quiz : 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	2	

Unit	Content	Hrs/Unit
1	Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, Binary Relation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum and Product of Functions, Bijective functions, Inverse and Composite Function, Size of a Set, Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument and The Power Set theorem, Schroeder-Bernstein theorem. Principles of Mathematical Induction: The Well- Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.	8
2	Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation and combination	5
3	Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proofby Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	8
4.	Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function,Disjunctive and Conjunctive	7

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

Text book and Reference books:

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

Economics for Engineers (Humanities-II)

Code: HSMC-301
Contacts: 3L

Name of the Course:	**Economics for Engineers (Humanities-II)**	
Course Code: HSMC-301	Semester: III	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	1. Economic Decisions Making – Overview, Problems, Role, Decision making process. 2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per- Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	9	
2	3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. 4. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis,Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector -Quantifying And Valuing Benefits & drawbacks.	9	

3	5. Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. 6. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. 7. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.	9	
4.	8. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. 9. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. 10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	9	

Text book and Reference books:

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

PRACTICAL SYLLABUS
Semester III

Data Structure & Algorithm Lab

Code: PCC-CS391

Contacts: 4P

Name of the Course:	**Data Structure & Algorithm Lab**
Course Code: PCC-CS391	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

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

Analog & Digital Electronics Lab

Code: ESC-391

Contacts: 4P

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

Laboratory Experiments:	
Analog Electronics	
1	Design a Class A amplifier
2	Design a Phase-Shift Oscillator
3	Design of a Schmitt Trigger using 555 timer
Digital Electronics	
4	Design a Full Adder using basic gates and verify its output / Design a Full Subtractor circuit using basic gates and verify its output.
5	Construction of simple Decoder & Multiplexer circuits using logic gates.
6	Realization of RS / JK / D flip flops using logic gates
7	Design of Shift Register using J-K / D Flip Flop
8	Realization of Synchronous Up/Down counter
9	Design of MOD- N Counter
10	Study of DAC

Computer Organization Lab

Code: PCC- CS392

Contacts: 4P

Name of the Course:	**Computer Organization Lab**
Course Code: PCC-CS392	Semester: III
Duration:6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

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

IT Workshop (Python - I)

Code: PCC-CS393

Contacts: 4P

Name of the Course:	IT Workshop (Python - I)
Course Code: PCC-CS393	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: NIL	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points: 2	

Programming in Python

Script file, Input commands, Output commands, Structure of function file, Inline functions, Feval command, Comparison between script file and function file Conditional statements and Loop
Relational and Logical Operators, If-else statements, Switch-case statements, Forloop, While loop, Special commands (Break and continue), Import data from large database, Export data to own file or database
2D Plotting
In-built functions for plotting, Multiple plotting with special graphics, Curvefitting, Interpolation, Basic fitting interface
3D Plotting
Use of meshgrid function, Mesh plot, Surface plot, Plots with specialgraphics Programming with Python Introduction History, Features, Setting up path, Working with Python, Basic Syntax, Variable andData Types, Operator Conditional Statements
If, If- else, Nested if-else, Looping, For, While, Nestedloops Control Statements
Break Continue, Pass String Manipulation Accessing Strings, Basic Operations, String slices, Function and Methods Lists Introduction, Accessing list, Operations, Working with lists, Function andMethods Tuple
Introduction, Accessing tuples, Operations, Working, Functions andMethods Dictionaries
Introduction, Accessing values in dictionaries, Working with dictionaries,Properties Functions
Defining a function, Calling a function, Types of functions, FunctionArguments, Anonymous functions, Global and local variables Modules Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions
Exception Handling
Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions.

Semester-IV

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

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	6	
2	Regularlanguagesandfiniteautomata:Regularexpressionsandlanguages,deterministicfiniteautomata(DFA)andequivalencewithregularexpressions,nondeterministicfiniteautomata(NFA)andequivalencewithDFA,regulargrammarsandequivalencewithfiniteautomata,propertiesofregularlanguages,pumpinglemmaforregularlanguages,minimizationoffiniteautomata)	7	
3	Context-freelanguagesandpushdownautomata:Context-freegrammars(CFG)andlanguages(CFL),Chomskyand Greibachnormalforms, nondeterministicpushdownautomata(PDA)andequivalencewithCFG,parsetrees,ambiguityinCFG,pumpinglemmaforcontext-freelanguages,deterministicpushdownautomata,closurepropertiesofCFLs.	6	
4.	Context-sensitivelanguages:Context-sensitivegrammars(CSG)andlanguages,linearboundedautomata andequivalencewithCSG.	6	
5	Turingmachines:ThebasicmodelforTuringmachines(TM),Turingrecognizable(recursivelyenumerable)andTuring-decidable(recursive)languagesandtheirclosureproperties,variantsofTuringmachines,nondeterministicTMsandequivalencewithdeterministicTMs,unrestrictedgrammarsandequivalencewithTuringmachines,TMsas enumerators	6	
6	Undecidability:Church-Turingthesis,universalTuringmachine,theuniversalanddiagonalizationlanguages,reductionbetweenlanguagesandRicestheorem,undecidableproblems about languages	6	

Text books/ reference books:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.
2. Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory ofComputation, Pearson Education Asia.
3. Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw

Hill., PEARSON.
1. Dr. R.B.Patel, Theory of Computation, Khanna Publishing House

Course Outcomes:
On completion of the course students will be able to
PCC-CS403.1 Write a formal notation for strings, languages and machines.
PCC-CS403.2 Design finite automata to accept a set of strings of a language.
PCC-CS403.3 For a given language determine whether the given language is regular or not.
PCC-CS403.4 Design context free grammars to generate strings of context free language.
PCC-CS403.5 Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
PCC-CS403.6 Write the hierarchy of formal languages, grammars and machines.
PCC-CS403.7 Distinguish between computability and non-computability and Decidability and undecidability.

Artificial Intelligence
Code: PCC-AI401
Contacts: 3L

Name of the Course:	**Artificial Intelligence**	
Course Code**:** PCC-AI401	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	3	

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

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

Text books/ 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)

Optimization Technique

Code: PCC-AI 402

Contacts: 3L

Name of the Course:	**OPTIMIZATION TECHNIQUE**		
Course Code:PCC-AI402	Semester: IV		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		
Course Objectives			
1.Use Matlab to implement important optimization methods.			
2. Learn efficient computational procedures to solve optimization problems			
3.Cast engineering minima/maxima problems into optimization framework.			

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Historical Development, Engineering applications of optimization, Statement of an optimization problem, Classification of optimization Problems	2	
2	Classical Optimization Techniques: Single variable optimization, Constrained and unconstrained multivariable optimization, Relevant applications	5	
3	Linear Programming: Standard form of a linear programming problem, Simplex method, Duality in linear programming, Quadratic programming, Stochastic linear programming, Relevant applications	6	
4	Nonlinear Programming: Unimodal function, Interpolation methods, Direct and indirect methods, Relevant applications	4	
5	Geometric Programming: Unconstrained and constrained geometric programming problems, Geometric programming with mixed inequality	5	
6	Integer Programming: Integer linear programming, Integer nonlinear programming, Relevant applications	4	
7	Game Theory: Introduction, Characteristics of Game Theory, Two Person, Zero sum games, Pure strategy. Dominance theory,	2	

8	Genetic Algorithms: Introduction, Representation methods, Selection methods, Operators, Replacement methods, Relevant applications	2	

Text book and Reference books:

1. Rao, S. S., & Rao, S. S., Engineering optimization: theory and practice. John Wiley & Sons.
2. Hadley, G., Linear programming, Narosa Publishing house.
3. Taha, H. A., Operations research: An introduction. Pearson Education India.
4. Deb. K, Optimization for engineering design: Algorithms and examples. PHI Learning Pvt. Ltd.
5. Kumar, D. N., Multicriterion analysis in engineering and management. PHI Learning Pvt. Ltd**.**

Course Outcomes:

At the end of the course, students will be able to –

1. Relate key concepts and applications of various optimization techniques
2. Identify the appropriate optimization technique for the given problem
3. Formulate appropriate objective functions and constraints to solve real life optimization problem

Design and Analysis of Algorithms

Code: PCC-CS404

Contacts: 3L

Name of the Course:	**Design and Analysis of Algorithms**	
Course Code: PCC-CS404	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: hrs./week		End Semester Exam: 70 Marks
Credit Points:	3	

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

Text books/ reference books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2. Fundamentals of Algorithms – E. Horowitz et al.
4. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
5. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
6. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
7. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
8. Algorithms D0052552esign and Analysis, Udit Agarwal, Dhanpat Rai

Biology
Code: BSC 401
Contacts: 2L

Name of the Course:	**Biology**	
Course Code: BSC-401	Semester: IV	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory: 2hrs./week		Mid Semester exam: 15
Tutorial:		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	2	

Unit	Content	Hrs/Unit
1	To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry Bring out the fundamental differences between science and engineering by drawing a comparison between eye and camera, Bird flying and aircraft. Mention the most exciting aspect of biology as an independent scientific discipline. Why we need to study biology? Discuss how biological observations of 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	2
2	The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c)	3

	energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus	
3	To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	4
4.	Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA.Two carbon units and lipids.	4
5	Enzymes**:** To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4
6	Information Transfer:The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA structure- from single stranded to double helix to nucleosomes. Concept of genetic code. Universality and degeneracy of genetic code. Define gene in terms of complementation and recombination.	4

7	Macromolecular analysis**:** How to analyse biological processes at the reductionist level Proteins- structure and function. Hierarch in protein structure. Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.	5
8	Metabolism**:** The fundamental principles of energy transactions are the same in physical and biological world. Thermodynamics as applied to biological systems. Exothermic and endothermic versus endergonic and exergoinc reactions. Concept of $K_{eq}$and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to $CO_2 + H_2O$ (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4
9	Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3

Text books/ reference books:

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

Environmental Science
Code: MC-401
Contacts: 2L

Name of the Course:	**Environmental Sciences**	
Course Code: MC-401	Semester: IV	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:2hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz : 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	2	

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

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

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

Text books/ reference books:

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

Artificial Intelligence Lab
Code: PCC-AI491
Contacts: 4P

Name of the Course:	Artificial Intelligence Lab
Course Code: PCC- AI491	Semester:IV
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2
COURSE OBJECTIVES	
1. Gain a historical perspective of AI and its foundations.	
2. Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.	
3. Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.	
4. Experience AI development tools such as an 'AI language', expert system shell, and/or data mining tool.	
5. Experiment with a machine learning model for simulation and analysis	

Unit 1
Prolog Representation: Introduction, Logic-Based Representation, Prolog Syntax, Creating, Changing, and Tracing a Prolog Computation, Lists and Recursion in Prolog.
Structured Representation and Inheritance Search: Abstract Data Types and Search, Using cut, Control Search in prolog, Abstract Data Types (ADTs) in Prolog.

Unit 2
1. Write a program to implementation of DFS
2. Write a program to implementation of BFS

Unit 3
1. Write a Program to find the solution for traveling salesman Problem
Unit 4
1. Write a program to implement Simulated Annealing Algorithm
2. Write a program to find the solution for wampus world problemUnit 5
1. Write a program to implement 8 puzzle problem
Unit 6
1. Write a program to implement Tower of Hanoi problem
Unit 7
1. Write a program to implement A* Algorithm
Unit 8
1. Write a program to implement Hill Climbing Algorithm
Unit 9
1. To Study JESS expert systemUnit 10
1. To Study RVD expert systemUnit 11
1. Write a Program to Perform Fibonacci Series
2. Write a Program to Check Sides of a TriangleUnit 12

1. Write a Program to Perform Length of List
2. Write a Program to Perform Reverse in
List.Unit 13
1. Write a Prolog program to perform Arithmetic Mean.
2. Write a Program to Check Vowels or
Not.Unit 14
Machine Learning Algorithms in Prolog: Machine Learning: Version Space Search, Explanation
Based Learning in Prolog.
Programming in Lisp: S-Expressions, Syntax of LISP, Lists and Recursive Search, Variables,
Datatypes, High Order Functions, Logic Programming in LISP, Lisp-Shell.
Unit 15
Semantic Networks, Inheritance and Machine Learning: Sematic Nets, Inheritance, Object Oriented Lisp, LearningID3 Algorithm, And Implementing ID3 Algorithm.
Java, Representation and Object-Oriented Programming, Problem Spaces and Search, a Logic- Based Reasoning System, an Expert System Shell.

Course Outcome

1) Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

2) Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

3) Demonstrate awareness and a fundamental understanding of various applications of AI

Techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.

4) Demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool.

5) Demonstrate proficiency in applying scientific method to models of machine learning.

Design & Analysis of Algorithm Lab

Code: PCC-CS494

Contact: 4P

Name of the Course:	**Design & Analysis Algorithm Lab**
Course Code: PCC-CS494	Semester: IV
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

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

PYTHON II / R Programming Lab

Code: PCC-AI492

Contacts: 4P

Name of the Course:	**R Programming**
Course Code:PCC-AI492	Semester: IV
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory:	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
	Distribution of marks: 40
Practical: 4 hrs./week	
Credit Points:	2

Objective:	
1	identify and use available R packages and associated Open Source software to meet given scientific objectives
2	design and write efficient programs using R (and similar high-level languages) to perform routine and specialized data manipulation/management and analysis tasks
3	document analytical workflow using R, markdown languages, and version control
4	document, share, and collaborate on code development using a suite of Open Source standards and tools

Pre-Requisite:	
1	Computer Concepts and C Programming,
2	Database Management Systems

Practical Syllabus

1. Introduction to mechanism for statistics, data analysis, and machine learning; Introduction of R Programming, How to install and run R, Use of R help files, R Sessions, R Objects – Vectors, Attributes, Matrices, Array, Class, List, Data Frames etc. Operators in R.
2. R Programming Structures, Control Statements, Loops, Repeat and Break, R-Function, R Vector Function, Recursive Function in R.
3. R Packages (Install and Use), Input /Output Features in R, Reading or Writing in File. Data Manipulation in R. Rearranging data, Random Number and Simulation, Statistical methods like min, max, median, mean, length, Linear Regression, Normal Distribution,Decision tree
4. Graphics, Creating Graphs, The Workhorse of R Base Graphics, Graphical Functions – Customizing Graphs, Saving Graphs to Files, Pie chart, Bar Chart, Histogram.

Text book and References.

1. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna BookPublishing.
2. Wickham, H. (2014) Advanced R. Chapman and Hall/CRC.
3. Hands-On Programming with R by Grolemund, O Reilly Publications
4. R for Everyone: Advanced Analytics and Graphics, 1e by Lander, Pearson Ltd.
5. R for Data Science Learning Dan Toomey December 2014 Packt Publishing Limited

Course Outcomes

1 Install and use R for simple programming tasks.
2 Extend the functionality of R by using add-on packages
3. Extract data from files and other sources and perform various data manipulation tasks on them.
4 Code statistical functions in R and apply data analytical techniques using R.

PYTHON II

Code: PCCAI492

Contacts: 4P

Name of the Course:	**PYTHON II**	
Course Code:PCC-AI492	Semester: IV	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical:4 hrs./week		End Semester Exam : 70 Marks
Credit Points:	2	

Objective:	
1	To acquire programming skills in core Python
2	To acquire Object Oriented Skills in Python
3	To develop the skill of designing Graphical user Interfaces in Python
4	To develop the ability to write database applications in Python

Pre-Requisite:	
1	Computer Concepts and C Programming,
2	Database Management Systems

Practical Syllabus
Programming with
Python-II

1. **Programs to read and write files.**
2. **Programs to perform exploratory data analysis, variance, standard deviation, summarization, distribution,statistical inference.**
3. **Plotting the various distribution for data set.**
4. **Write a program for K-mean clustering.**
5. **Program to demonstrate exception handling.**
6. **Program to demonstrate the use of regular expressions.**
7. **Program to show draw shapes & GUI controls.**
8. **Program to create server-client and exchange basic information.**
9. **Program to send email & read contents of URL.**
10. **Python with MySQL.**
11. **Python using linear regression, multiple regression and polynomial regression.**
12. **Python with**
MongoDB13.

Text book and Reference books:

Introduction to Computing and Problem Solving with Python, Jeeva Jose, Khanna Publishing.Taming Python by Programming, Jeeva Jose, Khanna Publishing.

Michael Urban and Joel Murach, Python Programming, Shroff/Murach,

2016Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010

Course Outcomes

1. Explain basic principles of Python programming language
2. Implement object oriented concepts Implement database and GUI applications.

SEMESTER –V

Subject: Probability & Statistics	
Course Code: PCC-AI 501	**Semester: V**
Teaching Scheme	**Maximum Marks: 100**
Theory: 3 hrs./week	**Examination Scheme**
Tutorial:	End Semester Exam: 70
Practical:0	Attendance: 5
Credit:3	Continuous Assessment: 25

Aim:

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

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

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

Pre-Requisite:

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

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

Assignments:

Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

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

Operating Systems
Code: PCC- CS502
Contacts: 3L

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

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

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

Text Books:

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

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

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

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

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

Text book and Reference books:

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

Subject Code	Subject Name	L	T	P		C
PCC-AI502	Machine Learning	3	0	0		3
Pre-requisite	NIL					

Course Objectives:

1. Ability to comprehend the concept of supervised and unsupervised learning techniques
2. Differentiate regression, classification and clustering techniques and to implement their algorithms.
3. To analyze the performance of various machine learning techniques and to select appropriate features for training machine learning algorithms.

Expected Course Outcome:

1. Understand the concepts of various machine learning strategies.
2. Handle computational data and learn ANN learning models.
3. Solve real world applications by selecting suitable learning model.
4. Boost the performance of the model by combining results from different approaches.
5. Recognize and classify sequencing patterns using HMM.
6. Infer the association and relationship between the data objects.
7. Construct machine learning model for unseen data and can solve real world application.

Module:1	Introduction to Machine Learning	3 hours

Introduction to Machine Learning (ML); Feature engineering; Learning Paradigm, Generalization of hypothesis, VC Dimension, PAC learning, Applications of ML.

Module:2	Data Handling and ANN	4 hours

Feature selection Mechanisms, Imbalanced data, Outlier detection- Artificial neural networks including Back propagation- Applications

Module:3	ML Models and Evaluation	6 hours

Regression: Multi-variable regression; Model evaluation; Least squares regression; Regularization; LASSO; Applications of regression, Classification – KNN, Naïve Bayes, SVM, Decision Tree; Training and testing classifier models; Cross-validation; Model evaluation (precision, recall, F1-mesure, accuracy, area under curve); Statistical decision theory including discriminant functions and decision surfaces

Module:4	Model Assessment and Inference	4 hours

Model assessment and Selection – Ensemble Learning – Boosting, Bagging, Model Inference and Averaging, Bayesian Theory, EM Algorithm

Module:5	Hidden Markov Models	3 hours

Hidden Markov Models (HMM) with forward-backward and Vierbi algorithms; Sequence classification using HMM; Conditional random fields; Applications of sequence classification such as part-of-speech tagging

Module:6	Association Rules	3 hours

Mining Association Rules in Large Databases. Mining Frequent Patterns-- basic concepts - Efficient and scalable frequent item set mining -methods, Apriori algorithm, FP-Growth algorithm		
Module:7	**Clustering**	**5 hours**
K Means, Hierarchical Clustering – Single, complete, Average linkage; Ward's algorithm; Minimum spanning tree clustering; BIRCH clustering		
Module:8	**Recent Trends**	**2 hours**
Recent Trends and case study		
	Total Lecture hours:	**30 hours**

Text Book(s)	
1.	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Pearson, Third Edition, 2014.
2.	Friedman Jerome, Trevor Hastie, and Robert Tibshirani. The Elements of StatisticalLearning. Springer-Verlag, 2nd Edition, 2013.
3.	Jeeva Jose, Introduction to Machine Learning, Khanna Book Publishing.
Reference Books	
1.	Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.
2.	Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense ofData", Cambridge University Press, 2012.
3.	Rajiv Chopra, Machine Learning, Khanna Book Publishing.

Introduction to Industrial Management (Humanities III)

Code: HSMC-501
Contacts: 3L

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

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

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

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

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

Text book and Reference books:

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

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Artificial Intelligence

(Applicable from the academic session 2023-2024)

Cloud Computing
Code: PEC-AI501A
Contact: 3L

Name of the Course:	**Cloud Computing**	
Course Code: **PEC-AI501A**	Semester: V	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical:		End Semester Exam: 70 Marks
Credit Points:	3	

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

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

3	**Cloud Infrastructure**: Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computingdeployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle). Concepts of Cloud Security: Cloud security concerns, Security boundary,Security service boundary Overview of securitymapping Security of data: Brokered cloudstorage access, Storage location and tenancy,encryption, and auditing and compliance Identity management (awareness of Identityprotocol standards)	7	
4.	**Concepts of Services and Applications :** Service Oriented Architecture: Basic conceptsof message-based transactions, Protocol stackfor an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs, Applications in the Cloud: Concepts of cloudtransactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs Cloud-based Storage: Cloud storage definition – Manned and Unmanned Webmail Services: Cloud mail services including Google Gmail, Mail2Web, WindowsLive Hotmail, Yahoo mail, concepts of Syndication services	8	

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

Internet of Things
Code: PEC-AI501B
Contacts: 3L

Course Code	PEC-CS801 E
Course Name	**Internet of Things**
Credits	3
Pre-Requisites	Wireless Networks

COURSE OBJECTIVE

- Able to understand the application areas of IOT

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Environmental Parameters Measurement and Monitoring: Why measurement and monitoring are important, effects of adverse parameters for the living being for IOT	7
Unit 2: Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc	8
Unit 3: Important Characteristics of Sensors: Determination of the Characteristics Fractional order element: Constant Phase Impedance for sensing applications such as humidity, water quality, milk quality Impedance Spectroscopy: Equivalent circuit of Sensors and Modelling of Sensors Importance and Adoption of Smart Sensors	11
Unit 4: Architecture of Smart Sensors: Important components, their features Fabrication of Sensor and Smart Sensor: Electrode fabrication: Screen printing, Photolithography, Electroplating Sensing film deposition: Physical and chemical Vapor, Anodization, Sol-gel	10
Unit 5: Interface Electronic Circuit for Smart Sensors and Challenges for Interfacing the Smart Sensor, Usefulness of Silicon Technology in Smart Sensor And Future scope of research in smart sensor	7
Unit 6: Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	5

□ Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
COURSE OUTCOMES
On completion of the course the student should be able to
□ Understand the vision of IoT from a global context.
□ Determine the Market perspective of IoT.
□ Use of Devices, Gateways and Data Management in IoT.
□ Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.
□ Building state of the art architecture in IoT.
□ Able to understand building blocks of Internet of Things and characteristics

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

Subject: Graph Theory	
Course Code: PEC-AI501C	**Semester: V**
	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	**End Semester Exam: 70**
Tutorial:	**Attendance : 5**
Practical: 0	**Continuous Assessment: 25**
Credit: 3	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

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

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

Pre-Requisite:			
Sl. No.			
	None		
Contents		**4 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**

01	**Introduction** Discovery of graphs, Definitions, Subgraphs, Isomorphic graphs, Matrix representations of graphs, Degree of a vertex, Directed walks, paths and cycles, Connectivity in digraphs, Eulerian and Hamilton digraphs, Eulerian digraphs, Hamilton digraphs, Special graphs, Complements, Larger graphs from smaller graphs, Union, Sum, Cartesian Product, Composition, Graphic sequences, Graph theoretic model of the LAN problem, Havel-Hakimi criterion, Realization of a graphic sequence.	**7**	**14**

02	**Connected graphs and shortest paths** Walks, trails, paths, cycles, Connected graphs, Distance, Cut-vertices and cut-edges, Blocks, Connectivity, Weighted graphs and shortest paths, Weighted graphs, Dijkstra's shortest path algorithm, Floyd-Warshall shortest path algorithm.	**7**	**14**
03	**Trees** Definitions and characterizations, Number of trees, Cayley's formula, Kircho-matrix-tree theorem, Minimum spanning trees, Kruskal's algorithm, Prim's algorithm, Special classes of graphs, Bipartite Graphs, Line Graphs, Chordal Graphs, Eulerian Graphs, Fleury's algorithm, Chinese Postman problem, Hamilton Graphs, Introduction, Necessary conditions and sufficient conditions.	**7**	**14**
04	**Independent sets coverings and matchings** Introduction, Independent sets and coverings: basic equations, Matchings in bipartite graphs, Hall's Theorem, K¨onig's Theorem, Perfect matchings in graphs, Greedy and approximation algorithms.	**8**	**14**

05	**Vertex Colorings** Basic definitions, Cliques and chromatic number, Mycielski's theorem, Greedy coloring algorithm, Coloring of chordal graphs, Brooks theorem, Edge Colorings, Introduction and Basics, Gupta-Vizing theorem, Class-1 and Class-2 graphs, Edge- coloring of bipartite graphs, Class-2 graphs, Hajos union and Class-2 graphs, A scheduling problem and equitable edge-coloring.	**7**	**14**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**
List of Books **Text Books:**			

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

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

Group	**Unit**	**Objective Questions** (MCQ only with thecorrect answer)		**Subjective Questions**			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1 to 5**	**10**	**10**				

B **C**	**1 to 5** **1 to 5**			**5** **5**	**3** **3**	**5** **15**	**60**

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

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	**All**	**1**	**10**	**10**
B	**All**	**5**	**5**	**3**
C	**All**	**15**	**5**	**3**

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

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

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

Creating a bash shell script, making a script executable, shell syntax (variables, conditions,control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks,Making file systems, Superblock, I-nodes,File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Passwordfile management, Password

security, Shadow file, Groups and the group file, Shells, restricted shells, user-managementcommands, homes and
permissions, default files, profiles, locking accounts, setting passwords, Switching user,Switching group, Removing users &user groups.
2. **Process [4P]**: starting new process, replacing a process image, duplicating aprocessimage, waiting for a process,
zombie process.
3. **Signal [4P]**: signal handling, sending signals, signal interface, signal sets.
4. **Semaphore [6P]**: programming with semaphores (use functions semctl, semget,semop,set_semvalue, del_semvalue, semaphore_p, semaphore_v).
5. **POSIX Threads [6P]**: programming with pthread functions (viz. pthread_create,pthread_join, pthread_exit,
pthread_attr_init, pthread_cancel)
6. **Inter-process communication [6P]**: pipes(use functions pipe, popen, pclose), namedpipes(FIFOs, accessing FIFO),
message passing & shared memory(IPC version V).

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

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

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

Laboratory Experiments:

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

Note: Use Java for programming

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

Subject Code	Subject Name	L	T	P		C
PCC-AI 592	**Machine Learning Lab**	**0**	**0**	**4**		**2**
Pre-requisite	**NIL**					
Lab Experiments						
1.	Implement Decision Tree learning	2 hours				
2.	Implement Logistic Regression	2 hours				
3.	Implement classification using Multilayer perceptron	2 hours				
4.	Implement classification using SVM	2 hours				
5.	Implement Adaboost	2 hours				
6.	Implement Bagging using Random Forests	2 hours				
7.	Implement K-means Clustering to Find Natural Patterns in Data	2 hours				
8.	Implement Hierarchical clustering	2 hours				
9.	Implement K-mode clustering	2 hours				
10	Implement Association Rule Mining using FP Growth	2 hours				
11.	Classification based on association rules	2 hours				
12.	Implement Gaussian Mixture Model Using the Ex ectation Maximization	2 hours				
13	Evaluating ML algorithm with balanced and unbalanced datasets	2 hours				
14	Comparison of Machine Learning algorithms	2 hours				
15	Implement k-nearest neighbour algorith	2 hours				
Total Lecture hours:		**30 hours**				

SEMESTER – VI

Database Management Systems
Code: PCC-AI601
Contact: 3L

Name of the Course:	**Database Management Systems**		
Course Code: **PCC-AI601**	Semester: VI		
Duration:6 months	Maximum Marks:100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: hrs./week		End Semester Exam:70 Marks	
Credit Points:	3		
Objective:			
1	To understand the different issues involved in the design and implementation of a database system.		
2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models		
3	To understand and use data manipulation language to query, update, and manage a database		
4	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.		
5	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.		
6	To understand the different issues involved in the design and implementation of a database system.		

Unit	Content	Hrs/Unit	Marks/Unit
1	**Database system architecture:** Data Abstraction, Data Independence,Data Definition Language(DDL),Data Manipulation Language(DML). **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	9	

2	**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQLserver. **Relational database design:** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Losslessdesign. **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	13	
3	**Storage strategies**: Indices, B-trees, hashing.	3	
4.	**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	5	
5	**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	3	
6	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	3	

Text book and Reference books:

1."Database System Concepts" , 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan,McGraw-Hill.
2."Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman,Computer Science Press.
3. Database Management Systems, R.P. Mahapatra, Khanna Publishing House, NewDelhi (AICTE Recommended Textbook – 2018)

4."Fundamentals of Database Systems" , 5th Edition by R. Elmasri and S. Navathe,
5.PearsonEducation "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley

Course Outcomes:

On completion of the course students will be able to

1. For a given query write relational algebra expressions for that query andoptimize the developedexpressions
2. For a given specification of the requirement design the databasesusing E R method andnormalization.
3. For a given specification construct the SQL queries for Open source andCommercial DBMS -MYSQL, ORACLE, andDB2.
4. For a given query optimize its execution using Query optimizationalgorithms
5. For a given transaction-processing system, determine the transactionatomicity, consistency, isolation, anddurability.
6. Implement the isolation property, including locking, time stampingbased on concurrency control and Serializability of scheduling.

Subject: Deep Learning			
Course Code: PCC-AI 602		**Semester: VI**	
Duration: 36 Hrs.		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		End Semester Exam: 70	
Tutorial: 0		Attendance : 5	
Practical:		Continuous Assessment:25	
Credit: 3			
Aim:			
Sl. No.			
1.	To improve the performance of a Deep Learning model		
2.	to the reduce the optimization function which could be divided based on the classification and the regression problems		
Objective:			
Sl. No.			
1.	To acquire knowledge on the basics of neural networks.		
2.	To implement neural networks using computational tools for variety of problems.		
3.	To explore various deep learning algorithms.		
Pre-Requisite:			
Sl. No.			
1.	Calculus, Linear Algebra		
2.	Probability & Statistics		
3.	Ability to code in R/Python		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**

01	**Introduction** Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	**3**	**5**
02	**Feed forward neural network** Artificial Neural Network, activation function, multi-layer neural network, cardinality, operations, and properties of fuzzy relations.	**6**	**10**
03	**Training Neural Network** Risk minimization, loss function, back propagation, regularization,model selection, and optimization.	**6**	**15**
04	**Conditional Random Fields** Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	**9**	**15**
05	**Deep Learning** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	**6**	**15**
06	**Deep Learning research** Object recognition, sparse coding, computer vision, natural **language**	**6**	**10**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Rajiv Chopra	Dep Learning (AICTE Recommended Textbook)	First Edition	Khanna Book Publishing
Goodfellow, I.,Bengio,Y., andCourville A.,	Deep Learning		MIT Press
Satish Kumar	Neural Networks: A Classroom Approach		Tata McGraw-Hill

Reference Books:

Bishop, C. ,M.	Pattern Recognition and Machine Learning		Springer
Yegnanarayana, B.	Artificial Neural Networks		PHI Learning Pvt. Ltd
Golub, G.,H., and VanLoan,C.,F.	Matrix Computations		JHU Press

Soft Computing
Code: PCC-AI603 & PCC-AI693
Contacts: 3L + 4P

Name of the Course:	**Soft Computing**
Course Code: **PCC-AI603 & PCC-AI693**	Semester: VI
Duration:6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz : 10 marks
	Attendance: 5 marks
Practical: 4 hrs./week	End Semester Exam: 70 Marks
	Practical Sessional internal continuous evaluation:40
	Practical Sessional external examination: 60
Credit Points:	3 + 2

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

Practical:

Skills to be developed:

1. Able to apply Soft Computing techniques to solve a number of real life problems.

Assignments: : Assignment from theory

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Timothy J. Ross, JohnWiley and Sons	Fuzzy logic with engineering applications		
S. Rajasekaran andG.A.V.Pai	Neural Networks, Fuzzy Logic and Genetic Algorithms		PHI
S N Sivanandam, S.Sumathi, John	Principles of Soft Computing		
Reference Books:			
George J. Klir and BoYuan	Fuzzy Sets and Fuzzy Logic: Theory and Applications		Prentice Hall
Simon Haykin	Neural Networks: A Comprehensive Foundation		Prentice Hall.

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

Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)		**Subjective Questions**			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**ALL**	**10**	**10**	**5**	**3**	**15**	**70**
B	**All**						
C	**All**			**5**	**3**	**45**	

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

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	**ALL**	**1**	**10**	**10**
B	**ALL**	**5**	**5**	**3**
C	**ALL**	**15**	**5**	**3**

Examination Scheme for Practical Sessional examination:		
Practical Internal Sessional Continuous Evaluation		
Internal Examination:		
Continuous evaluation		**40**
External Examination: Examiner-		
Signed Lab Assignments	**10**	
On Spot Experiment	**40**	
Viva voce	**10**	**60**

Computer Network

Code: PCC-CS602
Contact: 3L

Name of the Course:	**Computer Network**		
Course Code: PCC-CS602	Semester: VI		
Duration:6 months	Maximum Marks:100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: hrs./week		End Semester Exam:70 Marks	
Credit Points:	3		
Objective:			
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	Data communication Components: Representation of data and its flow Networks,Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	9	
2	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking,	8	

	Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA		
3	Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	14	
4.	**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	8	
5	**Application Layer:** Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	8	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Big Data Analytics
Code: PEC-AI601A
Contacts: 3L

Name of the Course:	**Big Data Analytics**	
Course Code: **PEC-AI601A**	Semester: VI	
Duration:6 months	Maximum Marks: 100	
Teaching Scheme	**Examination Scheme**	
Theory: 3 hrs./week	Mid Semester exam: 15	
Tutorial: NIL	Assignment and Quiz : 10 marks	
	Attendance: 5 marks	
Practical: NIL	End Semester Exam: 70 Marks	
Credit Points:	3	

LECTURE WITH BREAKUP	**NO. OF LECTUR**
Unit 1: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.	8

Unit 2: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	8
Unit 3: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based datastructures	9
Unit 4: MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats	10
Unit 5:	7
Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	
Unit 6: Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.	6

References:

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging
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 EmergingWorld of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
7. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
8. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
9. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
10. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
11. Alan Gates, "Programming Pig", O'Reilley, 2011.

Data Mining
Code: PEC-AI601B
Contacts: 3L

Name of the Course:	Data Mining		
Course Code: PEC-AI601B	Semester: VI		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam:70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
	Unit 1:		
1	Overiew of data ming and predictive analytics. Where does it apply and where does it not apply. The emerging interdisplinary field of Data Science – what on Earth is it? The potential pitfalls of analytics including big bad data and the problem of local sparsity in large data sets -- big never guarantees sufficient. Brief discussion of Career Opportunities including an overview of the UNH MS Analytics program.	4	
2	**Unit 2:** Data preprocessing and cleanup including informative missing values and imputation.	3	
3	**Unit 3:** Unsupervised learning: Exploring data with visualization (primarily JMP Pro and Enterprise Guide), Principal Components, Cluster Analysis, Variables Clustering, and Market Basket analysis (association analysis). The problem of explanatory (traditional) vs predictive modeling and why it matters.	8	
4.	**Unit 4:** The under and overfitting dilemma of predictive modeling. Includes a discussion of measures of overfitting and underfitting such as AICc, BIC, and the very new ERIC.	6	
5	**Unit 5:** Validation strategies to assess model predictive behavior and predictive inference	2	

6	**Unit 6:** Supervised learning for classification: k-nearest neighbors, Decision Trees and Random Forests, Naïve Bayes, Neural Nets, Logistic Regression, Generalized Regression, Support Vector Machines, Discriminant Analysis. Topics include boosted neural and tree models.	5	
7	**Unit 7:** Supervised learning for prediction: review of multiple linear regression and related topics like influence and multi-collinearity, PCR, Neural Nets, Generalized Regression including the LASSO (adaptive), LARS, Ridge, and Elastic Net (adaptive). Traditional variable Selection strategies such as Forward Selection and All Possible Models will also be covered.	6	
8	**Unit 8:** Model assessment measures for predictive and classification models: model scoring, prediction error analysis, ROC and Lift curves, profit matrices for classification, various model comparison criteria. Ensemble Modeling: combining predictive models to create even more powerful models; includes boosting and bagging strategies.	6	

1. Data Mining for Business Intelligence: Concepts, Techniques and Applications with JMP Pro; Shmueli, Bruce, Stephens, Patel 2017,Wiley & Sons
2. Preparing Data for Analysis with JMP by Robert Carver
3. Introduction to Statistical Learing, sixth printing, by Gareth, Tibshirani, Hastie, and Whitten

Human Computer Interaction
Code:OECAI-601B
Contact: 3L

Name of the Course:	**Human Computer Interaction**	
Course Code: OECML-601B	Semester: VI	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/ Unit
1	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; 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	
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 SoftwareSecurity,Addison Wesley.

Name of the Course:	**Cryptography & Network Security**	
Course Code:OEC-AI 601B	Semester: VI	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam : 70 Marks
Credit Points:	3	

Computer Security Concepts, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms , A Model for Network Security, Classical Encryption Techniques, Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography, Cryptographic Tools, Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Random and Pseudorandom Numbers, Practical Application: Encryption of Stored Data, User Authentication, Means of Authentication, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Security Issues for User Authentication, Malicious Software, Types of MaliciousSoftware (Malware), Propagation—Infected Content—Viruses, Propagation—Vulnerability Exploit—Worms, Propagation—Social Engineering—SPAM Email, Trojans, Payload—System Corruption, Payload—Attack Agent—Zombie, Bots, Payload—Information Theft—Key loggers,Phishing, Spyware, Payload—Stealthing— Backdoors, Rootkits, Countermeasures, Firewalls and Intrusion Prevention Systems, the Need for Firewalls, Firewall Characteristic, Types of Firewalls, Firewall Basing, Firewall Location and Configurations, Intrusion Prevention Systems.

Text Books:

1. Cryptography and Network Security: Principles and Practice by William Stalings 6thEdition published by PHI (2011)
2. Computer security principles and practice, William Stallings, Lawrie Brown, thirdedition, Prentice-Hall, 2011
3. Cryptography and Network Security, V.K. Jain, Khanna Publishing House

PRACTICAL SYLLABUS

Database Management System Lab

Code: PCC-AI691
Contacts: 4P

Name of the Course:	**Database Management System Lab**
Course Code: **PCC-AI691**	Semester: VI
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

Laboratory Experiments:

Structured Query Language

1. Creating Database

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

Table and Record Handling

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

Retrieving Data from a Database

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

Clause

5. Using Aggregate Functions
6. Combining Tables Using JOINS
7. Subqueries

Database Management

- Creating Views
- Creating Column Aliases
- Creating Database Users
- Using GRANT and REVOKE

Computer Networks Lab
Code: PCC-CS692
Contacts: 4P

Name of the Course:	Computer Networks Lab
Course Code: PCC-CS692	Semester: VI
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

1) NIC Installation & Configuration (Windows/Linux)
2) Understanding IP address, subnet etc
Familiarization with
- Networking cables (CAT5, UTP)
- Connectors (RJ45, T-connector)
- Hubs, Switches

3) TCP/UDP Socket Programming
- Simple, TCP based, UDP based
- Multicast & Broadcast Sockets
- Implementation of a Prototype Multithreaded Server

4) Implementation of
□ Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window)
□ Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)
□ Data Link Layer Error Control Mechanism (Selective Repeat, Go Back N)
5) Server Setup/Configuration FTP,
TelNet, NFS, DNS, Firewall

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

1.	Understand Image formation process
2.	Extract features form Images and do analysis of Images
	To develop applications using computer vision techniques

Pre-Requisite:			
Sl. No.			
1.	Programming		
2.	Mathematic course		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	**3**	**10**
02	Edge detection, Edge detection performance, Hough transform,corner detection	**6**	**10**
03	Segmentation, Morphological filtering, Fourier transform	**3**	**10**
04	Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing	**9**	**10**
05	**Pattern Analysis:** Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA,LDA, ICA, and Non-parametric methods.	**9**	**20**
06	Recent trends in Activity Recognition, computational photography, Biometrics	**6**	**10**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books Text Books:

Semester – VII

Computer Graphics

Code: PEC-AI701A

Contacts: 3L

Name of the Course:	**Computer Graphics**	
Course Code: **PEC-AI701A**	Semester: V	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	3	

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

3.	B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves. **Hidden surfaces [3L]:** 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. **Color & shading models [2L]:** Light & color model; interpolative shading model; Texture. **Introduction to Ray-tracing: [3L]** Human vision and color, Lighting, Reflection and transmission models.	6	

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

Quantum Computing
Code: PEC- AI701C
Contacts: 3L

Name of the Course:	**Quantum Computing**
Course Code: PEC- AI701C	Semester: VII
Duration: 6 months	Maximum Marks:100
Teaching Scheme	**Examination Scheme**
Theory:3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz: 10 marks
	Attendance : 5 marks
Practical: NIL	End Semester Exam :70 Marks
Credit Points: 3	

Unit	Content	Hrs/Unit	Marks/ Unit
1	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchyschwarez and triangle Inequalities.	3	
2	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators,	10	
3.	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics.	5	
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	5	
5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.	8	
6.	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	6	

Text book and Reference books:

Quantum Computing without Magic by Zdzislaw Meglicki
2. Quantum Computing Explained By DAVID Mc MAHON
3. Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann
4. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.

Multi-agent Intelligent System

Code: PEC- AI701D
Contacts: 3L

Name of the Course:	Multi-agent Intelligent Systems	
Course Code: **PEC-AI701D**	Semester: VII	
Duration:6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz : 10 marks
		Attendance: 5 marks
Practical:		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: what is an agent?: agents and objects; agents and expert systems; agents and distributed systems; typical application areas for agent systems.	3	
2	Intelligent Agents: the design of intelligent agents - reasoning agents (eg AgentO), agents as reactive systems (eg subsumption architecture); hybrid agents (eg PRS); layered agents (eg Interrap) a contemporary (Java-based) framework for programming agents (eg the Jack language, the JAM! system).	9	

3	Multi-Agent Systems: Classifying multi-agent interactions - cooperative versus non-cooperative; zero-sum and other interactions; what is cooperation? how cooperation occurs - the Prisoner's dilemma and Axelrod's experiments; Interactions between self-interested agents: auctions & voting systems: negotiation; Interactions between benevolent agents: cooperative distributed problem solving (CDPS), partial global planning; coherence and coordination; Interaction languages and protocols: speech acts, KQML/KIF, the FIPA framework.	12	
4.	Advanced topics: One issue selected from the contemporary research literature, perhaps by guest lecturer.	9	

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, JomiFred Hubner and Michael Wooldridge (Wiley, 2007)

Information Theory and Coding
Code:PEC- AI702B
Contact: 3L

Name of the Course:	**Information Theory and Coding**		
Course Code: **PEC-AIML702B**	Semester: VII		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical:NIL		End Semester Exam: 70 Marks	
Credit Points:	3		
Unit	Content	Hrs/Unit	Marks/Unit

1	**Source Coding [7L]** Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes	7	
2	**Channel Capacity And Coding [7L]** Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit	7	
3	**Linear And Block Codes For Error Correction [8L]** Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes	8	
4.	**Cyclic Codes [7L]** Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes..	7	
5	**BCH Codes [8L]** Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.	8	
6	**Convolutional Codes [8L]** Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding	8	

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.

Digital Signal Processing
Code: PEC- AI701D
Contacts: 3L

Name of the Course:	**Digital Signal Processing**		
Course Code: **PEC-AI701D**	Semester: VII		
Duration:6 months	Maximum Marks: 100		
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz : 10 marks	
		Attendance: 5 marks	
Practical:		End Semester Exam: 70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
1	Module 1: Discrete-time signals and systems (6 hours) Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	6	
2	Module 2: Z-transform (6 hours) z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.	6	
3	Module 2: Discrete Fourier Transform (10 hours) Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	10	
4.	Module 3:Designof 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. Schafer, "Discrete Time Signal Processing", Prentice Hall,1989.
3. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, AlgorithmsAnd 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 andW. S. Hodgkiss, "Digital Signal Processing", John Wiley& Sons, 1988.

Robotics

Code: PEC-AI702A
Contacts: 3L

Name of the Course:	**Robotics**	
Course Code: **PEC-AI702A**	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme	**Examination Scheme**	
Theory:3 hrs./week	Mid Semester exam: 15	
Tutorial: NIL	Assignment and Quiz: 10 marks	
	Attendance: 5 marks	
Practical: NIL	End Semester Exam: 70 Marks	
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	**Introduction :**Introduction -- brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.	1	
2	**Elements of robots – links, joints, actuators, and sensors** Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link	5	

	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	**Kinematics of serial robots** Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator**.**	4	

4.	**Kinematics of parallel robots** Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.	5	
5.	**Velocity and static analysis of robot manipulators** Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.	5	

6	**Dynamics of serial and parallel manipulators** Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Commercially available multi-body simulation software (ADAMS) and Computer algebra software Maple.	4	
7	**Motion planning and control** Joint and Cartesian space trajectory planning and generation, Classical **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**	6	
8	**Modeling and control of flexible robots Models of flexible links and joints, Kinematic modeling of multi- link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.**	4	
9	**Modeling and analysis of wheeled mobile robots 3Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three- wheeled WMR's on uneven terrain, Simulations using Matlab and ADAMS.**	3	
10	**Selected advanced topics in robotics Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough- Stewart platform and its singularities, use of near singularity for fine**	3	

	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).		

Text book and Reference books:

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

Subject Name: SOCIAL NETWORK ANALYSIS
Code- OEC-AI701A
Contact hrs./week: 3
Credit: 3

Introduction to Social Web, Nodes, Edges and Network Measures, Describing Nodes and Edges, Describing Networks, Layouts, Visualizing network features, The role of Tie strength, Measuring Tie strength and its network structures, network propagation, Link prediction, entity resolution, Case study, Introduction to community discovery, communities in context, quality functions, The Kernighan-Lin algorithm, Agglomerative algorithms, spectral algorithms, multi-level graph partitioning, Markov clustering, Other approaches, Introduction to social influence, Influence related statistics, social similarity and influence, Homophily, Existential Test for social influence, Influence and actions, Influence and interactions, influence maximization in viral marketing.

References:

1. Jennifer Golbeck., *Analysing the Social Web,* Morgan Kaufmann publications, 2013
2. Charu C. Aggarwal, *Social Network Data Analytics*, Springer publications, 2011
3. John Scott, *Social Network Analysis*, (3e), Sage publications limited, 2013
4. Jay Goldman, *Facebook Cookbook*, O'Reilly, 2009
5. Shamanth Kumar, Fred Morstatter, Huan Liu, *Twitter Data Analytics*, Springer publications, 2013

Subject: Bioinformatics	
Course Code: OEC-AI 701B	**Semester: VII**
Duration: 36 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3hrs./week	**End Semester Exam: 70**
Tutorial:	**Attendance : 5**
Practical: 0	**Continuous Assessment: 25**
Credit:3	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Aim:	
Sl. No.	
1.	To give students an introduction to the basic practical techniques of bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.
2.	The students will become familiar with the use of a wide variety of internet applications, biological database and will be able to apply these methods to research problems.

Objective:	
Sl. No.	After completion of the course, students will be able to:
1.	Describe the contents and properties of the most important bioinformatics databases, perform text- and sequence-based searches, and analyze and discuss the results in light of molecular biological knowledge
2.	Explain the major steps in pairwise and multiple sequence alignment, explain the principle for, and execute pairwise sequence alignment by dynamic programming
3.	Predict the secondary and tertiary structures of protein sequences.

Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Concepts of Cell, tissue, types of cell, components of cell, organelle. Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept. Concepts of RNA : Basic structure, Difference between RNA and DNA. Types of RNA. Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Tranlation Introduction to Metabolic Pathways	**7**	**12**

02	Sequence Databases 2 Introduction to Bioinformatics. Recent challenges in Bioinformatics. Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed;	**7**	**14**
03	DNA SEQUENCE ANALYSIS 14 Syllabus for B.Tech(Information Technology) Up to Fourth Year Revised Syllabus of B.Tech IT DNA Mapping and Assembly : Size of Human DNA ,Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays,	**8**	**18**
	Cutting DNA into Fragments, Sequencing Short DNA Molecules, Mapping Long DNA Molecules. DeBruijn Graph. Sequence Alignment: Introduction, local and global alignment, pair wise and multiple alignment, Dynamic Programming Concept. Alignment algorithms: Needleman and Wunsch algorithm, Smith-Waterman.		
04	Introduction Probabilistic models used in Computational Biology 8 Probabilistic Models; Hidden Markov Model : Concepts, Architecture, Transition matrix, estimation matrix. Application of HMM in Bioinformatics : Genefinding, profile searches, multiple sequence alignment and regulatory site identification. Bayesian networks Model :Architecture, Principle ,Application in Bioinformatics.	**7**	**12**
05	Biological Data Classification and Clustering 6 Assigning protein function and predicting splice sites: Decision Tree	**7**	**14**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Des Higgins (Editor), Willie Taylor.	Bioinformatics: Sequence, Structure and Databanks: A Practical Approach	ISBN: 978-0199637904. 1st edition,	Oxford University Press.
David W. Mount.	Bioinformatics: Sequence and Genome Analysis	ISBN: 978-0879697129 2nd edition,	Cold spring harbor laboratory press.
Reference Books:			

	Introduction to Bioinformatics	ISBN: 978-8178085074 1st edition	Pearson Education.
	Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins	ISBN: 978-0471478782. Second Edition,	John Wiley & Sons, Inc., Publication.

End Semester Examination Scheme.		**Maximum Marks-70.**	**Time allotted-3hrs.**
Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)	**Subjective Questions**

		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1 to 5**	**10**	**10**				
B	**1 to 5**			**5**	**3**	**5**	**60**
C	**1 to 5**			**5**	**3**	**15**	

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

Examination Scheme for end semester examination:

Group	**Chapter**	**Marks of each Question**	**Question to be Set**	**Question to be answered**
A	**All**	**1**	**10**	**10**
B	**All**	**5**	**5**	**3**
C	**All**	**15**	**5**	**3**

E-Commerce & ERP:

Code: OEC-AI701C
Contacts: 3L

1. Overview, Definitions, Advantages & Disadvantages of E – Commerce, Threats of E – Commerce, Managerial Prospective, Rules & Regulations For Controlling E – Commerce, CyberLaws. [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, WirelessWeb, Web Security, Infrastructure Requirement For E – Commerce . [5 L]
3. Business Models of e – commerce : Model Based On Transaction Type, Model Based OnTransaction 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 ; ContentMarketing. Call Center : Definition, Need, Tasks Handled, Mode of Operation, Equipment , Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE). [6 L]

6. 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]
7. E – Payment Mechanism : Payment through card system, E – Cheque, E – Cash, E – PaymentThreats & Protections. [1 L]
8. E – Marketing :. Home –shopping, E-Marketing, Tele-marketing [1 L]
9. Electronic Data Interchange (EDI) : Meaning, Benefits, Concepts, Application, EDI Model,Protocols (UN EDI FACT / GTDI, ANSI X – 12), Data Encryption (DES / RSA). [2 L]
10. Risk of E – Commerce : Overview, Security for E – Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital certificates, Digitalsignatures. [4 L]
11. 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, QualityManagement, Sales&Distribution ERPPackage, ERP Market: ERP Market Place, SAP AG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation ERP-Present and Future: EnterpriseApplication 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

Project Management and Entrepreneurship
Code: HSMC 701
Contact: 2L

Name of the Course:	Project Management and Entrepreneurship	
Course Code: HSMC 701	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**
Theory: 2 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:	2	

ENTREPRENEURSHIP

1. Introduction: Meaning and Concept of Entrepreneurship, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk-opportunities perspective and mitigation ofrisks [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 newventures – 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, theChanging Role of the Entrepreneur. [2L]
7. Applications and Project Reports Preparation [4L]
8. PROJECT MANAGEMENT : Definitions of Project and Project Management, Issues and Problems in Project Management, Project Life Cycle - Initiation / Conceptualization Phase,Planning Phase, Implementation / Execution Phase, Closure / Termination Phase [4L]
9. Project Feasibility Studies – Pre-Feasibility and Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis [2L]
10. Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope,Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS), Phased Project Planning [2L]
11. Project Scheduling and Costing – Gantt chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-offAnalysis, Project Cost Reduction Methods. [6L]
12. Project Monitoring and Control – Role of Project Manager, MIS in Project Monitoring, ProjectAudit [2L]
13. Case Studies with Hands-on Training on MS-Project [4L]

Text Books and References

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

Project-I
Code: PROJ-AI 781
Contact:
12P
Credit-6

Project work I

The object of Project Work I is to enable

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Artificial Intelligence

(Applicable from the academic session 2023-2024)

SEMESTER – VIII

Natural Language Processing
Code: PEC-AI 801A
Contacts: 3L

Name of the Course:	**Natural Language Processing**	
Course Code: PEC-AI 801A	Semester: VIII	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance : 5 marks
Practical:NIL		End Semester Exam :70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	**Regular Expressions and AutomataRecap)** - Introduction to NLP, Regular Expression, Finite State Automata [2L] **Tokenization -** Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance [5L] **Morphology -** Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer [4L]	11	
2	**Language Modeling** Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. [4L] **Hidden Markov Models and POS Tagging** Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation. [4L]	8	

3	**Text Classification** Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. [4L] **Context Free Grammar** Context Free Grammar and Constituency, Some common CFG phenomena for	9	
	English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing [4L]		
4.	**Computational Lexical Semantics** Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity [4L] **Information Retrieval** Boolean Retrieval, Term- document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback [5L]	9	

Text book and Reference books:

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

Cyber Law and Ethics
Code: PEC-AI801B
Contacts: 3L

Name of the Course:		Cyber Law and Ethics	
Course Code: **PEC-AI801B**		Semester: VIII	
Duration:6 months		Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz : 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
1	Intellectual Property: Intellectual property, copyrights, patents, trade secrets and its laws, employees and trade secret, key intellectual property issues, plagiarism, reverse engineering, open source code, competitive intelligence, trademark infringement, cybersquatting.	8	
2	Software Development: Strategies for engineering quality software, importance of software quality, software product liability, software development process, capability maturity model integration, safety critical system, quality management standards.	8	
3	The Impact of Information Technology on Productivity and Quality of Life: Impact of IT, IT investment and productivity, digital divide, impact of it on healthcare cost, electronic health records, use of mobile and wireless technology in healthcare industry, telemedicine, medical information websites.	8	
4.	Social Networking: Social networking website, business Application of online social networking, social networking ethical issues: cyberbullying, cyber stalking, sexual predators, uploading inappropriate material. Online virtual world: crime in virtual world, educational and business uses.	8	
5	Ethics of IT Organization: Key ethical issues, non-traditional Workers, contingent workers, H-1 B workers, outsourcing, whistle blowing, green computing, ICT industry code of conduct.	**8**	

Text book and Reference books:

1. "Ethics in Information Technology", 4th Edition, George Reynolds Strayer University, 2012.
2. "Ethics and Technology: Controversies, Questions, and Strategies for Ethical Computing", 3rd Edition,Herman T. Tavani, John Wiley & Sons, 2011.
2. "Information Technology Ethics: Cultural Perspectives", Soraj Hon ladarom, Charles Ess, Idea GroupInc (IGI), 2007.
3. "Information Security and Cyber Laws" by Gupta & Gupta, Khanna Book Publishing, New Delhi.

Mobile Computing
Code: PEC- AI801C
Contacts: 3L

Name of the Course:	**Mobile Computing**
Course Code: **PEC- AI801C**	Semester: VIII
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory:3 hrs./week	Mid Semester exam: 15
Tutorial: 3L	Assignment and Quiz: 10 marks
	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signalling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signalling.	5	
2	General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.	5	
3	Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML). Wireless Local Loop(WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.	7	

4.	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G	7	

5	Global Mobile Satellite Systems; case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.	7	
6	Server-side programming in Java, Pervasive web application architecture, Device independent example Application	8	

Text book and Reference books:

1. "Pervasive Computing", Burkhardt, Pearson
2. "Mobile Communication", J. Schiller, Pearson
3. "Wireless and Mobile Networks Architectures", Yi-Bing Lin & Imrich Chlamtac, John Wiley& Sons, 2001
4. "Mobile and Personal Communication systems and services", Raj Pandya, Prentice Hall ofIndia, 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

Economic Policies in IndiaCode:
OEC- AI801A
Contacts: 3L

Economic Development and its Determinants

Approaches to economic development and its measurement – sustainable development; Role ofState, market and other institutions; Indicators of development – PQLI, Human DevelopmentIndex (HDI), genderdevelopment indices.

Planning in India

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

Demographic Features, Poverty and Inequality

Broad demographic features of Indian population; rural-urban migration; Urbanizationand 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; IssuesTerms 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 inIndia; 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-importpolicy 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 andsafety 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.
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.

Micro-electronics and VLSI Design
Code: OEC- AI801B
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] .

Power Dissipation: Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation. Programmable Logic, Programmable Logic structure, Programmable interconnect, and Reprogramable 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

Software Engineering
Code:OEC-AI 801C
Contact: 3L

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

Unit	Content	Hrs/Unit	Marks/Unit
1	Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model. **[10L]**	10	
2	System Design – Context diagram and DFD, Problem Partitioning, Top-Down And Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach. **[5L]**	5	
3	Coding & Documentation – Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. **[4L]** Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control. **[8L]**	12	
4.	Software Project Management – Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. **[7L]**	7	

5	Static and dynamic models, why modeling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram. **[10 L]**	10	

Text book and Reference books:

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

Human Resource Development and Organizational Behavior
Code: OEC-AI 802 A
Contact: 3L

Name of the Course:	**Human Resource Development and Organizational Behavior**	
Course Code: OEC-AI 802A	Semester: VIII	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam:70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	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, Developmentof Personality, Types of Attitudes, Job Satisfaction.	4	

2	Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and DecisionMaking. **[2]** 4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor'sTheory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory ofNeeds, 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, Directionof 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 ModernView of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. **[2]** Organizational Design: Various Organizational Structures and their Effects on Human Behaviour,Concepts of Organizational Climate and Organizational Culture.	8	

Text book and Reference books:

1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.
2. Luthans, Fred: Organizational Behavior, McGraw Hill, 12th Edn.

3. Shukla, Madhukar: Understanding Organizations – Organizational Theory & Practice in India, PHI
4. Fincham, R. & Rhodes, P.: Principles of Organizational Behaviour, OUP, 4th Edn.
5. Hersey, P., Blanchard, K.H., Johnson, D.E.- Management of Organizational Behavior Leading Human Resources,
PHI, 10th Edn.

Research Methodology
Code: OEC-AI 802B
Contact: 3L

Name of the Course:	**Research Methodology**	
Course Code: OEC-AI 802B	Semester: VIII	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam:70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit
1	**RESEARCH FORMULATION AND DESIGN** Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of appliedand basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews,monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.	9	
2	**DATA COLLECTION AND ANALYSIS** Accepts of method validation, observation andcollection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.	9	

3	**RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING** Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS);scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.	9	
4.	**INTERPRETATION AND REPORT WRITING** Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Project Report, Layout of the Project/Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Project/Research Report, Precautions for Writing Research Reports, Conclusions.	9	

Text book and Reference books:

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

Additional reading

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

Soft Skill & Interpersonal Communication

Code: OEC-AI802C
Contact: 3L

Name of the Course:		**Soft Skill & Interpersonal Communication**	
Course Code: OEC-AI802C		Semester: VIII	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: A New Approach To Learning, Planning And Goal-Setting, Human Perceptions: Understanding People, Types Of Soft Skills: Self-Management Skills, Aiming For Excellence: Developing Potential And Self- Actualization, Need Achievement And SpiritualIntelligence	5	
2	Conflict Resolution Skills: Seeking Win-Win Solution, Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types Of Conflicts: Becoming 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: IdentifyingGood And Bad Habits, Habits: Habit Cycle, Breaking Bad Habits, Using The ZeigarnikEffect For Productivity And Personal Growth,Forming Habits Of Success	5	
4.	Communication: Significance Of Listening, Communication: Active Listening, Communication: Barriers To Active Listening, Telephone Communication: Basic Telephone Skills , Telephone Communication: Advanced Telephone Skills, Telephone Communication:Essential Telephone Skills	5	

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-ThinkingAssessment-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	
8	Presentation Skills: Overcoming Fear, 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	5	

TEXT BOOKS AND REFERENCES

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

Project-II
Code: PROJ-AI 881
Contact: 12P

Project Work II & Dissertation

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

1. In depth study of the topic assigned in the light of the Reportprepared under EC P1;
2. Review and finalization of the Approach to the Problem relatingto the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including teamwork;
4. Detailed Analysis/Modelling/Simulation/Design/ProblemSolving/Experiment as needed;
5. Final development of product/process, testing, results,conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, ifpossible;
7. Preparing a Dissertation in the standard format for beingevaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.