

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology) Draft Syllabus for B. Tech
in AI and Data Science

(Applicable from the academic session 2020-2021)

SEMESTER – III

Analog & Digital Electronics

Code: 301

Contact: 3L

Name of the Course:	Analog & Digital Electronics		
Course Code:301	Semester: III		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: hrs./week		End Semester Exam : 70 Marks	
Credit Points:	3		
Objective:			
1	To acquire the basic knowledge of different analog components and their applications		
2	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.		
3	To prepare students to perform the analysis and design of various digital electronic circuits		
Pre-Requisite:			
1	Basic Electronics Parts I & II learned in the First year, semesters 1 & 2. Basic BJTs,.		
2	Basic concept of the working of P-N diodes, Schottky diodes,		
3	Basic FETs and OPAMP as a basic circuit component. Concept of Feedback		

Unit	Content	Hrs/Unit	Marks/Unit
1	Different Classes of Amplifiers - (Class-A, B, AB and C - basic concepts, power, efficiency; Recapitulation of basic concepts of Feedback and Oscillation, Phase Shift, Wein Bridge oscillators Astable & Monostable Multivibrators; Schmitt Trigger circuits, 555 Timer.	9	
2	Binary Number System & Boolean Algebra (recapitulation); BCD, ASCII, 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	11	

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	expressions by algebraic method. Combinational circuits - Adder and Subtractor circuits (half & full adder & subtractor); Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator		
3	Sequential Circuits - Basic Flip-flop & Latch, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counters (detail design of circuits excluded), Design of Mod N Counter	10	
4.	A/D and D/A conversion techniques – Basic concepts (D/A :R-2-R only [2L] A/D: successive approximation [2L]) Logic families- TTL, ECL, MOS and CMOS - basic concepts. (2L)	6	

Text book and Reference books:

1. Microelectronics Engineering –Sedra & Smith-Oxford.
2. Analog Electronics, A.K. Maini, Khanna Publishing House (AICTE Recommended -2018)
3. Analog Electronics, L.K. Maheswari, Laxmi Publications (AICTE Recommended -2018)
4. Principles of Electronic Devices & circuits—B L Thereja & Sedha—S Chand
5. Digital Electronics – Kharate – Oxford
6. Digital Electronics – Logic & Systems by J.Bigmeil & R.Donovan; Cambridge Learning.
7. Digital Logic and State Machine Design (3rd Edition) – D.J.Comer, OUP
8. Electronic Devices & Circuit Theory – Boyelstad & Nashelsky - PHI
9. Bell-Linear IC & OP AMP—Oxford
10. P.Raja- Digital Electronics- Scitech Publications
11. 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

- 1.1. Realize the basic operations of different analog components.
- 1.2. Realize basic gate operations and laws Boolean algebra.
- 1.3. Understand basic structure of digital computer, stored program concept and different arithmetic and control unit operations.

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Data Structure & Algorithm

Code: 302

Contacts: 3L

Name of the Course:	Data Structure & Algorithm	
Course Code:302	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	201 (Basic Computation and Principles of C)	
2	101 & 201 (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	10	

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	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		
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

- 2.1. Differentiate how the choices of data structure & algorithm methods impact the performance of program.
- 2.2. Solve problems based upon different data structure & also write programs.
- 2.3. Identify appropriate data structure & algorithmic methods in solving problem.
- 2.4. Discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing
- 2.5. Compare and contrast the benefits of dynamic and static data structures implementations.

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Computer Organization And Architecture

Code: 303

Contacts: 3L

Name of the Course:	Computer Organization		
Course Code: 303	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 prepare students to perform the analysis and design of various digital electronic circuits.		
2	To know how Computer Systems work & its basic principles		
3	To know how I/O devices are being accessed and its principles etc		
Pre-Requisite:			
1	Concept of basic components of a digital computer, Basic concept of Fundamentals & Programme structures. Boolean Algebra		
2	Basic number systems, Binary numbers, representation of signed and unsigned numbers, Binary Arithmetic as covered in Basic Computation & Principles of Computer Programming		
3	Boolean Algebra		

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		

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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:

- 303.1. Understand basic structure of digital computer, stored program concept and different arithmetic and control unit operations.
 - 303.2. Understand basic structure of different combinational circuits- multiplexer, decoder, encoder etc.
 - 303.3. Perform different operations with sequential circuits.
 - 303.4. Understand memory and I/O operations.
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Mathematics-III

Code: 304

Contacts: 2L

Name of the Course:	Mathematics-III	
Course Code: 304	Semester: III	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory: 2 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	2	
Objective:		
1	To know Convergence of sequence and series	
2	To know Limit, continuity and partial derivatives, Chain rule, Implicit function	
3	To know First Order Differential Equation, Exact, Linear and Bernoulli's equations, Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph	
Pre-Requisite:		
1	Concept Linear Algebra Determinant and its properties (up to third order)	
2	Minor and cofactors, Matrices, addition, multiplication and transpose of a matrix, Symmetric and skew-symmetric	

Unit	Content	Hrs/Unit	Marks/Unit
1	Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.	8	
2	Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.	7	
3	First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x	9	

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	and Clairaut's form, general & singular solutions. [5L] (Applicable from the academic session 2020-2021) Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation. [4L]		
4	Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph. Matrix Representation: Incidence & Adjacency matrix. Tree: Basic Concept of tree, Binary tree, Spanning Tree, Kruskal and Prim's algorithm for finding the minimal spanning tree.	8	
5	Probability: Joint Marginal and Conditional Probability. Continuous and Discrete Probability Distribution, Probability Density functions and cumulative functions. Expectation and variance of Binomial, Poisson and Normal Distribution.		
6	Statistics: Importance and scope of statistics in Initial analysis. Primary and Secondary Data, Methods of Data Collection, Tabulation of Data. Diagrammatic presentation of Frequency Distribution.		
7	Initial Data Analysis : Relationship between attributes, Covariance, Correlation Coefficient. Measure of Distribution, Skewness and Kurtosis Box and Whisker plot and other Statistical Graphs.		

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

- 4.1. Express a logic sentence in terms of predicates, quantifiers, and logical connectives.
- 4.2. Apply the rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction, and mathematical induction.
- 4.3. Use tree and graph algorithms to solve problems

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Data Warehousing and Data Mining Code: 305
Contacts: 3L

Name of the Course:	Data Warehousing and Data Mining		
Course Code: 305	Semester: VI		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam:70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
	Unit 1:		
1	Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods;	8	
2	Unit 2: Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,	8	
3	Unit 3: Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;	8	
4.	Unit 4: Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;modulation for communication, filtering, feedback control systems.	11	

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5	Unit 5: in AI and Data Science Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.	9	
6	Unit 6: Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis	5	

Text book and Reference books:

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

Course Outcomes:

After completion of course, students would be:

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

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Python Programming

Code: 306

Contacts: 3L

Name of the Course:	Python Programming		
Course Code: 306	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	Understand the importance and basic concepts of Python Programming		
2	Understand the different advantages and limitations of Python over other Programming Languages		
3	Understand the concepts of Python Programming and their applications for solving simple and complex problems.		
4	Understand the concepts of packages in Python and their application.		
5	Appreciation of the role of Python Programming in Data Analysis and Data Visualization.		
Pre-Requisite:			
1	Mathematics and sound knowledge of statistics		

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction to Python – History and Overview, Python 3 versus Python 2. Python Basics: Variables and Data Types in Python, Type Conversions. Keywords and Operators. Control Flow Statements: Conditional Statements. Data Structures: Indexing and Slicing, Arrays, Tuples, Lists, Dictionaries and Sets.	9	
2	Modules, Packages and Libraries: Standard Modules Packages, Installation of External Libraries	9	

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	<p>Loops: Loop Control Statements. List Comprehensions. Iterators and Generators. Problem solving using Loops, Lambda Functions.</p> <p>String Manipulation: Accessing Strings, Basic Operations, String slices, Function and Methods</p> <p>Functions in Python: Recapping Built-in Functions, User defined Functions, Variables namespace and Scope.</p>		
3	<p>NumPy module: NumPy Arrays, Array Creation using Built-in Function, Random Sampling in NumPy, Array Attributes and Methods, Array Manipulation, Indexing and Iteration.</p> <p>Problem Solving using NumPy module.</p> <p>Exception Handling: Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions.</p>	9	
4.	<p>Pandas Module : Installation, Pandas series, Pandas DataFrame, Importing Data in Pandas, Indexing and Sub setting, Manipulating data in DataFrame, Statistical exploratory data analysis, Filtering and iterating Pandas DataFrame; Merge, Append and Concat Pandas, Time series in Pandas.</p> <p>Data Visualization: basic Concepts, Plotting and Customization</p>	9	

Text book and Reference books:

1. Python Basics with Illustrations from the Financial Markets
A QuanInstitute Publication January 2020
2. Python Crash Course
Eric Matthes (*No Starch Press, 2016*)

Course Outcome:

- 5.1. Solve complex Mathematical problems using Python Programming.
- 5.2. Code and execute programs and implement them in creating applications.
- 5.3. Perform Data analysis and help in decision making

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PRACTICAL SYLLABUS
Semester III

Analog & Digital Electronics Lab

Code: 391

Contacts: 4P

Name of the Course:	Analog & Digital Electronics Lab
Course Code: 1 Practical	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Course Outcomes:	
1	1.1
2	1.2
3	1.3
Pre-Requisite:	
Pre-requisites as in 1	

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

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

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Data Structure & Algorithm Lab

Code: 392

Contacts: 4P

Name of the Course:	Data Structure & Algorithm Lab
Course Code: 2	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Course Outcomes:	
1	2.1
2	2.2
3	2.3
4	2.4
5	2.5
Pre-Requisite:	
Pre-requisites as in 2	

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

Any experiment specially designed by the college

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

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Python Programming Practical

Lab Code: 396

Contacts: 4P

Name of the Course:	Python Programming Lab
Course Code: 396	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
Course Outcomes:	
1	To master an understanding of scripting & the contributions of scripting languages
2	Design real life problems and think creatively about solutions
3	Apply a solution in a program using Python.
4	To be exposed to advanced applications of mathematics, engineering and natural sciences to program real life problems.
Pre-Requisite:	
1.	Knowledge of Programming Logic
2.	Prior knowledge of a scripting language and Object-Oriented concepts is helpful but not mandatory.
3.	Prior knowledge of a scripting language and Object-Oriented concepts is helpful but not mandatory.

Python

Unit	Content
1.	Introduction History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator
2.	Conditional Statements If, If- else, Nested if-else, Looping, For, While, Nested loops Control Statements Break, Continue, Pass String Manipulation Accessing Strings, Basic Operations, String slices, Function and Methods
3.	Lists: Introduction, Accessing list, Operations, Working with lists, Function and Methods
4.	Tuple Introduction, Accessing tuples, Operations, Working, Functions and Methods

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5.	Dictionaries Introduction, Accessing values in dictionaries, Working with dictionaries, Properties
6.	Functions Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables
7.	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
8.	Exception Handling Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions.

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

SEMESTER – IV

Discrete Mathematics

Code: 401

Contacts: 3L+1T

Name of the Course:	Discrete Mathematics		
Course Code: 401	Semester: IV		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: 1 hour/week		Assignment and Quiz : 10 marks	
		Attendance : 5 marks	
Practical: NIL		End Semester Exam : 70 Marks	
Credit Points:	4		
Objective:			
1	Use mathematically correct terminology and notation.		
2	Construct correct direct and indirect proofs.		
3	To know Syntax, Semantics, Validity and Satisfiability, Graphs and Trees		
4	Use counterexamples. Apply logical reasoning to solve a variety of problems.		
Pre-Requisite:			
1	Some concepts from basic math – algebra, geometry, pre-calculus		

Unit	Content	Hrs/Unit	Marks/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,	8	

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	Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.		
4.	Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form	7	
5	Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle, Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring maps and Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph, definition properties and Example, rooted trees, trees and sorting, weighted trees and prefix codes, Bi-connected component and Articulation Points, Shortest distances.	8	

Text book and Reference books:

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

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Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.

14. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
15. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
16. N. Chandrasekaran and M. Umavathi, Discrete Mathematics, PHI
17. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
18. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
19. S.B. Singh, Discrete Structures – Khanna Publishing House (AICTE Recommended Textbook – 2018)
20. S.B. Singh, Combinatorics and Graph Theory, Khanna Publishing House (AICTE Recommended Textbook – 2018)

Course Outcome(s)

On completion of the course students will be able to

- 401.1 Express a logic sentence in terms of predicates, quantifiers, and logical connectives
- 401.2 Derive the solution for a given problem using deductive logic and prove the solution based on logical inference
- 401.3 Classify its algebraic structure for a given a mathematical problem,
- 401.4 Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra
- 401.5 Develop the given problem as graph networks and solve with techniques of graph Theory

Software Engineering

Code: 402

Contact: 3L

Name of the Course:	Software Engineering		
Course Code: 402	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
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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

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Cloud Computing

Code : 403

Contacts : 3L

Name of the Course:	Cloud Computing
Course Code: 403	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:	End Semester Exam: 70 Marks
Credit Points:	3

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

2	<p>Use of Platforms in Cloud Computing Concepts of Abstraction and Virtualization Virtualization technologies : Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance, Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks, Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service., Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service, Windows Azure platform: Microsoft’s approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services,</p>	12	
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3	<p><u>Cloud Infrastructure:</u> Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle). Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)</p>	7	
4.	<p><u>Concepts of Services and Applications</u> ;Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs, Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs Cloud-based Storage: Cloud storage definition – Manned and Unmanned Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services</p>	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

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Formal Language & Automata Theory

Code: 404

Contacts: 3L

Name of the Course:	Formal Language & Automata Theory	
Course Code: 404	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	
Objective:		
1	Be able to construct finite state machines and the equivalent regular expressions.	
2	Be able to prove the equivalence of languages described by finite state machines and regular expressions	
3	Be able to construct pushdown automata and the equivalent context free grammars. And Be able to prove the equivalence of languages described by pushdown automata and context free grammars.	
4	Be able to construct Turing machines and Post machines. Be able to prove the equivalence of languages described by Turing machines and Post machines	
Pre-Requisite:		
1	Grammar and its classification (Context Free Grammar)	

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	6	
2	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata)	7	
3	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms,	6	

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	nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.		
4	Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	6	
5	Turing machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators	6	
6	Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages	6	

Text books/ reference books:

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

Course Outcomes:

On completion of the course students will be able to

- 403.1 Write a formal notation for strings, languages and machines.
- 403.2 Design finite automata to accept a set of strings of a language.
- 403.3 For a given language determine whether the given language is regular or not.
- 403.4 Design context free grammars to generate strings of context free language.
- 403.5 Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
- 403.6 Write the hierarchy of formal languages, grammars and machines.
- 403.7 Distinguish between computability and non-computability and Decidability and undecidability.

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Design and Analysis of Algorithms

Code: 405

Contacts: 3L

Name of the Course:	Design and Analysis of Algorithms	
Course Code: 405	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	
Objective:		
1	The aim of this module is to learn how to develop efficient algorithms for simple computational tasks and reasoning about the correctness of them	
2	Through the complexity measures, different range of behaviors of algorithms and the notion of tractable and intractable problems will be understood.	
Pre-Requisite:		
1	To know data-structure and basic programming ability	

Unit	Content	Hrs/Unit	Marks/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	

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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 Design and Analysis, Udit Agarwal, Dhanpat Rai

Course Outcomes

On completion of the course students will be able to

404.1 For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.

404.2 Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.

404.3 Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.

404.4 Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and

404.5 develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

404,6 For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.

404.7 Explain the ways to analyze randomized algorithms (expected running time, probability of error).

404.8 Explain what an approximation algorithm is. Compute the approximation factor of an approximation algorithm (PTAS and FPTAS).

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Biology

Code: BSC 406

Contacts: 2L+1T

Name of the Course:	Biology		
Course Code: BSC-406	Semester: IV		
Duration: 6 months	Maximum Marks:100		
Teaching Scheme		Examination Scheme	
Theory: 2hrs./week		Mid Semester exam: 15	
Tutorial: 1 hour		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		
Objective:			
1	Bring out the fundamental differences between science and engineering		
2	Discuss how biological observations of 18 th Century that lead to major discoveries		
Pre-Requisite:			
1	Basic knowledge of Physics ,Chemistry and mathematics		

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

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	energy and Carbon utilisation -Autotrophs, heterotrophs, lithotrophs (d) Ammonia excretion – aminotelic, uricotelic, ureotelic (e) Habitata- aquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. 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	4	

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	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.		
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 exergonic 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. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

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Course Outcomes:

On completion of the course students will be able to

BSC-401.1 Describe how biological observations of 18th Century that lead to major discoveries.

BSC-401.2 Convey that classification *per se* is not what biology is all about but highlight the underlying

criteria, such as morphological, biochemical and ecological

BSC-401.3 Highlight the concepts of recessiveness and dominance during the passage of genetic material

from parent to offspring

BSC-401.4 Convey that all forms of life have the same building blocks and yet the manifestations are as

diverse as one can imagine

BSC-401.5 Classify enzymes and distinguish between different mechanisms of enzyme action.

BSC-401.6 Identify DNA as a genetic material in the molecular basis of information transfer.

BSC-401.7 Analyse biological processes at the reductionistic level

BSC-401.8 Apply thermodynamic principles to biological systems.

BSC-401.9 Identify and classify microorganisms.

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IT Workshop-1 (R Programming)

Code:

Contacts: 4P

Name of the Course:	IT Workshop
Course Code:	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
Course Outcomes:	
1	To master an understanding of scripting & the contributions of scripting languages
2	Design real life problems and think creatively about solutions
3	Apply a solution in a program using R/Matlab/Python.
4	To be exposed to advanced applications of mathematics, engineering and natural sciences to program real life problems.
Pre-Requisite:	
1.	Knowledge of Programming Logic
2.	Experience with a high level language (C/C++,) is suggested.
3.	Prior knowledge of a scripting language and Object-Oriented concepts is helpful but not mandatory.

Programming in R

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 Reference books:

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

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PRACTICAL SYLLABUS
Semester IV

Software Engineering Lab

Code: 492

Contact: 4P

Name of the Course:	Software Engineering Lab
Course Code: 492	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
Course Outcomes:	
1	To understand the software engineering methodologies involved in the phases for project development.
2	To gain knowledge about open source tools used for implementing software engineering methods.
3	To exercise developing product-startups implementing software engineering methods.
4	Learn simple optimization techniques
Pre-Requisite:	

Laboratory Experiments:

- Problem Analysis and Project Planning -Thorough study of the problem – Identify Project scope, Objectives and Infrastructure.
- Software Requirement Analysis – Describe the individual Phases/modules of the project and Identify deliverables. Identify functional and non-functional requirements.
- Data Modeling – Use work products – data dictionary.
- Software Designing - Develop use case diagrams and activity diagrams, build and test class diagrams, sequence diagrams and add interface to class diagrams.
- Prototype model – Develop the prototype of the product.

The SRS and prototype model should be submitted for end semester examination.

Any experiment specially designed by the college

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

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Design & Analysis Algorithm Lab

Code: 495

Contact: 4P

Name of the Course:	Design & Analysis Algorithm Lab
Course Code: 495	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 Outcomes:	
1	402.1
2	402.2
3	402.3
Pre-Requisite:	
Pre-Requisite as in : 404	

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

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11	Implement Breadth First Search (BFS) Implement Depth First Search (DFS)
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Programming Practices Using C++

Code:

Contact: 3P(1L+2P)

Credits: 2

1	Introduction of UNIX/Linux Operating System which includes preliminary commands, start-up & shutdown methodology, file handling as well as introduction to editors like Vi editor, introduction to GNU C & C++ compiler, as well as introduction to GNU & GDB script. [4P]
2	Introduction to C++, basic loop control, executing programs, writing functions, selection statements, review of functions and parameters, command line arguments, recursion, I/O streams, arrays and string manipulation, pointers, structures & unions. [6P]
3	Object-Oriented Programming in C++, fundamentals of classes, constructors- destructors. Dealing with member functions, operator overloading and polymorphism (both static & dynamic). [6P]
4	Dealing with inheritance, derived class handling, abstract class, virtual class, overriding, template class, name-space & exception handling. [4P]
5	Dynamic memory allocation, implementation of Linked Lists, using C++. [4P]

Note: GNU C++ can be used for the programming, since it is free and has no licensing anomaly

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SEMESTER – V

Compiler Design

Code: 501

Contact: 3L

Name of the Course:	Compiler Design	
Course Code: 501	Semester:V	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam:70 Marks
Credit Points:	3	
Objective:		
1	To understand and list the different stages in the process of compilation.	
2	Identify different methods of lexical analysis	
3	Design top-down and bottom-up parsers	
4	Identify synthesized and inherited attributes	
5	Develop syntax directed translation schemes	
6	Develop algorithms to generate code for a target machine	

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Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction to Compiling [3L] Compilers, Analysis of the source program, The phases of the compiler, Cousins of the compiler.	3	
2	Lexical Analysis [6L] The role of the lexical analyzer, Tokens, Patterns, Lexemes, Input buffering, Specifications of a token, Recognition of a tokens, Finite automata, From a regular expression to an NFA, From a regular expression to NFA, From a regular expression to DFA, Design of a lexical analyzer generator (Lex).	6	
3	Syntax Analysis [9L] The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Non-recursive Predictive parsing (LL), Bottom up parsing, Handles, Viable prefixes, Operator precedence parsing, LR parsers (SLR, LALR), Parser generators (YACC). Error Recovery strategies for different parsing techniques.	9	
4	Syntax directed translation [5L] Syntax director definitions, Construction of syntax trees, Bottom-up evaluation of S attributed definitions, L attributed definitions, Bottom-up evaluation of inherited attributes.	5	
5	Type checking [4L] Type systems, Specification of a simple type checker, Equivalence of type expressions, Type conversions	4	
6	Run time environments [5L] Source language issues (Activation trees, Control stack, scope of declaration, Binding of names), Storage organization (Subdivision of run-time memory, Activation records), Storage allocation strategies, Parameter passing (call by value, call by reference, copy restore, call by name), Symbol tables, dynamic storage allocation techniques.	5	
7	Intermediate code generation [4L] Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	4	

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8	Code optimization [5L] Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.	5	
9	Code generations [4L] Issues in the design of code generator, a simple code generator, Register allocation & assignment.	4	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

1. Understand given grammar specification develop the lexical analyser
2. Design a given parser specification design top-down and bottom-up parsers
3. Develop syntax directed translation schemes
4. Develop algorithms to generate code for a target machine

Artificial Intelligence

Code: 502

Contacts: 3L

Name of the Course:	Artificial Intelligence		
Course Code: 502	Semester: V		
Duration: 6 months	Maximum Marks:100		
Teaching Scheme	Examination Scheme		
Theory:3 hrs./week	Mid Semester exam: 15		
Tutorial: NIL	Assignment and Quiz: 10 marks		
	Attendance : 5 marks		
Practical: NIL	End Semester Exam :70 Marks		
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
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1	<p>Introduction [2] Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem.</p> <p>Intelligent Agents [2] Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.</p> <p>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.</p>	6	
2.	<p>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.</p> <p>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.</p> <p>Adversarial search [3] Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.</p>	13	
3	<p>Knowledge & reasoning [3] Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.</p>	3	
4	<p>Using predicate logic [2] Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction.</p> <p>Probabilistic reasoning [4] Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.</p>	6	
5	<p>Natural Language processing [2] Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing.</p> <p>Learning [2] Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.</p> <p>Expert Systems [2] Representing and using domain knowledge, expert system shells, knowledge acquisition.</p>	6	

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Text book and Reference books:

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

Operating Systems

Code: 503

Contacts: 3L

Name of the Course:	Operating Systems	
Course Code: 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	
Objective:		
1	To learn the mechanisms of OS to handle processes and threads and their communication	
2	To learn the mechanisms involved in memory management in contemporary OS	
3	To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols	
4	To know the components and management aspects of concurrency management	
Pre-Requisite:		

1	Computer Organization &Architecture
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Unit	Content	Hrs/Unit	Marks/Unit
1	<p>Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.</p>	3	
2	<p>Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.</p>	10	
3.	<p>Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dining Philosopher Problem etc.</p>	5	
4.	<p>Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.</p>	5	
5.	<p>Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently</p>	8	

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	used(LRU).		
6.	<p>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</p> <p>File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.</p> <p>Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks</p>	6	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

1. Create processes and threads.
2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.

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4. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

Object Oriented Programming
(JAVA)
Code: 504
Contacts: 3L

Name of the Course:	Computer Organization		
Course Code: 504	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. Implementing operations, 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. The iterator pattern.	6	
4	Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.	6	
5	Generic types and collections GUIs. Graphical programming with Scale and Swing . The software development process	6	

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Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

1. Specify simple abstract data types and design implementations, using abstraction functions to document them.
2. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
3. Name and apply some common object-oriented design patterns and give examples of their use.
4. Design applications with an event-driven graphical user interface.

Environmental Sciences

Code: MC-505

Contacts: 1L

Name of the Course:	Environmental Sciences	
Course Code: MC-505	Semester: IV	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:1hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz : 10 marks
		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	1	
Objective:		
1	Be able to understand the natural environment and its relationships with human activities.	
2	Be able to apply the fundamental knowledge of science and engineering to assess environmental and health risk.	
3	Be able to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues.	

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4	Be able to solve scientific problem-solving related to air, water, noise & land pollution
Pre-Requisite:	
1	Basic knowledge of Environmental science

Unit	Content	Hrs/Unit	Marks/Unit
1	<p>Basic ideas of environment, basic concepts, man, society & environment, their interrelationship (1L)</p> <p>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)</p> <p>Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. (1L)</p> <p>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)</p>	6	

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2	<p>Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. (1L)</p> <p>Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban); Food chain [definition and one example of each food chain], Food web.(2L)</p> <p>Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. (1L)</p> <p>Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.(2L)</p>	6	
3	<p>Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L)</p> <p>Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.(1L)</p> <p>Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L)</p> <p>Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L)</p> <p>Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L)</p> <p>Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria</p>	11	

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	<p>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)</p> <p>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)</p>		
4.	<p>Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L)</p> <p>River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L)</p> <p>Lake: Eutrophication [Definition, source and effect]. (1L)</p> <p>Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)(1L)</p> <p>Standard and control: Waste water standard [BOD, COD, Oil, Grease],</p> <p>Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L)</p> <p>Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)</p>	9	
5	Lithosphere; Internal structure of earth, rock and soil (1L)	3	

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	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)		
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, <i>L10</i> (18hr Index) , <i>n Ld</i> .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)	2	

Text books/ reference books:

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

Course Outcomes:

On completion of the course students will be able to

MC-401.1 To understand the natural environment and its relationships with human activities.

MC-401.2 To apply the fundamental knowledge of science and engineering to assess environmental and health risk.

MC-401.3 To develop guidelines and procedures for health and safety issues obeying the environmental laws and regulations.

MC-401.4 Acquire skills for scientific problem-solving related to air, water, noise& land pollution.

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Economics for Engineers

Code: 506

Contacts: 3L

Name of the Course:	Economics for Engineers (Humanities-II)	
Course Code: 506	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	
Objective:		
1	Understand the role and scope of Engineering Economics and the process of economic decision making	
2	Understand the different concepts of cost and different cost estimation techniques	
3	Familiarization with the concepts of cash flow, time value of money and different interest formulas	
4	Appreciation of the role of uncertainty in future events and using different concepts from probability to deal with uncertainty	
5	Understand the concepts of Depreciation and Replacement analysis along with their methods of calculation	
6	Familiarization with the phenomenon of inflation and the use of price indices in engineering Economics	
7	Introduction to basic concepts of Accounting and Financial Management	
Pre-Requisite:		
1	Mathematics	

Unit	Content	Hrs/Unit	Marks/Unit
1	1. Economic Decisions Making – Overview, Problems, Role, Decision making process. 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	Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of	9	

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	<p>Money, Debt repayment, Nominal & Effective Interest. 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.</p>		
3	<p>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.</p> <p>5. 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.</p> <p>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.</p>	9	
4.	<p>Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances.</p> <p>Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems.</p> <p>Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.</p>	9	

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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)

Course Outcome:

On completion of the course students will be able to

HSMC-301.1 Make different economic decisions and estimate engineering costs by applying different cost estimation models.

HSMC-301.2 Create cash flow diagrams for different situations and use different interest formulae to solve associated problems.

HSMC-301.3 Take decisions regarding different engineering projects by using various criteria like rate of return analysis, present worth analysis, cost-benefit analysis etc.

HSMC-301.4 Incorporate the effect of uncertainty in economic analysis by using various concepts like expected value, estimates and simulation.

HSMC-301.5 Understand the concepts of depreciation and replacement analysis and solve associated problems.

HSMC-301.6 Understand the process of inflation and use different price indices to adjust for its effect.

HSMC-301.7 Apply the various concepts of Accounting like balance sheet and ratio analysis.

HSMC-301.8 Understand the scope of Finance and the role of financial planning and management.

PRACTICAL SYLLABUS
SEMESTER V

Operating System Lab

Code: 593

Contacts: 4P

Name of the Course:	Operating System Lab
Course Code: 593 Practical	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

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

Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands). Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Backup schedules and methods Kernel loading, init and the inittab file, Run-levels, Run level scripts. Password file management, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user-management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users & user groups.

2. **Process [4P]:** starting new process, replacing a process image, duplicating a process image, waiting for a process, zombie process.

3. **Signal [4P]:** signal handling, sending signals, signal interface, signal sets.

4. **Semaphore [6P]:** programming with semaphores (use functions semctl, semget, semop, set_semvalue, del_semvalue, semaphore_p, semaphore_v).

5. **POSIX Threads [6P]:** programming with pthread functions (viz. pthread_create, pthread_join, pthread_exit, pthread_attr_init, pthread_cancel)

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

Object Oriented Programming (JAVA) Lab

Code: 594 Practical

Contacts: 4P

Name of the Course:	Object Oriented Programming Lab
Course Code: 594 Practical	Semester: V
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:

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

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- | |
|---|
| 5. Assignments on multithreaded programming
6. Assignments on applet programming |
|---|

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

Artificial Intelligence Lab
Lab Code: 592
Contacts: 4P

LIST OF EXPERIMENTS:

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

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

IT Workshop-2 (MATLAB/SCILAB)
Code:
Contacts: 4P

Name of the Course:	IT Workshop
Course Code:	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	

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Theory: NIL	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Course Outcomes:	
1	To master an understanding of scripting & the contributions of scripting languages
2	Design real life problems and think creatively about solutions
3	Apply a solution in a program using R/Matlab/Python.
4	To be exposed to advanced applications of mathematics, engineering and natural sciences to program real life problems.
Pre-Requisite:	
1.	Knowledge of Programming Logic
2.	Experience with a high level language (C/C++,) is suggested.
3.	Prior knowledge of a scripting language and Object-Oriented concepts is helpful but not mandatory.

Programming in Matlab

Introduction

Why MATLAB?, History, Its strengths, Competitors, Starting MATLAB, Using MATLAB as a calculator, Quitting MATLAB

Basics

Familiar with MATLAB windows, Basic Operations, MATLAB-Data types, Rules about variable names, Predefined variables

Programming-I

Vector, Matrix, Array Addressing, Built-in functions, Mathematical Operations, Dealing with strings (Array of characters), Array of array (cell) concept

Programming-II

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, For loop, 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, Curve fitting, Interpolation, Basic fitting interface

3D Plotting

Use of meshgrid function, Mesh plot, Surface plot, Plots with special graphics

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SEMESTER – VI

Database Management Systems

Code: 601

Contact: 3L

Name of the Course:	Database Management Systems		
Course Code: 601	Semester: VI		
Duration:6 months	Maximum Marks:100		
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: 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	<p>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.</p>	9	

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2	<p>Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQLserver.</p> <p>Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.</p> <p>Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.</p>	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, New Delhi (AICTE Recommended Textbook – 2018)

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

Course Outcomes:

On completion of the course students will be able to

1. For a given query write relational algebra expressions for that query and optimize the developed expressions
2. For a given specification of the requirement design the databases using E R method and normalization.
3. For a given specification construct the SQL queries for Open source and Commercial DBMS -MYSQL, ORACLE, and DB2.
4. For a given query optimize its execution using Query optimization algorithms
5. For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
6. Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Computer Networks

Code: 602

Contact: 3L

Name of the Course:	Computer Networks	
Course Code: 602	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.	

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

Text book and Reference books:

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

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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.

Image Processing

Code:603

Contact: 3L

Name of the Course:	Image Processing
Course Code: 603	Semester: VI
Duration:6 months	Maximum Marks:100
Teaching Scheme	Examination Scheme
Theory:3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz: 10 marks
	Attendance: 5 marks
Practical: NIL	End Semester Exam:70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction [3L] Background, Digital Image	9	
	Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.		

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2	Digital Image Formation [4L] A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4	
3	Mathematical Preliminaries[9L] Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.	9	
4.	Image Enhancement [8L] Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High-pass Filtering, High- boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8	
5	Image Restoration [7L] Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.	7	
6	Image Segmentation [7L] Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging.	7	

Text book and Reference books:

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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

Pattern Recognition

Code: 604

Contact: 3L

Name of the Course:	Pattern Recognition		
Course Code: 604	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	Basics of pattern recognition.	2	
2	Bayesian decision theory 8L Classifiers, Discriminant functions, Decision surfaces Normal density and discriminant functions Discrete features	8	
3	Parameter estimation methods 6L Maximum-Likelihood estimation Gaussian mixture models Expectation-maximization method Bayesian estimation	6	
4.	Hidden Markov models for sequential pattern classification 8L Discrete hidden Markov models Continuous density hidden Markov models	8	
5	Dimension reduction methods 3L 5.1. Fisher discriminant analysis 5.2Principal component analysis.	3	

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	Parzen-window method K-Nearest Neighbour method		
6	Non-parametric techniques for density estimation	2	
7	Linear discriminant function based classifier 5L Perceptron Support vector machines	5	
8	Non-metric methods for pattern classification 4L Non-numeric data or nominal data Decision trees	4	
9	Unsupervised learning and clustering 2L Criterion functions for clustering Algorithms for clustering: K-means, Hierarchical and other methods	2	

Text book and Reference books:

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

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Quantum Computing

Code: 605A

Contacts: 3L

Name of the Course:	Quantum Computing		
Course Code: 605A	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		
Objective:			
1	The course will provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing		
Pre-Requisite:			
1	Linear Algebra, Theory of Computation		

Unit	Content	Hrs/Unit	Marks/Unit
1	Qubit & Quantum States: The Qubit, Vector Spaces. Linear Combination Of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidt orthogonalization, bra-ket formalism, the Cauchy-Schwarz and triangle Inequalities.	3	
2	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators,	10	
3.	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition & singular values, Postulates of Quantum Mechanics.	5	
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of	5	

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	column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.		
5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.	8	
6.	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	6	

Text book and Reference books:

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

Course Outcomes:

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

Digital Signal Processing

Code: 605B

Contacts: 3L

Name of the Course:	Digital Signal Processing		
Course Code: 605B	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		

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Unit	Content	Hrs/Unit	Marks/Unit
1	Module 1: Discrete-time signals and systems (6 hours) Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.	6	
2	Module 2: Z-transform (6 hours) z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.	6	
3	Module 2: Discrete Fourier Transform (10 hours) Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.	10	
4.	Module 3: Design of Digital filters (12 hours) Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.	12	
	Module 4: Applications of Digital Signal Processing (6 hours) Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.	6	

Text book and Reference books:

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

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Multi-agent Intelligent Systems

Code: 605

Contacts: 3L

Name of the Course:	Multi-agent Intelligent Systems		
Course Code: 605C	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	

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4.	Advanced topics: One issue selected from the contemporary research literature, perhaps by guest lecturer.	9	
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Text book and Reference books:

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

**Human Computer
Interaction
Code:605D
Contact: 3L**

Name of the Course:	Human Computer Interaction		
Course Code: 605D	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		
Objective:			
1	Learn the foundations of Human Computer Interaction		
2	Be familiar with the design technologies for individuals and persons with disabilities		
3	Be aware of mobile Human Computer interaction		
4	Learn the guidelines for user interface.		
Pre-Requisite:			
1	Computer Organization &Architecture		

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

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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 Software Security, Addison Wesley.

Course Outcomes:

On completion of the course students will be able to

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

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Introduction to Industrial Management

Code: 606A

Contacts: 3L

Name of the Course:	Introduction to Industrial Management (Humanities III)		
Course Code: 606A	Semester: V		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz : 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		

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

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2	<p>Critical Path Method (CPM) and Programme Evaluation Review Technique (PERT):</p> <p>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.</p>	8	
3	<p>Materials Management:</p> <p>Material management-definition, functions, importance, relationship with other departments. Purchase - objectives, purchasing systems, purchase procedure, terms and forms used in purchase department. Storekeeping- functions, classification of stores as centralized and decentralized with their advantages, disadvantages and application in actual practice. Functions of store, types of records maintained by store, various types and applications of storage equipment, need and general methods for codification of stores. Inventory control: i. Definition. ii. Objectives. iii. Derivation for expression for Economic Order Quantity (EOQ) and numeric examples. iv. ABC analysis and other modern methods of analysis. v. Various types of inventory models such as Wilson's inventory model, replenishment model and two bin model. (Only sketch and understanding, no derivation.). 3.6 Material Requirement Planning (MRP)- concept, applications and brief details about software packages available in market.</p>	6	

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

Course Outcomes:

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On completion of the course students will be able to

1. Interpret given organization structure, culture, climate and major provisions of factory acts and laws.
2. Explain material requirement planning and store keeping procedure.
3. Plot and analyze inventory control models and techniques.
4. Prepare and analyze CPM and PERT for given activities.
5. List and explain PPC functions.

Human Resource Development and Organizational Behavior

Code: 606B

Contact: 3L

Name of the Course:	Human Resource Development and Organizational Behavior
Course Code: 606B	Semester: VI
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Semester exam: 15
Tutorial: NIL	Assignment and Quiz: 10 marks
	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2] Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction.	4	
2	Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. [2] 4. Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory McClelland's Theory of Needs, Vroom's Expectancy Theory.	8	

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

Text book and Reference books:

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

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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: 606C

Contact: 3L

Name of the Course:	Research Methodology
Course Code: 606C	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	RESEARCH FORMULATION AND DESIGN Motivation and objectives – Research methods vs. Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.	9	
2	DATA COLLECTION AND ANALYSIS Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools, data analysis with statically package (Sigma	9	

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

Text book and Reference books:

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

Additional reading

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual 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

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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.

PRACTICAL SYLLABUS

Database Management System Lab

Code: 691

Contacts: 4P

Name of the Course:	Database Management System Lab
Course Code: 691	Semester: VI
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:

Structured Query Language

1. Creating Database

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

2. Table and Record Handling

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

3. Retrieving Data from a Database

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

Clause

5. Using Aggregate Functions
6. Combining Tables Using JOINS

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7. Subqueries

4. Database Management

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

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

Any experiment specially designed by the college

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

Computer Networks

Lab Code: 692

Contacts: 4P

Name of the Course:	Computer Networks Lab
Course Code: 692	Semester: VI
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assessment: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2

Laboratory Experiments:

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

Any experiment specially designed by the college

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

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Digital Image Processing Lab
Code: 693
Contacts: 4P

LIST OF EXPERIMENTS:

- Study of image file formats and organization
- Enhancement of image
- Filters & edge enhancement
- Classify and assess accuracy of classification

Any experiment specially designed by the college

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

Pattern Recognition Lab
Code:694
Contacts: 4P

LIST OF EXPERIMENTS:

- Cricket Game Prediction.
- Machine Translation from English-Hindi.
- Query Expansion for Information Retrieval.
- Emotion detection for texts.

Any experiment specially designed by the college

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

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SEMESTER – VII

Machine Learning
Code: 701
Contacts: 3L

Name of the Course:	Machine Learning	
Course Code: 701	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	

COURSE OBJECTIVE		
<input type="checkbox"/> To learn the concept of how to learn patterns and concepts from data without being explicitly programmed		
<input type="checkbox"/> To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.		
<input type="checkbox"/> Explore supervised and unsupervised learning paradigms of machine learning.		
<input type="checkbox"/> To explore Deep learning technique and various feature extraction strategies.		
	Hrs/unit	Marks/unit
Unit 1: Supervised Learning (Regression/Classification) <ul style="list-style-type: none"> <input type="checkbox"/> Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes <input type="checkbox"/> Linear models: Linear Regression, Logistic Regression, Generalized Linear Models <input type="checkbox"/> Support Vector Machines, Nonlinearity and Kernel Methods <input type="checkbox"/> Beyond Binary Classification: Multi-class/Structured Outputs, Ranking 	10	
Unit 2: Unsupervised Learning <ul style="list-style-type: none"> <input type="checkbox"/> Clustering: K-means/Kernel K-means <input type="checkbox"/> Dimensionality Reduction: PCA and kernel PCA <input type="checkbox"/> Matrix Factorization and Matrix Completion <input type="checkbox"/> Generative Models (mixture models and latent factor models) 	7	

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Unit 3 Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6	
Unit 4 Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9	
Unit 5 Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9	
Unit 6: Recent trends in various learning techniques of machine learning and classification methods	5	

References:

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

Neural Networks and Deep Learning

Code: 702

Contacts: 3L

Name of the Course:	Neural Networks and Deep Learning	
Course Code: 702	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	

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Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Various paradigms of learning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	3	
2	Feed forward neural network: Artificial Neural Network, activation function, multi-layer neural network cardinality, operations, and properties of fuzzy relations.	6	
3	Training Neural Network: Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	6	
4.	Conditional Random Fields: Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	9	
5	Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	6	
6	Deep Learning research: Object recognition, sparse coding, computer vision, natural language	6	

Text book and Reference books:

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

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Cyber Security

Code: 703

Contact: 3L

Name of the Course:	Cyber Security	
Course Code: 703	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	
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	Introduction: Introduction to Cyber Security, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyberwarfare, CIA Triad, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cybersecurity - Organizational Implications.	6	
2	Hackers and Cyber Crimes: Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities, Malware threats, Sniffing, Gaining Access, Escalating Privileges, Executing Applications, Hiding Files, Covering Tracks, Worms, Trojans, Viruses, Backdoors.	7	

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3.	Cyber Forensics and Auditing: Introduction to Cyber Forensics, Computer Equipment and associated storage media, Role of forensics Investigator, Forensics Investigation Process, Collecting Network based Evidence, Writing Computer Forensics Reports, Auditing, Plan an audit against a set of audit criteria, Information Security Management System Management. Introduction to ISO 27001:2013	10	
4	Ethical Hacking and Social Engineering: Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies.	8	
5	Cyber Ethics and Laws: Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000, Intellectual Property Rights in Cyberspace. at Network Layer-IPSec.	5	

Text book and Reference books:

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

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Adhoc –Sensor Network

Code: 704A

Contact: 3L

Name of the Course:	Adhoc –Sensor Network	
Course Code: 704A	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory: 3 hrs		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: 4 hrs		End Semester Exam: 70 Marks
Credit Points:	3	
Objective:		
1	provide an overview about sensor networks and emerging technologies	
2	To study about the node and network architecture of sensor nodes and its execution environment.	
3	To understand the concepts of communication, MAC, routing protocols and also study about the naming and addressing in WSN	
4	To learn about topology control and clustering in networks with timing synchronization for localization services with sensor tasking and control.	
5	To study about sensor node hardware and software platforms and understand the simulation and programming techniques..	

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction and Overview [4L] :Overview of wireless networks, types, infrastructure-based and infrastructure-less, introduction to MANETs (Mobile Ad-hoc Networks), characteristics, reactive and proactive routing protocols with examples, introduction to sensor networks, commonalities and differences with MANETs, constraints and challenges, advantages, applications, enabling technologies for WSNs.	4	

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

Text book and Reference books:

1. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.

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

Information Theory and Coding

Code: 704B

Contact: 3L

Name of the Course:	Information Theory and Coding		
Course Code: 704B	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		
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	Source Coding [7L] Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.	7	

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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:

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

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 (Applicable from the academic session 2020-2021)

Operation Research

Code: 704C

Contact: 3L

Name of the Course:	Operation Research
Course Code: 704C	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	<p>Basic LPP and Applications; Various Components of LP Problem Formulation.</p> <p>Solution of Linear Programming Problems: Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex set and explanation with examples Solution of LPP by Simplex Method; Charnes' Big-M Method; Duality Theory. Transportation Problems and Assignment Problems.</p>	17	
2	<p>Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT- CPM (Cost Analysis, Crashing, Resource Allocation excluded).</p> <p>Inventory Control: Introduction to EOQ Models of Deterministic and Probabilistic ; Safety Stock; Buffer Stock.</p>	9	

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3	Game Theory: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of Dominance	5	
4.	Queuing Theory: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞ / FIFO) and (M/M/1: N / FIFO) and problems.	5	

Text book and Reference books:

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

Multimedia Technology

Code: 704D

Contacts: 3L

Name of the Course:	Multimedia Technology	
Course Code: 704D	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

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Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Multimedia today, Impact of Multimedia, Multimedia Systems, Components and Its Applications	2	
2	Text and Audio, Image and Video(14L) Text: Types of Text, Ways to Present Text, Aspects of Text Design, Character, Character Set, Codes, Unicode, Encryption; Audio: Basic Sound Concepts, Types of Sound, Digitizing Sound, Computer Representation of Sound (Sampling Rate, Sampling Size, Quantization), Audio Formats, Audio tools, MIDI Image: Formats, Image Color Scheme, Image Enhancement; Video: Analogue and Digital Video, Recording Formats and Standards (JPEG, MPEG, H.261) Transmission of Video Signals, Video Capture, and Computer based Animation.	14	
3.	Synchronization, Storage models and Access Techniques: Temporal relationships, synchronization accuracy specification factors, quality of service, Magnetic media, optical media, file systems (traditional, multimedia) Multimedia devices – Output devices, CD-ROM, DVD, Scanner, CCD	8	
4.	Image and Video Database, Document Architecture and Content Management (17L): Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k-d trees, R-trees, quad trees; Case studies- QBIC, Virage. Video Content, querying, video segmentation, indexing, Content Design and Development, General Design Principles Hypertext: Concept, Open Document Architecture (ODA), Multimedia and Hypermedia Coding Expert Group (MHEG), Standard Generalized Markup Language (SGML), Document Type Definition (DTD), Hypertext Markup Language (HTML) in Web Publishing. Case study of Applications	17	
5.	Multimedia Applications(4L): Interactive television, Video-on-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors	4	

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Text book and Reference books:

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

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Project Management and Entrepreneurship

Code: 705

Contact: 2L+1T

Name of the Course:	Project Management and Entrepreneurship	
Course Code: 705	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme	Examination Scheme	
Theory: 3 hrs./week	Mid Semester exam: 15	
Tutorial: 1hr	Assignment and Quiz: 10 marks	
	Attendance: 5 marks	
Practical: NIL	End Semester Exam: 70 Marks	
Credit Points:	3	

ENTREPRENEURSHIP

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

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10. Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope, Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS), Phased Project Planning [2L]
11. Project Scheduling and Costing – Gantt chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-off Analysis, Project Cost Reduction Methods. [6L]
12. Project Monitoring and Control – Role of Project Manager, MIS in Project Monitoring, Project Audit [2L]
13. Case Studies with Hands-on Training on MS-Project [4L]

Text Books and References

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

Project-I

Code: 781

Contact: 12P

Project work I

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

Project Work I & Dissertation

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

1. In depth study of the topic assigned in the light of the Report prepared under EC P1;

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2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee

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SEMESTER – VIII

Natural Language Processing

Code: 801

Contacts: 3L

Name of the Course:	Natural Language Processing		
Course Code: 801	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	<p>Regular Expressions and Automata(Recap) - Introduction to NLP, Regular Expression, Finite State Automata [2L]</p> <p>Tokenization - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance [5L]</p> <p>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]</p>	11	
2	<p>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]</p> <p>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]</p>	8	

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3	<p>Text Classification Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. [4L]</p> <p>Context Free Grammar Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing [4L].</p>	9	
4.	<p>Computational Lexical Semantics Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity [4L]</p> <p>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]</p>	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 Schütze, MIT Press
3. Multilingual Natural Language Processing Applications from Theory to Practice: Bikel, Pearson.

Internet of Things

Code: 802

Contacts: 3L

Course Code	802
Course Name	Internet of Things
Credits	3
Pre-Requisites	Wireless Networks

Total Number of Lectures: 48

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

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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

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

References:

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

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Big Data Analytics

Code: 804A

Contacts: 3L

Name of the Course:	Big Data Analytics	
Course Code: 804A	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	

Total Number of Lectures: 48

COURSE OBJECTIVE	
<input type="checkbox"/> Understand big data for business intelligence. Learn business case studies for big data analytics. Understand nosql big data management. Perform map-reduce analytics using Hadoop and related tools	
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

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Unit 3: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based datastructures	9
Unit 4: MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats	10
Unit 5: Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	7
Unit 6: Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.	6

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

References:

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

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Cyber Law and Ethics

Code: 804B

Contacts: 3L

Name of the Course:	Cyber Law and Ethics		
Course Code: 804B	Semester:VIII		
Duration:6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz : 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction of Cybercrime: What is cybercrime?, Forgery, Hacking, Software Piracy, Computer Network intrusion[4L]. Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cyberstalking. [4L]	8	
2	Cybercrime Mobile & Wireless devices: Security challenges posted by mobile devices, cryptographic security for mobile devices, Attacks on mobile/cellphones, Theft, Virus, Hacking. Bluetooth; Different viruses on laptop [8L]	8	
3	Tools and Methods used in Cyber crime: Proxy servers, panword checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow. [8L]	8	
4.	Phishing & Identity Theft: Phising methods, ID Theft; Online identity method. [4L] Cybercrime & Cybersecurity: Legal aspects, indian laws, IT act, Public key certificate. [4L]	8	

Text book and Reference books:

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

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Mobile Computing
Code: 804C
Contacts: 3L

Name of the Course:	Mobile Computing	
Course Code: 804C	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	

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Text book and Reference books:

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

Robotics

Code: 804D

Contacts: 3L

Name of the Course:	Robotics		
Course Code: 804D	Semester: VIII		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: NIL		End Semester Exam: 70 Marks	
Credit Points:	3		

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

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	representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.		
3	Kinematics of serial robots Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.	4	
4.	Kinematics of parallel robots Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-form and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.	5	
5.	Velocity and static analysis of robot manipulators Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.	5	
6	Dynamics of serial and parallel manipulators Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Commercially available multi-body simulation software (ADAMS) and Computer algebra software Maple.	4	
7	Motion planning and control Joint and Cartesian space trajectory planning and generation, Classical	6	

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	control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators. 8 Module 8: Modeling and		
8	Modeling and control of flexible robots Models of flexible links and joints, Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.	4	
9	Modeling and analysis of wheeled mobile robots 3Introduction and some well known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR's on uneven terrain, Simulations using Matlab and ADAMS.	3	
10	Selected advanced topics in robotics Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough-Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Over-constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).	3	

Text book and Reference books:

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

Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
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Project-II

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Contact: 12P

Project work II