Sl. No	Code No.	Course Title	Hours per week			Semes-ter	Credits
			L	T	P		
1.	ES101	Engineering Graphics	0	0	3	I	1.5
2.	ES103	Engineering Workshop Practice	0	0	3	I	1.5
3.	ES102	Introduction to IT Systems	2	0	0	II	2
4.	ES104	Fundamentals of Electrical & Electronics Engineering	2	1	0	II	3
5.	ES106	Engineering Mechanics	2	1	0	II	3
6.	ES108	Introduction to IT Systems Lab	0	0	4	II	2
7.	ES110	Fundamentals of Electrical & Electronics Engineering Lab	0	0	2	II	1
8.	ES112	Engineering Mechanics Lab	0	0	2	II	1
Total Credits							**15**

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Course Code	:	ES 102
Course Title	:	Introduction to IT Systems
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites (Course code)	:	NIL
Course Category	:	ES

Course Objectives::

This course is intended to make new students comfortable with computing environment - Learning basic computer skills, Learning basic application software tools, Understanding Computer Hardware, Cyber security awareness

Course Content:

UNIT 1:

Basic Internet skills: Understanding browser, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals.

General understanding of various computer hardware components – CPU, Memory, Display, Keyboard, Mouse, HDD and other Peripheral Devices.

UNIT 2:

OS Installation (Linux and MS Windows), Unix Shell and Commands, vi editor.

UNIT 3:

HTML4, CSS, making basic personal webpage.

UNIT 4:

Office Tools: OpenOffice Writer, OpenOffice Spreadsheet (Calc), OpenOffice Impress.

UNIT 5: Information security best practices.

Class lectures will only introduce the topic or demonstrate the tool, actual learning will take place in the Lab by practicing regularly.

Suggested Lab Work:

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. This course is all about some theory and a lot of practice.

References:

- R.S. Salaria, Computer Fundamentals, Khanna Publishing House
- Ramesh Bangia, PC Software Made Easy – The PC Course Kit, Khanna Publishing House
- Online Resources, Linux man pages, Wikipedia
- Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett

Course outcomes:

At the end of the course student will be able to comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, create worksheets, prepare presentations, protect information and computers from basic abuses/ attacks.

CHAPTER

7

Computer Engineering Curriculum Structure

(III to VI Semesters)

7.1 List of Programme Core Courses [PC]

Sl. No	Code No.	Course Title	Hours per week			Semester	Credits
			L	T	P		
1.	COPC201	Computer Programming	2	0	0	III	2
2.	COPC203	Scripting Languages (Python, Perl, etc – any one)	2	0	0	III	2
3.	COPC205	Data Structures	2	0	0	III	2
4.	COPC207	Computer System Organisation	3	1	0	III	4
5.	COPC209	Algorithms	3	1	0	III	4
6.	COPC211	Computer Programming Lab	0	0	4	III	2
7.	COPC213	Scripting Languages Lab	0	0	4	III	2
8.	COPC215	Data Structures Lab	0	0	2	III	1
9.	COPC202	Operating Systems	2	0	0	IV	2
10.	COPC204	Introduction to DBMS	2	0	0	IV	2
11.	COPC206	Computer Networks	2	0	0	IV	2
12.	COPC208	SSAD/Software Engineering	3	0	0	IV	3
13.	COPC210	Web Technologies	2	0	0	IV	2
14.	COPC212	Operating Systems Lab	0	0	2	IV	1
15.	COPC214	Introduction to DBMS Lab	0	0	2	IV	1
16.	COPC216	Computer Networks Lab	0	0	2	IV	1
17.	COPC218	Web Technologies Lab	0	0	2	IV	1
18.	COPC301	Introduction to e-Governance	2	1	0	V	3
19.	COPC303	IoT	2	1	0	V	3
Total Credits							**40**

7.2 List of Program Elective Courses [PE]

S.No	Code No.	Course Title
1	COPE301/302	Mobile Computing (3-0-2-4)
2	COPE303/304	Multimedia Technologies (3-0-2-4)
3	COPE305/306	Fundamentals of AI (3-1-0-4)
4	COPE307/308	Advance Computer Networks (3-0-2-4)
5	COPE309/310	Information Security (3-0-2-4)
6	COPE311/312	Network Forensics (3-0-2-4)
7	COPE313/314	Data Sciences: Data Warehousing and Data Mining (3-1-0-4)
8	COPE315/316	FOSS (Free and Open Source Software) (3-0-2-4)
9	COPE317/318	Software Testing (3-0-2-4)

More courses may be added to the list above.

7.3 Semester-wise Detailed Curriculum

Semester III

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Cred-its
				L	T	P		
1.	Program core course	COPC201	Computer Programming	2	0	0	2	2
2.	Program core course	COPC203	Scripting Languages (Python, Perl, etc – any one)	2	0	0	2	2
3.	Program core course	COPC205	Data Structures	2	0	0	2	2
4.	Program core course	COPC207	Computer System Organisation	3	1	0	4	4
5.	Program core course	COPC209	Algorithms	3	1	0	4	4
6.	Summer Internship-I (4 weeks) after IInd Sem	SI201	Summer Internship-1					2
7.	Program core course	COPC211	Computer Programming Lab	0	0	4	4	2
8.	Program core course	COPC213	Scripting Languages Lab	0	0	4	4	2
9.	Program core course	COPC215	Data Structures Lab	0	0	2	2	1
	Total Credits							**21**

Semester IV

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1.	Program core course	COPC202	Operating Systems	2	0	0	2	2
2.	Program core course	COPC204	Introduction to DBMS	2	0	0	2	2
3.	Program core course	COPC206	Computer Networks	2	0	0	2	2
4.	Program core course	COPC208	SSAD/Software Engineering	3	0	0	3	3
5.	Program core course	COPC210	Web Technologies	2	0	0	2	2
6.	Open Elective	**OE202	Open Elective-1					4
7.	Minor Project	Proj.202	Minor Project	0	0	4	4	2
8.	Program core course	COPC212	Operating Systems Lab	0	0	2	2	1
9.	Program core course	COPC214	Introduction to DBMS Lab	0	0	2	2	1
10.	Program core course	COPC216	Computer Networks Lab	0	0	2	2	1
11.	Program core course	COPC218	Web Technologies Lab	0	0	2	2	1
12.	Mandatory Course	AU202	Essence of Indian Knowledge and Tradition	2	0	0	2	0
	Total Credits							**21**

Semester V

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1.	Program core course	COPC301	Introduction to e-Governance	2	1	0	3	3
2.	Program core course	COPC303	IoT	2	1	0	3	3
3.	Program Elective course	COPE###	Program Elective-1					4
4.	Program Elective course	COPE###	Program Elective-2					4
5.	Open Elective	**OE301	Open Elective-2	3	0	0	3	3
6.	Summer Internship-II (6 weeks) after IVth Sem	SI301	Summer Intern-ship-2					3
7.	Major Project	PR302		0	0	2	2	^
	Total Credits							20

Semester VI

Sl. No	Category	Code No.	Course Title	Hours per week			Total contact hrs/ week	Credits
				L	T	P		
1.	Program Elective course	COPE###	Program Elective-3					4
2.	Program Elective course	COPE###	Program Elective-4					4
3.	Humanities and Social Science course	HS302	Entrepreneurship and Start-ups	3	1	0	4	4
4.	Open Elective	**OE###	Open Elective-3	3	0	0	3	3
5.	Mandatory Course	AU302	Indian Constitution	2	0	0	2	0
6.	Major Project	PR302		0	0	6	6	4^
7.	Seminar	SE302		1	0	0	1	1
	Total Credits							**20**

^1 credit is carried forward from the Vth semester major project evaluation.

Semester III

Course Code	:	COPC201
Course Title	:	Computer Programming
Number of Credits	:	2 (L:2; T:0; P:0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

To enable student, develop structured solutions to problems and implementing them using computers. This involves two parts: i) Formulating a solution for a given problem as a well-defined sequence of actions, and ii) Expressing solution in a machine readable form or a programming language. For the second part, we will learn the common units of programming languages. The first part can only be learned through the repeated practice of solving problems.

Course Content:

The language of choice will be C. The focus will be on problem solving and problem where these ideas can be applied. The main focus of the class will to take examples of problems where these ideas can be employed.

UNIT 1:

Introduction to Problem Solving (computational way of thinking); Variables and Representation

UNIT 2:

Arithmetic, Relational, Logical and Bitwise Operators; Input, Output, Formatting and File I/O

UNIT 3:

Conditional Statements, Repeat Statements, Loops and Nested Loops

UNIT 4:

Arrays and Memory Organization, Strings, Multidimensional Arrays, Functions and Parameter Passing

UNIT 5:

Recursion and Recursive solutions

Suggested Lab Work:

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should work on solved and unsolved problems listed in the text books. Teacher also should formulate problems and give them as assignment. This course is all about some theory and a lot of practice.

Reference Books:

1. Let Us C, Yashavant Kanetkar
2. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House
3. C Programming Absolute Beginner's Guide, Dean Miller and Greg Perry
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India
5. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill
6. C Programming & Data Structures, B. A. Fouruzan and R. F. Gilberg, CENGAGE Learning.
7. Outline of Programming with C, Byron Gottfried, Schaum, McGraw-Hill

Course outcomes:

Student should be able to computationally formulate basic problems and write code snippets to execute them. The focus of the course as mentioned above should be on example based learning. The basic nitty gritties can be skipped, however, the application part should be clear. For instance, when to use an array, when to use loop and when to use conditional statements.

****

Course Code	:	COPC203
Course Title	:	Scripting Languages
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

To learn how to work with a scripting language.

Course Content:

UNIT 1: Introduction, Variables and Data Types

History, Features, Setting up path, Installation and Working with Perl/Python, Basic Syntax

Understanding Perl/Python variables, Numeric data types, Using string data type and string operations, Basic Operators, Understanding coding blocks, Defining list andlist slicing, Other Data Types (Tuples, List, Dictionary -Python, Arrays, Associative Arrays/Hashes - Perl)

UNIT 2: Control Structures

Conditional blocks using if, else and elif, For loops and iterations, while loops, Loop manipulation using continue, break and else (and pass in Python), Programming using conditional and loops block

UNIT 3: Functions, Modules and Packages

Organizing Perl codes using functions, Organizing Perl projects into modules, Importing own module as well as external modules, Understanding Packages

UNIT 4: File I/O, Text Processing, Regular Expressions

Understanding read functions, Understanding write functions, Programming using file operations, Powerful pattern matching and searching, Power of pattern searching using regex

UNIT 5: Frameworks

Frameworks - Web2Py, Django, Ruby on Rails, Struts (any one of these or any other)

Suggested Lab Work:

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should work on solved and unsolved problems listed in the text books. Teacher also should formulate problems and give them as assignment. This course is all about some theory and a lot of practice.

Reference Books:

1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House
2. Starting Out with Python, Tony Gaddis, Pearson
3. Core Python Programming, Wesley J. Chun, Prentice Hall
4. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University
5. Introduction to Computation and Programming Using Python. John V. Guttag, MIT Press.
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing
7. Practical Programming: An Introduction to Computer Science using Python 3, Paul Gries, The Pragmatic Bookshelf

Course outcomes:

At the end of the course student will be able to build program with a scripting language and will be able to learn any other scripting language on their own.

****

Course Code	:	COPC205
Course Title	:	Data Structures
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

To provide strong foundation for implementing programming language to formulate, analyze and develop solutions related to various data structures problems.

Course Content:

UNIT 1:

Introduction to Data Structures: Basic Terminology, Classification of Data Structures, Operations on Data Structures.

UNIT 2:

Linear Data Structures- Stacks: Introduction to Stacks, Array Representation of Stacks, Operations on a Stack, Applications of Stacks-Infix-to-Postfix Transformation, evaluating Postfix Expressions.

Queues: Introduction to Queues, Array Representation of Queues, Operations on a Queue, Types of Queues-DeQueue, Circular Queue, Applications of Queues-Round Robin Algorithm.

UNIT 3:

Linked Lists: Singly Linked List, Representation in Memory, Operations on a Single Linked List, Circular Linked Lists, Doubly Linked Lists, Linked List Representation and Operations of Stack, Linked List Representation and Operations of Queue.

UNIT 4:

Non Linear Data Structures - Trees: Basic Terminologies, Definition and Concepts of Binary Trees, Representations of a Binary Tree using Arrays and Linked Lists, Operations on a Binary Tree-Insertion, Deletion, Traversals, Types of Binary Trees.

GRAPHS: Graph Terminologies, Representation of Graphs- Set, Linked, Matrix, Graph Traversals

Suggested Lab Work:

This is a skill course. Topics/concepts taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should work on solved and unsolved problems listed in the text books. Teacher also should formulate problems and give them as assignment. This course is all about some theory and a lot of practice.

This course is linked with a previous course on Computer Programming and a parallel course on Algorithms, hence exercises should not be done in isolation.

Reference Books:

1. Data Structures, R.S. Salaria, Khanna Book Publishing, New Delhi
2. Data Structures Using C, Reema Thareja, Oxford University Press India.
3. Classic Data Structures, Samanta Debasis, Prentice Hall of India.
4. Fundamentals of Data Structure in C, Horowitz, Ellis, Sahni, Sartaj, Anderson-Freed, Susan, University Press, India.
5. Data Structures: A Pseudo code approach with C, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India.
6. Data Structures and Algorithms: Concepts, Techniques and Applications, G. A. V. Pai, McGraw-Hill Education, India.

Course outcomes:

Have a good understanding of Data Structures and its applications in algorithms.

****

Course Code	:	COPC207
Course Title	:	Computer System Organisation
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

To have a thorough understanding of the basic structure and operation of a digital computer, its architectures and computational designs.

Course Content:

UNIT 1:

Structure of Computers: Computer Functional units, Von-Neumann architecture, Bus structures, Basic Operational Concepts, Data representation (Fixed and Floating point), Error detecting codes.

Register Transfer and Micro Operations: Register transfer, Bus and memory transfers, Arithmetic micro-operations, Logic micro-operations, Shift micro-operations, and Arithmetic logic shift unit.

UNIT 2:

Micro Programmed Control: Control memory, Address sequencing, and design of control unit.

Computer Arithmetic: Addition and Subtraction, Multiplication and Division algorithms, Floating-point arithmetic operation, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline Vector Processing, Array Processors.

UNIT 3:

Introduction to Microproccessor Architecture: Instruction Set Architecture design principles from programmer's perspective. One example microprocessor (Intel, ARM, etc).

UNIT 4:

Assembly Language Programming: Simple programs, Assembly language programs involving logical, branch and call instructions, sorting, evaluation of arithmetic expressions, string manipulation, assembler directives, procedures and macros.

UNIT 5:

Memory and Digital Interfacing: addressing and address decoding, interfacing RAM, ROM, EPROM, programmable peripheral interface, various modes of operation and interfacing to processor, interfacing keyboard, displays, etc.

Reference Books:

1. Computer System Architecture, M. Moris Mano, Pearson/PHI, India.
2. Microprocessors Interface, Douglas V.Hall, Tata McGraw-Hill.
3. Computer Organization, Carl Hamacher, Zvonks Vranesic, SafeaZaky, McGraw-Hill
4. Advanced Microprocessors and Peripherals- Architecture, Programming and interfacing, A.K.Ray, K.M.Bhurchandi, Tata McGraw-Hill, New Delhi, India.
5. Computer Organization and Design: A Hardwar/Software Interface (MIPS Edition) by Patterson and Hennessy

Course outcomes:

Have a good understanding of functioning of computer system as such and its various subcomponents. Student will be able to understand computing requirement for a specific purpose, analyse performance bottlenecks of the computing device and choose appropriate computing device for a given use case.

****

Course Code	:	COPC209
Course Title	:	Algorithms
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

The objective of this course is to prepare the student with the algorithmic foundations of computing. A sound grasp of algorithms is essential for any computer science engineer. Almost all programming involves algorithms at some level.

Course Content:

UNIT 1: Fundamentals

Programming Models. Data Abstraction. Sets, Multisets, Stacks, Queues. Asymptotic and worst-case analysis of algorithms.

UNIT 2: Sorting

The sorting problem. Bubble sort, Selection sort, Insertion sort, Mergesort, Quicksort.

UNIT 3: Searching

Symbol Tables, Binary Search Trees, Balanced Search Trees. Hash Tables.

UNIT 4: Graphs

Definition of a directed and undirected graph. Paths, Cycles, spanning trees. Directed Acyclic Graphs. Topological Sorting. Minimum Spanning Tree algorithms. Shortest Path algorithms: Dijkstra's algorithm. Flow-based algorithms.

UNIT 5: Strings

String Sort. Tries. Substring Search. Regular Expressions. Elementary Data compression.

Reference Books:

1. Algorithms, Sedgewick and Wayne, Pearson
2. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein. MIT Press
3. Introduction to Theory of Computation, Sipser Michael, Cengage Learnng.
4. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House

Course outcomes:

The student should be able to design basic algorithms for sorting and searching. The student should be able to understand the basic notions of time and space complexity of algorithms. The student should be able to implement sorting, searching, tree and graph algorithms in a modern computer programming language.

****

Course Code	:	COPC211
Course Title	:	Computer Programming Lab
Number of Credits	:	2 (L: 0, T: 0, P: 4)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice what is taught in theory class of 'Computer Programming' and become proficient in computer programming. Computer programming is all about regular practice. Students should work on solved and unsolved problems listed in the text books, and the problems given by the teacher. Some of the topics that should necessary be covered in lab are listed below.

Course Content:

S.No.	Topics for Practice
1	Familiarization with programming environment (Editor, Compiler, etc.)
2	Programs using I/O statements and various operators
3	Programs using expression evaluation and precedence
4	Programs using decision making statements and branching statements
5	Programs using loop statements
6	Programs to demonstrate applications of n dimensional arrays
7	Programs to demonstrate use of string manipulation functions
8	Programs to demonstrate parameter passing mechanism
9	Programs to demonstrate recursion
10	Programs to demonstrate use of pointers
11	Programs to demonstrate command line arguments
12	Programs to demonstrate dynamic memory allocation
13	Programs to demonstrate file operations

The language of choice will be C. This is a skill course. More you practice, better it will be.

Reference Books:

1. Let Us C, Yashavant Kanetkar
2. Problem Solving and Programming in C, R.S. Salaria, Khanna Publishing House
3. C Programming Absolute Beginner's Guide, Dean Miller and Greg Perry
4. The C Programming Language, Kernighan and Ritchie, Prentice Hall of India
5. Programming in ANSI C, E. Balagurusamy, Tata McGraw-Hill
6. C Programming & Data Structures, B. A. Fouruzan and R. F. Gilberg, CENGAGE Learning.

Course outcomes:

Student should be able to write code snippets, and then compile, debug and execute them.

****

Course Code	:	COPC213
Course Title	:	Scripting Languages Lab
Number of Credits	:	2 (L: 0, T: 0, P: 4)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Scripting Languages' and become proficient in scripting. Computer programming is all about regular practice. Students should work on solved and unsolved problems listed in the text books, and the problems given by the teacher. Some of the topics that should necessary be covered in lab are listed below.

Course Content:

S.No.	Topics for Practice
1	Practice basic coding syntax
2	Write and execute scripts based on data types
3	Write and execute Python scripts with conditionals and loops
4	Write and execute Scripts based on Functions and Modules
5	File Processing scripts
6	Write and execute Regular Expressions
7	Write and execute SQL Queries
8	Write and execute scripts using DBI
9	Develop a simple web application

Teacher may choose any one scripting language. This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Taming Python by Programming, Jeeva Jose, Khanna Publishing House
2. Starting Out with Python, Tony Gaddis, Pearson
3. Core Python Programming, Wesley J. Chun, Prentice Hall
4. Python Programming: Using Problem Solving Approach, Reema Thareja, Oxford University Press
5. Introduction to Computation and Programming Using Python. John V. Guttag, MIT Press.
6. Beginning Python using Python 2.6 and Python 3, James Payne, Wrox publishing
7. Practical Programming: An Introduction to Computer Science using Python 3, Paul Gries, The Pragmatic Bookshelf

Course outcomes:

At the end of the course student will be able to build program with a scripting language and will be able to learn any other scripting language on their own.

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Course Code	:	COPC215
Course Title	:	Data Structures Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Data Structures', 'Algorithms' and is an extension of previous course on 'Computer Programming'. Students should work on problems listed in the text books, and the problems given by the teacher. Some of the topics that should necessary be covered in lab are listed below. This Lab course requires a good coordination between theory course in Data Structures and Algorithms.

Course Content:

S.No.	Topics for Practice
1	Write a program using recursive and non-recursive functions to perform search operation in a given list of integers using linear search technique
2	Search operation in a given list of integers using binary search technique
3	Write a program to implement insertion sorting for a given random data
4	Write a program to implement bubble sorting for a given random data
5	Write a program to implement quick sorting for a given random data
6	Write a program to implement selection sorting for a given random data
7	Write a program to implement heap sorting for a given random data
8	Write a program to implement Hashing tables
9	Write a program to implement single linked list
10	Write a program to implement double linked list
11	Write a program to implement circular linked list
12	Write a program to Implement Stack operations using array and linked list
13	Write a program to Implement Queue operations using array and linked list.
14	Write a program to implement Breadth First Search (BFS)
15	Write a program to implement Depth First Search (DFS)
16	Write a program to implement a binary tree of integers
17	Write a program to find the minimum depth of a binary tree

Use 'C' as programming language for the purpose. This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Data Structures, R.S. Salaria, Khanna Book Publishing
2. Data Structures Using C, Reema Thareja, Oxford University Press India.
3. Classic Data Structures, Samanta Debasis, Prentice Hall of India.
4. Fundamentals of Data Structure in C, Horowitz, Ellis, Sahni, Sartaj, Anderson-Freed, Susan, University Press, India.
5. Data Structures: A Pseudo code approach with C, Richard F. Gilberg, Behrouz A. Forouzan, CENGAGE Learning, India.
6. Data Structures and Algorithms: Concepts, Techniques and Applications, G. A. V. Pai, McGraw-Hill Education, India.

Course outcomes:

Student will be able to write programs for creating and doing different operations on various data structures. Student will be able to use/implement various algorithms learnt in the course on Algorithms. In summary student will have a good command over Data Structures and its applications in Algorithms.

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SEMESTER IV

Course Code	:	COPC202
Course Title	:	Operating Systems
Number of Credits	:	2 (L:2, T:0, P;0)
Pre-requisites	:	COPC205
Course Category	:	PC

Course Learning Objectives:

A general introduction to various ideas in implementation of operating systems, particularly UNIX. Introduce to various options available so as to develop capacity to compare, contrast, and evaluate the key trade-offs between different design choices.

Course Content:

UNIT 1:

Overview of Operating System, basic concepts, UNIX/LINUX Architecture, Kernel, services and systems calls, system programs.

UNIT 2:

Process Management: Process concepts, operations on processes, IPC, Process Scheduling, Multithreaded programming

Memory management: Memory allocation, Swapping, Paging, Segmentation, Virtual Memory, various faults.

UNIT 3:

File management: Concept of a file, access methods, directory structure, file system mounting, file sharing and protection, file system structure and implementation, directory implementation, free-space management, efficiency and performance. Different types of file systems

UNIT 4:

I/O System: Mass storage structure - overview, disk structure, disk attachment, disk scheduling algorithms, swap space management, RAID types.

UNIT 5:

OS Security: Authentication, Access Control, Access Rights, System Logs

Reference Books:

1. Operating System Concepts, Silberschatz and Galvin, Wiley India Limited
2. UNIX Concepts and Applications, Sumitabha Das, McGraw-Hill Education
3. Operating Systems, Internals and Design Principles, Stallings, Pearson Education, India
4. Operating System Concepts, Ekta Walia, Khanna Publishing House
5. Modern Operating Systems, Andrew S. Tanenbaum, Prentice Hall of India
6. Operating systems, Deitel & Deitel, Pearson Education, India

Course outcomes:

Students should be able to demonstrate basic knowledge about Operating System, be able to apply OS concepts such as processes, memory and file systems to system design, able to configure OS in an efficient and secure manner.

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Course Code	:	COPC204
Course Title	:	Introduction to DBMS
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	COPC203
Course Category	:	PC

Course Learning Objectives:

It covers the development of database-driven applications using the capabilities provided by modern database management system software. The concepts include conceptual modeling, relational database design and database query languages.

Course Content:

As a part of the lab, project work is included.

UNIT 1:

Introduction; Database System Concepts and Architecture

UNIT 2 :

Data Modeling using the Entity-Relationship Model; The Enhanced Entity-Relationship (EER) model

UNIT 3:

The Relational Data Model and Relational Database Constraints; ER/EER to Relational Model mapping; Relational Algebra and Relational Calculus

UNIT 4:

SQL-99: Schema definition, Constraints, Queries, and Views; Security; Introduction to SQL programming Techniques

UNIT 5:

Functional dependencies and normalization for relational databases; Relational database design algorithms and further dependencies.

Reference Books:

1. Fundamentals of Database Systems, Elmasri & Navathe, Pearson Education
2. Database Management Systems, Raghurama Krishnan, Johannes Gehrke, Tata McGraw-Hill.
3. Database System Concepts, Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill, New Delhi, India.
4. Introduction to Database Systems, C.J.Date, Pearson Education
5. Introduction to SQL, Rick F.Vander Lans, Pearson Education

Course outcomes:

After completing the course, the students will understand (i) how to design a database, database-based applications (ii) How to use a DBMS (iii) the critical role of database system in designing several information system-based software systems or applications.

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Course Code	:	COPC206
Course Title	:	Computer Networks
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

Understand functioning of computer networks and popular networking protocols

Course Content:

UNIT 1:

Introduction to computer networks; Network Models- OSI Reference Model, TCP/IP Model;

UNIT 2:

Transmission Media – principles, issues and examples; Wired Media – Coaxial, UTP, STP, Fiber Optic Cables; Wireless Media – HF, VHF, UHF, Microwave, Ku Band; Network topologies; Data Link Layer – design issues, example protocols (Ethernet, WLAN, Bluetooth); Switching Techniques;

UNIT 3:

Network Layer - design issues, example protocols (IPv4); Routing - principles/issues, algorithms (Distance-vector, Link-state) and protocols (RIP, OSPF);

UNIT 4:

Transport Layer - design issues, example protocols (TCP); Application Layer Protocols (SMTP, DNS).

UNIT 5:

Functioning of Network Devices – NIC, Hub, Switch, Router, WiFi Devices; Network Management System and example protocol (SNMP).

Reference Books:

1. Computer Networks, 4th Edition (or later), Andrew S. Tanenbaum, PHI
2. TCP/IP Illustrated, Volume-1, W. Richard Stevens, Addision Wesley
3. Data and Computer Communications, William Stallings, PHI
4. An Engineering Approach to Computer Networking, S. Keshav, Addision Wesley/Pearson
5. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publishing House

Course outcomes:

1. Understanding of computer networks, issues, limitations, options available.
2. Understanding of the care that needs to be taken while developing applications designed to work over computer networks
3. Able to configure basic LAN and connect computers to it.

******

Course Code	:	COPC208
Course Title	:	SSAD/Software Engineering
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

Inculcate essential technology and software engineering knowledge and skills essential to build a reasonably complex usable and maintainable software iteratively. 2) Emphasize on structured approach to handle software development. 3) Enhance communication skills.

Course Content:

As per the course design, concepts learned as part of this course will/should be used in the Minor Project (Proj.202). These two courses should go hand in hand to be effective.

UNIT 1:

Introduction to Software Engineering, Lifecycle, Process Models - Traditional v/s Agile processes.

UNIT 2:

Development Activities - Requirements Gathering and Analysis, Design Concepts, Software architecture and Architectural styles, Basic UI design, Effective Coding and Debugging techniques.

UNIT 3:

Software Testing Basics, Unit, Integration, System and Acceptance Testing, Introduction to various testing techniques (e.g. Stress testing), Writing and executing test cases, Quality Assurance.

UNIT 4:

Project Management - Project management concepts, Configuration and Release Management, Version Control and its tools (Git), Release Planning, Change Management, Software Maintenance, Project Metrics.

Reference Books:

1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
2. Software engineering, Ian Sommerville, Pearson Education
3. An Integrated Approach to Software Engineering, Pankaj Jalote, Springer Verlag
4. Software Engineering, Nasib Singh Gill, Khanna Book Publishing Co. India.
5. Software Engineering, K. K. Agarval, Yogesh Singh, New Age International Publishers

Course outcomes:

The proposed course is expected to provide an introduction to software engineering concepts and techniques to undergraduate students, thus enabling them to work in a small team to deliver a software system. The course content and project will introduce various software technologies, process and project management skills that are needed for the delivery of software in a team setting.

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Course Code	:	COPC210
Course Title	:	Web Technologies
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Prerequisites	:	-
Course Category	:	PC

Course Learning Objectives:

To provide basic skills on tools, languages and technologies related to website development. Learnings from this course may be used in the Mini Project and summer internship.

Course Content:

UNIT 1: Introduction to www

Protocols and programs, secure connections, application and development tools, the web browser,

What is server, setting up UNIX and LINUX web servers, Logging users, dynamic IP Web Design: Web site design principles, planning the site and navigation

UNIT 2: Web Systems Architecture

Architecture of Web based systems- client/server (2-tier) architecture, 3-Tier architecture, Building blocks of fast and scalable data access Concepts - Caches-Proxies- Indexes-Load Balancers- Queues, Web Application architecture (WAA)

UNIT 3: Javascript

Client side scripting, What is Javascript, simple Javascript, variables, functions,conditions, loops and repetition

UNIT 4: Advance scripting

Javascript and objects, Javascript own objects, DOM and web browser environments, forms and validations

DHTML: Combining HTML, CSS and Javascript, eventsand buttons, controlling your browser,

Ajax: Introduction advantages & disadvantages,ajax based web application, alternatives of ajax

XML, XSL and XSLT: Introduction to XML, uses of XML, simple XML,XML keycomponents, DTD and Schemas, XML with application, XSL and XSLT.

Introduction to Web Services

UNIT 5: PHP

server side scripting, Arrays, function andforms,advance PHP Databases :Basic command with PHP examples, Connection to server,creating database, selecting a database, listing database, listing tablenames creating a table, inserting data,altering tables, queries, deletingdatabase, deleting data and tables, PHP myadmin and database bugs.

Reference Books:

1. "Web Technologies--A Computer Science Perspective", Jeffrey C.Jackson,
2. "Internet & World Wide Web How To Program", Deitel, Deitel, Goldberg, Pearson Education
3. "Web programming- Building Internet Application", Chris Bales
4. Web Applications: Concepts and Real World Design, Knuckles.

Course Outcomes:

Student will be able to develop/build a functional website with full features.

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Course Code	:	COPC212
Course Title	:	Operating Systems Lab
Number of Credits	:	1 (L:0, T:0, P:2)
Prerequisites	:	COPC205
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice and do experiment on concepts taught in theory class of 'Operating Systems' and gain insight into functioning of the Operating Systems.

Course Content:

S.No.	Topics for Practice
1	Revision practice of various commands like man, cp, mv, ln, rm, unlink, mkdir, rmdir, etc and many more that were learnt in IT Workshop course and later.
2	Implement two way process communication using pipes
3	Implement message queue form of IPC
4	Implement shared memory and semaphore form of IPC
5	Simulate the CPU scheduling algorithms - Round Robin, SJF, FCFS, priority
6	Simulate Bankers algorithm for Deadlock Avoidance and Prevention

7	Simulate all FIFO Page Replacement Algorithm using C program
8	Simulate all LRU Page Replacement Algorithms using C program
9	Simulate Paging Technique of Memory Management
10	Practice various commands/utilitiessuch as catnl, uniq, tee, pg, comm, cmp, diff, tr, tar, cpio, mount, umount, find, umask, ulimit, sort, grep, egrep,fgrep cut, paste, join, du, df , ps, who, etc and many more.

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Operating System Concepts, Silberschatz, Abraham and Galvin, Peter, Wiley India Limited
2. UNIX Concepts and Applications, Sumitabha Das, McGraw-Hill Education
3. Operating System Concepts, Ekta Walia, Khanna Publishing House

Course outcomes:

Students should be able to demonstrate basic knowledge about Operating System, be able to apply OS concepts such as processes, memory and file systems to system design, able to configure OS in an efficient and secure manner, and become an advance user of operating system.

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Course Code	:	COPC214
Course Title	:	Introduction to DBMS Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	COPC211
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Introduction to DBMS'. A few sample case studies are listed with some suggested activities. More case studies may be added to this list. You need to develop these case studies, apply all relevant concepts learnt in theory class as the course progress, identify activities/operations that may be performed on the database. It will be a good idea to also use concepts learnt in the course on Software Engineering/SSAD.

Course Content:

S.No.	Topics for Practice
1	Case Study-1: Employee database – 'Create' employee table, 'Select' and display an employee matching a given condition, 'Delete' duplicate records, delete rows using triggers, insert and update records, find net salary, etc.
2	Case Study-2: Visitor Management database
3	Case Study-3: Students Academic database
4	Case Study-4: Inventory Management System database
5	Case study-5: Bank Operations database
6	Case Study-6: Bus Operator (Roadways) – Do related activities such as prepare E-R Model, Relational Model, do Normalisation, Create Tables, Insert data, Delete Data, Query database, create stored procedures, etc.

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Elmasri & Navathe, Fundamentals of Database Systems, Pearson Education
2. Raghurama Krishnan, Johannes Gehrke, Database Management Systems, Tata McGraw-Hill, New Delhi, India.

3. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw-Hill, New Delhi, India.
4. Introduction to Database Systems, C.J.Date, Pearson Education
5. Introduction to SQL, Rick F.Vander Lans, Pearson Education

Course outcomes:

After completing the course, the students will understand (i) how to design a database, database-based applications (ii) How to use a DBMS (iii) the critical role of database system in designing several information system-based software systems or applications.

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Course Code	:	COPC216
Course Title	:	Computer Networks Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	-----
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Computer Networks'. Some of the things that should necessary be covered in lab are listed below:

Course Content:

S.No.	Topics for Practice
1	Showing various types of networking cables and connectors, identifying them clearly
2	Looking at specifications of cables and connectors of various companies on Internet, find out differences.
3	Making patch cords using different types of cables and connectors - crimping, splicing, etc
4	Demonstration of different type of cable testers, using them for testing patch cords prepared by the students in Lab and standard cables prepared by professionals
5	Configuring computing devices (PC, Laptop, Mobile, etc) for network, exploring different options and their impact – IP address, gateway, DNS, security options, etc
6	Showing various networking devices – NICs, Hub, Switch, Router, WiFi access point, etc.
7	Looking at specifications of various networking devices various companies on Internet, find out differences.
8	Network simulation tool (e.g. Cisco Packet Tracer)
9	Setting up a small wired LAN in the Lab
10	Setting up a small wireless LAN in the Lab

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. Cisco press books on CCNA
2. User manual of networking devices available in the lab
3. Wiki pages on networking devices

Course outcomes:

1. Understanding of computer networks, issues, limitations, options available.
2. Able to configure basic small LAN and connect computers to it.

****

Course Code	:	COPC218
Course Title	:	Web Technologies Lab
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Prerequisites	:	-----
Course Category	:	PC

Course Learning Objectives:

This Lab course is intended to practice whatever is taught in theory class of 'Web Technologies'. Some of the things that should necessary be covered in lab are listed below:

Course Content:

S.No.	Topics for Practice
1	Coding Server Client Programs
2	Developing Web Application using HTML, JavaScript
3	Developing Advanced Web Application Programs using CSS
4	Practicing PHP : Basics
5	Practicing PHP : Web Application Development
6	Practicing PHP: MySql - tiered Applications
7	Developing a fully functional Web Service Application using all the technologies learned in this course.

This is a skill course. More student practice and try to find solution on their own, better it will be.

Reference Books:

1. "Web Technologies--A Computer Science Perspective", Jeffrey C.Jackson,
2. "Internet & World Wide Web How To Program", Deitel, Deitel, Goldberg, Pearson Education
3. "Web programming- Building Internet Application", Chris Bales
4. Web Applications: Concepts and Real World Design, Knuckles

Course outcomes:

Student will be able to program web applications using and will be able to do the following:

- Use LAMP Stack for web applications
- Use Tomcat Server for Servlets and JSPs
- Write simple applications with Technologies like HTML, Javascript, AJAX, PHP, Servlets and JSPs
- Connect to Database and get results
- Parse XML files using Java (DOM and SAX parsers)

Student will be able to develop/build a functional website with full features.

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Semester V / VI

Course Code	:	COPC301
Course Title	:	Introduction to e-Governance
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	-----
Course Category	:	PC

Course Learning Objectives:

To cover the concepts of e-Governance and to understand how technologies and business models shape the contours of government for improving citizen services and bringing in transparency.

Course Content:

UNIT 1:

Exposure to emerging trends in ICT for development; Understanding of design and implementation of e-Government projects, e-governance lifecycle.

UNIT 2:

Need for Government Process Re-engineering (GPR); National e-Governance Plan(NeGP) for India; SMART Governments & Thumb Rules

UNIT 3:

Architecture and models of e-Governance, including Public Private Partnership (PPP); Need for Innovation and Change Management in eGovernance; Critical Success Factors; Major issue including corruption, resistance for change, e-Security and Cyber laws

UNIT 4:

Focusing on Indian initiatives and their impact on citizens; Sharing of case studies to highlight best practices in managing e-Governance projects in Indian context. Visits to local e-governance sites (CSC, eSeva, Post Office, Passport Seva Kendra, etc) as part of Tutorials.

UNIT 5:

Mini Projects by students in groups – primarily evaluation of various e-governance projects.

Reference Books:

1. Managing Transformation –Objectives to Outcomes. J Satyanarayana, Prentice Hall India
2. The State, IT and Development. Kenneth Kenniston, RK Bagga and Rohit Raj Mathur, Sage Publications India Pvt Ltd.
3. e-Government -The Science of the Possible. J Satyanarayana, Prentice Hall, India
4. http://www.csi-sigegov.org/publications.php
5. https://negd.gov.in
6. https://www.nisg.org/case-studies-on-e-governance-in-india

Course outcomes:

Through exposure to introductory ideas and practices followed in a selected number of e-Governance initiatives in India, the course will help students to understand and appreciate the essence of e-Governance.

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Course Code	:	COPC303
Course Title	:	Internet of Things
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Prerequisites	:	-----
Course Category	:	PC

Course Learning Objectives:

Internet of Things (IoT) is presently an important technology with wide ranging interest from Government, academia and industry. IoT cuts across different application domain verticals ranging from civilian to defence sectors which includes agriculture, space, health care, manufacturing, construction, water, mining, etc. Today it is possible to build different IoT solutions such as shopping system, infrastructure management in both urban and rural areas, remote health monitoring and emergency notification systems, and transportation systems. Therefore, it is very important to learn the fundamentals of this emerging technology.

Course Content:

UNIT 1:

Introduction to IoT; Sensing; Actuation

UNIT 2 :

Basics of IoT Networking, Communication Protocols, Sensor networks

UNIT 3:

Introduction to Arduino programming, Integration of Sensors/Actuators to Arduino

UNIT 4:

Implementation of IoT with Raspberry Pi; Data Handling Analytics

UNIT 5:

Case Studies: Agriculture, Healthcare, Activity Monitoring

Reference Books:

1. https://nptel.ac.in/noc/individual_course.php?id=noc17-cs22
2. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
3. Internet of Things by Dr. Jeeva Jose, Khanna Publishing House (Edition 2017)
4. "Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
5. *Internet of Things: Architecture and Design Principles, Raj Kamal,* McGraw Hill
6. Research papers

Course outcomes:

Students will have good understanding of various aspect of IoT, know some tools and have basic implementation skills.

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Course Code	:	COPE301/302
Course Title	:	Mobile Computing
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC203, COPC204, COPC208
Course Category	:	PE

Course Learning Objectives:

To teaches how to build mobile apps for Android. Students are expected to work on a project as part of the course.

Course Content:

UNIT 1:

A brief history of Mobile, Types of mobile phone generations, The Mobile Ecosystem, Types of Mobile Applications, Mobile Information Architecture Android Versions, Features of Android, Android Architecture, Installing Android SDK Tools, Configuring Android in Eclipse IDE, Android Development Tools (ADT), Creating Android Virtual Devices (AVD)

UNIT 2:

Creating first android application, Anatomy of android application, Deploying Android app on USB connected Android device, Android application components, Activity life cycle, Understanding activities, Exploring Intent objects, Intent Types, Linking activities using intents

UNIT 3:

Fragments life cycle, Interaction between fragments, Understanding the components of a screen (Layouts), Adapting to display orientation, Action Bar, Views(UI Widgets)-Button, Toast, ToggleButton, CheckBox, RadioButton, Spinner, WebView, EditText, DatePicker, TimePicker, ListView, ProgressBar, Analog and Digital clock, Handling UI events, List fragment, Dialog fragment

UNIT 4:

Menus-Option, Context, Popup, Images-ImageView, ImageSwitcher, AlertDialog, Alarm manager, SMS, E-mail, Media Player, Using camera, recording video, Handling Telephony Manager

UNIT 5:

Storing the data persistently-Data Storage Options: preferences, Internal Storage, External Storage, Content Provider , The SQLite database, Connecting with SQLite database and operations-Insert, Delete, Update, Fetch, Publishing android applications, Deploying APK files

Suggested Lab Work:

This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various tools/technologies introduced during the course and become comfortable with their use. Teacher should give weekly practice tasks as assignment. Learnings from this course should be used in the project/software built.

Reference Books:

1. Wei-Meng Lee, Beginning Android 4 Application Development, Wiley Publishing, Inc.
2. Pradeep Kothari, "Android Application Development Black Book", DreamTech Press
3. James C.Sheusi, "Android Application Development for Java Programmers", Cengage Learning
4. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
5. Sayed Y Hashimi and Satya Komatineni(2009), "Pro Android", Wiley India Pvt Ltd
6. Reto Meier, Professional Android 4 Application Development, Wiley India Pvt Ltd

Course outcomes:

Will be able to develop and deploy basic mobile applications.

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Course Code	:	COPE303/304
Course Title	:	Multimedia Technologies
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC203, COPC204, COPC208
Course Category	:	PE

Course Learning Objectives:

To introduce students to the domain of Multimedia Technologies, which explain the technologies underlying digital images, videos and audio contents, including various compression techniques and standards, and the issues to deliver multimedia content over the Internet.

Course Content:

UNIT 1: Introduction to Multimedia

Multimedia Foundation and Concepts: Multimedia Hardware, Multimedia Software , Multimedia operating systems , Multimedia communication system

UNIT 2: Basic Compression Techniques

Video and Audio Data Compression Techniques – Lossy and Lossless. Example algorithms/standards: Huffman, RLE, JPEG, MPEG, MP3, MP4, LZMA, FLAC, ALAC, ITU G.722, H.261, H.265

UNIT 3: Content Development and Distribution

Desktop publishing (Coral Draw, Photoshop, Page maker)

Multimedia Animation & Special effects (2D/3D animation, Flash)

UNIT 4: Introduction to Digital Imaging

Basics of Graphic Design and use of Digital technology, Definition of Digital images, Digital imaging in multimedia

UNIT 5: Introduction to Multimedia Programming and Applications

Suggested Lab Work:

This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various tools introduced during the course and become comfortable with their use. Teacher should give weekly tasks as assignment.

Reference Books:

1. An Introduction to Multimedia Authoring, A. Eliens
2. Fundamentals of Multimedia, Prentice Hall/Pearson, Ze-Nian Li & Mark S. Drew.
3. Multimedia and Animation, V.K. Jain, Khanna Publishing House, Edition 2018
4. Fundamentals of Multimedia, Ramesh Bangia, Khanna Book Publishing Co., N. Delhi (2007)

Course outcomes:

Student will understand various aspects of Multimedia and related standards. Student will be able to build multimedia content and applications and also multimedia enable Web applications and mobile applications.

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Course Code	:	COPE305
Course Title	:	Fundamentals of AI
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	COPC207
Course Category	:	PE

Course Learning Objectives:

To introduce students to the domain of Artificial Intelligence.

Course Content:

UNIT 1: Introduction

Overview and Historical Perspective, Turing test, Physical Symbol Systems and the scope of Symbolic AI, Agents.

UNIT 2: Search

Heuristic Search: Best First Search, Hill Climbing, Beam Search, Tabu Search

Randomized Search: Simulated Annealing, Genetic Algorithms, Ant Colony Optimization.

UNIT 3:

Finding Optimal Paths: Branch and Bound, A*, IDA*, Divide and Conquer approaches, Beam Stack Search.

Problem Decomposition: Goal Trees, AO*, Rule Based Systems, Rete Net.

Game Playing: Minimax Algorithm, AlphaBeta Algorithm, SSS*.

UNIT 4:

Planning and Constraint Satisfaction: Domains, Forward and Backward Search, Goal Stack Planning, Plan Space Planning, Graphplan, Constraint Propagation.

UNIT 5:

Logic and Inferences: Propositional Logic, First Order Logic, Soundness and Completeness, Forward and Backward chaining.

Reference Books:

1. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India)
2. https://nptel.ac.in/courses/106106126/
3. Stefan Edelkamp and Stefan Schroedl. Heuristic Search, Morgan Kaufmann.
4. Pamela McCorduck, Machines Who Think: A Personal Inquiry into the History and Prospects of Artificial Intelligence, A K Peters/CRC Press
5. Elaine Rich and Kevin Knight. Artificial Intelligence, Tata McGraw Hill.
6. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, Prentice Hall
7. M.C. Trivedi, A classical approach to Artificial Intelligence, Khanna Publishing House

Course outcomes:

Student will have general idea about Artificial Intelligence, will be able to explore AI tools effectively.

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Course Code	:	COPE307/308
Course Title	:	Advance Computer Networks
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC206
Course Category	:	PE

Course Learning Objectives:

Introduce Advance Networking Concepts, Theories and Tools

Course Content:

UNIT 1:

Review of Networking Basics; Advance Topics in IPv4 – Subnetting, Multicasting, Multicast Routing Protocols (IGMP, PIM, DVMRP); Advance Topics in TCP – flow management, congestion avoidance, protocol spoofing; IPv6

UNIT 2:

Telecom Networks, Switching Techniques; Introduction to Frame Relay, ATM, MPLS;

VSAT Communication – Star and Mesh architectures, bandwidth reservation;

Wireless Networks – WiFi, WiMax, Cellular Phone Technologies – GSM, CDMA, 3G, 4G

UNIT 3:

Network Redundancy, Load Balancers, Caching, Storage Networks; QoS; Network Monitoring – SNMP, RMON;

UNIT 4:

Introduction to Network Security – VLAN, VPN, Firewall, IPS, Proxy Servers

UNIT 5:

Network Simulation, Network design case studies and exercises, IP Addressing schema, Protocol Analysers (Wireshark, etc)

Reference Books:

1. RFCs and Standards Documents (www.ietf.org and other standard body websites)
2. Communication Networking – An Analytical Approach, Anurag-Manjunath-Joy
3. TCP/IP Illustrated (Vol.1,2), Stevens
4. Data Networks, Bertsekas-Gallager
5. An Engineering Approach to Computer Networking, S. Keshav

Course outcomes:

1. Understanding core concepts/theories/algorithms of computer networks
2. Some hands-on capability on various network devices and tools
3. Capability to design and implement a computer network

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Course Code	:	COPE309/310
Course Title	:	Information Security
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC102
Course Category	:	PE

Course Learning Objectives:

To learn how to evaluate and enhance information security of IT infrastructure and organisations

Course Content:

UNIT 1:

Introduction to Information Security, Various aspects of information security (PAIN), Security Features of Operating Systems – Authentication, Logs, Audit Features, File System Protection, User Privileges, RAID options, Anti-Virus Software, etc.

UNIT 2:

Understanding security weaknesses in popular networking protocols – IP, TCP, UDP, RIP, OSPF, HTTP, SMTP, etc.; security weaknesses in common networking devices – Hub, switch, router, WiFi; Security solutions to mitigate security risk of networking protocols (IPSec, HTTPS, etc) and devices (VLAN, VPN, Ingress Filtering, etc)

UNIT 3:

Basics of Cryptography, PKI, Security considerations while developing softwares

UNIT 4:

Network Security Products – Firewall, IDS/IPS, VPN Concentrator, Content Screening Gateways, etc.

UNIT 5:

Introduction to Security Standards – ISO 27001, Indian IT Act, IPR Laws; Security Audit procedures; Developing Security Policies; Disaster Recovery, Business Continuity Planning

Reference Books:

1. Information Security and Cyber Laws, Sarika Gupta, Khanna Publishing House
2. RFCs of protocols listed in content (https://www.ietf.org)
3. Various Acts, Laws and Standards (IT Act, ISO27001 Standard, IPR and Copyright Laws, etc.)
4. Security Guideline documents of Operating Systems (OS Manual, Man Pages, etc)
5. https://www.cert-in.org.in/
6. https://www.sans.org/

Course outcomes:

Understanding of security needs and issues of IT infrastructure. Have basic skills on security audit of networks, operating systems and application software.

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Course Code	:	COPE311/312
Course Title	:	Network Forensics
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC202, COPC206
Course Category	:	PE

Course Learning Objectives:

To understand various network forensic aspects for analysing network security breach

Course Content:

UNIT 1:

Review of Networking concepts and Protocols, Introduction to Network Forensics, various aspects of Network Forensics

UNIT 2:

Introduction to Network Forensic Tools and techniques: Wireshark, TCP Dump, Syslog, NMS, Promiscuous Mode, Network Port Mirroring, snooping, scanning tools, etc.

UNIT 3:

Understanding and Examining Data Link Layer, Physical Layer, Ethernet Switch Logs, MAC Table, ARP Table, etc.

Understanding and Examining Network Layer, Router Logs, WiFi Device logs, Firewall logs,

UNIT 4:

Understanding audit features of OS and applications; Enabling and Examining Server logs, User activity logs, Browser history analysis, Proxy server logs, Antivirus logs, Email logs

UNIT 5:

Limitations and challenges of network forensics due to encryption, spoofing, mobility, storage limitations, privacy laws, etc.

Suggested Lab Work:

This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various tools/applications introduced during the course. Teacher should give weekly tasks as assignment.

Reference Books:

1. Manuals of OS, application software, network devices
2. RFCs of various networking protocols (https://www.ietf.org/)
3. https://www.sans.org/
4. https://www.cert-in.org.in/
5. Handbook of Digital Forensics and Investigation, Eoghan Casey, Elsevier Academic Press
6. Cyber Forensics, Albert Marcella and Doug Menendez, CRC Press
7. Computer Forensics (5 volume Set) mapping to CHFI (Certified Hacking Forensics Investigator), by EC-Council

Course outcomes:

Student will understand basic concepts of network forensics, learn tools, and will be able to do basic forensic investigations and handle security incidents.

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Course Code	:	COPE313/314
Course Title	:	Data Sciences: Data Warehousing and Data Mining
Number of Credits	:	4 (L: 3, T: 1, P: 0)
Prerequisites	:	COPCC 203, COPC204, COPC 207
Course Category	:	PE

Course Learning Objectives:

Introduce students to the domain of Data Warehousing and Data Mining

Course Content:

UNIT 1: Introduction

Motivation, Importance, Definitions, Kind of Data, Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System with A Database or Data Warehouse System, Major Issues in Data Mining, Types of Data Sets and Attribute Values, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity. PREPROCESSING: Data Quality, Major Tasks in Data Preprocessing, Data Reduction, Data Transformation and Data Discretization, Data Cleaning and Data Integration.

UNIT 2: Data Warehousing and on-line Analytical Processing

Data Warehouse basic concepts, Data Warehouse Modeling - Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction, Data Cube Computation.

UNIT 3: Patterns, Associations and Correlations

Mining Frequent Patterns, Associations and Correlations: Basic Concepts, Efficient and Scalable Frequent Itemset Mining Methods, Pattern Evaluation Methods, Applications of frequent pattern and associations.

Frequent Patterns and Association Mining: A Road Map, Mining Various Kinds of Association Rules, Constraint-Based Frequent Pattern Mining, Extended Applications of Frequent Patterns.

UNIT 4: Classification

Basic Concepts, Decision Tree Induction, Bayesian Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Ensemble Methods, Handling Different Kinds of Cases in Classification, Classification by Neural Networks, Support Vector Machines, Pattern-Based Classification, Lazy Learners (or Learning from Your Neighbors).

UNIT 5: Cluster Analysis

Basic Concepts of Cluster Analysis, Clustering Structures, Major Clustering Approaches, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Model-Based Clustering, Why outlieranalysis, Identifying and handling of outliers, Outlier Detection Techniques. WEB MINING: Basic concepts of web mining, different types of web mining, PAGE RANK Algorithm, HITS Algorithm

Reference Books:

1. Jiawei Han, Micheline Kamber, Jian Pei, Data Mining: Concepts and Techniques, Elsevier
2. Margaret H Dunham, Data Mining Introductory and Advanced Topics, Pearson Education
3. Amitesh Sinha, Data Warehousing, Thomson Learning, India.
4. Xingdong Wu, Vipin Kumar, the Top Ten Algorithms in Data Mining, CRC Press, UK.

Course outcomes:

Student will have general idea about Data Warehousing and Data Mining techniques, will be able to explore further and effectively use related tools.

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Course Code	:	COPE315/316
Course Title	:	FOSS (Free and Open Source Software)
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC202, COPC204, COPC208
Course Category	:	PE

Course Learning Objectives:

Exposure to free and open source software philosophy and tools.

Course Content:

UNIT 1: FOSS PHILOSOPHY

Understanding the FOSS Community and FOSS Philosophy, Benefits of Community based Software Development, Guidelines for working with FOSS community, Requirements for being open, free software, open source software, FOSS Licensing Models, FOSS examples

UNIT 2: LINUX

Linux Installation and Hardware Configuration, Boot Process, Dual-Booting Linux and other Operating Systems, Kernel Options during Boot, X Windows System Configuration, System Administration (Server Administration, Backup and Restore Procedures, Strategies for keeping a Secure Server)

UNIT 3: Programming Tools and Techniques

Libreoffice Tools; Samba: Cross platform; Introduction about LAMP; Brief Introduction to Programming using languages like Java /Python / Perl; Database Systems Mysql, PostgreSQL or equivalent; Open Source UML Tools; Introduction to Mobile Programming; Version Control Systems like SVN, Git or equivalent; Project Management Tools; Bug Tracking Systems; Package Management Systems

UNIT 4: FOSS CASE STUDIES

Some example case studies of FOSS implementation

Suggested Lab Work:

This is a skill course. Topics/tools taught in the class should be practiced in the Lab same week and practiced regularly during the semester till student becomes confident about it. Students should explore features of various FOSS tools/applications on a Linux system. Teacher should give weekly tasks as assignment. Learnings from this course should be used in the major project.

Reference Books:

8. **Linux in a Nutshell, by Ellen Siever**
9. Philosophy of GNU URL: http://www.gnu.org/philosophy/.
10. Linux Administration URL: http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/.
11. Version control system URL: http://git-scm.com/.
12. Samba: URL : http://www.samba.org/.
13. Libre office: http://www.libreoffice.org/.

Course outcomes:

Student will be able to work with FOSS tools, find and evaluate FOSS alternatives for any software requirement.

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Course Code	:	COPE317/318
Course Title	:	Software Testing
Number of Credits	:	4 (L: 3, T: 0, P: 2)
Prerequisites	:	COPC208
Course Category	:	PE

Course Learning Objectives:

Inculcate essential software testing knowledge and skills, required to reasonably test a system under development in a systematic manner.

Course Content:

As per the course design, concepts learned in this course will/should be used in the major project (Proj.202).

UNIT 1: Basics

Introduction to Software Quality basics: Verification and validation, quality perspectives, Testing terminology, Software Testing Life Cycle (STLC), "V" model of Testing, QA process, cost of testing, types of tests,

UNIT 2: Writing Test Cases

Writing test cases, Functional Testing, non-functional testing, (Performance testing), UI testing. Preparing test data, Writing Unit test, Integration test and User Acceptance Tests, preparing test scenarios from Software requirements

UNIT 3: Test Execution and Management

test execution, Test Oracles, test planning, test strategy including when to stop testing, test-coverage - Traceability matrix, JIRA, Bugzilla and other bug tracking tools. Test data mining, test reporting.

UNIT 4: Test Automation

Why automation, when not to automate, writing simple automated test cases, learn and practice any one automated testing framework like Selenium and ...

UNIT 5: Other quality Assurance

Quality and Defect management - Code reviews, Quality tools, Change management, version control

Suggested Lab Work:

Writing and executing test cases of different types for a sample system, may be for the minor project done earlier; using Bugzilla to report cases; writing performance test cases for different types of test (load, stress, benchmarking, etc.); Writing automated test for UI, writing-executing test scripts for a sample system

Reference Books/Resources:

1. Software Engineering – A Practitioner's Approach, 7th Edition, Roger Pressman.
2. Bugzilla (https://www.bugzilla.org/)
3. JIRA (https://www.atlassian.com/software/jira)

Course outcomes:

Student will develop skills to understand the system, choose suitable testing methods, strategies, tools and technology, execute and report the test. Student will also be able to understand need and usage of test automation and gain expertise in at least 1 test automation tool.

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