Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech in Computer Science & Design
(Applicable from the academic session 2021-2022)

SEMESTER – III

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

Name of the Course:	Analog & Digital Electronics		
Course Code: ESC-301	Semester: III		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Continuous Assessment: 25	
Tutorial: NIL		Attendance: 5 marks	
Practical: hrs./week		End Semester Exam : 70 Marks	
Credit Points:	3		
Objective:			
1	To acquire the basic knowledge of different analog components and their applications		
2	To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.		
3	To prepare students to perform the analysis and design of various digital electronic circuits		
Pre-Requisite:			
1	Basic Electronics Parts I & II learned in the First year, semesters 1 & 2. Basic BJTs,.		
2	Basic concept of the working of P-N diodes, Schottky diodes,		
3	Basic FETs and OPAMP as a basic circuit component. Concept of Feedback		

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

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

Text book and Reference books:

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

15. Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
16. J.Bignell & R.Donovan-Digital Electronics-5/e- Cenage Learning.
17. Leach & Malvino—Digital Principles & Application, 5/e, McGraw Hill 18. Floyed & Jain-Digital Fundamentals-Pearson.

Course Outcomes:
On completion of the course students will be able to

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

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

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

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

Name of the Course:		Data Structure & Algorithm	
Course Code: PCC-CS301		Semester: III	
Duration: 6 months		Maximum Marks:100	
Teaching Scheme			Examination Scheme
Theory: 3 hrs./week			Continuous Assessment: 25
Tutorial: NIL			Attendance : 5 marks
Practical: hrs./week			End Semester Exam :70 Marks
Credit Points:		3	
Objective:			
1	To learn the basics of abstract data types.		
2	To learn the principles of linear and nonlinear data structures.		
3	To build an application using sorting and searching		
Pre-Requisite:			
1	CS 201 (Basic Computation and Principles of C		
2	M101 & M201 (Mathematics), basics of set theory		

Unit	Content	Hrs/Unit	Marks/Unit

1	Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Technique sand their complexity analysis.	9	
2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	9	
3	Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis	9	
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: BasicTerminologies 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 Andersonfreed.
4. "Data Structures in C" by Aaron M. Tenenbaum.
5. "Data Structures" by S. Lipschutz.
6. "Data Structures Using C" by Reema Thareja.
7. "Data Structure Using C", 2/e by A.K. Rath, A. K. Jagadev.
8. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein
9. "Data Structures through C" by Yashwant Kanetkar, BPB Publications.
10. "Expert Data Structures with C++" by R.B Patel, Khanna Publishing House

Course Outcomes:

On completion of the course students will be able to

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

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

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

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

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

Computer Organization & Architecture
Code: PCC-CS302
Contacts: 3L

Name of the Course:		Computer Organization & Architecture	
Course Code: PCC-CS302		Semester: III	
Duration:6 months		Maximum Marks: 100	
Teaching Scheme			Examination Scheme
Theory: 3 hrs./week			Continuous Assessment: 25
Tutorial: NIL			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		
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, Hazards [2L] Introduction to RISC architectures. RISC vs CISC architectures. [2L] I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA. [3L]	10	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

PCC-CSD302.1 Understand basic structure of digital computer, stored program concept and different arithmetic and control unit operations.

PCC-CSD302.2 Understand basic structure of different combinational circuits- multiplexer, decoder, encoder etc.

PCC-CSD302.3 Perform different operations with sequential circuits.

PCC-CSD302.4 Understand memory and I/O operations.

Mathematics-III (Differential Calculus)
Code: BSC-301
Contacts: 2L

Name of the Course:		Mathematics-III (Differential Calculus)	
Course Code: BSC-301		Semester: III	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme			Examination Scheme
Theory:2 hrs./week			Mid Semester exam: 15
Tutorial: NIL			Assignment and Quiz: 10 marks
			Attendance: 5 marks
Practical: NIL			End Semester Exam: 70 Marks
Credit Points:		2	
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.	7	
2	Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.	7	

3	Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar). Theorems of Green, Gauss and Stokes (Statement only) and related problems.	7	
4.	First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution. Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation.	7	
5	Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph. Matrix Representation: Incidence & Adjacency matrix. Tree: Basic Concept of tree, Binary tree, Spanning Tree, KrusKal and Prim's algorithm for finding the minimal spanning tree.	8	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to:

BSC-301.1 Express a logic sentence in terms of predicates, quantifiers, and logical connectives.
BSC-301.2 Apply the rules of inference and methods of proof including direct and indirect proof forms, proof by contradiction, and mathematical induction.
BSC-301.3Use tree and graph algorithms to solve problems
BSC-301.4 Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.

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

Name of the Course:		Economics for Engineers (Humanities-II)	
Course Code: HSMC-301		Semester: III	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme			Examination Scheme
Theory:3 hrs./week			Continuous Assessment: 25
Tutorial: NIL			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. 2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per- Unit Model, Segmenting Model, Cost Indexes, PowerSizing Model, Improvement & Learning Curve, Benefits.	9	
2	3. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal& Effective Interest. 4. Cash Flow & Rate of Return Analysis – Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing an Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity and Breakeven Analysis. Economic Analysis In The Public Sector -Quantifying And Valuing Benefits & drawbacks.	9	
3	5. Inflation and Price Change – Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. 6. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Borrowed Money Viewpoint, Effect Of Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. 7. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.	9	

4.	8. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. 9. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. 10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	9	

Text book and Reference books:

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

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 III

Analog & Digital Electronics Lab
Code: ESC-391
Contacts: 4P

Name of the Course:	Analog & Digital Electronics Lab
Course Code: ESC-391	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Course Outcomes:	
1	ESC-301.1
2	ESC-301.2
3	ESC-301.3
Pre-Requisite:	
Pre-requisites as in ESC-301	

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)

Data Structure & Algorithm Lab
Code: PCC-CS391
Contacts: 4P

Name of the Course:	Data Structure & Algorithm Lab
Course Code: PCC-CS391	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Course Outcomes:	
1	PCC-CS301.1
2	PCC-CS301.2
3	PCC-CS301.3
4	PCC-CS301.4
5	PCC-CS301.5
Pre-Requisite:	
Pre-requisites as in PCC-CS301	

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)

Computer Organization & Architecture Lab
Code: PCC-CS392
Contacts: 4P

Name of the Course:	Computer Organization Lab
Course Code: PCC-CS392	Semester: III
Duration:6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 60
Practical: 4 hrs./week	Distribution of marks: 40
Credit Points:	2
Course Outcomes:	
1	PCC-CS302.1
2	PCC-CS302.2
3	PCC-CS302.3
4	PCC-CS302.4
Pre-Requisite:	
Pre-requisites as in PCC-CS302	

Laboratory Experiments:	
1	Familiarity with IC-chips: a) Multiplexer, b) Decoder, c) Encoder b) Comparator Truth Table verification and clarification from Data-book.

2	Design an Adder/Subtractor composite unit.
3	Design a BCD adder.
4	Design of a 'Carry-Look-Ahead' Adder circuit.
5	Use a multiplexer unit to design a composite ALU
6	Use ALU chip for multibit arithmetic operation
7	Implement read write operation using RAM IC
8	8. (a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.

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

IT Workshop (Sci Lab/MATLAB/Python/R)
Code: PCC-CS393
Contacts: 4P

Name of the Course:	IT Workshop
Course Code: PCC-CS393	Semester: III
Duration: 6 months	Maximum Marks: 100
Teaching Scheme:	
Theory: NIL	Continuous Internal Assessment
Tutorial: NIL	External Assesement: 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.

Practical Syllabus

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, RVector 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, Begineer's Guide for Data Analysis Using R Programming, Khanna Publishing House, New Delhi

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

Programming with Python

Introduction
History, Features, Setting up path, Working with Python, Basic Syntax, Variable and Data Types, Operator

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

Lists
Introduction, Accessing list, Operations, Working with lists, Function and Methods

Tuple
Introduction, Accessing tuples, Operations, Working, Functions and Methods

Dictionaries
Introduction, Accessing values in dictionaries, Working with dictionaries, Properties

Functions
Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables

Modules
Importing module, Math module, Random module, Packages, Composition, Input-Output Printing on screen, Reading data from keyboard, Opening and closing file, Reading and writing files, Functions
Exception Handling
Exception, Exception Handling, Except clause, Try? finally clause, User Defined Exceptions.

Laboratory Experiments:

1	Practical Assignments related with implementation of PCC-CS393

Computer Graphics & Animation
Code: PCC-CSD401
Contacts: 3L

Name of the Course:	Computer Graphics & Animation		
Course Code: PCC-CSD401	Semester: IV		
Duration:6 months	Maximum Marks:100		
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Continuous Assessment: 25	
Tutorial: NIL		Attendance : 5 marks	
Practical: 4 hrs /week		End Semester Exam :70 Marks	
Credit Points:	4		
Objective:			
1	To understand computer graphics, devices		
2	To understand algorithms for drawing line, circle, polygon, filling		
3	To understand algorithms for scalling, rotation, projection, viewing, clipping, transformations		
4	To understand and apply computer animations		
Pre-Requisite:			
1	PCC-CS201, Mathematical concept on Geometry, Matrix.		

Unit	Content	Hrs/Unit	Marks/Unit
1	Overview of computer graphics, representing, preparing, presenting & interacting with pictures for presentations; RGB color model, storage tube graphics display, Raster/Random scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software. Scan conversion: Points & Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	9	

2	2D transformation & viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse. Cohen and Sutherland line clipping, Sutherland-Hodgeman Polygon clipping & viewing:	9	
3	Curves : Curve representation, surfaces, designs, Bezier, Hermit curves, B-spline curves, Hidden surfaces: Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Painter's algorithm, scan-line algorithm; Hidden line elimination. Fractal - geometry. Color & shading models: Light & color model; interpolative shading model; Texture. Introduction to Ray-tracing: Human vision and color, Lighting, Reflection and transmission models.	8	
	Animation : Definition of Animation, Types of Animation, Cell Animation, Path Animation, 2D & 3D Animation Computer assisted Animation Techniques of Animation, Onion skinning, Motion cycling, Masking, Color cycling, Morphing Camera effects, Camera Location, Camera movement, Zones of vision Special effects, Methods of controlling the Animation, Procedural Animation, Tracking live action, Kinematics of controlling Animation, Tweening, Warping, Color dissolve Animation Software.	10	

Text book and Reference books:

1. Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education
2. Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH
3. D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH
4. M.K.Pakhira – "Computer graphics, multimedia and Animation", PHI.
5. The complete animation course by Chris Patmore Pub.-Baron's Educational Series.(New York)
6. Animation Unleashed by Ellen Bessen, Michael Weise Productions,2008(U.S.A)
7. The Animator's Survival Kit by Richard Williams , Arrar Straus & Giroux Pub.(U.S.A)

Course Outcome(s)

On completion of the course students will be able to

CO1: Define, understand & explain the basics of computer graphics, algorithms, 2D, 3D graphics,

CO2: Implement and apply programming skill to draw line, circle and polygon.

CO3: Understand and apply transformation techniques scale, rotate, view, clip , translate the objects.

CO4: Understand and create animations

Design and Analysis of Algorithms
Code: PCC-CSD402
Contacts: 3L

Name of the Course:	Design and Analysis of Algorithms		
Course Code: PCC-CSD402	Semester: IV		
Duration: 6 months	Maximum Marks:100		
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Continuous Assessment: 25	
Tutorial: NIL		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 tradeoffs, 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 andBound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	8	
3	Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	6	
4.	Tractable and Intractable Problems: Computability 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: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
7. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

Course Outcomes

On completion of the course students will be able to

CO1: Define and explain the asymptotic complexity for a given algorithms.

CO2: Analyse a given problem and decide the suitable algorithmic paradigm for its optimum solution.

CO3: Derive and solve recurrence relation of a problem and explain what algorithmic paradigm is required for a suitable solution

CO4: Explain the ways to analyze dynamic-programming paradigm and randomized algorithms and explain when an algorithmic design situation calls for it.

Object Oriented Programming & Design
Code: PCC-CSD403
Contacts: 3L

Name of the Course:	**Object Oriented Programming & Design**	
Course Code: PCC-CSD403	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	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	

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.

Computer Networks
Code: PCC-CSD404
Contact: 3L

Name of the Course:	**Computer Networks**	
Course Code: PCC-CSD404	Semester: VI	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		
		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	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.	8	

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.	10	
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.	6	
5	Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	4	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to

CO1: Define, Understand and explain concept of network layers and its necessity.
CO2: Understand the functions of different layers and their interactions.
CO3: Learn and illustrate protocols of different layers and their usefulness.
CO4: Understand different network architectures for different modern network applications and explore latest trends in it to remain self-updated.

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

Name of the Course:	Biology		
Course Code: BSC-401	Semester: IV		
Duration: 6 months	Maximum Marks:100		
Teaching Scheme		Examination Scheme	
Theory: 2hrs./week		Continuous Assessment: 25	
Tutorial: 1 hour			
		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 18th Century that lead to major discoveries. Examples from Brownian motion and the origin of thermodynamics by referring to the original observation of Robert Brown and Julius Mayor. These examples will highlight the fundamental importance of observations in any scientific inquiry.	2	

2	The underlying criterion, such as morphological, biochemical or ecological be highlighted. Hierarchy of life forms at phenomenological level. A common thread weaves this hierarchy Classification. Discuss classification based on (a) cellularity- Unicellular or multicellular (b) ultrastructure- prokaryotes or eucaryotes. (c)	3	
	energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitata- acquatic or terrestrial (e) Molecular taxonomy- three major kingdoms of life. A given organism can come under different category based on classification. Model organisms for the study of biology come from different groups. E.coli, S.cerevisiae, D. Melanogaster, C. elegance, A. Thaliana, M. musculus		
3	To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" Mendel's laws, Concept of segregation and independent assortment. Concept of allele. Gene mapping, Gene interaction, Epistasis. Meiosis and Mitosis be taught as a part of genetics. Emphasis to be give not to the mechanics of cell division nor the phases but how genetic material passes from parent to offspring. Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes. Discuss about the single gene disorders in humans. Discuss the concept of complementation using human genetics.	4	
4.	Biomolecules: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine Molecules of life. In this context discuss monomeric units and polymeric structures. Discuss about sugars, starch and cellulose. Amino acids and proteins. Nucleotides and DNA/RNA.Two carbon units and lipids.	4	

5	Enzymes: To convey that without catalysis life would not have existed on earth Enzymology: How to monitor enzyme catalysed reactions. How does an enzyme catalyse reactions? Enzyme classification. Mechanism of enzyme action. Discuss at least two examples. Enzyme kinetics and kinetic parameters. Why should we know these parameters to understand biology? RNA catalysis.	4	
6	Information Transfer:The molecular basis of coding and decoding genetic information is universal Molecular basis of information transfer. DNA as a genetic material. Hierarchy of DNA	4	
	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 exergoinc reactions. Concept of $K_{eq}$and its relation to standard free energy. Spontaneity. ATP as an energy currency. This should include the breakdown of glucose to CO_2 + H_2O (Glycolysis and Krebs cycle) and synthesis of glucose from CO_2 and H_2O (Photosynthesis). Energy yielding and energy consuming reactions. Concept of Energy charge	4	
9	Microbiology Concept of single celled organisms. Concept of species and strains. Identification and classification of microorganisms. Microscopy. Ecological aspects of single celled organisms. Sterilization and media compositions. Growth kinetics.	3	

Text books/ reference books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. 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

Course Outcomes:

On completion of the course students will be able to

BSC-401.1 Describe how biological observations of 18_{th} 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.

Environmental Sciences
Code: MC-401
Contacts: 1L

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

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

	pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L) Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green-house gases, effect of ozone modification. (1L) Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference). (1L)		
4.	Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. (2L) River/Lake/ground water pollution: River: DO, 5-day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river [deoxygenation, reaeration], COD, Oil, Greases, pH. (2L) Lake: Eutrophication [Definition, source and effect]. (1L) Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only)(1L) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Waste water treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. (2L) Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic (1L)	9	
5	Lithosphere; Internal structure of earth, rock and soil (1L)	3	

	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, L10 (18hr Index) ,n Ld.Noise pollution control. (1L)	3	
7	Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol. (2L)	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.

PRACTICAL SYLLABUS
Semester IV

Computer Graphics & Animation Lab
Code: PCC-CSD491
Contacts: 4P

Name of the Course:	Computer Graphics & Animation Lab
Course Code: PCC-CSD491	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	PCC-CSD401.1
2	PCC-CSD401.2
3	PCC-CSD401.3
Pre-Requisite:	
1	Programming, basic understanding of Geometry, Matrix

Laboratory Experiments:	
1	Implementation DDA algorithm, Bresenham's line algorithm
2	Implementation Circle generation algorithm; polygon drawing; fill algorithm
3	Implementation Scalling, Rotation, Clipping & Viewing
4	Introduction to A nimation in Maya, Animation related interface of Maya and animation preferences
5	Tools used for Animation in Maya, Keyframming, playback and playblast
6	Introduction to Tangents, Graph editor, Dope sheet.
7	Applying animation principles to object like bouncing ball
8	Character Jump Animation,
9	Character walk cycle animation

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

Design & Analysis of Algorithms Lab
Code: PCC-CSD492
Contact: 4P

Name of the Course:	Design & Analysis of Algorithms Lab
Course Code: PCC-CSD492	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	PCC-CSD402.1
2	PCC-CSD402.2
3	PCC-CSD402.3
Pre-Requisite:	
Pre-Requisite as in : PCC-CSD402	
Laboratory Experiments:	
Divide and Conquer:	
1	Implement Binary Search using Divide and Conquer approach Implement Merge Sort using Divide and Conquer approach
2	Implement Quick Sort using Divide and Conquer approach Find Maximum and Minimum element from a array of integer using Divide and Conquer approach
3	Find the minimum number of scalar multiplication needed for chain of matrix
4	Implement all pair of Shortest path for a graph (Floyed- Warshall Algorithm) Implement Traveling Salesman Problem
5	Implement Single Source shortest Path for a graph (Dijkstra , Bellman Ford Algorithm
Brunch and Bound:	
6	Implement 15 Puzzle Problem

Backtracking:	
7	Implement 8 Queen problem
8	Graph Coloring Problem Hamiltonian Problem
Greedy method	
9	Knapsack Problem Job sequencing with deadlines
10	Minimum Cost Spanning Tree by Prim's Algorithm Minimum Cost Spanning Tree by Kruskal's Algorithm
Graph Traversal Algorithm:	
11	Implement Breadth First Search (BFS)
	Implement Depth First Search (DFS)

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

Object Oriented Programming & Design Lab
Code: PCC-CSD493
Contacts: 4P

Name of the Course:	Object Oriented Programming & Design Lab
Course Code: PCC-CSD493	Semester: IV
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Internal Assessment
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

Laboratory Experiments:

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

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

Software Engineering
Code: ESC501
Contact: 3L

Name of the Course:	**Software Engineering**		
Course Code: **ESC501**	Semester: V		
Duration:6 months	Maximum Marks:100		
Teaching Scheme		**Examination Scheme**	
Theory:3 hrs./week		Mid Semester exam: 15	
Tutorial: NIL		Assignment and Quiz: 10 marks	
		Attendance: 5 marks	
Practical: hrs./week		End Semester Exam:70 Marks	
Credit Points:	3		

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

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

Text book and Reference books:

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

Augmented Reality, Virtual Reality & Mixed Reality;
Code: PCC- CSD501
Contact: 3L

Name of the Course:	**Augmented Reality, Virtual Reality & Mixed Reality**
Course Code: PCC-CSD501	Semester: V
Duration:6 months	Maximum Marks:100
Teaching Scheme	Examination Scheme
Theory:3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam:70 Marks
Credit Points:	3

Pre-requisite: Computer Graphics & Animation

CO1: Learn and understand the fundamental concepts of AR/VR/MR.
CO2: Apply the learned concepts to design moderate to large AR/VR based systems.
CO3: Understand rendering in AR/VR/MR and challenges
CO4: Be able to use geometric modeling algorithms to design virtual worlds
CO5: Be able to design user interactions in AR/VR

Module 1: (**12 L**)

Introduction, Historical perspective, Graphics pipeline, Real-time rendering in VR, Transformations, viewing and projection, Geometric modelling

Module 2: (**12 L**)
Light and optics, lens systems and imaging, lens aberrations, Stereoscopy, depth and motion perception, Human perception: visual, audio, vestibular, and tactile

Module 3: (10L)
Introduction to Augmented Reality (AR), Mixed Reality (MR), Extended Reality (xR); Taxonomy, technology and features of augmented reality, difference between AR, VR, MR; Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR/MR environments, evaluating AR systems.

Module 4: (**10L**)
Procedural modelling and creation of large virtual worlds, Telepresence and interaction, User interfaces, social interaction and evaluation of VR systems.

Reference

1. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
2. LaValle "Virtual Reality", Cambridge University Press, 2016, edition, 2009.
3. Doug A. Bowman, Ernst Kruijff, Joseph J. LaViola, and Ivan Poupyrev, 3D User Interfaces, Addison-Wesley, 2005.
4. K. S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd edition, CRC Press, 2015.
5. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
6. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
7. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.

Database Management Systems

Code: PCC-CSD502
Contact: 3L

Name of the Course:	Database Management Systems
Course Code: PCC-CSD502	Semester: V
Duration:6 months	Maximum Marks:100

Teaching Scheme	Examination Scheme
Theory:3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: hrs./week	End Semester Exam:70 Marks
Credit Points:	3

Objective:	
1	To understand the different issues involved in the design and implementation of a database system.
2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
3	To understand and use data manipulation language to query, update, and manage a database
4	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.
6	To understand the different issues involved in the design and implementation of a database system.

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

2	Relational query languages: Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQLserver. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Losslessdesign. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	13	
3	Storage strategies: Indices, B-trees, hashing.	3	
4.	Transaction processing: Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multiversion 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. [3L]		

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
4. Delhi (AICTE Recommended Textbook – 2018)
5. "Fundamentals of Database Systems" , 5th Edition by R. Elmasri and S. Navathe,
6. PearsonEducation "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu,Addison-Wesley

Course Outcomes:

On completion of the course students will be able to

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

Operating System
Code: PCC-CSD503
Contacts: 3L

Name of the Course:	**Operating System**	
Course Code: PCC-CSD503	Semester: V	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		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:		

Unit	Content	Hrs/Unit	Marks/ Unit

1	**Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of "Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, and Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	3	
2	**Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non preemptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	9	
3.	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problemetc.	5	
4.	**Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	5	
5.	**Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation– Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation –Page allocation Hardware support for paging, Protection and sharing, Disadvantages of paging. **Virtual Memory**: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).	8	

6.	**I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, SecondaryStorage Structure: Disk structure, Disk scheduling algorithms **File Management**: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency andperformance. **Disk Management:** Disk structure, Disk scheduling FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks	6	

Text book and Reference books:

1. Operating System Concepts Essentials, 9th Edition byAviSilberschatz, 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, AddisonWesley
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 thetechniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time. Design and implement file management system.
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.

Introduction to Industrial Management (Humanities III)
Code: HSMC-501
Contacts: 3L

Name of the Course:	**Introduction to Industrial Management (Humanities III)**	
Course Code: HSMC-501	Semester: V	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		**Examination Scheme**
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		Attendance: 5 marks
Practical: NIL		End Semester Exam:70 Marks
Credit Points:	3	

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

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

4	**Production planning and Control (PPC):** Types and examples of production. PPC : i. Need and importance. ii. Functions. iii. Forms used and their importance. iv. General approach 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 57 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.	8	
5	**Value Analysis (VA) and Cost Control:** 5.1 VA-definition, terms used, process and importance. 5.2 VA flow diagram. DARSIRI method of VA. Case study of VA-at least two. Waste-types, sources and ways to reduce them. Cost control-methods and important guide lines.	4	
6	**Recent Trends in IM:** ERP (Enterprise resource planning) - concept, features and applications. Important features of MS Project. Logistics- concept, need and benefits. Just in Time (JIT)-concept and benefits. Supply chain management-concept and benefits.	4	

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

Course Outcomes:

1. On completion of the course students will be able to
2. Interpret given organization structure, culture, climate and major provisions of factory acts and laws.
3. Explain material requirement planning and store keeping procedure.
4. Plot and analyze inventory control models and techniques.
5. Prepare and analyze CPM and PERT for given activities.

6. List and explain PPC functions.

Digital Image Processing
Code: PEC-CSD 501/A
Contact: 3L

Name of the Course:	Digital Image Processing
Course Code: PEC-CSD 501A	Semester: V
Duration:6 months	Maximum Marks:100
Teaching Scheme	Examination Scheme
Theory:3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	6	
2	Digital Image Formation A Simple Image Model, Geometric Model-Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4	
3	Mathematical Preliminaries Neighbour of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & SineTransform.	8	

4.	Image Enhancement Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. Highpass Filtering, High- boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	8	
5	Image Restoration 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.	5	
6	Image Segmentation 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.	5	

Text book and Reference books:

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

Creative Thinking Process and Design
Code: PEC-CSD501B
Contacts: 3L

Course Objectives:

This course aims to present an overview of the design thinking involved at each stage of the design process: the methods used by designers to generate and refine creative ideas, the key

considerations that help shape them and the feedback and review elements that allow design teams to learn from each job and contribute to future commissions.

Pre-requisites: NA

Course Outcomes:

The students will be able to:

1. Understand contemporary work and basic theories,
2. Analyse ideas to produce creative solutions
3. Create effective solutions for given problems

Name of the Course:	**Creative Thinking Process and Design**
Course Code: **PEC-CSD501B**	Semester: V
Duration:6 months	Maximum Marks:100
Teaching Scheme	Examination Scheme
Theory:3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit

1	Introduction: Example of different kinds of designs and designers, Good and bad designs, Design problems, Definition of Design, engineering design and design research, their Importance. Product life cycle, Morphology of design, Introduction to system design process, Stage models. Introduction to Task Clarification: overall process and steps, Methods for Data collection and collation including patent analysis, Methods for identification of requirements: Role Playing, Checklists, Solution neutral problem statements, etc. Quantifying requirements and Assigning importance to requirements, Linking Customer requirements to engineering requirements: Quality Function Deployment techniques.	14	
2	**Idea generation** Introduction to conceptual design: Identification of functions, Ideation, Simulation and Consolidation into solution proposals, Methods for Identification of functions such as functional decomposition techniques, Methods for Ideation, such as Brainstorming, value, Synectics, etc., Methods for consolidation into solution proposals, such as Morphological charts, Morphological matrix, etc., Methods for simulation: analytical, virtual and physical simulations **Refinement** Methods for improvement of solution proposals, such as contradiction analysis, various other TRIZ techniques, etc, Systematic evaluation of concepts: ordinal methods and cardinal methods. Thinking in images, Thinking in signs, Appropriation, Humour, Personification, Visual metaphors, Modification, Thinking in words, Words and language, Type 'faces', Thinking in shapes, Thinking in proportions, Thinking in colour	14	
3	**Prototyping** Developing designs, 'Types' of prototype, Vocabulary **Implementation** Format, Materials, Finishing, Media, Scale, Series/Continuity	8	

Text Books & References:

1. Gavin Ambrose, Paul Harris, "Basics Design - 8: Design Thinking", illustrated, reprint, AVA Publishing, 2010
2. Christian Müller-Roterberg, "Handbook of Design Thinking", Kindle Direct Publishing ISBN: 978-1790435371, November 2018.
3. Christine Charyton, *Creative Engineering Design Assessment*, Springer
4. Warren K Wake Wake, *Design Paradigms: A Sourcebook for Creative Visualization*, John Wiley & Sons

GPU Computing

Code: PEC-CSD501C
Contacts: 3L

Course Description:
This course will introduce parallel computing paradigms with focus on GPGPU programming to harness the massively parallel GPU architecture in solving computationally demanding tasks. The NVIDIA CUDA and industry standard OpenCL frameworks will be introduced and used with most of the labs. This is a project based course where the students will work on scientific computational problems.

Pre-requisite:
C Programming, Data Structures & Algorithms,

CO1: Students are able to understand concepts behind parallel computing
CO2: Students are able to understand parallel computing paradigms, GPU architecture and GPGPU development frameworks (CUDA, OpenCL, and GLSL)
CO3: Students are able to analyse an algorithms to provide parallel solutions to computationally challenging problems
CO4: Students are able to implement such solutions on GPU using CUDA, and show effectiveness of the GPU based solutions using standard benchmarks and tools

Name of the Course:	**GPU Computing**	
Course Code: **PEC-CSD501C**	Semester: V	
Duration:6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/Unit	Marks/Unit

1	**Introduction and overview**: advances in architecture and technology, need for parallel computing, examples, and challenges, **Basics on architecture and programming**: CPU/GPU architecture, multicore architecture, Flynn's taxonomy, **Single instruction, multiple threads** (SIMT) execution model.	8	
2	**Parallel programming paradigms**: parallel algorithm design, analytical modelling of parallel programs, limits on achievable performance, Amdahl's law, Gustafson's law, scalability, work optimality, message passing, shared address space machines, basic communication operations, concurrency	10	
3	**Introduction to CUDA C**: kernel based data parallel execution model, memory model and locality, CUDA threads, atomics, GPU utilisation. **Parallel computing using CUDA**: data transfer and CUDA streams, performance considerations, floating-point accuracy, synchronisation, communication, reduction trees, parallel prefix sum, optimisations	10	
4	OpenMP, OpenACC, Multi-GPU systems, GPGPU-computing using OpenCL and OpenGL	8	

Text Books and References:

1. David B. Kirk, and Wen-mei W. Hwu, Programming massively parallel processors: a hands-on approach, Elsevier.
2. A. Grama, A. Gupta, G. Karypis, and V. Kumar, Introduction to parallel computing, 2nd edition.

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

Name of the Course:	**Constitution of India**
Course Code: **MC-CS501A**	Semester: V
Duration:6 months	Maximum Marks:100
Theory:3 hrs./week	
Tutorial: NIL	
Practical: NIL	
Credit Points:	0

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction: Constitution' meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy	3	
2	Union Government and its Administration : Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha	6	
3	State Government and its Administration Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions	6	
4	Local Administration District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different 4.departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	8	
5	Election Commission Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women	7	

Text book and Reference books:

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

Essence of Indian Knowledge Tradition: MC-CS501B

Contacts: 3L

Name of the Course:	**Essence of Indian Knowledge Tradition**
Course Code: **MC-CS501B**	Semester: V
Duration:6 months	Maximum Marks:100
Theory:3 hrs./week	
Tutorial: NIL	
Practical: NIL	
Credit Points:	0

Unit	Content	Hrs/Unit	Marks/Unit
1	Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, Indigenous Knowledge (IK), characteristics, traditional knowledge visa-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge	3	
2	Protection of traditional knowledge: The need for 6 protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK	6	
3	Legal framework and TK: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFR Act); The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016.	6	
4	Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge	7	

5	Traditional Knowledge in Different Sectors: Traditional knowledge and engineering, Traditional medicine system, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK	2	

Text book and Reference books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002.
2. "Knowledge Traditions and Practices of India" Kapil Kapoor1, Michel Danino
3. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
4. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
5. Fritzof Capra, Tao of Physics
6. Fritzof Capra, The wave of Life

PRACTICAL SYLLABUS

Name of the Course:	**Augmented Reality, Virtual Reality & Mixed Reality Lab**
Course Code: **PCC-CSD591**	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

Sr. No	**Experiment**
1	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.
2	Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.
3	Develop a scene in Unity that includes: i. a cube, plane and sphere, apply transformations on the 3 game objects. ii. add a video and audio source
4	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a program to change the colour and material/texture of the game objects dynamically on button click
5	Develop a scene in Unity that includes a sphere and plane. Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using vr controller.
6	Develop a simple UI (User interface) menu with images, canvas, sprites and button. Write program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene.
7	Create an immersive environment (like - living room/ battlefield/ tennis court etc) with only static game objects. 3D game objects can be created using Blender or use available 3D models.
8	Include animation and interaction in the immersive environment created in Assignment 7.

Database Management System Lab
Code: PCC-CSD592
Contacts: 4P

Name of the Course:	Database Management System Lab
Course Code: PCC-CSD592	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

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
   - The SELECT statement
   - Using the WHERE clause
   - Using Logical Operators in the WHERE clause
   - Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
   - Using Aggregate Functions
   - Combining Tables Using JOINS
   - 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)

Name of the Course:	**Operating System Lab**
Course Code: **PCC-CSD593**	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

Managing Unix/Linux Operating System [8P]:

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

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

Games and Applications Design
Code: PEC-CSD601

Contact: 3L

Name of the Course:	**Games and App Design**	
Course Code: PEC-CSD601	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:		End Semester Exam:70 Marks
Credit Points:	3	

Course Description

This hands-on project-based course will introduce students to the fundamentals of game development & design game engine. Topics include level design, lighting, materials, particle effects, game AI, game logic, user input mappings, audio, physics and motion. Students will learn to implement custom game logic using Visual Scripting system. In this course students will create an architectural visualization, a shooting gallery mini-game and a basic first person shooter. Students will be evaluated on both technical and creative ability

Unit	Content	Hrs/Unit	Marks/Unit
1	**Architectural Visualization** Intro to the UE4 Editor, Adding Static Meshes & Materials, Creating and Detailing an Interior Room, Lighting Techniques, Post Processing Effects, Camera Sequencing, Particle Effects, Introduction to Blueprints, Adding Physics to Static Meshes, Triggering Events (Lighting, Effects, Text), Create a Key Pickup and HUD, Animating and Opening a Door in Blueprints	10	

2	**Shooting Gallery Mini-Game** Intro to the Material Editor, Adding Motion to Objects, Spawning and Destroying Objects, Create a Destructible Mesh to Shatter Objects, Design a Simple User Interface, Creating a Win Condition	10	
3	**First Person Shooter** Audio and Particle Effects (Explosions), Character Enhancements (Sprint, Rifle Zoom, Rate of Fire), Game Objectives and Constraints, Collectible Objects & Win Condition, User Interface Design II, Material Design II, AI	8	
4.	**Side-Scroller (If Time Allows)** Animation Assets, Animation Notifications, Audio II, Character Animation & Blend Spaces, State Machines, Ragdoll Effect, Finalizing & Packaging Games	8	

Course Outcomes

Students will be able to:

CO1: Utilize and implement general game design theory and techniques
CO2: Design and utilize custom scripts
CO3: Creatively design specific game elements based on topics learned in class
CO4: Understand and implement basic AI concepts

Text book and Reference books:

1. Carnall, Benjamin. *Unreal Engine 4.X by Example*. Birmingham, UK: Packt Publishing, 2016
2. Sewell, Brenden. *Blueprints Visual Scripting for Unreal Engine*. Birmingham, UK: Packt Publishing, 2015.
3. Doran, John. *Unreal Engine Game Development Cookbook*. Birmingham, UK: Packt Publishing, 2015.
4. Schell, Jesse. The Art of Game Design: A Book of Lenses. Boca Raton, USA: CRC Press, 2008.

Artificial Intelligence & Machine Learning
Code: PCC- CSD602
Contacts: 3L

Name of the Course:	**Artificial Intelligence & Machine Learning**	
Course Code PCC- CSD602	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:		End Semester Exam:70 Marks
Credit Points:	3	

Course Objectives

Students are able to:

1. Apply basic search techniques for problem solving.
2. Explain how to represent Knowledge required for problem solving.
3. Utilize AI for application in real world.
4. Apply ML in decision making and problem solving.

COURSE OBJECTIVE		
1. To learn the concept of how to learn patterns and concepts from data without being explicitly programmed		
2. To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.		
3. Explore supervised and unsupervised learning paradigms of machine learning.		
4. To explore Deep learning technique and various feature extraction strategies.		
	Hrs/unit	Marks /unit

Unit 1: Introduction [1] Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents [2] Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. Problem Solving [2] Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	5	
Unit 2: Search techniques [5] Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies.	5	
Unit 3: Supervised Learning (Regression/Classification) • Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes • Linear models: Linear Regression, Logistic Regression, Generalized Linear Models • Support Vector Machines, Nonlinearity and Kernel Methods • Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	8	
Unit 4: Unsupervised Learning • Clustering: K-means/Kernel K-means • Dimensionality Reduction: PCA and kernel PCA • Matrix Factorization and Matrix Completion • Generative Models (mixture models and latent factor models)	8	
Unit 5 Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6	
Unit 6 Introduction to Deep Learning and Feature Representation Learning, Reinforcement Learning, Introduction to Bayesian Learning and Inference, Recent trends in various learning techniques of machine learning and classification methods	4	

Text book and Reference books:

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

Human Computer Interaction
Code:PEC- CSD601A
Contact: 3L

Name of the Course:	**Human Computer Interaction**	
Course Code: PEC-CSD601A	Semester: VI	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		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	Digital Electronics, Computer Organization &Architecture

Unit	Content	Hrs/Unit	Marks/ Unit
1	Human: I/O channels – Memory – Reasoning and problem solving; The computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.	9	
2	Interactive Design basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process – software life cycle usability engineering – Prototyping in practice – design rationale. Design rules, principles, standards, guidelines, rules. Evaluation Techniques – Universal Design.	11	
3.	Cognitive models –Socio-Organizational issues and stake holder requirements –Communication and collaboration models-Hypertext, Multimedia and WWW.	8	

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.

Data Visualization
Code:PEC- CSD601B
Contact: 3L

Name of the Course:	**Data Visualization**	
Course Code: PEC-CSD601B	Semester: VI	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	3	
Objective:		

1	Learn the foundations of visual perception
2	Be familiar with the data analysis and visual design techniques
3	Learn to apply visualization principles for data analysis and applications
Pre-Requisite:	
1	Basic Mathematics, Programming, Python

Unit	Content	Hrs/Unit	Marks/ Unit
1	**Introduction to Data Visualization** Evolution of Data Visualizing, its Need, Infographics Vs Data Visualization, Gestalt's theory of visual perception, Advantage and Benefits of Data Visualization, Digital data and its classification. Reading Data from Standard text files (.txt, .csv, XML), Displaying JSON content Outputting Basic Table Data (Building a table, Using Semantic Table, Configuring the columns), Good chart Design.	10	
2	**Data Handling in Python** Pandas Data manipulation – Pandas, Series, Dealing with missing values, Reshaping, filtering, merging, DataFrames, Pivot Tables. Pandas Functions – Groupby, CorrelationsDataFrame methods and Properties.	8	
3.	**Visualizing data using Matplotlib** Matplotlib's pyplot API, Box plot, Relating data table to a chart, Pie chart, Scatter plot, Histogram, line plot, Bar plot, Interactive features of Matplotlib.	6	
4.	Data Visualization with Seaborn Seaborn plots using "iris" dataset, Swarm plot, count plot, Violin Plot, Pair Plot, Implot plot, DistPlot,	6	
5.	**Making charts interactive and Animated:** Data joins, updates and exits, interactive buttons, Updating charts, Adding transactions, using keys	6	

Course Outcome

After learning the course the students should be able to:

1. Explain principles of visual perception.
2. Apply core skills for visual analysis.
3. Apply visualization techniques for various data analysis tasks.
4. Design interactive and animated visualization.

CAD & CAM
Code: PEC- CSD601C
Contact: 3L

Name of the Course:	**CAD & CAM**
Course Code: PEC-**CSD601C**	Semester : VI
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance : 5 marks
Practical: NIL	
Credit Points: 3	End Semester Exam :70 Marks

Course objective: To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.

Unit	Content	Hrs/Unit	Marks/ Unit
1	**Introduction:** Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process. **Transformations:** 2D and 3D transformations.	6	
2	**Curves and Surfaces:** Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Geometric modeling curves and surfaces, Representation, Wire frame models, Parametric representations, Parametric curves and surfaces, Manipulations of curves and surfaces, DDA, Bresenham's Mid point line, circle, ellipse algorithms.	10	
3.	**Solid modeling:** Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half - spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modeling, Perspective, Parallel projection, Hidden line removal algorithms. CAD/CAM Data Exchange Formats: Types of file formats & their exchange, Graphics standards.	10	

4.	**Introduction to Generative Design:** What is generative design? Common applications of generative design, Additive Manufacturing. The mindset shift needed to build a generative design, its parameters, and exposure to the generative workflow by exploring Autodesk tools, Rapid prototyping.	8	

Course Outcomes: The students will be able to:

1. Define and explain the different principles used in CAD/CAM.
2. Create surface primitives using parametric modelling.
3. Develop solid models using the different representation schemes.
4. Understand Generative design and learn to explore it applications in design.

Recommended Books

1. Zeid, I., CAD/CAM, McGraw Hill (2008).
2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill (1989).
3. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008).
4. Rooney, J. and Steadman, P., Principles of Computer Aided Design, prentice Hall (1988).
5. Rooney, J. and Steadman, P., Computer Aided Design, Pitman/Open University (1987).
6. Mallineuse, G., Computational Concepts and Methods, Kogan Page Ltd. (1986).

Wearable Devices, Interactions and Applications
Course Code: PEC- CSD602A
Contact: 3L

Name of the Course:	**Wearable Devices, Interactions and Applications**
Course Code: PEC- CSD602A	Semester:VI
Duration:6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Course Description:

This is a course about the current paradigm of Wearable Computing. This course will cover the origins, pioneering contributions, and principles of Wearable Computing. With this foundation, it

will initiate the exploration into the space by learning how to design physical device, digital (applications) as well as human (interaction techniques) aspects of wearable. It will help to develop the skills needed to conduct design of these three interrelated elements and also get a chance to apply them.

Course Outcomes

Students will be able to:

CO1: Identify the motivation, guiding principles, and challenges of Wearable Computing.
CO2: Develop skills pertaining to the design of a holistic interactive wearable system comprising of the physical, digital, and the human aspects.
CO3: generate new project ideas that illustrate effective use of wearable for a problem you identify.
CO5: plan and produce proof-of- concepts to test hypotheses about a wearable solution.

Module 1: (6)
Introduction to Wearable Computing; Course overview, Looking inside technology, Applications of Wearable Technology,

Module 2: (10)
Manual Prototyping, Emerging opportunities for wearables; Wearable Prototyping, Designing for wearability, Arduino Prototyping, Challenges of Wearable Computing

Module 3: (12)
Intelligent agents: Sensing, Activity Recognition, Thresholding based event detection,
Intelligent agents II: Just-in-time Information Retrieval, Context awareness, Capture and Access, Context-aware prototyping,

Module 4: (10)
Input techniques, Soft-good prototyping, Output: Audio, visual, tactile, Privacy and Social Acceptability.

Reference:

Krumm, J. (2010).Ubiquitous computing fundamentals. Boca Raton: Chapman & Hall/CRC Press.

Interactive Interface Design
Code:PEC-CSD602B

Contact 3L

Name of the Course:	**Interactive Interface Design**
Course Code: PEC- CSD602B	Semester:VI
Duration:6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Course Description

Why are things so hard to use these days? Why does not this thing I just bought work? Why is this web site so hard to use? Why do users not like my design? Why is my app not getting popular? These are frustrations that we have all faced from systems not designed with people in mind. The question this course will focus on is: how can we design human-centered systems that people find useful and usable? This course is an introduction to designing, prototyping, and evaluating user interfaces.

Unit	Content	Hrs/Unit	Marks/ Unit
1	Introduction to interactive design, Design process overview, Contextual Inquiry, Human-centered perspectives in computing, Conceptualizing interaction; mental models, affordances, signifiers, and constraints. Task analysis; Sketching and prototyping, Human factors & Mental models; Low-Fidelity prototyping;	10	
2	Visual design; Usability engineering, Usability evaluation: think aloud, observing users, testing and modeling users, expert evaluations, Information visualization; HCI and mobility; HCI and security, User modeling, personalization.	12	

3.	Types of Interfaces, Interface modalities: color, sound, etc.; the role of graphic and industrial design; Cool characteristics of a good HCI designer, User experience (UX) & user experience engineer,	10	
4.	Recent trends and happenings in HCI; Whirlwind tour of different research groups, academic conferences, and organizations in the space of HCI	4	

CO1: Students are able to understand what makes interfaces more / less usable by humans, and the science / theories of usability
CO2: Students are able to design usable interfaces (for desktop screens / touch screens / mobile phone interfaces) using established design paradigms
CO3: Students are able to build usable interfaces (for desktop screens / touch screens / mobile phone interfaces) using established design paradigms
CO4: Students are able to methodologically / scientifically evaluate the usability of a given interface (for desktop screens / touch screens / mobile phone interfaces) using quantitative and qualitative methods and identify specific scopes for improvement

Design Processes & Perspectives
Code: PEC-CSD602C
Contact: 3L

Name of the Course:	**Design Processes & Perspectives**
Course Code: PEC- CSD602C	Semester:VI
Duration:6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Course Description

This course introduces students to the theoretical and practical aspects of design evolving processes. The course presents the varied palette of design from design of physical objects, to design of human-computer interactions, to design of services, to design of micro systems and connected/complex systems. It initiates the process of learning fundamental skills such as observation & representation, investigation, analyisation, synthesisation, conceptualization,

reflections, projection, visualization & representation. Topics such as Design Processes, Design Perspectives, Design Context & Concerns, Problem Solving Methods, Idea Generation, User-Focused Thinking and Basic Communication are covered during the course.

Unit	Content	Hrs/Unit	Marks/ Unit
1	**INTRODUCTION TO PROBLEM SOLVING PROCESS** Factors Influencing Design, Brief/Opportunity/Need/'Leap of Faith', Research/ Investigation, Analysis/ Synthesis/ Findings/ Insights, Problem Statement, Conceptualisation /Ideation/ Visualization, Options & Alternatives, Final Solution, Implementation/execution, Evaluation/ Validation/Testing, Improve/Modify/ Amend/ Revise	8	
2	**2 ANALYSIS OF A SIMPLE PROBLEM IN A GIVEN CONTEXT** Mind Maps, affinity mappings, Empathy Mapping, User Story Mapping, Semiotic Analysis (Syntax-Semantic-Pragmatic), observations, Insights and Opportunities, Soft Prototyping the idea/ concept, Documentation, report making and presentations, understanding and defining 'Context' – Exposure to different perspectives, concerns and issues in the context of design.	10	
3.	**DESIGN PERSPECTIVES: CONTEXT & CONCERNS** Understanding and defining 'Concerns' – Fundamental yet subjective questions like what makes a good designer. Areas of concerns : social concerns, economic concerns, political concerns, environmental concerns etc Tangible and Intangible relevance of broadening one's perspectives in Arts Aesthetics, Science and Technology in Design, The Challenges in Design - Designing for the Real World, Emerging Areas of Design. Relevance of Design in the Context of India. Importance of Sustainable Design Practices - Preserving traditional practices & designing for the underserved communities.	10	

4.	THE NOTION OF THE DESIGNER 'SELF' AND THE 'OTHER/USER' The Hierarchy of the 'Other' Framing the Problem with Rreference to Context; Framing Research Questions, Framing the Design Process: Identifying Methodologies and Strategies related to the different stages of Problem Solving Process, CREATIVE DESIGN THINKING METHODS Introduction to various Techniques/Tools for Ideation: Brain Storming, Browsing, Word Association, Attribute Listing, Mind Mapping, Affinity Mapping, Card Sorting, Visualization, Conceptualisation, Ideation of multiple solutions, Validation, Testing.	8	

CO1: Develop the ability to identify, reflect, analyze and evaluate an issue or problem, keeping subjective views of all stakeholders in mind, in order to develop insights, which can help develop well defined problem statement.
CO2: Develop the ability to empathise with the 'other' while developing the ability to reflect critically on the designer 'self' thus developing the ability to create scenarios and initiate, express and communicate concepts.
CO3: Develop the ability to select methodologies and develop processes in problem solving
CO4: Develop the ability to engage in complex problem solving and to create collaborations engaging by planning and generating design solutions in a more holistic approach, which includes all stakeholders, systems, communities and complexities of issues.

Robotics
Code: OEC- CSD601 A

Contacts: 3L

Name of the Course:	**Robotics**		
Course Code: OEC-CSD601A	Semester: VI		
Duration: 6 months	Maximum Marks:100		
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Continuous Assessment: 25	
Tutorial: NIL		Attendance : 5 marks	
Practical: NIL		End Semester Exam :70 Marks	
Credit Points:	3		

Unit	Content	Hrs/ Unit	Marks / Unit

1	Introduction : brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.	1	
2	Elements of robots – links, joints, actuators, and sensors Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	5	
3	Kinematics of serial robots Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator.	4	
4	Kinematics of parallel robots Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform	5	
5	Velocity and static analysis of robot manipulators Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.	5	
6	Dynamics of serial and parallel manipulators Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, Commercially available multi-body simulation software (ADAMS) and Computer algebra software Maple.	4	

7	Motion planning and control Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in nonlinear control of manipulators. 8 Module 8: Modeling and	6	
8	Modeling and control of flexible robots Models of flexible links and joints, Kinematic modeling of multilink 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 threewheeled 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. GoughStewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors. Overconstrained 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.

Computer Vision
Code: OEC- CSD601 B
Contacts: 3L

Course Description
The goal is to develop understanding of the fundamental concepts in computer vision and enable students to understand and develop applications using existing tools. Students will be given theoretical and programming assignments targeted towards solving real-world computer vision problems.

Pre-requisite: Linear Algebra, Image Analysis, Digital Signal Processing

Name of the Course:	**Computer Vision**
Course Code: **OEC- CSD60- B**	Semester: VI
Duration: 6 months	Maximum Marks:100
Teaching Scheme	**Examination Scheme**
Theory:3 hrs./week	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: NIL	End Semester Exam :70 Marks
Credit Points: 3	

Unit	Content	Hrs/Unit	Marks/ Unit
1	**Module 1:** Introduction to Computer Vision, Camera geometry and camera calibration, Camera geometry and camera calibration Review of Digital Image Processing,	8	
2	**Module 2:** Edge Detection and Hough Transforms, Image Segmentation, Feature Point Detection - Harris, SIFT, HOG, LBP, STIP, Feature Detection and Description - Bag Of Words, VLAD, Object Recognition – SVMs, Detection - Viola Jones Object detector	10	
3	**Module 3:** Convolutional Neural Networks and Applications Convolutional Neural Networks and Applications, Optical Flow/ Overflow, KLT based object tracking,	8	

4	**Module 4:** Projective Geometry - Basics and 2D transformations (Euclidean, Similarity, Affine and Projective), Epipolar Geometry - Fundamental and Essential Matrix, Least Squares and Robust Estimation (RANSAC), Stereo reconstruction, SfM and Bundle Adjustment, Homography and panorama creation., Recent Progress in Computer Vision, Review and Overflow	10

Course Outcomes

CO1: Apply techniques for feature extraction and representation, tracking, segmentation, object detection and recognition.
CO2: Apply ideas from single and multi-view geometry in applications requiring depth/3D estimation.
CO3: Look up relevant literature and identify potential solutions for a given computer vision problem and implement them using existing tools/libraries (Matlab/OpenCV).
CO4: Evaluate and compare quantitative performance of vision algorithms by using appropriate metrics.

Text book and Reference books:

1. Richard Szeliski's draft "Computer Vision: Algorithms and Applications"
2. Richard Hartley and Andrew Zisserman, \Multiple View Geometry", Cambridge University Press, 2004
3. David Forsyth, Jean Ponce, \Computer Vision: A Modern Approach", Pearson Education, second edition.
4. Simon J. D. Prince, \Computer Vision: Models, Learning, and Inference", 1st Edition, Cambridge University Press, 2012

Wireless Sensor Networks
Code: OEC-CSD601C

Contact: 3L

Name of the Course:	Wireless Sensor Networks
Course Code: OEC-CSD601C	Semester: VI
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs	Continuous Assessment: 25
Tutorial: NIL	Attendance: 5 marks
Practical: Nil	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 :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, ommonalities and differences with MANETs constraints and challenges, advantages, applications, enabling technologies for WSNs.	4	
2	Architectures Single-node architecture - hardware components, design constraints, energy consumption of sensor nodes , operating systems And execution environments, examples of sensor nodes 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	9	

	principles		
3	Communication Protocols: 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, energyefficient routing, unicast protocols, multipath 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	8	
5	Sensor Network Platforms and Tools :Sensor node hardware, Berkeley motes, programming challenges, nodelevel software platforms, node-level simulators, state-centric programming, Tiny OS, nesC components, NS2 simulator, TOSSIM.	6	

Text book and Reference books:

1. Holger Karl & Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

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.

Internet of Things
Code: OEC-CSD601D

Contacts: 3L

Course Code	OEC-CSD601 D
Course Name	Internet of Things
Credits	3

COURSE OBJECTIVE
Able to understand the application areas of IOT
Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
Able to understand building blocks of Internet of Things and characteristics

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	6
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	6
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	8
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	8
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	5
Unit 6: Recent trends in smart sensor for day to day life, evolving sensors and their architecture.	3

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

References:

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

Research Methodology
Code: PROJ-CSD 601
Contact: 2L

Name of the Course:	**Research Methodology**	
Course Code: **PROJ-CSD 601**	Semester: VI	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25
Tutorial: NIL		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	2	

Unit	Content	Hrs/ Unit	Marks/ Unit
1	RESEARCH FORMULATION AND DESIGN The role of Design Research-Why is it so Important? 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.	6	
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 STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.	7	
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 publishingIMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability	5	

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.	6	

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

Games & App Design Lab
Code: PCC-CSD691
Contacts: 4P

Name of the Course:	**Games & Applications Design Lab**
Course Code: PCC- CD691	Semester:VI
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Practical Continuous Assessment (PCA)
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

Software Requirement: Game Maker Studio 2 (or other suitable one), Hardware Requirement: Dual Core Processsor, 2 GB RAM.

Laboratory Experiments:
1. Digital Art / Infographics
2. Isometric Drawing and Perspective
3. Modelling of 3d Objects
4. Surface Mapping of Images and materials – Lighting
5. Principles of Animation, Creating Movement Paths , Camera Positioning
6. Create programmatic images, animations, interactive art, and games.
7. Starting off with simple, primitive shapes and building up to more sophisticated sprite-based games
8. Android Native Application Overview
9. Activity Life Cycle
10. View and View Group(Relative, Linear, Etc), and Basic UI Design
11. List View with Custom Adapter
12. API Call With Volley
13. Broadcast and Background Service.

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

AI & ML Lab
PCC-CSD692
Contacts: 4P

LIST OF EXPERIMENTS:

1. WAP in Python to simulate the rolling DICE and calculate MEAN and Standard Deviation (SD).
2. WAP in Python to read DATA from a file and check the distribution of the DATA through Histogram.
3. WAP in Python to estimate the Mean, SD and Confidence on the estimation about the quality of the DATA in experiment 2.
4. WAP in Python to estimate the Mean Standard Error (MSE) and Coefficient of Determination (R) from a set of experimental DATA of your choice.
5. Implement Logistic Regression.
6. Implement K-means Clustering to Find Natural Patterns in Data
7. Implement Hierarchical clustering
8. Implement K-mode clustering
9. Implement k-nearest neighbour algorithms
10. Implement classification based on association rules
11. Implement Gaussian Mixture Model Using the Ex excitation Maximization
12. Compare Machine Learning algorithms on a data set of your choice.
13. Evaluating ML algorithm with balanced and unbalanced datasets

Robotics Workshop
Code: PCC-CSD693
Contacts: 4P

Name of the Course:	**Robotics Workshop**
Course Code: PCC- CD693	Semester: VI
Duration:6 months	Maximum Marks:100
Teaching Scheme:	
Theory: hrs./week	Practical Continuous Assessment (PCA)
Tutorial: NIL	External Assesement:60
Practical: 4 hrs./week	Distribution of marks:40
Credit Points:	2

Laboratory Experiments:

1. Basics of Robotics - Introduction to robotics, what are robots? What are their characteristics? Classification of robots, Applications of robots in different fields.
2. Understanding the basic components of a mobile robot - gripper, wheels, actuators, chassis, sensors, brain.
3. Build the robot chassis & embed components.
4. Study of geometry of robot manipulator. Determination of Work space of manipulator.
5. Denavit-Hartenberg convention. Forward and inverse kinematics.
6. Robotics design and schematics.
7. Importance of programming in robotics? Build your Computer using Raspberry Pi, Installing OS on your Raspberry Pi, Raspberry Pi - Setup SSH connection using Putty
8. Robot programming and simulation for pick and place. Program to Control DC Motors using Raspberry Pi & Python,
9. Interface Motor Driver & DC Motor to Raspberry Pi,
10. Programming Logic for the Raspberry Pi Robot
11. Smartphone Controlled Robot Assembly - How to assemble the basic structure of a mobile robot? How to control the movement of a two wheel mobile robot?
12. How to make a custom block (function)?
13. What is an IR sensor? How does it work? How to control a robot Calibrating IR Sensors, How to connect it to controller and calibrate it to detect objects in close proximity?
14. How to program the IR sensors of the robot to detect objects in front of it and follow them?

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

Course Outcomes: Students will be able to:

CO1: Explain the fundamental concept of Robotics.
CO2: Identify and illustrate basic components of robot.
CO3: Integrate and assemble components to build a robot.
CO4: Program the controller and automate the functionality of robot.

Semester VII

Deep Learning
Code: PEC-CSD701A
Contacts: 3L

Name of the Course:	**Deep Learning**	
Course Code: **PEC-CSD701A**	Semester: VII	
Duration: 6 months	Maximum Marks:100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25 Marks
Tutorial: NIL		Attendance : 5 marks
Practical: NIL		End Semester Exam :70 Marks
Credit Points:	3	

Unit	Content	Hrs/ Unit	Marks/ Unit
1	Introduction: Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	3	
2	Feed forward neural network: Artificial Neural Network, activation function, multilayer neural network, cardinality, operations, and properties of fuzzy relations.	6	
3	Training Neural Network: Risk minimization, loss function, back propagation, 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 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)

Prototyping Interactive Systems
Course Code: PEC-CSD701B

Contact: 3L

Name of the Course:	Prototyping Interactive Systems
Course Code: PEC-CSD701B	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

Course Description:

Introduction to Engineering Design is a multidisciplinary course offered with an aim to ignite the students' mind with concepts in design and innovation as well as engineering skills needed to build physical prototypes. Students will learn to work with microcontrollers, smartphones, low-cost materials, and power tools through several in-class activities and lab exercises.

Pre-requisits: Basic fluency with computers Basic programming knowledge

CO1: Students will learn different methods of interacting with computers including command line, GUI, and novel sensors and actuators.
CO2: Students will be able to plan, design and develop prototypes of interactive systems including its form, function, and interface.
CO3: Students will be able to identify important components of a PC and how they are connected.
CO4: Students will learn to document and share your projects through self- made websites and posters.
CO5: Students will be able to identify electronic components, and procure them.

Detail Syllabus:

Module 1: (16P)
Course logistics and Overview, System design and functioning of Computing systems, Shell Scripting, Introduction to MIT App Inventor (http://appinventor.mit.edu) for rapid prototyping of apps for Android smartphones, Continuation of MIT App Inventor, Implementation of a simple game using the MIT App Inventor

Module 2:(16P)

Setting up a Raspberry Pi. Accessing ports on Raspberry Pi using python, Shell Scripting, Analog and digital sensors (temperature, GPS, IR, ultrasonic, light intensity, accelerometer, etc), Actuators, Arduino Microcontroller and IDE; Criteria to select a microcontroller: Arduino v/s Raspberry Pi, Processing Language and IDE, Arduino + Processing Integration, Arduino + Android Integration

Module 3: (16P)

Fusion 360: 3D CAD Modeling for 3D Printing, Eagle CAD: Printed Circuit Board (PCB) Designing, Cloud Computing and Storage: Google Cloud, Github.

Reference:

1. Fraden, J. 2010. Handbook of modern sensors. Springer.Azuma, R.T. 1997. A survey of augmented reality. Presence. 6, 4 (1997), 355–385.
2. Siewiorek, D. et al. 2008. Application Design for Wearable Computing. Synthesis Lectures on Mobile and Pervasive Computing. 3, 1 (Jan. 2008), 1–66.
3. Wearable Computing Tutorial: http://www.iswc. net/iswc03/iswc2003-intro-tutorial.pdf
4. Making Things Talk, 3e Paperback – 12 Sep 2017 Practical Electronics for Inventors, Fourth Edition Paperback – 16 Apr 2016
5. Make: Paper Inventions (Make : Technology on Your Time) Paperback – 22 Sep 2015
6. Brief history of wearable computing: https://www.media.mit.edu/wearables/lizzy/timeline.html

Quantum Computing
Code: PEC-CSD701C

Contacts: 3L

Name of the Course:	Quantum Computing
Course Code: PEC-CSD701C	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 Cauchyschwarez and triangle Inequalities.	3	
2	Matrices & Operators: Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators,	10	
3.	Commutator Algebra, Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics.	5	
4.	Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices. Density Operator: Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector.	5	
5.	Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures.	8	
6.	Recent trends in Quantum Computing Research, Quantum Computing Applications of Genetic Programming.	6	

Text book and Reference books:

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

Course Outcomes:

On completion of the course students will be able to:
CO1: Define Q-Bit and Quantum state
CO2: Explain Vector spaces, Matrices
CO3: Understand Density operators and Quantum Mechanics
CO4: Explore Tensor products, Quantum theories and recent trends in QC research.

Multi-agent Intelligent Systems
Code: PEC-CSD701D

Contacts: 3L

Name of the Course:	Multi-agent Intelligent Systems
Course Code: PEC-CSD701D	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 selfinterested agents: auctions & voting systems: negotiation; Interactions between benevolent agents: cooperative distributed problem solving (CDPS), partial global planning; coherence and coordination; Interaction languages and protocols: speech acts, KQML/KIF, the FIPA framework.	12	
4.	Advanced topics: One issue selected from the contemporary research literature, perhaps by guest lecturer.	9	

Text book and Reference books:

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

Blockchain Technology
Code: PEC-CSD702A

Contact: 3L

Name of the Course:	Blockchain Technology	
Course Code: PEC-CSD702A	Semester: VII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory: 3 hrs./week		Mid Semester exam: 15
Tutorial: NIL		Assignment and Quiz: 10 marks
		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/ Unit	Marks /Unit
1	Introduction to Cryptography and Cryptocurrency, Bitcoin, Wallet: managing and protecting crypto assets	10	
2	Consensus: network models, corruption tolerance, sybil resistance, Nakamoto Consensus: : security, attacks and incentives, Randomness beacons, VDFs, and applications to consensus,	10	
3	Ethereum: Decentralized Apps, EVM, and the Ethereum blockchain (Ethereum white paper, Ethereum yellow paper, Solidity documentation, Hyperledger Fabric,	6	
4	Scaling the Blockchain, Privacy: de-anonymizing the blockchain and mixing, zkSNARKs (Zero-Knowledge Succinct Non-Interactive Argument of Knowledge): a proof construction where one can prove possession of certain information, zkSNARK applications: : confidential transactions and Zcash.	12	

Course Outcomes:

The students are expected to:

CO1: Learn and understand the fundamentals of Blockchain technology.
CO2: Understand how cryptography primitives drive blockchains and crypto-currency infrastructures.
CO3: Learn how bitcoin and other coins work in real world.
CO4: Understand how cryptocurrency and blockchains will move for future directions (ex. Privacy, multiparty computation, anonymity).

Text book and Reference books:

1. Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016
2. Foundation of Consensus, http://elaineshi.com/docs/blockchain-book.pdf

Information Security Code: PEC- CSD702B

Contact 3L

Name of the Course:	Information Security	
Course Code: PEC-CSD702B	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 study and practice fundamental techniques in developing secure applications
2	To understand the policy, procedures and guidelines to protect the computing resources

Course Outcomes	
1	To understand security parameters and access control methods.
2	To understand the fundamental policies and design principle of computing resources
3	To recognize system design, logic-based system
4	To study the security architecture of database, operating system and associated vulnerabilities

Unit	Content	Hrs/ Unit	Marks /Unit
1	Overview of Security Parameters: Confidentiality, integrity and availability; Security violation and threats; Security policy and procedure; Assumptions and Trust; Security Assurance, Implementation and Operational Issues; Security Life Cycle.	6	
2	Access Control Models: Discretionary, mandatory, roll-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models.	5	
3	Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-interferenceand policy composition, international standards.	5	
4	Systems Design: Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.	6	

5	Logic-based System: Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, operating system security, user security, program security.Special Topics: Data privacy, introduction to digital forensics, enterprise security specification.	8	
6	Operating Systems Security: Security Architecture, Analysis of Security in Linux/Windows, Database Security: Security Architecture, Enterprise security, Database auditing.	6	

Text and Reference Books:

1. Anderson, R. Security engineering. John Wiley & Sons, 2008.
2. Bishop, M. Computer Security: Art and Science. Pearson Education, Boston, US, 2003.
3. Stamp, M. Information security: principles and practice. John Wiley & Sons, 2014.
4. Pfleeger, C. P., Pfleeger, S. L., and Margulies, J. Security in Computing,ProQuest Safari Tech Books Online, 2017.
5. Wheeler, D. A. Secure programming HOWTO, 2017.
6. Zalewski, M. Google browser security handbook, 2009.
7. Gertz, M., & Jajodia, S. (Eds.). Handbook of database security: applications andtrends. Springer Science & Business Media, 2007.
8. Information Security & Cyber Laws, Gupta & Gupta, Khanna Book Publishing.

Cyber Security, Laws and Ethics
Code: PEC- CSD702C

Contact: 3L

Name of the Course:	Cyber Security Laws and Ethics	
Course Code: PEC-CSD702C	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	
3	Ethical Hacking and Social Engineering: Ethical Hacking Concepts and Scopes, Threats and Attack Vectors, Information Assurance, Threat Modelling, Enterprise Information Security Architecture, Vulnerability Assessment and Penetration Testing, Types of Social Engineering, Insider Attack, Preventing Insider Threats, Social Engineering Targets and Defence Strategies, Introduction to Cyber Forensics and Auditing.	10	

4	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. Indian laws, IT act, Public key certificate.	5	
5	Introduction of Cybercrime: Forgery, Software Piracy, Computer Network intrusion. Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cyberstalking, Security challenges posted by mobile devices, cryptographic security for mobile devices, Tools and Methods used in Cyber crime, Phishing & Identity Theft.	10	

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)

Cloud Computing
Code: PEC- CSD702D

Contact: 3L

Name of the Course:	Cloud Computing
Course Code: PEC- CSD702D	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	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)	9	

2	Use of Platforms in Cloud Computing Concepts of Abstraction and Virtualization Virtualization technologies : Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including 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,	12	
	Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service., Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service, Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services,		

3	Cloud Infrastructure: Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle). Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)	7	
4	Concepts of Services and Applications : 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	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

Big Data Analysis
Code: OEC- CSD701A

Contact: 3L

Name of the Course:	Big Data Analytics	
Course Code: OEC- CSD701A	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	

Total Number of Lectures: 48

COURSE OBJECTIVE	
1. Understand big data for business intelligence. 2. Learn business case studies for big data analytics. 3. Understand nosql big data management. 4. Perform map-reduce analytics using Hadoop and related tools	
Content	NO. OF LECTURE
Unit 1: What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics.	8
Unit 2: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	8

Unit 3: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures	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:
1. Describe big data and use cases from selected business domains 2. Explain NoSQL big data management 3. Install, configure, and run Hadoop and HDFS 4. Perform map-reduce analytics using Hadoop

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.

Aesthetics and Art
Code: OEC-CSD701B
Contacts: 3L

Course Description

What is the nature of mind/consciousness - is it immaterial or material, or both? How do we understand the relation between the mind, brain and the body on the one hand, and the mind and the external world, on the other? What is it to have a mental representation or a 'thought'? Are such mental representations, intentional states, and 'experiencing' itself (such as experiencing pain) inseparable from self-consiousness, such that without self-consciousness there can be no consciousness? Can 'thinking' be processively or functionally reproduced in computers? Is the possibility of such reproduction essential to fully grasping what the mind is? These are some of the issues that this course will investigate, by first situating them within the broader epistemological and ontological debates in which they arose, before turning to more contemporary approaches and theoretical responses.

Course Outcomes:

CO1: To situate contemporary debates in the philosophy of mind with respect to epistemological and ontological problematics in the history of philosophy
CO2: To articulate some of the basic problems, debates and systematic responses in the domain of the philosophy of mind.
CO3: To critically analyse and evaluate these responses, with respect to the problems they address, and in relation to each other.
CO4: To enable students to frame possible responses that bring to light implicit dimensions of these issues that have been insufficiently thematized.

Name of the Course:	Aesthetics and Art
Course Code: OEC- CSD701B	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 Content

Module 1: (10L)
Introduction: Descartes and Mind-Body dualism, Kant: Copernican turn; The 'I think' argument , The link between Consciousness, self-consciousness and the 'Transcedental I' , Hume: Empiricism, Skepticism and the argument against a permanent self,

Module 2: (12L)
Ryle: The Concept of Mind, 'Descartes Myth', Crane: The Mechanical Mind, Intro and 'The Puzzle of Rpresentation', Nagel, "What is it Like to be a Bat",

Module 3: (10L)
Turing: Computing Machinary and Intelligence , Crane: The Mechanical Mind, 'Computers and Thoughts', Crane: 'Computers and Thoughts' continued,

Module 4: (8L)
Searle:“Minds, Brains, and Programs",Chinese Room Analogy, Dennett: “Can Machines Think?”,

Reference:

1. Rene Descartes, Meditations on First Philosophy
2. Immanuel Kant, Critique of Pure Reason
3. David Hume, A Treatise of Human Nature
4. Gilbert Ryle, The Concept of Mind
5. Tim Crane, The Mechanical Mind
6. David Chalmers (ed), Philosophy of Mind: Classical and Contemporary Readings
7. A. M. Turing , "Computing Machinary and Interlligence", in Mind, Vol. LIX, Issue 26
8. J. Searle, Minds, Brains, and Programs.”in Behavioral and Brain Sciences, Vol. 3 Issue 3

Introduction to Philosophical Thoughts
Code: OEC-CSD701C
Contacts: 3L

Name of the Course:	Introduction to Philosophical Thoughts	
Course Code: OEC- CSD701C	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	Nature of Indian Philosophy : Plurality as well as common concerns. 2. Basic concepts of the Vedic and Upanisadic views : Atman, Jagrata, Svapna, Susupti, Turiya, Brahman, Karma, Rta,Rna,	15	
2	Carvaka school : its epistemology, metaphysics and ethics. Mukti	6	
3	Jainism : Concepts of sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada, and nayavada ; pramanas, ahimsa, bondage and liberation.	5	
4	5. Buddhism : theory of pramanas, theory of dependent origination, the four noble truths; doctrine of momentaryness; theory of no soul. The interpretation of these theories in schools of Buddhism : Vaibhasika, Sautrantrika, Yogacara, Madhyamika.	5	
5	6. Nyaya : theory of Pramanas; the individual self and its liberation ; the idea of God and proofs for His existence.	5	

Text book and Reference books:

1. M. Hiriyanna : Outlines of Indian Philosophy.
2. C.D.Sharma : A Critical Survey of Indian Philosophy.

3. S.N.Das Gupta : A History of Indian Philosophy Vol – I to V.
4. S.Radhakrishnan : Indian Philosophy Vol – I & II.
5. T.R.V.Murti : Central Philosophy of Buddhism.
6. J.N.Mahanty : Reason and Tradition of Indian Thought.

Project Management and Entrepreneurship
Code: HSMC 701

Contact: 2L + 1T

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

ENTREPRENEURSHIP

1. Introduction: Meaning and Concept of Entrepreneurship, Innovation and entrepreneurship, Contributions of entrepreneurs to the society, risk-opportunities perspective and mitigation of risks [2L]
2. Entrepreneurship – An Innovation: Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent v/s Convergent Thinking, Qualities of a prospective Entrepreneur [2L]
3. Idea Incubation: Factors determining competitive advantage, Market segment, blue ocean strategy, Industry and Competitor Analysis (market structure, market size, growth potential), Demand-supply analysis [4L]
4. Entrepreneurial Motivation: Design Thinking - Driven Innovation, TRIZ (Theory of Inventive Problem Solving), Achievement motivation theory of entrepreneurship – Theory of McClelland, Harvesting Strategies [2L]
5. Information: Government incentives for entrepreneurship, Incubation, acceleration. Funding new ventures – bootstrapping, crowd sourcing, angel investors, Government of India's efforts at promoting entrepreneurship and innovation – SISI, KVIC, DGFT, SIDBI, Defense and Railways [4L]
6. Closing the Window: Sustaining Competitiveness, Maintaining Competitive Advantage, the Changing Role of the Entrepreneur. [2L]

7. Applications and Project Reports Preparation [4L]
8. PROJECT MANAGEMENT : Definitions of Project and Project Management, Issues and Problems in Project Management, Project Life Cycle - Initiation / Conceptualization Phase, Planning Phase, Implementation / Execution Phase, Closure / Termination Phase [4L]
9. Project Feasibility Studies – Pre-Feasibility and Feasibility Studies, Preparation of Detailed Project Report, Technical Appraisal, Economic/Commercial/Financial Appraisal including Capital Budgeting Process, Social Cost Benefit Analysis [2L]
10. Project Planning – Importance of Project Planning, Steps of Project Planning, Project Scope, Work Breakdown Structure (WBS) and Organization Breakdown Structure (OBS), Phased Project Planning [2L]
11. Project Scheduling and Costing – Gantt chart, CPM and PERT Analysis, Identification of the Critical Path and its Significance, Calculation of Floats and Slacks, Crashing, Time Cost Trade-off 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.
1. Text Book of Project Management: Gopalkrishnan, P. and Ramamoorthy, V.E.; McMillan
2. Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.; PHI
3. Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V.; MGH

Project-II Code: PROJ-CSD781

Contact: 12P

Project work I

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

Project Work II & Dissertation

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

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

Semester VIII

Inclusive Design, Universal Design & Accessibility PEC- CSD801A

Contact: 3L

Name of the Course:	Inclusive Design, Universal Design & Accessibility
Course Code: PEC- CSD801A	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

Unit	Content	Hrs/Unit	Marks/ Unit
1	Introduction: Example of different kinds of designs and designers, Good and bad designs, Design problems, Definition of Design, engineering design and design research Their Importance.	8	
2	Product life cycle, Morphology of design, Introduction to system design process, Stage models. Introduction to Task Clarification: overall process and steps, Methods for Data collection and collation including patent analysis, Methods for identification of requirements: Role Playing, Checklists, Solution neutral problem statements, etc.	7	
3	Quantifying requirements and Assigning importance to requirements, Linking Customer requirements to engineering requirements: Quality Function Deployment techniques.	5	
4	Introduction to conceptual design: Identification of functions, Ideation, Simulation and Consolidation into solution proposals, Methods for Identification of functions such as functional decomposition techniques, Methods for Ideation, such as Brainstorming, Synectics, etc., Methods for consolidation into solution proposals, such as Morphological charts, Morphological matrix, etc.,	10	
5	Methods for simulation: analytical, virtual and physical simulations, Methods for improvement of solution proposals, such as contradiction analysis, various other TRIZ techniques, etc, Systematic evaluation of concepts: ordinal methods and cardinal methods	8	

COURSE OBJECTIVES

1. This course provides a broad overview of the generic concepts of design

2. Design thinking and design research,
3. Processes and techniques

COURSE OUTCOMES

This course provides a broad overview of the generic concepts of design, design thinking and design research, and within the backdrop of this understanding, focuses specifically on the processes and techniques for carrying out engineering design in a creative manner.

Text Books and References

1. Christine Charyton, *Creative Engineering Design Assessment*, Springer
2. Warren K Wake Wake, *Design Paradigms: A Sourcebook for Creative Visualization*, John Wiley & Sons
3. Christine Charyton, *Creative Engineering Design Assessment*, Springer
4. Warren K Wake Wake, *Design Paradigms: A Sourcebook for Creative Visualization*, John Wiley & Sons

Multimedia Systems
Code: PEC- CSD801B

Contact: 3L

Name of the Course:	Multimedia Systems
Course Code: PEC-CSD801B	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

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- kd 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, Videoon-demand, Video Conferencing, Educational Applications, Industrial Applications, Multimedia archives and digital libraries, media editors	4	

Text book and Reference books:

1. Ralf Steinmetz and Klara Nahrstedt , Multimedia: Computing, Communications & Applications , Pearson Ed.
2. Nalin K. Sharda , Multimedia Information System , PHI.
3. Fred Halsall , Multimedia Communications , Pearson Ed.
4. Koegel Buford , Multimedia Systems , Pearson Ed.
5. Fred Hoffstetter , Multimedia Literacy , McGraw Hill.
6. Ralf Steinmetz and Klara Nahrstedt , Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing , PHI.

7. J. Jeffcoate , Multimedia in Practice: Technology and Application , PHI.
8. V.K. Jain, Multimedia and Animation, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

Web Design & Development
Code: PEC-CSD801C

Contacts: 3L

Name of the Course:	Web Design & Development	
Course Code: PEC- CSD801C	Semester: VIII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25 marks
Tutorial: 3L		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/ Unit	Marks/Unit
1	INTERNET BASICS: • Familiarity with internet browser (Internet Explorer, Netscape Navigator etc.) • Working with browser window tool bar , menu bar • Browsing a given web site address, searching a particular topic through search engines. • Familiarity with E-Mail, sending viewing printing e-mail message. • Use of mailbox (inbox, outbox) in outlook express. Use of attachment facility available in e-mailing.	9	
2	WEB SERVER: • Familiarity with web server – IIS, PWS etc. – Configuring web server – Creating virtual directory.		
3	INTERNET SERVICES • Concept and familiarity of various internet services (www, http, ftp, chat etc).		
4.	HTML/XML • Creating simple HTML & XML file, place it in web server and access it from client Browser. • Creating a HTML form incorporating GUI components (Command button, text box, radio button, check box, combo box etc).		

5	ACTIVE SERVER PAGES • Introduction to Active Server Pages. • Elements of PHP (Scripts, Objects, Components). • Making your first Active Server Page.		
6	INTRODUCING VB SCRIPT: • Variables, Mathematical operators, functions — Logical operators, Loop, Conditional statements — String Function, Date and Time Function. • Subroutine — Formatting Display, Adding Components to scripts — Handling Event driven programming.		
	WORKING WITH PHP : • Using HTTP — Writing simple ASP files — Controlling Execution of server side scripts. • Problems on HTML forms to get user information and retrieving HTML form contents • Working with query string.		
	PHP SESSION: • Introduction to session. • Familiarity and working with session objects (simple problems). • Using session events. • Familiarity and working with cookies.		
	PHP APPLICATION: • Introduction to PHP Application features of PHP Application • Creating a Simple PHP Application, Setting the properties of PHP Application — Using Application objects and Application events.		
	PHP COMPONENTS: • Using Components in PHP (Simple problems) — Creating Components with page scope, session scope, Application scope. • Working with browser capability component, file assess components , counter components etc.(Simple problems)		
	DATABASE MANAGEMENT THROUGH PHP: • Brief overview of ActiveX Data Objects. • Using ADODB to access a database from PHP (Simple Problem) — Opening, closing database connection • Executing SQL statements.		

Visual Design & Communication
OEC- CSD801A

Contact: 3L

Name of the Course:	Visual Design & Communication
Course Code: OEC-CSD801A	Semester: VIII
Duration: 6 months	Maximum Marks:100

Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 marks
Tutorial: NIL	Attendance : 5 marks
Practical:NIL	End Semester Exam :70 Marks
Credit Points:	3

VISUAL DESIGN

Based on the premise that Visual Design is a discipline of design that applies the principles of visual language for better analysis and understanding of design problem and solution, this course focuses on the elements and principles of the visual language and their semantic use. A multi- disciplinary domain, design consists of, aesthetics, architecture, products, communication, processes, systems, technology, business/commerce, ramification on environment and society and demands clear understanding of design fundamentals. Apart from the thorough knowledge of core concepts, design also requires the representation of concepts visually to make effective or functional communication and iteration of ideas. For creative skills and aesthetic sense, one must clearly understand the use of basic design elements and their applications for a particular design solution. For a designer to communicate more concisely and in a visually appropriate manner, it is necessary to use commonly understood principles, perspective and design layout standards. Together, these conventions constitute a visual language, and help to ensure that the drawing is clear and relatively easy to understand.

VISUAL COMMUNICATION

The concept and science of Visual Communication is introduced as the relationship between human information processing, with emphasis on processing of visual information and design of messages. It includes visual perception, organization, semantics, working memory (STM & LTM) and their implications.

The course also introduces students to the fundamentals of Typography and Photography. The Typography course introduces students to the fundamentals of Typography and its application in effective product interface/communication. And the Photography course introduces the students to photography as a medium of visual language and applies it to visual design. In today's world that is crowded with visual stimulus it is important to cut through the noise and be able to decipher, capture and create visual images that communicate.

Pre-requisite: Concept on Graphics, DESIGN DRAWING, VISUALISATION, Working Knowledge of Software like Adobe Photoshop, Illustrator and Indesign (Alternate Open Sourse.)

CO1: Students will develop the ability to create visual compositions using basic elements and by applying appropriate principles of visual composition to communicate

CO2: Students will develop the ability to perceive, visualize, and communicate visual elements as visual narratives.

CO3: Students will develop the ability to address simple communication problems through a visualization process and construct mental imageries.

CO4: Students will demonstrate the ability to plan, develop, design and execute communication products

Unit	Content	Hrs/ Unit	Marks /Unit
1	**INTRODUCTION TO VISUAL DESIGN:** The importance of understanding visual language and its relation in context to nature and environment **ELEMENTS OF VISUAL LANGUAGE** Exploring and	10	

	understanding Dots, Lines, Forms, Space, Pattern, Texture and Colour as an elements of visual language. **INTRODUCTION TO THE PRINCIPLES OF VISUAL LANGUAGE** Visual explorations and experiments with Form, Colour, and Space, Texture, in relation to the context and environments – Concepts of harmony, balance, contrast, proportion, order, symmetry, asymmetry, rhythm, tension, juxtaposition, proximity, size, scale, proportion, orientation, alignment, variety, gradation, dominance, subordination, transition etc.		
2	**INTRODUCTION TO FUNDAMENTALS OF TYPOGRAPHY** Introduces Typography as a means of Communication and engages in typographical explorations to understand the technicalities, nuances and aesthetics of types, Study of visual principles of text and image composition : Layouts, Grids, Content Development and Information Hierarchy. Application of Typography, Image and layouts in the design of signage systems, identity systems, social communications	10	
3	**INTRODUCTION TO PHOTOGRAPHY** Study of photography as a medium to document, communicate and create photographic imagery. Exploring photo story as a narrative medium. **INTRODUCTION TO VIDEOGRAPY** Study of videography as a medium to document, communicate and create a short video.	8	
4	**COMMUNICATION THEORIES, SEMIOTICS AND VISUAL PERCEPTION** Understand the process of communication and the theories that make a difference to the development of a visual language. **STORY TELLING, NARRATIVES AND ITS ROLE IN DESIGN** Understand story telling and narratives as effective methods to scope problems and problem solving processes.	8	

Compiler Design
Code: OEC- CSD801/B
Contact: 3L

Name of the Course:	Compiler Design
Course Code: OEC- CSD801/B	Semester: VIII
Duration: 6 months	Maximum Marks:100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 marks
Tutorial: NIL	Attendance : 5 marks
Practical: Nil	End Semester Exam :70 Marks

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.	2	
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).	5	
3	**Syntax Analysis** [9L] The role of a parser, Context free grammars, Writing a grammar, Top down Parsing, Nonrecursive 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.	5	
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.	4	
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.	4	
7	**Intermediate code generation** [4L] Intermediate languages, Graphical representation, Three-address code, Implementation of three address statements (Quadruples, Triples, Indirect triples).	4	

8	**Code optimization** [5L] Introduction, Basic blocks & flow graphs, Transformation of basic blocks, Dag representation of basic blocks, The principle sources of optimization, Loops in flow graph, Peephole optimization.	4	
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

Mobile Computing
Code: OEC- CSD801C

Contacts: 3L

Name of the Course:	Mobile Computing		
Course Code: OEC-CS801C	Semester: VIII		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme		Examination Scheme	
Theory:3 hrs./week		Continuous Assessment: 25 marks	
Tutorial: 3L		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 (WCDMA), 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	5	

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

Natural Language Processing
Code: OEC- CSD801D

Contacts: 3L

Name of the Course:	Natural Language Processing
Course Code: Code: OEC- CSD801D	Semester: VIII
Duration: 6 months	Maximum Marks:100

Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 marks
Tutorial: NIL	Attendance : 5 marks
Practical:NIL	End Semester Exam :70 Marks
Credit Points:	3

Unit	Content	Hrs/Unit	Marks/Unit
1	Regular Expressions and AutomataRecap) - Introduction to NLP, Regular Expression, Finite State Automata Tokenization - Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance 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	10	
2	Language Modeling Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. 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.	8	

3	Text Classification Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. 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	9	
4.	Computational Lexical Semantics Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity Information Retrieval Boolean Retrieval, Termdocument 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	9	

Text book and Reference books:

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

Optical Networking
Code: OEC- CSD802A

Contracts: 3L Credits- 3

Name of the Course:	**Optical Networking**
Course Code: OEC- CSD802A	Semester: VIII
Duration: 6 months	Maximum Marks:100

Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Continuous Assessment: 25 marks
Tutorial: NIL	Attendance : 5 marks
Practical: Nil	End Semester Exam :70 Marks

Unit	Content	Hrs/Unit	Marks/ Unit
1	Optical communications - Basics of Sources. Transmitters. Modulators. Optical fiber. Photodetectors, and Receivers. Switching in networks. Circuit switched. Packet switched. Cell switched. Virtual circuit switched. Burst switched (fast circuit switched). Transmission Asynchronous. Synchronous. Layering in packet switched networks. Motivation. Commonly used abstraction, Physical layer. Data link layer. Network layer. Transport layer. Application layer. Layering in circuit switched networks. Physical layer. Multiplexing standards. Signalling - CAS, CCS. 15. SS7 concept.	9	
2	Data plane, management plane, control plane - concept. First generation networks. SDH/SONET. Computer interconnections - ESCON, Fiber Channel, HIPPI. FDDI. ATM. DQDB. Components – description. Mode locked laser (for ps pulses). Tunable filters. Multiplexers. Demultiplexers. Tunable wavelength convertors. Optical amplifiers. a. Fiber - EDFA. b. SOA. Tunable transmitters. Tunable receivers. Dispersion compensating fibers. Multiplexing techniques - SDM. TDMA. WDMA (OFDMA). DWDM. 2. SCM. 15. CDMA.	9	
3.	Protocols for single channel broadcast networks. (recapitulation) ALOHA, CSMA/CD. Problems with CSMA/CD. Definition of high speed network. Classification of multiple access methods. (recapitulation) Random access. Reserved acces. Scheduled access. Multichannel multiple access protocols. Desirable charactersticks of protocol. 1. Scalability. 2. Fairness. 4. TTTR. 5. TTFR. 6. FTTR. 7. FTFR. 8. Problem of wavelength stability. Multihop WDM network. xii. Shufflenet. xiii.MSN.	9	

	Wavelength routed networks.		
4.	IP over Optical framework. ASON. MPëS. Burst switched network (bufferless networks) All-optical circuit switches. All-optical packet switches. Broadcast and select. Wavelength routed. Space switch based. Discussion on various switch architectures. Packet buffering techniques. Travelling type. Recirculating type. Protection and restoration. Restoration mechanism. Restoration timing issues. Path protection. Span protection. P-cycles.	9	

Text and References: 1. WDM Networks: Biswanath Mukherjee.
2. Optical Networks - A Practical Perspective: Rajiv Ramaswamy & Kumar Sivarajan.

3D Printing and Design
Code: OEC- CSD802B

Contacts: 3L

Name of the Course:	3D Printing and Design	
Course Code: OEC- CSD802B	Semester: VIII	
Duration: 6 months	Maximum Marks: 100	
Teaching Scheme		Examination Scheme
Theory:3 hrs./week		Continuous Assessment: 25 marks
Tutorial: 3L		Attendance: 5 marks
Practical: NIL		End Semester Exam: 70 Marks
Credit Points:	3	

Unit	Content	Hrs/ Unit	Marks /Unit
1	3D Printing (Additive Manufacturing): Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications. CAD for Additive Manufacturing: CAD Data formats, Data translation, Data loss, STL format.	5	

2	Additive Manufacturing Techniques: Stereo-Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools	10	
3	Materials: Polymers, Metals, Non-Metals, Ceramics Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials	10	
4.	Additive Manufacturing Equipment: Process Equipment- Design and process parameters Governing Bonding Mechanism Common faults and troubleshooting, Process Design Post Processing: Requirement and Techniques	11	

Course Outcomes:

At the end of the course, the student will be able to:

1. Develop CAD models for 3D printing, import and export CAD data to generate .stl file.
2. Select a specific material for the given application.
3. Select a 3D printing process for an application.
4. Produce a product using 3D Printing or Additive Manufacturing. Learning

Resources:

5. L. Gibson, D.W. Rosen and B. Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
6. A. Gebhardt, Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing, Hanser Publisher, 2011.
7. C.K. Chua and K.F. Leong, 3D Printing and Rapid Prototyping- Principles and Applications, World Scientific, 2017.
8. J.D. Majumdar and I. Manna, Laser-Assisted Fabrication of Materials, Springer Series in Material Science, 2013.
9. L. Lu, J. Fuh and Y.S. Wong, Laser-Induced Materials and Processes for Rapid Prototyping, Kulwer Academic Press, 2001.
10. Z. Fan and F. Liou, Numerical Modelling of the Additive Manufacturing (AM)Processes of Titanium Alloy, InTech, 2012.

Micro-electronics and VLSI Design
Code: OEC-CSD802C
Contact: 3L

Name of the Course:	**Micro-electronics and VLSI Design**
Course Code: OEC- CSD802C	Semester: VIII
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory:3 hrs./week	Continuous Assessment: 25 marks
Tutorial: 3L	Attendance: 5 marks
Practical: NIL	End Semester Exam: 70 Marks
Credit Points:	3

Unit	Content	Hrs/ Unit	Marks /Unit
1	Introduction to CMOS circuits: MOS Transistors, MOS transistor switches, CMOS Logic, The inverter, Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers.	6	
2	Processing Technology: Silicon Semiconductor Technology- An Overview, wafer processing, oxidation, epitaxy deposition, Ion-implantation and diffusion, The Silicon Gate Process- Basic CMOS Technology, basic n-well CMOS process, p-well CMOS process, Twin tub process, Silicon on insulator, CMOS process enhancement-Interconnect, circuit elements, 3-D CMOS. Layout Design Rule: Layer Representations, CMOS n-well Rules, Design Rule of background scribe line, Layer Assignment, SOI Rule.	10	
3	Power Dissipation: Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation. Programmable Logic, Programmable Logic structure, Programmable interconnect, and Reprogramable Gate Array: Xilinx Programmable Gate Array, Design Methods: Behavioural Synthesis, RTL synthesis	8	
4.	Placement: placement: Mincut based placement – Iterative improvement placement simulated annealing. Routing: Segmented channel routing – maze routing – routability and routing resources – net delays.	5	

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

Text Book:

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

References:

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