Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

Syllabus for B. Tech in Computer Science & Engineering

(Applicable from the academic session 2018-2019)

Curriculum Structure

Semester III (Second year)							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Engineering Science Course	ESC 301	Analog and Digital Electronics	3	0	0	3
2	Professional Core Courses	PCC-CS301	Data Structure & Algorithms	3	0	0	3
3	Professional Core Courses	PCC-CS302	Computer Organisation	3	0	0	3
4	Basic Science course	BSC 301	Mathematics-III (Differential Calculus)	2	0	0	2
5	Humanities & Social Sciences including Management courses	HSMC 301	Economics for Engineers (Humanities-II)	3	0	0	3
Practical							
6	Professional Core Courses	PCC-CS393	IT Workshop (Sci Lab/MATLAB/Python/R)	1	0	4	3
7	Engineering Science Course	ESC 301	Analog and Digital Electronics	0	0	4	2
8	Professional Core Courses	PCC-CS301	Data Structure & Algorithms	0	0	4	2
9	Professional Core Courses	PCC-CS302	Computer Organisation	0	0	4	2
						Total credits	**23**

Semester IV (Second year)							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
Theory							
1	Professional Core Courses	PCC-CS401	Discrete Mathematics	3	1	0	4
2	Professional Core Courses	PCC-CS 402	Computer Architecture	3	0	0	3
3	Professional Core Courses	PCC-CS403	Formal Language & Automata Theory	3	0	0	3
4	Professional Core Courses	PCC-CS404	Design & Analysis of Algorithms	3	0	0	3

5	Humanities &Social Sciences including Management courses	HSMC 401	Management 1 (Organizational Behaviour)	3	0	0	3
6	Mandatory Courses	MC401	Environmental Sciences	1	-	-	1
Practical							
7	Engineering Science Course	PCC-CS 492	Computer Architecture	0	0	4	2
8	Professional Core Courses	PCC-CS494	Design & Analysis of Algorithms	0	0	4	2
						Total credits	**21**

Semester V (Third year)							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Engineering Science Course	ESC501	Signals & Systems	3	0	0	3
2	Professional Core Courses	PCC-CS501	Compiler Design	3	0	4	5
3	Professional Core Courses	PCC-CS502	Operating Systems	3	0	4	5
4	Professional Core Courses	PCC-CS503	Object Oriented Programming	2	0	4	4
5	Humanities &Social Sciences including Management courses	HSMC-501	Introduction to Industrial Management (Humanities III)	3	0	0	3
6	Professional Elective courses	PEC-CS501	(Elective-I) Theory of Computation/Artificial Intelligence/ Advanced Computer	3	0	0	3

			Architecture/ Computer Graphics				
7	Mandatory Courses	MC- CS501	Constitution of India/ Essence of Indian Knowledge Tradition	-	-	-	0
						Total credits	**23**

Semester VI (Third year)							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Core Courses	PCC-CS601	Database Management Systems	3	0	4	5
2	Professional Core Courses	PCC-CS602	Computer Networks	3	0	4	5
3	Professional Elective courses	PEC-CS601	(Elective-II)Advanced Algorithms/ Distributed Systems/Software Engineering/ Image Processing	3	0	0	3
4	Professional Elective courses	PEC-CS602	(Elective-III) Parallel and Distributed Algorithms/ Data Mining/Human Computer Interaction/Pattern Recognition	3	0	0	3
5	Open Elective courses	OEC-CS601	(Open Elective-) Numerical Methods/ Human Resource Development and Organizational Behavior	3	0	0	3
6	Project	PROJ-CS601	Project-1	0	0	6	3
						Total credits	**22**

Semester VII (Fourth year]							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Elective courses	PEC-CS701	(Elective-IV) Quantum Computing/ Cloud Computing/ Digital Signal Processing/Multi-agent Intelligent Systems/Machine learning	3	0	0	3
2	Professional Elective courses	PEC-CS702	(Elective-V) Neural Networks and Deep Learning/Soft Computing/ Ad-Hoc and Sensor Networks/Information Theory and Coding/Cyber Security	3	0	0	3
3	Open Elective courses	OEC-CS701	(Open Elective-II) Operations Research/Multimedia Systems/Introduction to Philosophical Thoughts	3	0	0	3
4	Basic Science course	BSC 701	Biology	2	1	0	3
5	Project	PROJ-CS701	Project-II	0	0	12	6
						Total credits	**18**

Semester VIII (Fourth year) [Summer Industry Internship]							
Sl. No.	**Type of course**	**Code**	**Course Title**	**Hours per week**			**Credits**
				L	**T**	**P**	
1	Professional Elective courses	PEC-CS801	(Elective-VI) Signals and Networks/Cryptography & Network Security/ Speech and Natural Language Processing/ Web and Internet Technology/Internet of Things	3	0	0	3
2	Open Elective courses	OEC-CS801	Open Elective-III Big Data Analysis/Cyber Law and Ethics/ Mobile Computing/Robotics/Soft Skill & Interpersonal Communication	3	0	0	3
3	Open Elective courses	OEC-CS802	(Open Elective-IV) E-Commerce and ERP/Micro-electronics and VLSI Design/Economic Policies in India	3	0	0	3
4	Project	PROJ-CS801	Project-III	0	0	12	6
						Total credits	**15**

Subject Code : ECS 301	**Category:** Engineering Science course
Subject Name : **Analog and Digital Electronics**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module – 1: [9L]

Different Classes of Amplifiers - (Class-A, B, AB and C - basic concepts, power, efficiency [2L];
Recapitulation of basic concepts of Feedback and Oscillation [1L], Phase Shift, Wein Bridge oscillators [2L].

Astable&MonostableMultivibrators [1L]; Schimtt Trigger circuits [1L], 555 Timer [2L].

Module – 2: [11 L]

Binary Number System & Boolean Algebra (recapitulation) [1L]; BCD, ASCII, EBDIC, Gray codes and their conversions [1L]; Signed binary number representation with 1's and 2's complement methods [1L], Binary arithmetic, Venn diagram, Boolean algebra (recapitulation) [1L]; Representation in SOP and POS forms [1L];Minimization of logic expressions by algebraic method. [2L]

Combinational circuits - Adder and Subtractor circuits (half & full adder &subtractor) [2L];
Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator [2L].

Module – 3: [10L]

Sequential Circuits - Basic Flip-flop & Latch [1L],
Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops[3L],

Registers (SISO,SIPO,PIPO,PISO) [2L]
Ring counter, Johnson counter [1L]
Basic concept of Synchronousand Asynchronous counters (detail design of circuits excluded), [2L]
Design of Mod N Counter [2L]

Module – 4: [6L]

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)

Textbooks:

Microelectronics Engineering – Sedra& Smith-Oxford.
Principles of Electronic Devices & circuits—B L Thereja&Sedha—S Chand
Digital Electronics – Kharate – Oxford
Digital Electronics – Logic & Systems by J.Bigmell&R.Donovan; Cambridge Learning.
Digital Logic and State Machine Design (3rd Edition) – D.J.Comer, OUP

Reference:

Electronic Devices & Circuit Theory – Boyelstad&Nashelsky - PHI
Bell-Linear IC & OP AMP—Oxford
P.Raja- Digital Electronics- Scitech Publications
Morries Mano- Digital Logic Design- PHI
R.P.Jain—Modern Digital Electronics, 2/e ,McGraw Hill
H.Taub&D.Shilling, Digital Integrated Electronics- McGraw Hill.
D.RayChaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publishers
Tocci, Widmer, Moss- Digital Systems,9/e- Pearson
J.Bignell&R.Donovan-Digital Electronics-5/e- Cenage Learning.
Leach &Malvino—Digital Principles & Application, 5/e, McGraw Hill
Floyed& Jain- Digital Fundamentals-Pearson.

Subject Code : PCC-CS 301	**Category:** Professional Core course
Subject Name : **Data Structure & Algorithm**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module 1:[10L]

Introduction: Basic Terminologies: Elementary Data Organizations, Data StructureOperations: insertion, deletion, traversal etc.; Analysis of an Algorithm, AsymptoticNotations, Time-Space trade off. Searching: Linear Search and Binary Search Techniquesand their complexity analysis.

Module 2:[9L]

Stacks and Queues: ADT Stack and its operations: Algorithms and their complexityanalysis, Applications of Stacks: Expression Conversion and evaluation – correspondingalgorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, CircularQueue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.

Module 3:[10L]

Linked Lists: Singly linked lists: Representation in memory, Algorithms of severaloperations: Traversing, Searching, Insertion into, Deletion from linked list; Linkedrepresentation of Stack and Queue, Header nodes, Doubly linked list: operations on it andalgorithmic analysis; Circular Linked Lists: all operations their algorithms and thecomplexity analysis.

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded BinaryTree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and theiralgorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree:definitions, algorithms and analysis.

Module 4:[9L]

Sorting and Hashing: Objective and properties of different sorting algorithms:Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort;Performance and Comparison among all the methods, Hashing.Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and
complexity analysis.

Recommended books:

1. “Data Structures And Program Design In C”, 2/E by Robert L. Kruse, Bruce P. Leung.
2. “Fundamentals of Data Structures of C” by Ellis Horowitz, SartajSahni, Susan Anderson-freed.
3. “Data Structures in C” by Aaron M. Tenenbaum.
4. “Data Structures” by S. Lipschutz.
5. “Data Structures Using C” by ReemaThareja.
6. “Data Structure Using C”, 2/e by A.K. Rath, A. K. Jagadev.
7. “Introduction to Algorithms” by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.

Subject Code : PCC-CS 302	**Category:** Professional Core course
Subject Name : **computer Organisation**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module – 1:[8L]

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]

Module – 2:[8L]

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]

Module – 3: [10L]

Memory unit design with special emphasis on 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]

Module – 4: [10L]

Design of control unit - hardwired and microprogrammed control. [3L]
Introduction to instruction pipelining. [2L]
Introduction to RISC architectures. RISC vs CISC architectures. [2L]
I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA. [3L]

Text Book:

1. Mano, M.M., “Computer System Architecture”, PHI.
2. BehroozParhami“ Computer Architecture”, Oxford University Press

Reference Book:

1. Hayes J. P., “Computer Architecture & Organisation”, McGraw Hill,
2. Hamacher, “Computer Organisation”, McGraw Hill,
3. N. senthil Kumar, M. Saravanan, S. Jeevananthan, “Microprocessors and Microcontrollers” OUP
4. Chaudhuri P. Pal, “Computer Organisation & Design”, PHI,
5. P N Basu- “Computer Organization & Architecture” ,Vikas Pub

Subject Code : BSC 301	**Category:** Basic Science course
Subject Name :**Mathematics-III**	**Semester** : Third
L-T-P : **2-0-0**	**Credit:2**
Pre-Requisites: No-prerequisite	

Course Content:

Module 1: Sequences and series [8L]

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.

Module 2: Multivariable Calculus (Differentiation)[7L]

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.

Module 3: Multivariable Calculus (Integration)[8L]

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.

Module 4: Ordinary Differential Equation [9L]

First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution. [5L]

Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation. [4L]

Module 5: Graph Theory [8L]

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.

Subject Code : HSMC 301	**Category:** Humanities & Social Sciences including Management Courses
Subject Name :**Economics for Engineers (Humanities-II)**	**Semester** : Third
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module I: [9L]

1. Economic Decisions Making – Overview, Problems, Role, Decision making process.
2. Engineering Costs & Estimation – Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And
Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models - Per-
Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.

Module-II: [9L]

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.

Module-III: [9L]

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.

Module-IV: [9L]

8. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, DepreciationCalculation Fundamentals, Depreciation And

Capital Allowance Methods, Straight-Line Depreciation Declining BalanceDepreciation, 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 CostLife Problems.

10. Accounting – Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct andIndirect Costs, Indirect Cost Allocation.

Text books /References

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,DavidB.Pratt : Principle of Engineering Economic Analysis, John Wiley

4. Sullivan and Wicks: Engineering Economy, Pearson

5. R.PaneerSeelvan: Engineering Economics, PHI

6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

PRACTICAL

Subject Code : ECS 391	**Category:** Engineering Science course
Subject Name : **Analog and Digital Electronics Lab**	**Semester** : Third
L-T-P : **0-0-4**	**Credit:2**
Pre-Requisites: No-prerequisite	

ANALOG: At least any two of the following

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

DIGITAL : At least any five of the following

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

Any one experiment specially designed by the college.

(Detailed instructions for Laboratory Manual to follow for further guidance. The details will be uploaded in the website from time to time)

Subject Code : PCC-CS 391	**Category:** Professional Core course
Subject Name : **Data Structure & Algorithm Lab**	**Semester** : Third
L-T-P : **0-0-4**	**Credit:2**
Pre-Requisites: No-prerequisite	

Experiments should include but not limited to :
Implementation of array operations:
Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem :
Evaluation of expressions operations on Multiple stacks &queues :
Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues
using linked lists:
Polynomial addition, Polynomial multiplication
Sparse Matrices : Multiplication, addition.
Recursive and Nonrecursive traversal of Trees
Threaded binary tree traversal. AVL tree implementation
Application of Trees. Application of sorting and searching algorithms
Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.
(Detailed instructions for Laboratory Manual to follow for further guidance. The details will be uploaded in the websitefrom time to time)

Subject Code : PCC-CS 392	**Category:** Professional Core course
Subject Name : **computer Organisation**	**Semester** : Third
L-T-P : **0-0-4**	**Credit:2**
Pre-Requisites: No-prerequisite	

1. Familiarity with IC-chips, e.g.
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. (a) & (b) Cascade two RAM ICs for vertical and horizontal expansion.
(Detailed instructions for Laboratory Manual to follow for further guidance. The details will be uploaded in the website from time to time)

Subject Code : PCC-CS 393	**Category:** Professional Core course
Subject Name : **IT Workshop (Sci Lab/MATLAB/Python/R)**	**Semester** : Third
L-T-P : **1-0-4**	**Credit:3**
Pre-Requisites: No-prerequisite	

Programming in R

1.Introduction to mechanism for statistics, data analysis, and machine learning; Introduction of R Programming, How to install and run R, Use of R help files, R Sessions, R Objects – Vectors, Attributes, Matrices, Array, Class, List, Data Frames etc.Operators in R.

2. R Programming Structures, Control Statements, Loops, Repeat and Break, R-Function, R-Vector Function, Recursive Function in R.

3.R Packages (Install and Use), Input/Output Features in R, Reading or Writing in File. Data Manipulation in R.Rearranging data , Random Number and Simulation, Statistical methods like min, max, median, mean, length, Linear Regression, Normal Distribution, Decision tree

4.Graphics, Creating Graphs, The Workhorse of R Base Graphics, Graphical Functions – Customizing Graphs, Saving Graphs to Files, Pie chart, Bar Chart, Histogram.

Programming in Matlab

1. Introduction
1.1 Why MATLAB? 1.2 History 1.3 Its strengths 1.4 Competitors 1.5 Starting MATLAB, 1.6 Using MATLAB as a calculator, 1.7 Quitting MATLAB

2. Basics
2.1 Familiar with MATLAB windows 2.2 Basic Operations 2.3 MATLAB-Data types 2.4 Rules about variable names 2.5 Predefined variables

3. Programming-I
3.1 Vector 3.2 Matrix 3.3 Array Addressing 3.4 Built-in functions 3.5 Mathematical Operations 3.6 Dealing with strings (Array of characters) 3.7 Array of array (cell) concept

4. Programming-II
4.1 Script file 4.2 Input commands 4.3 Output commands 4.4 Structure of function file 4.5 Inline functions 4.6 Feval command 4.7 Comparison between script file and function file

5. Conditional statements and Loop

5.1 Relational and Logical Operators – 5.2 If-else statements 5.3 Switch-case statements 5.4 For loop 5.5 While loop 5.6 Special commands (Break and continue) 5.7 Import data from large database 5.8 Export data to own file or database

6. 2D Plotting
6.1 In-built functions for plotting 6.2 Multiple plotting with special graphics 6.3 Curve fitting 6.4 Interpolation 6.5 Basic fitting interface

7. 3D Plotting
7.1 Use of meshgrid function 7.2 Mesh plot 7.3 Surface plot 7.4 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

SEMESTER – IV

Subject Code : PCC-CS 401	**Category:** Professional Core course
Subject Name : **Discrete Mathematics**	**Semester** : Four
L-T-P : **3-1-0**	**Credit:4**
Pre-Requisites: No-prerequisite	

Course Content:

Module 1:[8L]

Sets, Relation and Function: Operations and Laws of Sets, Cartesian Products, BinaryRelation, Partial Ordering Relation, Equivalence Relation, Image of a Set, Sum andProduct of Functions, Bijective functions, Inverse and Composite Function, Size of a Set,Finite and infinite Sets, Countable and uncountable Sets, Cantor's diagonal argument andThe Power Set theorem, Schroeder-Bernstein theorem.
Principles of Mathematical Induction: The Well-Ordering Principle, Recursivedefinition, The Division algorithm: Prime Numbers, The Greatest Common Divisor:Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

Module 2:[5L]

Basic counting techniques-inclusion and exclusion, pigeon-hole principle, permutation andcombination.

Module 3:[8L]

Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives andTruth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules ofInference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methodsand Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof ofNecessity and Sufficiency.

Module 4:[7L]

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation,Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures,Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, NormalSubgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domainand Fields. Boolean Algebra and Boolean Ring, Identities of Boolean Algebra,Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form

Module 5:[8L]

Graphs and Trees: Graphs and their properties, Degree, Connectivity, Path, Cycle,Sub Graph, Isomorphism, Eulerian and Hamiltonian Walks, Graph Colouring, Colouring mapsand Planar Graphs, Colouring Vertices, Colouring Edges, List Colouring, Perfect Graph,definition properties and Example, rooted trees, trees and sorting, weighted trees and prefixcodes, Bi-connected component and Articulation Points, Shortest distances.

Text Book :

1. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
2. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
3. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
4. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
5. J.K. Sharma, Discrete Mathematics, Macmillan
6. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
7. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
8. Douglas B. West, Introduction to graph Theory, PHI
9. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
10. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
11. R. L. Graham, D. E. Knuth, and O. Patashnik, Concrete Mathematics, 2nd Ed., Addison-Wesley, 1994.
1214. N. Deo, Graph Theory, Prentice Hall of India, 1974.
15. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
16. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.
17. Russell Merris, Combinatorics, Wiley-Interscience series in Discrete Mathematics and Optimisation
18. N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
19. Gary Haggard, John Schlipf and Sue Whitesides, Discrete Mathematics for Computer Science, CENGAGE Learning
20. Gary Chartrand and Ping Zhang – Introduction to Graph Theory, TMH
21. J.K. Sharma, Discrete Mathematics, Macmillan
22. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
23. S. K. Chakraborty and B. K. Sarkar, Discrete Mathematics, OXFORD University Press.
24. Douglas B. West, Introduction to graph Theory, PHI

Subject Code : PCC-CS 402	**Category:** Professional Core course
Subject Name : **Computer architecture**	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module – 1: [12 L]

Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design,
measuring and reporting performance. (3L)
Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards,techniques for handling hazards. Exception handling. Pipeline optimization techniques; Compiler techniques forimproving performance. (9L)

Module – 2: [8L]

Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations,
Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement policies. (8L)

Module – 3: [6L]

Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, superpipelined and VLIWprocessor architectures. Array and vector processors. (6L)

Module – 4: [12 L]

Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared-memory architecture:
synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture. Clustercomputers. (8L)
Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures. (4L)

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, “Computer organization”, McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, “The Intel microprocessors”, Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, “Computer Architecture A Quantitative Approach”, Morgan Kauffman, 2011.
4. W. Stallings, “Computer organization”, PHI, 1987.
5. P. Barry and P. Crowley, “Modern Embedded Computing”, Morgan Kaufmann, 2012.
6. N. Mathivanan, “Microprocessors, PC Hardware and Interfacing”, Prentice Hall, 2004.
7. Y. C. Lieu and G. A. Gibson, “Microcomputer Systems: The 8086/8088 Family”, Prentice Hall India, 1986.
8. J. Uffenbeck, “The 8086/8088 Design, Programming, Interfacing”, Prentice Hall, 1987.
9. B. Govindarajalu, “IBM PC and Clones”, Tata McGraw Hill, 1991.
10. P. Able, “8086 Assembly Language Programming”, Prentice Hall India.

Subject Code : PCC-CS 403	**Category:** Professional Core course
Subject Name : **Formal Language & Automata Theory**	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module 1:[6L]
Introduction: Alphabet, languages and grammars, productions and derivation, Chomskyhierarchy of languages.

Module 2:[7L]
Regular languages and finite automata: Regular expressions andlanguages, deterministic finite automata (DFA) and equivalence with regular expressions,nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars andequivalence with finite automata, properties of regular languages, pumping lemma for
regular languages, minimization of finite automata.

Module 3:[6L]
Context-free languages and pushdownautomata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibachnormal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG,parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministicpushdown automata, closure properties of CFL*s*.

Module 4:[6L]
Context-sensitive languages:Context-sensitive grammars (CSG) and languages, linear bounded automata andequivalence with CSG.

Module 5:[6L]
Turing machines: The basic model for Turing machines (TM), Turingrecognizable(recursively enumerable) and Turing-decidable (recursive) languages and theirclosure properties, variants of Turing machines, nondeterministic TMs and equivalence withdeterministic TMs, unrestricted grammars and equivalence with Turing machines, TMsas enumerators.

Module 6:[5L]
Undecidability: Church-Turing thesis, universal Turing machine, theuniversal and diagonalization languages, reduction between languages and Rice s theorem,undecidable problems about languages.

Text books/ reference books:
1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to AutomataTheory, Languages, and Computation, Pearson Education Asia.
2.Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory ofComputation, Pearson Education Asia.

3.Dexter C. Kozen, Automata and Computability, Undergraduate Texts in ComputerScience, Springer.
4. Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
5. John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill.

Subject Code : PCC-CS 404	**Category:** Professional Core course
Subject Name : **Design and Analysis of Algorithms**	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module 1: [8L]

Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis ofcomplexity bounds – best, average and worst-case behavior; Performance measurements ofAlgorithm, Time and space trade-offs, Analysis of recursive algorithms throughrecurrence relations: Substitution method, Recursion tree method and Masters' theorem.

Module 2: [8L]

Fundamental Algorithmic Strategies: Brute-Force, Greedy,Dynamic Programming, Branchand-Bound and Backtracking methodologies for the design of algorithms; Illustrationsof these techniques for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.

Module 3: [6L]

Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and BreadthFirst Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree,Topological sorting, Network Flow Algorithm.

Module 4: [10L]

Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P,NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems andReduction techniques.

Module 5: [4L]

Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problemsbeyond NP – P SPACE

Suggested 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.

Suggested reference books

1. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA

Subject Code : HSMC 401	**Category:** Humanities & Social Sciences including Management Courses
Subject Name : **Management 1 (Organizational Behaviour)**	**Semester** : Four
L-T-P : **3-0-0**	**Credit:3**
Pre-Requisites: No-prerequisite	

Course Content:

Module 1: [2L]
Organizational Behaviour: Definition, Importance, Historical Background, Fundamental Concepts of OB, Challenges and Opportunities for OB. [2]

Module 2: [2L]
Personality and Attitudes: Meaning of personality, Personality Determinants and Traits, Development of Personality, Types of Attitudes, Job Satisfaction. [2]

Module 3: [2L]
Perception: Definition, Nature and Importance, Factors influencing Perception, Perceptual Selectivity, Link between Perception and Decision Making. [2]

Module 4: [4L]

Motivation: Definition, Theories of Motivation - Maslow's Hierarchy of Needs Theory, McGregor's Theory X & Y, Herzberg's Motivation-Hygiene Theory, Alderfer's ERG Theory, McClelland's Theory of Needs, Vroom's Expectancy Theory. [4]

Module 5: [2L]
Group Behaviour: Characteristics of Group, Types of Groups, Stages of Group Development, Group Decision Making. [2]

Module 6: [2L]
Communication: Communication Process, Direction of Communication, Barriers to Effective Communication. [2]

Module 7: [6L]
Leadership: Definition, Importance, Theories of Leadership Styles. [2]

Organizational Politics: Definition, Factors contributing to Political Behaviour. [2]

Conflict Management: Traditional vis-a-vis Modern View of Conflict, Functional and Dysfunctional Conflict, Conflict Process, Negotiation – Bargaining Strategies, Negotiation Process. [2]

Module 8:[4L]
Organizational Design: Various Organizational Structures and their Effects on Human Behaviour, Concepts of Organizational Climate and Organizational Culture. [4]

References:
1. Robbins, S. P. & Judge, T.A.: Organizational Behavior, Pearson Education, 15th Edn.

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

Subject Code : MC 401	**Category:** Mandatory Courses
Subject Name : **Environmental Sciences**	**Semester** : Four
L-T-P : **1-0-0**	**Credit:1**
Pre-Requisites: No-prerequisite	

Course Content:

Basics: [6L]

Basic ideas of environment, basic concepts, man, society & environment, their interrelationship (1L)

Mathematics of population growth and associated problems, Importance of population study in environmental
engineering, definition of resource, types of resource, renewable, non-renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. (2L)

Materials balance: Steady state conservation system, steady state system with non conservative pollutants, step function.(1L)

Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management; Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering. (2L)

Ecology:[6L]

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 ofbiodiversity. (2L)

Air pollution and control: [11L]

Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere, Tropopause and Mesopause. (1L)

Energy balance: Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model[Earth as a black body, earth as albedo], Problems.(1L)

Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level,agriculture and marine food.Global warming and its consequence, Control of Global warming. Earth's heat budget.(1L)

Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion).(2L)

Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model.(2L)

Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant.Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. (2L)

Smog, Photochemical smog and London smog.Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification.(1L)

Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP.cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).(1L)

Water Pollution and Control: [9L]

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)

Land Pollution: [3L]

Lithosphere; Internal structure of earth, rock and soil (1L)

Solid Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes;
Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling.
Solid waste management and control (hazardous and biomedical waste).(2L)

Noise Pollution: [3L]
Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] (1L)
Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level,
*L*10 (18hr Index) ,*n Ld*.Noise pollution control. (1L)

Environmental Management:[2L]
Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol. (2L)

References/Books
1. Masters, G. M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd.,1991.
2. De, A. K., "Environmental Chemistry", New Age International.

Practical

Subject Code : PCC-CS 492	**Category:** Professional Core course
Subject Name : **Computer architecture Lab**	**Semester** : Four
L-T-P : **0-0-4**	**Credit:2**
Pre-Requisites: No-prerequisite	

All laboratory assignments are based on Hardware Description Language (VHDL or Verilog) Simulation.
[Pre-requisite: The hardware based design has been done in the Analog& Digital Electronics laboratory and ComputerOrganisation laboratory]

1. HDL introduction
2. Basic digital logic base programming with HDL
3. 8-bit Addition, Multiplication, Division
4. 8-bit Register design
5. Memory unit design and perform memory operatons.
6. 8-bit simple ALU design
7. 8-bit simple CPU design
8. Interfacing of CPU and Memory

Subject Code : PCC-CS 494	**Category:** Professional Core course
Subject Name : **Design and Analysis of Algorithms Lab**	**Semester** : Four
L-T-P : **0-0-4**	**Credit:2**
Pre-Requisites: No-prerequisite	

Programming Language used: C

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