

MALNAD COLLEGE OF ENGINEERING, HASSAN

(An Autonomous Institution Affiliated to VTU, Belgavi)



Autonomous Programmes

Bachelor of Engineering

DEPARTMENT

OF

COMPUTER SCIENCE AND ENGINEERING

SCHEME and SYLLABUS

Admitted Batch : 2020-21

VISION

To become a prominent department of Computer Science & Engineering producing competent professionals with research and innovation skills, inculcating moral values and societal concerns.

MISSION

- Provide learning ambience to generate innovative and problem solving skills with professionalism.
- Create facilities and expertise in advanced computer technology thereby promote research.
- Enhance Industry Institute Interaction programme to get acquainted with corporate culture.
- Induce ethical values and spirit of social commitment.

PROGRAM EDUCATIONAL OBJECTIVES

- PEO 1 : Graduates will be efficient software developers in diverse fields and will be successful professionals and/or pursue higher studies.
- PEO 2 : Graduates will be capable to adapt to new computing technology for professional excellence and Research and will be lifelong learners.
- PEO 3 : Graduates will work productively exhibiting ethical qualities for the betterment of society.
- PEO 4 : Graduates will possess leadership qualities, work harmoniously in a team with effective communication skills

PROGRAM OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Upon graduation, students with a degree B.E. in Computer Science & Engineering will be able to:

PSO – 1: Gain capability to use current techniques, skills and tools necessary for carrying out multidisciplinary projects.

Academic Year: 2021-2022

III Semester							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
BS-7	20MA301	Linear Algebra and Integral Transforms	3	1	0	4	5
PC-1	20CS302	Computer Organization	3	0	0	3	3
PC-2	20CS303	Digital Electronics	3	0	0	3	3
PC-3	20CS304	Data Structures and its Applications	4	0	0	4	4
PC-4	20CS305	Finite Automata and Formal Languages	3	0	0	3	3
PC-5	20CS306	UNIX and Shell Programming	3	0	1	4	5
PC-6	20CS307	Data Structures Laboratory	0	0	1	1	2
PC-7	20CS308	Digital Electronics Laboratory	0	0	1	1	2
HSM-2	20KNS/ 20KNB	Samskruthika Kannada(Kannada for Administration) /Balake Kannada(Kannada for Conversation)	0	1	0	1	2
HSM-3	20LSK	Language Skills (Mandate Audit Course)	0	1	0	0	2
BS	20BCM301	Bridge Course Mathematics-1 (Mandate Audit Course)	3	0	0	0	3
Total			22	3	3	24	34

IV Semester							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
BS-8	20MA401	Statistics and Complex analysis	3	1	0	4	5
BS-9	20MA402	Discrete Mathematical Structures	2	1	0	3	4
PC-8	20CS403	Object Oriented Programming with JAVA	3	0	1	4	5
PC-9	20CS404	Design and Analysis of Algorithms	4	0	0	4	4
PC-10	20CS405	Microcontroller and Embedded Systems	4	0	0	4	4
PC-11	20CS406	Software Engineering	3	0	0	3	3
PC-12	20CS407	Algorithms Laboratory	0	0	1	1	2
PC-13	20CS408	Microcontroller Laboratory	0	0	1	1	2
HSM-4	20SSK	Social Skills (Mandatory Audit Course)	0	1	0	0	2
BS	20BCM401	Bridge Course Mathematics - 2 (Mandate Audit Course)	3	0	0	0	3
Total			22	3	3	24	34

Academic Year: 2022-2023

V Semester							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
HSM-5	20CS501	Technology Management and Entrepreneurship	4	0	0	4	4
PC-14	20CS502	Operating Systems	4	0	0	4	4
PC-15	20CS503	Data Communications	4	0	0	4	4
PC-16	20CS504	Web Programming	3	0	1	4	5
PC-17	20CS505	Advanced Java	3	0	1	4	5
PC-18	20CS506	Database Management System	4	0	0	4	4
PC-19	20CS507	Database Application Laboratory	0	0	1	1	2
HSM-6	20CIP	Constitution of India and Professional Ethics(Mandate Audit)	2	0	0	0	2
HSM-7	20AAD	Analytical Ability Development	0	1	0	1	2
Total			24	1	3	26	32

VI Semester							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
PC-20	20CS601	System Software and Compiler Design	4	0	0	4	4
PC-21	20CS602	Computer Graphics and Visualization	3	1	0	4	5
PC-22	20CS603	Computer Networks	4	0	0	4	4
PC-23	20CS604	Application Development Laboratory	0	0	1	1	2
PC-24	20CS605	System Software Laboratory	0	0	1	1	2
PROJ-1	20CS606	Mini Project -1 (Inter Discipline)	0	0	2	2	4
PE-1	20CS65X	Elective – I	3	0	0	3	3
OE-1	20OECSXX	Open Elective – 1	3	0	0	3	3
HSM-8	20ARD	Aptitude Reasoning Development (Mandate Audit Course)	0	1	0	0	2
HSM-9	20EVS	Environmental Studies (Mandate Audit Course)	2	0	0	0	2
OE-2	20SW01	SWAYAM Course -1 (Mandate Audit Course)	3	0	0	0	3
Total			22	2	4	22	34

Elective - I	
Course Code	Course Title
20CS651	Multimedia Computing
20CS652	Python Applications Programming
20CS653	Graph Theory and Combinatorics
20CS654	Data Mining and Warehousing
20CS655	Principles of Programming Languages

Open Electives	
Course Code	Course Title
20OECS61	Introduction to Cloud Computing
20OECS62	Introduction to JAVA programming

Academic Year: 2023-2024

Semester VII							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
PC-25	20CS701	Machine Learning	4	0	0	4	4
PROJ-2	20CS702	Mini Project	0	0	2	2	4
PC-26	20CS703	Network Security and Cyber Law	4	0	0	4	4
PC-27	20CS704	Cloud Computing	3	0	0	3	3
PC-28	20CS705	Machine Learning Laboratory	0	0	1	1	2
PC-29	20CS706	Networks Laboratory	0	0	1	1	2
PE-2	20CS75X	Elective – II	3	0	0	3	3
PE-3	20CS76Y	Elective – III	3	0	0	3	3
OE-3	20OEXXX X	Open Elective – II	3	0	0	3	3
OE-4	20SW02	SWAYAM- II (Mandate Audit Course)	3	0	0	0	3
Total			23	0	4	24	31

Elective - II		Elective - III	
Course Code	Course Title	Course Code	Course Title
20CS751	Artificial Intelligence	20CS761	Internet of Things
20CS752	Advanced DBMS	20CS762	Advanced Computer Architecture
20CS753	Digital Image Processing	20CS763	Software Testing
20CS754	Big Data Analytics	20CS764	Software Architecture

Open Electives	
Course Code	Course Title
20OECS71	Introduction to Python Programming
20OECS72	IoT and its Applications
20OECS73	Big Data Analytics
20OECS74	Web Technology

VIII Semester							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
SR	20CS801	Seminar on Advanced Topics	0	0	1	1	2
PROJ-3	20CS802	Project Work	0	0	9	9	18
IN	20CS803	Internship (Four Weeks)	0	0	2	2	4
PE-4	20CS88X	Elective -IV	3	0	0	3	3
Total			3	0	12	15	27

Elective - IV	
Course Code	Course Title
20CS881	C# Programming and .NET
20CS882	Advanced Algorithms
20CS883	Operations Research
20CS884	Principles of Compiler Design
20CS885	Storage Area Networks
20CS886	Mobile Communications

**III SEMESTER & IV SEMESTER
(SECOND YEAR)**

SYLLABUS

Course Title	COMPUTER ORGANIZATION		
Course Code	20CS302	L-T-P	(3-0-0)3
Exam.	3 Hrs	Hours / Week	03
SEE	50 Marks	Total hours	40
Course Objective: A student should quantitatively evaluate different designs and organizations of a computer system. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Explore the overall system architecture and functioning of a digital computer	1	1
2.	Apply appropriate techniques to demonstrate system organization concepts	1,3, 5	-
3.	Apply various techniques to perform arithmetic and logical operations	2,3	1
4.	Demonstrate the different ways of communication in a computer system	1,2	-
Course Contents:			
MODULE – 1			10 Hrs
Basic Structures of Computers: Computer types: Functional units: Input unit, Memory unit, Arithmetic & logic unit, output unit, Control unit; Basic Operational Concepts : Bus Structures, Performance: Processor clock, Basic Performance Equation, Pipelining and Superscalar operation, Clock rate, Performance measurement; Historical perspective machine instructions and programs, Data Organization: Numbers, Arithmetic operations and characters, Memory Locations and Addresses: Byte addressability, Big-endian & Little-endian assignments, Word Alignment, Accessing Numbers, Characters & Character strings.			
MODULE – 2			10 Hrs
Input/Output Organization: Accessing I/O devices, Interrupts: Interrupt Hardware, Enabling & Disabling Interrupt, Handling Multiple devices, Controlling Device Requests, Exceptions; Direct Memory Access: Bus Arbitration. Buses: Synchronous Bus, Asynchronous Bus; PCI bus, SCSI bus, USB. The Memory System: Some Basic Concepts: Semiconductor RAM Memories: Internal Organization of Memory Chips, Static Memories, Asynchronous DRAMs, Synchronous DRAMs.			
MODULE – 3			10 hrs
The Memory System (continued): Structure of Larger Memories, RAMBUS memory. Read-only Memories: ROM, PROM, EPROM, EEPROM, Flash memory. Speed, Size & Cost. Cache Memories: Mapping functions; Performance considerations: Interleaving, Hit Rate & Miss Penalty Secondary Storage: Magnetic Hard Disks, Optical Disks.			
MODULE – 4			10 hrs
Arithmetic: Addition & Subtraction of Signed Numbers: Addition/Subtraction. Multiplication of Positive numbers: Signed-Operand Multiplication: Booth Algorithm; Fast Multiplication; Bit-pair Recoding of Multipliers; Integer division: Floating-Point Numbers & Operations: IEEE Standard for Floating-Point Numbers, Arithmetic Operations on Floating-Point Numbers, Implementing floating Point Operations.			
<u>Text Books :</u>			
1. Carl Hamacher, Z Vranesic & S Zaky, Computer Organization , 5 th Edition, McGraw Hill, 2012			

2. Hesham El-Rewini, H. & Mostafa Abd-el-Barr, M. Advanced Computer Architecture and Parallel Processing, John Wiley & Sons, 2005

MOOCs

<http://www.nptelvideos.in/2012/11/computer-organization.html>

Reference Books:

1. David A. Patterson and John L. Hennessey, Computer Organization and Design, Morgan kaufmann / elsevier, Fifth edition, 2014.
2. William Stallings, Computer Organization and Architecture, 9th Edition, Pearson India, 2013
3. Kai Hwang: Advanced Computer Architecture Parallelism, Scalability, Programmability, 2nd Edition, TataMc Graw Hill, 2011

Course Title	DIGITAL ELECTRONICS		
Course Code	20CS303	L-T-P	(3-0-0) 3
Exam.	3 Hrs	Hours / Week	3
SEE	50 Marks	Total hours	40
Course Objective : To design and perform analysis of various analog and digital circuits. Course Outcomes (COs) : Upon Completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe the various logical and analog circuits	1	-
2.	Apply various techniques to design circuits	1	-
3.	Analyze digital and analog circuits	1,2	1
4.	Design combinational and sequential logic circuits	1,2,3	1
5.	Implement combination and sequential logic circuits using tools	1,5	1
Course Contents:			
MODULE – 1			10 Hrs
Digital Logic: The Basic Gates: NOT, OR, AND, Universal Logic Gates: NOR, NAND, Positive and Negative Logic. Combinational Logic Circuits: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications - Overlapping, Eliminating Redundant Groups, Simplification of Entered Variable Map, Don't-care Conditions. Product-of-sums Method, Product-of-sums simplifications.			
MODULE – 2			10 Hrs
Data-Processing Circuits: Multiplexers, De-multiplexers, 1-of-16 Decoder, Encoders, Exclusive-or Gates, Parity Generators and Checkers, Magnitude Comparator, Programmable Array Logic, Programmable Logic Arrays. Arithmetic Circuits Arithmetic building blocks, The Adder, subtracter, Fast Adder. Flip-Flops: RS flip flop, Gated FlipFlop, Edge triggered flipflop, D FLIP-FLOP, Edge-triggered D FLIP-FLOP, Edge-triggered JK FLIP-FLOP, JK Master-slave FLIP-FLOP			
MODULE – 3			10 Hrs
Flip-Flops (continued) : Various Representation of FLIP-FLOPs. Analysis of sequential Circuits, Conversion of flipflops. Registers: Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out, Applications of Shift Registers. Counters: Asynchronous Counters, Decoding Gates, Synchronous Counters, Changing the Counter Modulus			
MODULE – 4			10 Hrs
Counters (conti.): Decade Counters, Counter Design as a Synthesis problem			

Design of Synchronous Sequential Circuits: Model Selection, State Transition Diagram, State Synthesis Table, Design equation and circuit diagram.

D/A Conversion and A/D Conversion: Variable, Resistor Networks, Binary Ladders, D/A Converters, D/A Accuracy and Resolution, A/D Converter- Simultaneous Conversion, A/D Converter-Counter Method, Continuous A/D Conversion, A/D Techniques, A/D Accuracy and Resolution.

Text Book:

Donald P Leach, Albert Paul Malvino & Goutam Saha: Digital Principles and Applications, 8th Edition, Tata McGraw Hill, 2015

Reference Books:

1. Stephen Brown, Zvonko Vranesic: Fundamentals of Digital Logic Design with VHDL, 2nd Edition, Tata McGraw Hill, 2014.
2. Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss: Digital Systems Principles and Applications, 10th Edition, Pearson Education, 2013.
3. M Morris Mano: Digital Logic and Computer Design, 1st Edition, Pearson, 2013.

MOOCs

1. <http://www.nptelvideos.in/search?q=Digital+Logic>
2. <http://www.nptelvideos.in/2012/12/digital-circuits-and-systems.html>

Course Title	DATA STRUCTURES AND ITS APPLICATIONS		
Course Code	20CS304	L-T-P	(4-0-0) 4
Exam.	3 Hrs	Hours / Week	4
SEE	50 Marks	Total hours	52
Course Objective : Students will be able to become accustomed to the use of appropriate data structures for designing programs. Course Outcomes (COs) : Upon Completion of the course, students shall be able to			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Apply programming constructs for writing data structure programs	3	2
2.	Demonstrate the various operations on data structures	1	-
3.	Design applications using linear data structures	2,3	2
4.	Design applications using non-linear data structures	2,3	
Course Contents:			
MODULE – 1			13 Hrs
Introduction: Structures and pointers revisited, File Management in C – Defining, opening, closing, I/O operations, Random access to files. Introduction to data structures - Basic terminology, Classification, Operations. The Stack - Definition, Operations, Array Representation of stacks in C Applications of stack: Infix, postfix and prefix, Basic definitions and examples, evaluating a postfix expression, Program to evaluate a postfix expression, converting an expression from infix to postfix, Program in C to convert an expression from infix to postfix.			
MODULE – 2			13 Hrs
Recursion - finding GCD, Fibonacci Series, Recursion Types, Tower of Hanoi, and Recursion versus iteration. Queues - Definition, Array representation of Queues, Operations on Queues, Types of Queues- Circular Queue and its implementation in C, Priority queue definition and its array representation, Deque (implementation in C excluded), Applications of Queues. Linked List: Dynamic Memory allocation in C programs, Introduction to linked list, linked list versus Arrays, Singly linked list operations - Insert, Delete, Display, Search and Traverse.			
MODULE – 3			13 Hrs
Other Lists structures: Circular Lists - C Implementation by adding and deleting nodes from front, Doubly Linked List - C implementation by adding and deleting nodes from front, Circular doubly linked list, Linked list Applications: Linked Implementation of stacks and Queues, Polynomial Representation. Trees: Basic Terminology, Types, Representation using array and Linked List.			
MODULE – 4			13 Hrs
Creating a binary tree from a general tree, Traversing a binary tree- In-order, Pre-order, Post order, Level order, Constructing a binary tree from traversal results. Efficient Binary Trees: Binary Search trees-			

definition, Operations- Create, Insert, delete, display, Finding height, Finding number of nodes. Threaded Binary tree - One way threading, two-way threading, Traversing a threaded binary tree, Advantages of threaded binary tree. AVL trees - Definition, Rotations, Constructing an AVL tree.

Text Book:

Data Structures Using C, Second edition, Reema Thereja, Oxford Press, 2017.

Reference Books:

1. Yedidyah, Augenstein, Tannenbaum: Data Structures Using C and C++, 2nd Edition, Pearson Education, 2003.
2. Richard F. Gilberg and Behrouz A. Forouzan: Data Structures A Pseudocode Approach with C, CengageLearning, 2005.
3. Debasis Samanta: Classic Data Structures, 2nd Edition, PHI, 2009.
4. Balagurusamy E, Programming in ANSI C, 7th Edition, Tata McGraw Hill, 2017.

MOOC

http://nptel.ac.in/keyword_search_result.php?word=data+structures

Course Title	FINITE AUTOMATA AND FORMAL LANGUAGES		
Course Code	20CS305	L-T-P	(3-0-0)3
Exam.	3 Hrs	Hours / Week	3
SEE	50 Marks	Total hours	40
Course Objective: To design grammar production for the programming constructs.			
Course Outcomes (COs) : Upon Completion of the course, students shall be able to			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Explain various automata to write grammar productions	1	
2.	Design automata for a given programming construct	3	
3.	Apply appropriate automata to obtain grammar productions	1,2	
4.	Construct a given grammar using a simulation tool	3,5	1
Course Contents:			
MODULE – 1			10 Hrs
Introduction to Finite Automata: Why Study Automata Theory?, The Central Concepts of Automata Theory. Finite Automata: An Informal Picture of Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with Epsilon-Transitions.			
MODULE – 2			10 Hrs
Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions. Properties of Regular Languages: Proving Languages Not to Be Regular – Pumping Lemma, Closure Properties of Regular Languages, Equivalence and Minimization of Automata.			
MODULE – 3			10 Hrs
Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages. Pushdown Automata: Definition of the Pushdown Automata, The languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.			
MODULE – 4			10 Hrs
Properties of Context-Free Languages: Normal Forms for Context-Free Grammars- Eliminating Useless symbols, Eliminating epsilon productions, Eliminating Unit productions, Chomsky Normal Form (CNF), Greibach Normal Form (GNF). Introduction to Turing Machines: Problems that Computers cannot Solve, The Turing Machine Programming Techniques for Turing Machines.			
<u>Text Book:</u>			
John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation, 3 rd Edition, Pearson Education, 2013.			

Reference Books:

1. Peter Linz, An Introduction to Formal Languages and Automata, IV Edition, Narosa Publishing House, 2011.
2. John C Martin, Introduction to Languages and Automata Theory, 3rd Edition, Tata McGraw-Hill, 2007.
3. Thomas A. Sudkamp: An Introduction to the Theory of Computer Science, Languages and Machines, 3rd Edition, Pearson Education, 2006.
4. K.L.P. Mishra, Chandrasekaran N: Theory of Computer Science, Automata, Languages and Computation, 3rd Edition, PHI Learning, 2012.

MOOC:

<http://elearning.vtu.ac.in>

Course Title	UNIX AND SHELL PROGRAMMING		
Course Code	20CS306	L-T-P	(3-0-2)4
Exam. Hours	3 Hrs	Hours / Week	4
SEE	50 marks	Total hours	52
Course Objective : To provide the skills needed to develop and customize Unix shell programs and to make effective use of a wide range of UNIX commands.			
Course Outcomes (COs) : Upon Completion of the course, students shall be able to			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Apply the functionality of UNIX commands for a given scenario	1	-
2.	Demonstrate the commands	2	-
3.	Design and implement shell scripts	3,5	-
4.	Administer UNIX operating system	1,2	-
Course Contents:			
MODULE – 1			13 Hrs
The Unix Operating System, The UNIX architecture and Command Usage: Features of UNIX, Locating commands, internal and external commands, command structure, Flexibility of command usage. General Purpose Utilities: cal, date, echo, printf, bc, script, passwd, who, uname, tty, and stty. The File System: The File, what's in a (file) name?, The Parent-Child relationship, The Home Variable, pwd, cd, mkdir, rmdir, Absolute pathnames, Relative pathnames, ls, The Unix File system. Handling Ordinary Files: cat, cp, rm, mv, more, The lpSubsystem: Printing a File, file, wc, od, cmp, comm., diff, dos2unix and unix2dos, Compressing and Archiving Files, gzip and gunzip, tar, zip and unzip.			
MODULE – 2			13 Hrs
Basic File Attributes: ls -l, the -d option, File Ownership, File Permissions, chmod, Directory Permissions, Changing File Ownership. The vi Editor: vi Basics, Input Mode, Saving Text and Quitting, Navigation, Editing text, Undoing Last Editing Instructions, Repeating the last command (.), Searching for the Pattern (/ and ?), Substitution – Search and Replace. The Shell: The Shell's Interpretive Cycle, Shell Offerings, Pattern Matching, Escaping and Quoting, Redirection, /dev/null and /dev/tty: Two special files, Pipes, tee, Command Substitution, Shell Variables.			
MODULE – 3			13 Hrs
The Process: Process Basics, ps, System Processes (-e or -a), Mechanism of Process Creation, Internal and External Command, Process States and Zombies, Running jobs in Background, nice: job execution with Low priority, Killing processes with signals, Job control, at and batch, cron, time. Customizing the Environment: The shells, Environment Variables, The Common Environment Variables, Aliases (bash and ksh), Command History (bash and ksh), In-Line Command Editing (bash and ksh), The initialization Scripts. More File Attributes: File Systems and Inodes, Hard Links, Symbolic Links and ln, The Directory, umask: Default File and Directory Permissions, Modification and access times, find: Locating Files. Simple Filters: The sampledatabse, pr, head, tail, cut, paste, sort, uniq, tr, Filters using Regular Expressions: grep, grep-searching for a pattern, Basic Regular Expressions (BRE), Extended Regular Expressions and egrep.			
MODULE – 4			13 Hrs

Essential Shell Programming: Shell Scripts, read, Using Command Line Arguments, exit and Exit status of command, The Logical Operators: && and || - Conditional Execution, The if conditional, Using test and [] to evaluate Expressions, The case conditional, expr, \$0-Calling a Script by different names, while, for, set and shift, the Here Document (<<), Debugging Shell Scripts with set -x.
Essential System Administration: root, the administration privileges, Maintaining security, User management, startup and start down Managing disk space, Device files.

Text Books:

1. Sumitabha Das, UNIX- Concepts and Applications, Fourth Edition, Tata McGraw Hill, 2006.
2. W Richard Stevens, Stephen A Rago: Advanced programming in the UNIX Environment, 2nd Edition, Pearson Education, 2011.

Reference Books:

1. Behrouz A. Forouzan and Richard F. Gilberg, UNIX and Shell Programming A Textbook, First edition, Thomson course Technology, 2005.
2. Kenneth Rosen, Douglas Host, James Farber and Richard Rosinski, The Complete Reference- UNIX, Tata McGraw- Hill, Edition 2000.

MOOCs:

1. <https://nptel.ac.in/courses/106108101>
2. <https://www.mooc-list.com/course/command-line-tools-genomic-data-science-coursera>

Course Title		DATA STRUCTURES LABORATORY			
Course Code	20CS307	L-T-P		(0-0-2)1	
Exam.	3 Hrs	Hours / Week		2	
SEE	50 Marks	Total Hours		28	
Course Objective : Design and implement various data structures.					
Course Outcomes (COs) : Upon the completion of the course the students will be able to					
#	Course outcomes	Mapping to PO's	Mapping to PSO's		
1.	Develop C programs to implement data structures and its applications	1,2,3,5,8,9, 12	1		
2.	Document and present the executed programs.	8,9,10	-		
Course Contents:					
PRACTICE PROGRAMS (SELF STUDY COMPONENT)					
Following set of programs are given for execution in lab, which will be helpful in understanding the basics of programming and serves as base for execution of exercise programs. These programs are not considered for CIE and SEE, but carry 10 marks for writing record.					
Practice the following Programs before executing the corresponding programs of exercise part					
1	Write a C program to find the maximum and minimum element in an array of n integers. Use only pointers for referencing the array.				
2	Write a C program to calculate the area of circle, square and rectangle using pointers.				
3	Write a C program for Dynamic Memory allocation of 10 elements and find the largest element.				
4	Write a C program to concatenate 2 strings and check if the second string is present in the first string.				
5	Write a C program to add and subtract 2 polynomials of degree n.				
6	Write a C program to represent a complex number using structure variable. Write user defined functions that accept two complex numbers and finds their sum and difference.				
7	Write a C function that checks if every element of array A is equal to corresponding element in array B. That is the function must check if a[0]=b[0], a[1]=b[1]a[n]=b[n]. It is assumed that A and B have equal number of elements. The function must accept only two pointer values and the integer n representing number of elements. Function returns 0 for equal and nonzero for unequal.				
8	Write a C program to create an array of structure where each structure holds the following details of a student				
	USN	Name	Marks1	Marks2	Marks3
	Non-zero Positive integer	25 Characters	Positive integer	Positive integer	Positive integer

9	Write necessary functions1) Input details for n students. (n is the parameter to be read) 2) To display all the records created 3) To search for specific record based on the USN using pointers. In case the required record is not found, suitable message should be displayed. Both the options in this case must be demonstrated
10	Define a structure Author name with fields: First name, Middle name and Last name. Using the above structure, design another structure Book: ISBN, Author name, Book_Title, Price, Publisher, and Edition. Write a function to search a book given the Author name. Using the above function write a C Program to store N books information and display the details of a book given the author name.
EXERCISE PROGRAMS	
<i>Following set of programs are included in CIE and SEE, students have to pick a program from lot of programs in CIE and SEE</i>	
1.	Files are placed one over another in my study room. The file which is at the top is the first one to be removed, i.e. the file which has been placed at the bottom most position remains in the pile of files for the longest period of time. Help me out to add a file and remove the bottom most file from the pile of files.
2.	Consider an algebraic expression which needs to be evaluated by a computer system. OperatingSystem (OS) consumes less time to evaluate if it is in postfix form of the expression. Thus, help your OS to evaluate by converting the expression into its postfix form.
3.	Assume you have converted an algebraic expression into its postfix form to process the expression fast. This expression need to be evaluated for a given set of values. Implement the above.
4.	Assume you come across a toll gate while you are on your way to home town. Illustrate the working of the toll gate using suitable data structure
5.	Consider a traffic signal controlled by a computer system. Traffic signal has three colors: Red, Yellow and Green. All these glows in a circular fashion based on the traffic. Implement the above using suitable data structure.
6.	Assume in a religious temple, there are three queues available to visit Lord Venkateshwara at Tirupathi. Queue 1 is for politicians; Queue 2 is for senior citizens and Queue 3 is for general people. Queue 1 is of highest priority, then Queue 2 and last priority is Queue 3. Consider a scenario where in Queue 3 is being processed. In between if a politician or a senior citizen enter their respective queue, priority is given to higher priority queue and processed. Applying a suitable data structure, illustrate the above scenario.
7.	Consider a treasure hunt task where a series of clues are given. Clue1 given hint to clue2, clue2 provides hint for clue3 and so on until you can get a hint to the final treasure. Develop an illustration to demonstrate the above scenario.
8.	Assume you have an iPod, where in you have stored plenty of songs so that you get engaged during along journey. If you want to hear a particular song, you need to use forward button to reach that song and can also traverse back using backward button. Implement the following using relevant datastructure.
9.	Consider a multiplayer board game like Cards, Carom, Ludo, Snake and Ladder etc. Players get their turn to play in clockwise or antilock wise direction. Design and execute the above game situation using appropriate data structure.
10.	Your text book contains chapters, sections, subsections, subdivisions, etc. Illustrate this scenario of text book using tree structure.
11.	a) Suppose you want to search a text book in a huge library where books are arranged in alphabetical order. Optimize your search by using recursion. b) Implement Tower of Hanoi problem using recursion.

Course Title	DIGITAL ELECTRONICS LABORATORY		
Course Code	20CS308	L-T-P	(0-0-2)1
Exam. Hours	3	Hours / Week	2
SEE	50 Marks	Total hours	28
Course Objective : Students will be able to design and implement various analog and digital circuits.			
Course Outcomes (COs) : Upon Completion of the course, students shall be able to			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Demonstrate various Electronic Components like CRO, Resistors, Capacitors, Op amp ,IC, etc.	1	
2.	Design and demonstrate various combinational logic and analog circuits.	1,2,3, 5, 8, 9, 12	2
3.	Document the designed digital and analog circuits.	8, 9, 10	
Course Contents:			
Following set of programs are included in CIE and SEE.			
1.	In a battery powered computer, the diskette driver motor 1 should be ON iff - There is a diskette in the drive. - The diskette drive door is closed. - Diskette drive motor 2 is not ON. - The battery low signal is not present and - The computer has started a read operation, or the computer has started awrite operation. Design a circuit to solve the above scenario using basic gates.		
2.	You will gain weight if you eat too much or you do not exercise enough, and your metabolism rate is too low. Design a system such that it alarms you when you gain weight using NAND gates.		
3.	The circuit breaker will trip iff - The hair drier is turned ON. - The microwave oven is used. - All the lights in the room are ON or - There is a short circuit in any appliance. Solve the above issue using relevant MUX.		
4.	In an automated house, two lamps L1 and L2 are controlled by 3 switches: A, B, C. Any one of the lamps should be ON, following the below conditions. - L1 is ON if switch A and B are open but not C. - L1 is ON if switch B and C are open but not A. - L2 is ON if only switch C is open. - L2 is ON if only switch B is open. - L2 is ON if switch A or C is open, but not B. Design a circuit to make the lamp ON using decoder.		
5.	Assume you need to send a secret message consisting of numbers from 1 to 9 and letters from A to F. Secret message is encoded using excess 3 code. Design a circuit using ADDER IC to send a secret message to your friend.		
6.	Assume you are generating and transmitting binary data from one place to another. Check whether sent data is transmitted properly or not.		
7.	Consider a computer operator who needs to generate a sequence 1011 continuously which is transmitted across the network. Design a circuit to implement this job.		

8.	Consider a scenario where in you want to take print out of few selected random pages in sequence numbered from 0 to 15. Design a circuit to achieve this task using J-K Flipflops.
9.	Design and implement a 3-stage up/down counter that counts from a preset value using Decade pre- settable counter ICs. Display the result suitably.
10.	Generate a Ramp output waveform using DAC0800 (Inputs are given to DAC through IC74393 dual 4-bit binary counter).

Course Title	BALAKE KANNADA (KANNADA FOR CONVERSATION)		
Course Code	20KNB	L-T-P	(0-2-0) 1
CIE	100	Hours/Week	2
		Total Hours	30

Course Learning Objectives:

At the end of course student will be able to

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Understand Kannada language	P10	-
2.	Communicate (converse) in Kannada language	P10	-

Chapte rNo.	Contents
1.	Vyavaharika Kannada – Parichaya (Introduction to Vyavaharika Kannada)
2.	Kannada Aksharamalehaaguuchcharane (Kannada Alpabets and Pronunciation)
3.	Sambhashanegaagi Kannada Padagalu (Kannada Vocabulary for Communication)
4.	Kannada in Conversations (Sambhashaneyalli Kannada)
5.	Activities in Kannada. (Kannada SambhashanegaagiChatuvatikegalu)

University Guidelines for CIE Procedure:

- CIE Marks in Vyavaharika Kannada and Aadalita Kannada shall be the sum of marks prescribed for tests and assignments. Marks prescribed for tests shall be 75 and that for the assessments be 25.
- The CIE marks awarded for the tests shall be based on three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 25 marks and the final CIE marks shall be the sum of the marks of all the three tests.
- The remaining 25 marks shall be awarded based on the evaluation of assignments/unit tests/written quizzes that supports to communication skills as per Bloom's Revised Taxonomy and Course/programme outcomes.
- Final marks awarded shall be the sum of (ii) and (iii) for a maximum of 100 marks.
- The candidates shall write the test in Blue Books and also assignments/unit-tests/written quizzes in Blue Books/Notes which shall be preserved by the Principal/Head of the Department for at least six months after the announcement of University results and shall be made available for verification at the direction of the Registrar (Evaluation).

Course Title	III Semester Bridge Course for Diploma Students Bridge Course Mathematics - I (Common to all branches of Engineering) (Mandatory Audit Course)		
Course Code	20BCM30 1	L-T-P	(3-0-0) 3
Exam	3	Hours/Week	3
SEE	50 Marks	Total Hours	42
Course outcomes: To introduce simple concepts of calculus and numerical methods			
#	Course outcomes	Mapping to POs	Mapping to PSOs
1	Able to solve simple problems on determinants, matrix multiplication, partial differentiation and integration.	1	-
2	Able to find the roots of transcendental equations and interpolate when the experimental data is given	1	-
3	Able to expand the given function in terms of Taylors/ Maclaurin series	1	-
MODULE-1			10 Hrs
Basic formulas: Partial fractions. Matrices and determinants: matrix multiplication, evaluation of determinants, finding inverse. Differentiation-I: Review of limit and Continuity, differentiation- Basic formulas, Sum rule, product rule, quotient rule, chain rule and problems. Differentiation-II: Taylor's series, and Maclaurin series of simple functions for single variable, simple problems			
MODULE-2			10 Hrs
Partial differentiation: Definition, Illustrative examples on Partial differentiation, Total differentiation, chain rule, Differentiation of composite and implicit functions, Jacobians, illustrative examples and problems, simple problems.			
MODULE-3			10 Hrs
Integration: Basic formulas, Illustrative examples, evaluation of definite integrals, Integration by parts, Bernoulli's rule of Integration. Integral calculus: Reduction formula for function $\sin^n x, \cos^n x, \sin^n x \cos^m x$ (without proof), Simple problems, Double & triple integration, simple problems with standard limits.			
MODULE-4			10 Hrs
Numerical methods - Numerical Solution of algebraic & transcendental equations by Bisection method, Newton Raphson method, Regula falsi method. Numerical Interpolation -Definition of forward, backward differences, Newton's forward and backward interpolation formulae, Lagrange's interpolation formula, central difference formulas-Bessel and Stirling formulas, illustrative examples			
Note - Theorems and properties without proof. Applicable to all the units.			
Text Books: 1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 40th edition (2007). 2. Erwin Kreyezig, Advanced Engineering Mathematics, Tata McGraw Hill Publications, 8th edition (2007).			

Reference books:

1. Calculus by Thomas Finney, 9th edition, Pearson education, 2002.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

Course Title	STATISTICS AND COMPLEX ANALYSIS		
Course Code	20MA401	L-T-P-C	3-1-0-4
Exam.	3 Hrs	Hours / Week	05
SEE	50 Marks	Total hours	42
Course Objective: The student will study Statistics, probability and calculus of a complex valued function Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Fit a suitable curve/regression line for the given experimental data, solve simple problems connected with complex variable	PO1	-
2.	Validate an assumption through "hypothesis testing" (that is the assumption is not simply because of chance)	PO1, PO2	-
3.	Examine the region of integration in which given function is analytic and hence solve the problems of complex integration and residues	PO1, PO2	-
4.	Model real life problems/engineering application problems and solve the same.	PO1, PO2	-
Course Contents:			
MODULE – 1			10 Hrs
Statistics: Curve fitting by least square method – Straight lines, parabola, (when the experimental output depends on one input) Correlation – Karl Pearson coefficient of correlation and Spearman's rank correlation coefficient. Physical interpretation of numerical value of the rank correlation coefficient. Linear Regression analysis (when the experimental output depends on one input). Illustrative examples from engineering field, Multiple regression analysis. (linear- when the experimental output depends on two inputs) Probability: Discrete Random Variables: Definitions of PDF & CDF, Expectation and Variance. Binominal pdf, Illustrative examples. Poisson probability distribution function-examples.			
MODULE – 2			12 Hrs
Continuous Random Variables: Definition of PDF and CDF, Expectation and Variance, illustrative examples. Uniform pdf, exponential pdf, Normal/Gaussian pdf, discussion on the choice of PDF. Illustrative examples from engineering field. Sampling Distribution: Introduction, Testing a hypothesis, central limit theorem-statement, Level of significance, Simple sampling of attributes, confidence intervals, Test of significance for large samples, Comparison of large samples, Student's t-distribution, Chi-square distribution.			
MODULE – 3			10 Hrs
Joint Probability Distribution & Stochastic Processes: Concept of joint probability, Joint distributions of discrete random variables, Independent random variables – problems. Joint expectation, co-variance and correlation. Markov Chains: Introduction, stochastic matrices, fixed probability vectors and regular stochastic matrices.			
Functions of a complex variable: Analytic functions. -Statement of Cauchy-Riemann equations in Cartesian form and illustrative examples, Construction of an analytic function using Milne-Thomson method (Cartesian form). Illustrative examples from engineering field.			
MODULE – 4			10 Hrs

Harmonic functions and Conformal Mapping: Properties of Harmonic functions and Illustrative examples (Cartesian form) Definition of Conformal transformation and discussion of some standard transformations ($w = u + jv, z = x + jy$). Bilinear transformation, Illustrative examples. Applications of conformal mapping.

Complex Integration: – Evaluation of line integrals, Statement of Cauchy's theorem, generalized Cauchy's Integral formula- illustrative examples. Brief introduction to Taylor and Laurent series and illustrative examples, Zeros of an analytic function, Singularities and Residues. Calculation of residues, Evaluation of real definite integrals using Cauchy's residue theorem.

Text Books :

1. Dr. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications, 44th edition, 2016
2. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley India Pvt. Ltd 9th edition, 2014
3. B V Ramana Higher Engineering Mathematics, Tata McGraw Hill Publications, 2nd edition, 2007

Reference Books:

1. Scott L. Miller, Donald G. Childers: Probability and Random Process with application to Signal Processing, Elsevier Academic Press, 2nd Edition, 2013.
2. Statistics for engineers and Scientists, William Navide, Mc-Graw hill education, India pvt. Ltd., 3rd edition 2014.
3. T. Veerarajan: Probability, Statistics and Random Process, 3rd Edition, Tata McGraw Hill Co., 2008.
4. Theory and problems of probability, Seymour Lipschutz and marclarslipson, Schaum out line series, 2nd edition.

Course Title	DISCRETE MATHEMATICAL STRUCTURES		
Course Code	20MA402	L-T-P-C	2-1-0-3
Exam.	3 Hrs	Hours / Week	04
SEE	50 Marks	Total hours	42
Course Objective: Introduction of Discrete structures and principle of Combinatory which may be employed as tools in the applications of Computer Science & Information Technology. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Use logical notation to define and reason about fundamental mathematical concepts such as sets, relations, functions, and integers	PO1,PO2	-
2.	Apply induction hypotheses, predicates and quantifiers concept in mathematical proofs	PO1,PO2,PO3	-
3.	Solve problems of basic counting principles.	PO1,PO2,PO3	-
Course Contents:			
MODULE – 1			10 Hrs
Fundamental principles of Counting: The rule of sum and product, permutation principle, combination principle, rule of generalized permutations and Combinations. A note on Catalan numbers. Properties of Integers: The well ordering principle: mathematical induction. Recursive Definitions			
MODULE – 2			10 Hrs
Fundamentals of logic: Basic logic connectives and truth tables. Logical equivalence and Tautologies. Statement of laws of logic. Logic implication - Rules of inference theory. Relations : Cartesian products and relations, computer representation of a relation and directed graph, properties / various types of relations. Equivalence relations and partitions. Methods of proof; indirect and direct approach.			
MODULE – 3			10 Hrs
Function I: Definition, various types of functions - Injective and Surjective functions, invertible functions, function composition. Functions - II: Ceiling function, Floor function, Characteristic function, and Application of Stirling numbers of second kind. The Pigeon hole principle.			
MODULE – 4			12 Hrs
Graph theory: Basic terminologies of a graph. Discussion of connected and disconnected graphs, Euler and Hamilton graphs, Planar graphs and Graph colouring. Trees: Definition, properties of a tree. Weighted trees, prefix codes and biconnected components. Modelling of real-life problems using graphical approach and their analysis.			
Text Books :			
Discrete and Combinatorial Mathematics, R C Grimaldi, Pearson's publications, 5th edition, 2007.			
Reference Books:			
Discrete Mathematical Structures, by D. S. Malik & M. K. Sen, Thomson's Publications, First edition, 2006..			

Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA		
Course Code	20CS403	L-T-P-C	3-0-1-4
Exam.	3 Hrs	Hours / Week	05
SEE	50 Marks	Total hours	52
Course Objective: Design and Develop java application programs using object-oriented concepts Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Apply Java constructs for the development of object oriented programs.	PO1	-
2.	Analyze the given java program to make suitable changes.	PO2	-
3.	Design a java program for the given problem.	PO3	-
4.	Conduct practical experiments for demonstrating object oriented concepts through java using IDE.	PO1,PO2, PO5	-
Course Contents:			
MODULE – 1			13 Hrs
Java programming fundamentals – The Java Language, The key attributes of Object Oriented programming, Java Development Kit (JDK), JVM, A first Simple program, handling syntax errors, The Java Keywords, Identifiers in Java. Introducing Data Types and Operators : Java's Primitive Types, A Closer Look at Variables, The Scope and Lifetime of Variables, operators, Shorthand Assignments, Type conversion in Assignments, Using Cast, Operator Precedence, Expressions. Program Control Statements: Input characters from the Keyboard, if statement, Nested ifs, if-else-if Ladder, Switch Statement, Nested switch statements, for Loop, Enhanced for Loop, While Loop, do-while Loop, Use break, Use continue, Nested Loops. Introducing Classes, Objects and Methods : Class Fundamentals, How Objects are Created, Reference Variables and Assignment, Methods, Returning from a Method, Returning Value, Using Parameters, Constructors, Parameterized Constructors, The new operator Revisited, Garbage Collection. The this Keyword. More Data Types and Operators: Arrays, Multidimensional Arrays, Alternative Array Declaration Syntax, Assigning Array References, Using the Length Member, The For-Each Style for Loop, Strings, The Bitwise operators.			
MODULE – 2			13 Hrs
A Closer Look at Methods and Classes: Controlling Access to Class Members, Pass Objects to Methods, How Arguments are passed, Returning Objects, Method Overloading, Overloading Constructors, Recursion, Understanding Static, Introducing Nested and Inner Classes, Varargs: Variable-Length Arguments. Inheritance: Inheritance Basics, Member Access and Inheritance, Constructors and inheritance, Using super to Call Superclass constructors, Using super to Access Superclass Members, Creating a Multilevel Hierarchy, When are Constructors Executed, Superclass References and Subclass Objects, Method Overriding, Overridden Methods support polymorphism, Why overridden Methods, Using Abstract Classes, Using final, The object class.			
MODULE – 3			13 Hrs
Interfaces: Interface Fundamentals, Creating an Interface, Implementing an Interface, Using Interface References, Implementing Multiple Interfaces, Constants in Interfaces, Interfaces can be extended, Nested Interfaces. Packages: Package Fundamentals, Packages and Member Access, Importing Packages, Static import. Exception Handling: The Exception Hierarchy, Exception Handling Fundamentals, The Consequences of an Uncaught Exception, using Multiple catch clauses, Catching subclass Exceptions, try blocks can be nested, Throwing an Exception, A Closer look at Throwable, using finally, using throws, Java's Built-in Exceptions.			
MODULE – 4			13 Hrs
Multithreaded Programming: Multithreading fundamentals, The Thread Class and Runnable Interface, Creating Thread, Creating Multiple Threads, Determining When a Thread Ends, Thread Priorities, Synchronization, using Synchronization Methods, The Synchronized Statement, Thread Communication using notify(), wait() and notify All(), suspending, Resuming and stopping Threads. Exploring java.io – The I/O Classes and Interfaces, File, Auto			

closeable, Closeable and Flushable Interfaces, I/O Exceptions, The Stream Classes, The Byte Streams, The Character Streams, The Console Class

Text Books :

1. Java Fundamentals, A comprehensive Introduction by Herbert Schildt, Dale Skrien. Tata McGraw Hill Edition 2013 (Chapters 1,2,3,4,5,6,7,8,9,10,12)
2. Java –The complete Reference, by Herbert Schildt Eight Edition Tata McGraw Hill Education (Chapter 19).

MOOCs:

1. <http://nptel.ac.in/courses/106106147/>
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. <https://www.coursera.org/specializations/object-oriented-programming>

Reference Books:

1. Programming in JAVA2 by Dr K Somasundaram ,Jaico publications
2. Java Programming by Hari Mohan Pandey, Pearson Education, 2012.
3. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson.

Activity:

Write and execute the following programs in java

1. Design Java application to model Employee of an “ABC” organization. Consider types of employees as :
a) Manager b) Sales Person Perform the following:
 - Implement simple inheritance where Employee (employee ID, First Name, Last Name, Current salary) is super class, consider Manager (number of stock options) and SalesPerson (number of sales, commission rate) as subclasses.
 - Define parameterized constructors in class hierarchy.
 - Define methods to display status of employee (override toString()) and increase current payment (salary) as giving bonus by a small amount.
2. Create class Employee with name, Id, cellNum, designation, department, salary permanent (boolean) as members. Also create separate class for member name as EmpName, department as Department and salary as Salary. Members of EmpName are firstName, midName, lastName . Members of Salary are BASIC, DA percent, HRA , PF, insurance. Members of Department are deptName, deptCode. Create an instance of Employee and initialize all its members from user input console. Access the same instance by more than one reference of Employee. Count the number of references and objects being created. [class, reference, objects].
3. Create a super class Bind {x,y} and subclass Bind3d {z} include
 - Parameterized constructor in class Bind to initialize object.
 - Include a method in class Bind to Print data members of object. Override the same method in sub-class and reuse the inherited method in it.
 - Create final static member printArr (Bind[]) which print array of objects. In this method use above method to print member of individual objects of array.
 - Write test class to create to array of Bind3d type. Use the above method to print all the objects of array.
4. A bank maintains two kinds of accounts – Savings account and Current account. The savings account provides simple interest, deposit and withdrawal facilities. The current account only provides deposit and withdrawal facilities. Current account holders should also maintain minimum balance. If balance falls below minimum level a service charge is imposed. Create an abstract class Account that stores customer name, account

number type of account and abstract methods. From this derive the classes Curr_Account (double balance, double min_bal, double serviceCharge / penalty) and Sav_Account (double balance).

Include the necessary methods in order to achieve the following:

- Define parameterized constructor in a class hierarchy. P
- Allow deposit and update the balance.
- Display the balance.
- Compute interest and add to balance.
- Permit withdrawal and update the balance (check for minimum balance).
- Apply polymorphism if required for methods in class hierarchy.
- Create an array of super class / object and populate with subclass objects and call the overridden /object methods.
- Write a test program to demonstrate the above said implementations.

5. Define a interface EMPInterface (void displayEMP(), void giveBonus (double amount)). Define an abstractclass Employee(empID, fName, lName, salary). Define a concrete class Manager (noOfOtockOptions), subclass of Employee and define interface methods.

Perform the following:

1. Define appropriate constructors in a class hierarchy.
2. Ensure the bonus amount should not be negative and zero using exception handling mechanism (use throws and throw clauses of exception handling)
3. Create array of interface reference variables and populate with manager objects.
4. Write a test program to implement the above said requirements of interface implementation and exception handling.

Course Title	DESIGN AND ANALYSIS OF ALGORITHMS		
Course Code	20CS404	L-T-P-C	4-0-0-4
Exam.	3 Hrs	Hours / Week	04
SEE	50 Marks	Total hours	52
Course Objective: Students should be capable of designing algorithms using suitable algorithm design method and mathematically analyze it.			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Explain basic knowledge of algorithm analysis, algorithm design strategies, various algorithms, NP problems.	PO1	-
2.	Apply algorithms to solve a given computational problem.	PO1	PSO 1
3.	Analyze algorithms, determine time & space complexity of algorithms	PO2	PSO 1
4.	Design algorithm for a given problem using suitable algorithm design strategy	PO3	PSO 1
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
Course Contents:			
MODULE – 1			13 Hrs
Introduction: Notion of Algorithm, Fundamentals of Algorithmic Problem Solving, Fundamentals of the Analysis of Algorithm Efficiency: Analysis Framework, Asymptotic Notations and Basic efficiency classes, Mathematical analysis of Recursive and Non-recursive algorithms, Examples. Brute Force: Selection Sort and Bubble Sort, Sequential Search and String Matching, Exhaustive Search;			
MODULE – 2			13 Hrs
Divide-and-Conquer: Merge sort, Quick sort, Binary Search, Binary tree Traversals and related properties, Multiplication of large integers, Strassen's Matrix Multiplication. Decrease-and-Conquer: Insertion Sort, Depth First and Breadth First Search, Topological Sorting, Algorithms for Generating Combinatorial Objects.			
MODULE – 3			13 Hrs
Transform-and—Conquer: Presorting, Heaps and Heapsort, Problem Reduction. Space and Time Tradeoffs: Sorting by Counting, Input Enhancement in String Matching, Hashing. Dynamic Programming: Computing binomial coefficient, Warshall's Algorithm, Floyd's Algorithm, The knapsack Problem and Memory Functions.			
MODULE – 4			13 Hrs
Greedy Technique: Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees. Limitations of Algorithm Power Lower-bound Arguments, Decision Trees, P, NP and NP-Complete Problems. Coping with the Limitations of Algorithm Power: Backtracking, Branch-and-Bound, Approximation Algorithms for NP-hard problems.			
Text Books :			
1. Anany Levitin, Introduction to The Design and Analysis of Algorithms, 3 rd Edition, Pearson Education, 2012 2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Fundamentals of Computer Algorithms, 2 nd Edition, Press 2014.			
Reference Books:			
1. Cormen T.H., Leiserson C. E., and Rivest R. L., Introduction to Algorithms, 3 rd edition, PHI, 2015. 2. R.C.T. Lee, S.S. Tseng, R.C. Chang and Y.T. Tsai, Introduction to the Design and Analysis of Algorithms A Strategic Approach, 1 st Edition, Tata McGraw Hill, 2005.			

Course Title	MICROCONTROLLERS AND EMBEDDED SYSTEMS		
Course Code	20CS405	L-T-P-C	4-0-0-4
Exam.	3 Hrs	Hours/Week	04
SEE	50 Marks	Total hours	52
Course Objective: To make familiar with importance and applications of microcontrollers and embedded systems. Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Explain the concepts of ARM embedded system and its components	PO1	-
2.	Design ARM based Assembly Language Programs to solve problems	PO3, PO5,	PSO 1
3.	Illustrate different embedded systems and its applications	PO1	PSO 1
4.	Develop embedded programs using IDE	PO1, PO5	PSO 1
Course Contents:			
MODULE – 1			13Hrs
ARM Embedded Systems: Microprocessors, Microcontrollers, Microprocessors v/s Microcontrollers, RISC v/s CISC, Harvard v/s Von-Neumann processor, Big-endian v/s Little-endian processors, Load store operation, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table, Core Extensions-cache and tightly coupled memory.			
MODULE – 2			13Hrs
Introduction to the ARM Instruction Set: Data Processing Instructions-move, barrel shifter, arithmetic, logical comparison, multiply. Branch Instructions, Load-store instructions-single register transfer, single register load-store addressing modes, multiple register transfer, stack operations, swap instruction. Program Status Register Instructions, Loading Constants, conditional execution. Introduction to Embedded Systems: What is an embedded system?, Embedded Vs General computing system, Classification of Embedded systems, Major applications and purpose of ES.			
MODULE – 3			13Hrs
Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Embedded firmware. RTOS and IDE for Embedded System Design: operating system basics, Types of operating systems integration of hardware and firmware-out of circuit programming, ISP, IAP, use of factory programmed chip firmware loading; Dynamic host configuration			
MODULE – 4			13Hrs
Embedded system Development Environment – Block diagram, disassemble/decompile, simulators, emulators and debugging. Characteristics and Quality Attributes of Embedded Systems: characteristics of an embedded system, Operational and non-operational quality attributes, Embedded Systems Application and Domain specific, Hardware Software Co-Design and computational models in Embedded design, embedded firmware design and development languages.			

Text Books :

1. ARM system developers guide, Andrew N Sloss, Dominic Symes and Chris Wright, Elsevier, Morgan Kaufman publishers, 2008. (1.1 to 1.4, 2.1 to 2.5.1, 3.1 to 3.3, 3.5 to 3.6 (Excluding 3.5.1, 3.5.2), 3.8)

2. Raguinandan, An Introduction to ARM System Design, Cengage Publication

Reference Books:

1. The Insider's Guide to the ARM7 Based Microcontrollers, Hitex Ltd., 1st edition, 2005

2. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015

3. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008

MOOCs:

https://onlinecourses.nptel.ac.in/noc18_ec03/preview

Course Title	SOFTWARE ENGINEERING		
Course Code	20CS406	L-T-P-C	3-0-0-3
Exam.	3 Hrs	Hours / Week	03
SEE	50 Marks	Total hours	40
Course Objective: To create software development and testing skills and to introduce some major tools for software testing and software project management. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Professional software development, Software engineering Ethics, Case studies, Software processes, Software process models, Process activities, Coping with change, The RU process. Requirements Engineering: Functional and non-functional requirements, the software requirements document, requirements specification, requirements engineering processes, requirements elicitation and analysis, requirements validation			
MODULE – 2			10 Hrs
Requirements Management and System modeling: Context models interaction Models, Structural models, Behavioral models model-driven engineering Software testing: Development testing Test-driven development Release testing, User testing. Software evolution: Evolution processes Program evolution dynamics. Software maintenance, Legacy system management			
MODULE – 3			10 Hrs
Dependability and Security: Dependability properties, Availability and Reliability, Safety, Security Component-Based Software Engineering: CBSE Process Component composition, Project management: Risk management, Managing People, teamwork Quality Management Software quality, software standards, Reviews and Inspections, software measurement.			
MODULE – 4			10 Hrs
Agile software development: Agile Methods, plan-drive and agile development, extreme programming Agile project management, scaling agile methods and metrics, Scrum: an online tool for agile development, Scrum events, Scrum Artifacts			
Text Book:			
Ian Sommerville, Software Engineering, Person Education Ltd., 9th Edition, 2013.			
Reference Books:			
Roger .S. Pressman, Software Engineering-A Practitioners approach, McGraw-Hill, 7th Edition, 2007.			

MOOCs

1. www.infoweblinks.com/content/casetools.htm
2. <https://www.mooc-list.com/categories/cs-software-engineering>
3. <https://www.scrum.org/resources/what-is-scrum>

Activity:

1. You are expected to develop software for a typical management system. Create SRS for the same.
2. Assume you are the manager for a given project. You are given 20 employees; your project needs only 8 employees. Develop a report on how the team is formed with necessary justification.
3. Design test cases for a sales organization. Assume that four different products are available. Minimum two products are to be ordered. Minimum of any product quantity is four and maximum total products ordered are 40.

Course Title	ALGORITHMS LABORATORY		
Course Code	20CS407	L-T-P-C	0-0-1-1
Exam.	3 Hrs	Hours / Week	02
SEE	50 Marks	Total hours	28
Course Objective: To demonstrate various algorithmic design techniques. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course outcomes	Mapping to PO's	Mapping to PSO's
1.	Design and implement programs to solve a given problem using suitable algorithm design techniques.	PO1, PO2, PO3, PO5, PO8, PO9, PO12	PSO1
2.	Document and present the executed programs.	PO8, PO9, PO10	
Course Contents:			
Programs to Execute in the Laboratory:			
1. a. Consider the runs scored by batsmen in a cricket match. Implement Recursive Binary search to find whether the specified runs have been scored by any batsman or not. Determine the time required for search. b. Sort a given set of elements using the Heap sort method. 2. a. Employees in an organization need to be grouped for a tournament based on their ages. Sort the ages using Merge sort and find the time required to perform the sorting. b. Print all the nodes reachable from a given starting node in a graph using Depth First Search method and check whether a graph is connected. 3. a. Students in a department need to be selected for a high jump competition based on their height (integer values only). Sort the heights of students using Quick sort and find the time required for the Sorting. b. Print all the nodes reachable from a given starting node in a digraph using BFS method. 4. a. Sort a given set of elements using Insertion sort method. b. Obtain the topological ordering of vertices in a given digraph. 5. a. Implement Horspool algorithm for String Matching. b. Write a program using Transform and Conquer technique for checking whether the digits of mobile number of a person are unique. 6. a. Consider n cities. The shortest path between every pair of cities needs to be determined. Implement Floyd's algorithm for the All-Pairs- Shortest-Paths problem. b. Find the Binomial Co-efficient using Dynamic Programming. 7. a. There are n different routes from hostel to college. Each route incurs some cost. Find the minimum cost route to reach the college from hostel using Prim's algorithm. b. Compute the transitive closure of a given directed graph using Warshall's algorithm. 8. a. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm. b. Implement computing a mode using pre-sorting method. 9. Consider the distance between Hassan and n different cities. Every city can be reached from Hassan directly or by using intermediate cities whichever costs less. Find the shortest distance from Hassan to other cities using Dijkstra's algorithm. 10. Implement 0/1 Knapsack problem using dynamic programming. 11. Implement N Queens problem using Back Tracking. 12. Find the subset of given set $S = \{s_1, s_2, \dots, s_n\}$ of an positive integers whose sum is equal to a given positive integer d. A suitable message is to be displayed if the given problem instance doesn't have a solution			

Course Title	MICROCONTROLLER LABORATORY		
Course Code	20CS408	L-T-P-C	0-0-1-1
Exam.	3 Hrs	Hours / Week	02
SEE	50 Marks	Total Hours	28
Course Objective: To develop and test Assembly Level Programs using ARM7TDMI/LPC2148. Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
Course Contents:			
PART- A Conduct the following experiments by writing Assembly Language Program (ALP) using ARM7TDMI/LPC2148 using an evaluation board/simulator and the required software tool.			
1.	In a class of strength 40 students, I need to find the tallest guy in the class to reach the projector of the classroom. Help me to identify the tallest guy.		
2.	To determine the number of ways to distribute ‘N’ marbles to a group of children you need to find factorial of N. Hence find factorial of a number.		
3.	To illustrate the working of lookup table in ARM processor, find the square of a number (1 to 10) stored in look-up table.		
4.	RAM is an important component of microcontroller. To understand how it can be accessed, add anarray of 16 bit numbers and store the 32 bit result stored in internal RAM.		
5.	Count the number of ones and zeros in two consecutive memory locations		
PART – B Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' and Keil Uvision-4 tool/compiler.			
1.	In the retail shop, the owner wants to know how many customers have been using the service of the shop. A device is used to keep count of incoming customers in the shop. Program the device to carry out the counting. Also the device should reset back to ZERO by down counting. Implement the above using Logic Controller Interface.		
2.	In a petrol bunk, if a fire occurs accidently you need to display messages FIRE and HELP alternately on a7-segment display interface to alarm the people. Implement the above scenario.		
3.	A toy car uses a Stepper Motor interface to rotate the motor in specified direction. Program the toy to rotate (Clockwise or Counter-Clockwise) by N steps. Introduce suitable delay between successive steps. (Any arbitrary value for the delay may be assumed by the student).		

4.	Generate Sine Wave using DAC interface (The output of the DAC is to be displayed on the CRO).
<u>Activity</u>	
Scan a 4X4 keypad for key pressed and display the key pressed on LCD screen.	

Note: Students need to execute one from PART-A and one form PART-B for SEE

**V Semester & VI SEMESTER
(THIRD YEAR)
SYLLABUS**

Course Category	Course Code	Course Title	L-T-P			Credits	Contact Hours
HSM-5	20CS501	Technology Management and Entrepreneurship	4	0	0	4	4
PC-14	20CS502	Operating Systems	4	0	0	4	4
PC-15	20CS503	Data Communications	4	0	0	4	4
PC-16	20CS504	Web Programming	3	0	1	4	5
PC-17	20CS505	Advanced Java	3	0	1	4	5
PC-18	20CS506	Database Management System	4	0	0	4	4
PC-19	20CS507	Database Application Laboratory	0	0	1	1	2
HSM-6	20CIP	Constitution of India and Professional Ethics (Mandate Audit Course)	2	0	0	-	2
HSM-7	20AAD	Analytical Ability Development	0	1	0	1	2
		Total	20	1	3	26	32

VI Semester							
Course Category	Course Code	Course Title	Credits			Total Credits	Contact Hours
			L	T	P		
PC-20	20CS601	System Software and Compiler Design	4	0	0	4	4
PC-21	20CS602	Computer Graphics and Visualization	3	0	1	4	5
PC-22	20CS603	Computer Networks	4	0	0	4	4
PC-23	20CS604	Mobile Application Development Laboratory	0	0	1	1	2
PC-24	20CS605	System Software Laboratory	0	0	1	1	2
PROJ-1	20CS606	Mini Project -1 (Inter Discipline)	0	0	2	2	2
PE-1	20CS65X	Elective – I	3	0	0	3	3
OE-1	20OECSXX	Open Elective – 1	3	0	0	3	3
HSM-8	20ARD	Aptitude Reasoning Development (Mandate Audit Course)	0	1	0	0	2
HSM-9	20EVS	Environmental Studies (Mandate Audit Course)	2	0	0	0	2
OE-2	20SW01	SWAYAM Course -1 (Mandate Audit Course)	0	0	0	0	3
Total			21	3	4	22	32

Elective – I		
Sl. No.	Course Code	Course Title
1.	20CS651	Multimedia Computing
2.	20CS652	Python Applications Programming
3.	20CS653	Graph Theory and Combinatorics
4.	20CS654	Data Mining and Warehousing
5.	20CS655	Principles of Programming Languages
Open Electives		
1	20OECS61	Introduction to Cloud Computing
2	20OECS62	Database Fundamentals

Course Title	TECHNOLOGY MANAGEMENT AND ENTREPRENEURSHIP		
Course Code	20CS501	L-T-P-C	(4-0-0)4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: To lead and manage teams, become entrepreneur and to prepare project proposal.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore corporate culture and building impressive profiles	10	-
2.	Develop motivation and management skills	9, 11	-
3.	Inculcate skills for Entrepreneurship and Start ups	6, 7	-
4.	Impart knowledge on IPR and R&D in technology industries	1, 4	-
5.	Inculcate the skills of building project proposal	1,11	-
Course Contents:			
MODULE – 1			13 Hrs
Planning, Forecasting and Decision making: Preview. Nature of planning, the foundation for planning, some planning concepts. Forecasting. Strategies for managing technology. Decision Making: Preview. Nature of planning. Decision making. CBIS, implementation. Organizing and human aspects of organizing: Preview, Nature of organizing. Traditional organization theory. Technology and modern organizational structures. Teams. Some human aspects of organizing: Preview. Staffing technical organizations. Authority and power. Delegation. Committees and meetings.			
MODULE – 2			13 Hrs
Motivating & Leading Technical People and Controlling: Motivating and leading technical people: Preview. Motivation. Leadership. Motivating and leading technical professionals (methods). Controlling: Preview. The process of control. Financial controls-Definitions only. Nonfinancial controls. Managing the Research Functions: Managing the research functions: Preview. Product and technology life cycles. Nature of R & D. Research strategy and organization. Selecting R & D projects. Protection of ideas. Intellectual Property Rights (IPR). Creativity.			
MODULE – 3			12 Hrs
Management: Meaning, Nature, Characteristics and Scope of Management, Functional Areas of Management, Management and Administration, Roles of Management, Levels of Management, Early Management Approaches: Psychological Development, Scientific Management; Administrative Management, Human Relations Movement; Modern Management Approaches: Behavioral Approach, Quantitative Approach, Systems Approach, Contingency Approach; Entrepreneurship: Meaning, evolution of the concept, functions of an Entrepreneur, Characteristics of an Entrepreneur, types of entrepreneur, Intrapreneur. Entrepreneurship: Concept of Entrepreneurship, Characteristics of Entrepreneurship, Development of Entrepreneurship, Stages in Entrepreneurial process, Role of Entrepreneurs in economic development, Entrepreneurship in India, Entrepreneurship barriers, Women entrepreneur – Concept & steps to develop Women Entrepreneur. Small Scale Industry: Definition, Characteristics, Objectives, Scope and role of SSI in economic Development, Advantages of SSI, Problems of SSI, Steps to start an SSI.			

MODULE – 4	12 Hrs
Government Policy towards SSI; Different Policies of SSI, Introduction to GATT/ WTO. Supporting Agencies of Government for SSI: Meaning, Nature of support; Objectives, functions. Ancillary Industry and Tiny Industry. Institutional Support: Different Schemes: SSIDC, SSIB, DICs/ Single Window Concept, TCOs, ICICI, NSIC, SIDO, IDBI, SIDBI, SFCS, IFCI. Preparation of Project: Meaning, Project identification, Project selection, Project Report - Need of Project, Contents; formulation, Network Analysis Errors of project report, Project Appraisal, Feasibility Study-Market Feasibility Study, Technical Feasibility Study, Financial Feasibility Study, Social Feasibility Study	
Text Books: 1. Daniel Babcock & Lucy C. Morse, “Managing Engineering and Technology”, PHI, 6th edition, 2014. 2. Management and Entrepreneurship- N.V.R Naidu, T Krishna Rao.	
Reference Books: 1. Entrepreneurship Development, Small Business Enterprises – Poornima. M. Charantimath, –Pearson Education – 2006. 2. Dynamics of Entrepreneurial Development & Management-Vasant Desai, Himalaya Publishing House. 3. Management Fundamentals - Concepts, Application, Skill Development – Robers Lusier, Thomson. 4. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill.	
MOOCs: 1. https://nptel.ac.in/courses/110/106/110106141 2. https://nptel.ac.in/courses/127/105/127105007	

Course Title	OPERATING SYSTEMS		
Course Code	20CS502	L-T-P-C	(4-0-0)4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: To recognize and schedule critical resources of operating system appropriately.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify fundamental concepts in designing the operating system	1	-
2.	Apply resource management strategies in designing operatingsystem	1, 3	-
3.	Compare various resource scheduling techniques	2	-
4.	Analyze synchronization and deadlock handling mechanisms	2	-
Course Contents:			
MODULE – 1			13 Hrs
Introduction to Operating Systems, System structures: What operating systems do; Computer System organization; Computer System architecture; Operating System structure; Operating System operations; Process management; Memory management; Storage management; Protection and security; Distributed system. Operating System Services; User - Operating System interface; System calls; Types of system calls; System programs; Operating System design and implementation; Operating System structure; Virtual Machines.			
MODULE – 2			13 Hrs
Process Management: Process concept; Process scheduling; Operations on processes; Inter-process communication, Threads: Overview; Multithreading models; Thread Libraries; Threading issues. Process Scheduling: Basic concepts; Scheduling criteria; Scheduling algorithms; Thread Scheduling : Multiple-Processor scheduling; Process Synchronization: Synchronization: The Critical section problem; Peterson's solution; Synchronization hardware; Semaphores; Classical problems of synchronization; Monitors.			
MODULE – 3			13 Hrs
Deadlocks: Deadlocks: System model; Deadlock characterization; Methods for handling deadlocks; Deadlock prevention; Deadlock avoidance; Deadlock detection and recovery from deadlock. Memory Management: Main Memory: Background; Swapping; Contiguous memory allocation; Paging; Structure of page table; Segmentation. Virtual Memory Management: Background; Demand paging; Copy-on- write; Page replacement.			
MODULE – 4			11 Hrs
File System Interface: File System: File concept; Access methods; Directory and Disk structure; Mass-Storage Structures: Mass storage structures; Disk structure; Disk attachment; Disk scheduling; Disk management; Swap space management, Access matrix implementation.			
Text Book: Abraham Silberschatz, Peter Baer Galvin, Greg Gagne: Operating System Principles, 8 th edition, Wiley-India, 2012.			

Reference Books:

1. D.M Dhamdhere: Operating systems - A Concept-based Approach, 2nd Edition, Tata McGraw-Hill,2002.
2. P.C.P. Bhatt: Operating Systems, 2nd Edition, PHI, 2006.
3. Harvey M Deital: Operating systems, 3rd Edition, Pearson Education, 1990.

MOOC:

1. <http://nptel.ac.in/courses/106108101>

Course Title	DATA COMMUNICATIONS		
Course Code	20CS503	L-T-P-C	(4-0-0)4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: Students able to gain knowledge of TCP/IP Protocol Model and Functionalities of Data link Layer and Physical Layer Course Outcomes (COs): Upon Completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Perceive the different types of Networks and demonstrate the responsibility each layers of TCP/IP protocol suite.	1,12	-
2.	Enumerate signal transmission along with impairments and performance analysis	2,4	-
3.	Explore the concept of data and signal with different techniques	1,2	-
4.	Acquire the knowledge of bandwidth utilization and transmission media	3,4	-
5.	Design and Apply Error detection and correction algorithms	2,3	-
6.	Familiarize the detailed functionalities of different framing formats, Medium Access Control Methods and Ethernet Protocol	1,4	-
Course Contents:			
MODULE-1			13 Hrs.
Introduction: Data Communications; Networks; Network Types; Network Models: Protocol Layering; TCP / IP Protocol Suite; The OSI Model; Physical Layer: Introduction to Physical Layer, Data and Signals; Periodic Analog Signals; Digital Signals; Transmission impairment; Data rate limits; Performance.			
MODULE-2			13 Hrs
Digital Transmission: Digital-to-Digital conversion: Line Coding, Line Coding Schemes, Block Coding, and Scrambling; Analog-to-Digital conversion: Pulse Code Modulation (PCM), Delta Modulation (DM); Multiplexing and Transmission Media: Multiplexing; Spread spectrum; Twisted pair cable, Coaxial cable, Fiber-Optic cable, Radio waves, Microwaves, Infrared.			
MODULE-3			12 Hrs
Switching: Introduction; Circuit-Switched Networks: Three Phases and Delay; Packet Switching: Datagram Networks: Virtual Circuit Networks; Structure of a Switch: Circuit-Switches and Packet Switches; Introduction to Data-Link Layer: Nodes and Links, Services, Two Categories of Links, Two Sublayers; Link-layer Addressing: Three Types of Addresses, Address Resolution Protocol (ARP); Error Detection and Correction: Introduction; Block coding: Error Detection; Cyclic codes: CRC, Polynomials, Cyclic Code Encoder using Polynomials, Cyclic Code Analysis, Checksum: Concept, Other Approaches to the Checksum; Forward Error Correction.			
MODULE-4			12 Hrs
Data Link Control: DLC Services: Framing, Flow and Error control, Connectionless and Connection Oriented; Data Link Layer Protocols: Simple, Stop & Wait, Piggybacking; HDLC; Point to Point Protocol: Services and Framing; Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA; Controlled Access: Reservation, Polling, Token Passing; Channelization: FDMA, TDMA, CDMA. Ethernet: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet;			
Text Book: 1. Behrouz A. Forouzan, “Data Communications and Networking”, Tata McGraw-Hill, 5th Edition. (Chapters 1.1,1.2,.1.3, 2, 3, 4.1,4.2, 6, 7, 8, 9, 10, 11,12, 13)			
Reference Books: 1. Alberto Leon-Garcia and Indra Widjaja, “Communication Networks–Fundamental Concepts and Key architectures”, Tata McGraw- Hill, 2nd Edition. 2. William Stallings, “Data and Computer Communication”, Pearson Education, 8th Edition			
MOOC: 1. http://nptel.ac.in/keyword_search_result.php?word=data+communication			

Course Title	WEB PROGRAMMING		
Course Code	20CS504	L-T-P-C	(3-0-1)4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	50
Course Objective: Create web pages with client side and server-side scripting			
Course Outcomes (COs): Upon completion of the course, students shall be able to :			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge of HTML/XHTML and CSS in designing webpage.	1	2
2.	Develop client-side script to design webpage	3	2
3.	Design server-side script to create webpage	3,5	2
4.	Create web pages using JavaScript, xml, PHP and MySQL for the real world applications.	1,3,5	2
Course Contents:			
MODULE – 1			13 Hrs
Fundamentals of Web, XHTML: Internet, WWW, Web Browsers, and Web Servers; URLs; MIME; HTTP; the Web Programmers Toolbox. XHTML: Basic syntax; Standard structure; basic text markup; Images; Hypertext Links; Lists; Tables; Forms; the audio element, the video element, organization elements, time element.			
MODULE – 2			13 Hrs
CSS: Introduction; Levels of style sheets; Selector forms; Property value forms; Font properties. List properties; Color; Alignment of text; The box model; Background images; Theand<div>tags. JavaScript: Overview of JavaScript; Syntactic characteristics; Primitives, operations, and expressions; Screen output and keyboard input; Control statements; Object creation, and modification; Arrays; Functions; Pattern matching using regular expressions.			
MODULE – 3			12 Hrs
JavaScript and HTML Documents: The JavaScript execution environment; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The navigator object. Dynamic Documents with JavaScript: Introduction to dynamic documents; Element positioning; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor.			
MODULE – 4			12 Hrs
XML: Introduction; Syntax; Document structure; Namespaces, XML schemas, Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets. PHP: Origins and uses of PHP; Overview of PHP; General syntactic characteristics; Primitives, operations and expressions; Output; Control statements; Arrays; Functions; Pattern matching; Form handling; Files; Cookies; Session tracking; Database Access using PHP and MySQL.			
Text Book: 1. Robert W. Sebesta: Programming the World Wide Web, 8th Edition, Pearson Education, 2014.			
Reference Books: 1. Deitel H.M. and Deitel P.J., “Internet and World Wide Web How to program”, PearsonInternational, 2012, 4th Edition. 2. Randy Connolly, Ricardo Hoar, “Fundamentals of Web Development”, Pearson, 2015. 3. ISRD Group: Internet Technology and Web Design, Tata McGraw Hill Publishing Ltd, 2011			
MOOCs: 1. https://www.mooc-list.com/course/programming-and-web-beginners-coursera 2. http://nptel.ac.in/courses/117105080/3			

- | |
|--|
| 3. https://www.coursera.org/specializations/web-design |
| 4. http://www.w3c.org |
| Activity:
Web programs are to be developed. |

Course Title	ADVANCED JAVA		
Course Code	20CS505	L-T-P-C	(3-0-2)4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	50
Course Objective: To use Java and J2EE concepts to create applications.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design Java programs that demonstrate enumeration, autoboxing, generics and event handling	3	-
2.	Adopt Java collection framework wherever required and develop applets and GUI with Java Swing	3,5	1
3.	Build Java applications using Servlets, JSP and JDBC	1,2,3,5	1
4.	Construct a Simple Client/Server application using RMI and servlet programming	1,2,3	1
Course Contents:			
MODULE – 1			13 Hrs
Enumeration, Autoboxing and Generics: Enumeration fundamentals, values() and valueOf() Methods, Java Enumerations are class types, example, Type Wrappers, Autoboxing, Generics – What are generics? A simple generics example, Generic class with two type parameters, General form of generic class, Creating Generic method, Generic Interfaces. Event Handling - Two event handling mechanisms; The delegation event model; Event classes; Sources of events; Event listener interfaces; Using the delegation event model; Adapter classes; Inner classes.			
MODULE – 2			12 Hrs
Applets - Applet basics, A complete Applet Skeleton, Applet Initialization and Termination, A key Aspect of an Applet Architecture, Requesting Repainting, using the status window, Passing parameters to Applets. User Interface components with Swing -The origin and Design philosophy of swing, Components and containers. Layout managers, A first simple swing Example Event Handling, Creating a swing applet, Exploring Swing Controls-JLabel and ImageIcon, JTextField The Swing buttons, JTabbedPane, JScrollPane, JList, JCombobox, JTrees.			
MODULE – 3			13 Hrs
The Collections Framework – Collections overview, The collection Interfaces, The collection classes, Accessing collection via an iterator, Storing user defined classes in collections. Java 2 Enterprise Edition Overview, Database Access- Overview of J2EE and J2SE. The Concept of JDBC, JDBC DriverTypes, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Associating the JDBC/ODBC Bridge with the Database, Statement Objects, Result Set, Transaction Processing.			
MODULE – 4			12 Hrs
Servlets and JSP - Background, Lifecycle of a servlet, Using Tomcat, A simple servlet, The ServletAPI, javax. servlet Package, Reading Servlet parameters, The javax.servlet.http Package, Handling HTTP Request and Responses, Using Cookies, Session tracking. Java Server Pages (JSP): JSP, JSP Tags, Request String, User Sessions, Cookies, Session Objects. RMI -. Java Remote Method Invocation: Remote Method Invocation concept; Server side, Client side. Java Beans –What is a Java Bean? Advantages of Java Beans, Bound and Constrained Properties, Persistence, Customizer, A Bean Example.			

Text Books:

1. Herbert Schildt: Java The Complete Reference Eighth Edition, Mc Graw Hill, 2013.
2. Jim Keogh: J2EE The Complete Reference, Tata McGraw Hill, 2007.

Reference Books:

1. Advanced Java Programming, Uttam.K.Roy , Oxford Press,2015.
2. Java Fundamentals Herbert Schildt Dale Skrien, Mc GrawHill 2013.
3. Y. Daniel Liang: Introduction to JAVA Programming, 6th Edition, Pearson Education,2007.
4. Stephanie Bodoff et al: The J2EE Tutorial, 2nd Edition, Pearson Education, 2004.
5. "Head First Servlets and JSP" by Shroff, 2nd Edition, O'Reilly Publications , 2008.

MOOCs:

1. <http://nptel.ac.in/courses/106106147>
2. http://www.nptelvideos.com/java/java_video_lectures_tutorials.php
3. https://www.youtube.com/watch?v=0KL_zftem4g
4. <https://www.coursera.org/specializations/object-oriented-programming>

Activity:

1. A traveler is travelling around the world. He wants to convert the Indian currency to the currency denomination of the other countries when he wants to purchase some items. Use enumerations concepts and help him to convert other countries currency to Indian currency.
2. Implement the stack operation which allows working on different data types.
3. A stopwatch is a handheld timepiece designed to measure the amount of time that elapses between its activation and deactivation. Great for races, games and other timed activities, this stopwatch is easy to use, making it perfect for both children and adults. Create a simple stop watch with start, pause and reset button using JLabel and JButton.
4. A substitution cipher is a method of encrypting by which units of plaintext are replaced with ciphertext, according to a fixed system; the "units" may be single letters, pairs of letters, triplets of letters, mixtures of the above, and so forth. The receiver deciphers the text by performing the inverse substitution. Implement a simple substitution cipher for encoding and decoding a message using swing controls.
5. Design an application for online food ordering that allows the customer to order the food based on the menu display to him, using different swing components.
6. Create a student database to hold student name, usn, marks in five course and display the result as fail if he/she scores less than 40 in any one course else print pass. Also calculate the total percentage of marks. Display the information using the JDBC concepts.
7. A bank offers home loan to its customer at different interest rates based on the location. Create an application for home loan processing using servlets and JDBC. The application has to provide functionality to calculate EMI, pay EMI and display the customer details along with his loan details
8. Do the following with only JSPs (and no servlets) and using JSP scripting elements
 - a. Create a method that take two int numbers and return their sum as int.
 - b. Invoke the method from within template text using JSP elements (example o/p - Sum of 3 and 4 is 7.)
 - c. Print above line using JSP elements.
9. Manage the user session on a browsing activity using session management and display its information.
10. Design a client server application using RMI.

Course Title	DATABASE MANAGEMENT SYSTEM		
Course Code	20CS506	L-T-P-C	(4-0-0)4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: Design a database and write SQL queries.			
Course Outcomes(COs): Upon completion of the course, students shall be able to			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply knowledge of database concepts in designing database	1	-
2	Analyze a problem, in identifying appropriate computing requirements to get a solution	3	-
3	Formulate SQL queries to perform database operations	3	-
4	Design a database for a given scenario using appropriate techniques	3	2
Course Contents:			
MODULE – 1			13 Hrs
Introduction: Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems. Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design; An sample Database Application; Entity Types, Entity Sets, Attributes and Keys.			
MODULE – 2			13 Hrs
Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two. Relational Model and Relational Algebra: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION. SQL: SQL Data Definition and Data Types; Specifying basic constraints in SQL; Basic Retrieval queries in SQL; Insert, Delete and Update statements in SQL; Additional features of SQL, More complex SQL Retrieval Queries; Views; Schema Change Statements in SQL.			
MODULE – 3			12 Hrs
Database Design-1: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form. Multi-valued Dependencies and Fourth Normal Form; Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover;			
MODULE – 4			12 Hrs
Database Design-2: Dependency preservation, Non-additive join property; Dependency-preserving and Non-additive join decomposition into 3NF schemes. Concurrency control techniques: Two- Phase Locking Techniques for Concurrency control; Concurrency Control Based on Timestamp Ordering. Database Security: Introduction to Database Security Issues; Discretionary Access Control Based on Granting and Revoking;			

Text Books:

1. Elmasri and Navathe, Fundamentals of Database Systems, Addison-Wesley, 7th Edition, 2015.
2. Raghuram Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3rd Edition, 2007.

Reference Books:

1. Silberschatz, Korth and Sudharshan, Database System Concepts, 5th Edition, Mc-Graw Hill, 2006.
2. C.J. Date, A. Kannan, S. Swamynathan, An Introduction to Database Systems, Pearson education, 8th Edition, 2006.

MOOCs:

1. <http://nptel.ac.in/courses/106106093>
2. <https://www.edx.org/course/database-systems-concepts-design-gtx-cs6400x>

Course Code	DATABASE APPLICATION LABORATORY		
Course Code	20CS507	L-T-P-C	(0-0-1)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28
Course Objective: Develop database application for real world scenarios.			
Course Outcomes(COs): Upon Completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Design and create relational schema	PO3,PO5	-
2	Implement queries using SQL	PO3,PO5	-
3	Design and develop database applications	PO3,PO5,PO6,PO8,PO9,PO10	PSO1
EXERCISE PROGRAMS			
1. Consider the following schema: EMPLOYEE (EmpNo, EmpName, Gender, Salary, Address, DNo, age) DEPARTMENT (DeptNo, DeptName, Location) Create Employee table with following constraints: Make EmpNo as Primary key, do not allow EmpName, Gender, Salary and Address to have null values, set the default salary value to Rs. 1000. Create Department table with following: Make DeptNo as Primary key, Make DeptName as candidate key, make DNo of Employee as foreign key which refers to DeptNo of Department Design a database to satisfy the above requirements and answer following queries: - List all the employees who are above 40 years of age - List the employees who work in a particular department - List the female employees who are 30 years of age and drawing salary >8000			
2. Consider the following schema: SUPPLIERS (Sid: integer, sname: string, address: string) PARTS (PID: integer, pname: string,color: string) CATALOG (Sid: integer, PID: integer, cost: real) Design a database to satisfy the above requirements and answer the following queries: - Find the names of parts for which there is some supplier. - Find the names of suppliers who supply every part. - Find the id's of suppliers who supply only red parts.			
3. Consider the following relations for an order processing database application in a company. CUSTOMER (cust #: int , cname: string, city: string) ORDER (order #: int, odate: date, cust #: int, ord-Amt: int) ORDER _ ITEM (order #: int, Item #:int, qty: int) ITEM (item # : int, unit price: int) SHIPMENT (order #: int, warehouse#: int, ship-date: date) WAREHOUSE (warehouse #: int,city: string). Create the above tables by properly specifying the primary keys and the foreign keys. Enter atleast five tuples for each relation.			

a. Produce a listing: CUST#, #of orders, AVG_ORDER_AMT, where the middle column is the total numbers of orders by the customer and the last column is the average order amount for that customer. b. Create a view for average price of each item as average_item_price and number of quantities of that item as number_of_items.
4. Consider the following database of student enrolment in courses & books adopted for each course. STUDENT (Regno: string, name: string, major: string, bdate: date) COURSE (Course #: int, Cname: string, dept: string) ENROLL (Regno: string, course#: int, SEM: int, marks: int) BOOK _ ADOPTION (Course#: int, SEM: int, book-ISBN: int) TEXT (Book-ISBN: int, book-title: string, publisher: string, author: string) Create the above tables by properly specifying the primary keys and the foreign keys. Enter atleast five tuples for each relation. a. Demonstrate how you add a new text book to the database and make this book beadopted by some department. b. Produce a list of text books (include Course #, Book-ISBN, Book-title) in thealphabetical order for courses offered by the 'CS' department. c. List any department that has all its adopted books published by a specific publisher.
5. Consider the Insurance database given below. The primary keys are underlined and the datatypes are specified. PERSON (<u>driver – id #</u>: String, name: string, address: string) CAR (<u>Regno#</u>: string, model:string, year: int) ACCIDENT (<u>report-number#</u>: int, <u>date_of_acc</u>: date, location: string) OWNS (<u>driver-id #</u>:string, Regno:string) PARTICIPATED (<u>driver-id</u>: string, Regno:string, <u>report-number</u>:int, damage amount:int). Create the above tables by properly specifying the primary keys and the foreign keys. Enter atleast five tuples for each relation. a. Demonstrate how you i. Update the damage amount for the car with report number 12. ii. Add a new accident to the database. b. Find the name of the person who is involved in maximum number of accidents in theyear 2007. c. Find the number of accidents in which cars belonging to a specific model were involved.
6. Consider the following relations for the details maintained by a book dealer. AUTHOR (Author-id: int, Name: string, City: string, Country: string) PUBLISHER (Publisher-id: int, Name: string, City: string, Country: string) CATALOG (<u>Book-id</u>: int, title: string, <u>author-id</u>: int, <u>Publisher-id</u>: int, <u>Category-id</u>: int, Year: int, Price:int) CATEGORY (<u>Category-id</u>: int, Description: string) ORDER-DETAILS (<u>Order-no</u> : int, <u>Book-id</u>: int, Quantity: int) a. Create the above tables by properly specifying the primary keys and the foreign keys. b. Enter at least five tuples for each relation. c. Give the details of the authors who have 2 or more books in the catalog and the price of the books is greater than the average price of the books in the catalog and the year of publication is after 2000. d. Find the author of the book which has maximum sales. e. Demonstrate how you increase the price of books published by a specific publisher by 10%.

7. Consider a Video-Parlor database. The database holds members details, details of videos, details of copies of videos for rent, and details of video rentals by members. Design a database satisfying the above requirements and solve following queries as outlined below using SQL. - List only videos in the Children category with a daily rental rate of less than £4.00 and sorted according to video title. - List the catalog No, title and category of the Video table, ordered by video title - List all videos with a certification of “PG” or “18” in the Video table.
8. Design a relational database for a real estate agency. It should store information about houses for sale, seller information, Buyer information, agents information (who can act on behalf of either the buyer or the seller), and the sale of houses. Answer the following queries in SQL. - What are the ids, addresses, asking_price, and selling_price of all houses that sold for less than the asking price? - What are names of all of (prospective) buyers who have not bought a house? Each name should appear only once. - Find the addresses and asking prices of all houses that have at least 3 bedrooms and two bathrooms that have not sold. Each address, asking price pair should appear only once.
Activity: Design database for applications.

Course Title	APTITUDE REASONING DEVELOPMENT		
Course Code	20ARD	L-T-P	(0-2-0)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	32
Course Objective: To enhance reasoning skills.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Apply Logical reasoning and deductions for given situations	1	-
Course Contents:			
Introduction and concepts of Logical reasoning, Illustrative examples, Logical analysis. Technical aptitude on C and C++. Language fundamental. Illustrative programs. MCQs on coding constructs, error detection, finding the output of code segments.			
Scheme of Evaluation:			
1.	CIE- 5 quizzes each for 10 marks.		
2.	SEE- One examination for 50 Marks at the end.		

Course Title	SYSTEM SOFTWARE AND COMPILER DESIGN		
Course Code	20CS601	L-T-P-C	(4-0-0)4
Exam Hrs.	3	Hours/Week	4
SEE	50 Marks	Total Hours	50
Course Objective: To learn the features of system software and different phases of a compiler.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Explain system software concepts and the features of various machine architectures.	1	-
2.	Demonstrate function and features of assembler used to generate the object program.	1, 2	-
3.	Apply the concepts of Loaders, Linkers and Macro Processors for a given problem.	1,2	-
4.	Apply Lexical and Syntactic analysis for a given grammar.	1, 2	
Course Contents:			
MODULE – 1			13 Hrs
Machine Architecture, Assembler 1: The Simplified Instructional Computer (SIC) Assemblers: Basic assembler functions, Machine dependent assembler features. Assembler 2: Machine Independent Assembler Features, Assembler Design Options.			
MODULE – 2			13 Hrs
Loaders and Linkers: Basic Loader Functions, Machine-Dependent Loader Features, Machine-Independent Loader Features, Loader Design Options. Macro Processor: Basic Macro Processor Functions, Machine-Independent Macro Processor Features.			
MODULE – 3			12 Hrs
Introduction: Language Processors, The structure of a Compiler, Applications of Compiler Technology, Programming Language Basics. Lexical Analysis: Role of Lexical Analyzer, Input buffering, Specifications of tokens, Recognition of Tokens.			
MODULE – 4			12 Hrs
Syntax Analysis: Introduction, Context –free Grammar and Structure of Language, Parser and its Types, Top- Down parser-Recursive descent parsing and Non-Recursive descent parsing, Predicting parsing table, Error recovering strategies.			
Text Books : 1. Leland Beck, D. Manjula - System Software – An Introduction to Systems Programming, Third Edition, Pearson Education 2013. 2. Alfred V Aho, Ravi Sethi, Jeffrey D Ullman, Compilers- Principles, Techniques and Tools, Addison-Wesley 2013.			
Reference Books: 1. K. Muneeswaran, Compiler Design , Oxford University Press,2013 2. Alfred V Aho, Ravi Sethi, Jeffrey D Ullman, Compilers- Principles, Techniques and Tools, Addison-Wesley 2013. 3. D. M. Dhamdhare, Systems Programming and Operating Systems, Tata McGraw Hill Company, Second Edition, 2009. 4. John J. Donovan, Systems Programming, Tata McGraw Hill Company, Second Edition, 2000. 5. John. R. Levine, Tony Mason and Doug Brown: Lex and Yacc, O'Reilly, SPD, 2012.			

6. S. V. Raghavan, Principles of Compiler Design, Tat McGraw Hill Education Publication, 2010.

MOOC:

1. <https://in.udacity.com/course/compilers-theory-and-practice--ud168>

Course Title	COMPUTER GRAPHICS AND VISUALIZATION		
Course Code	20CS602	L-T-P-C	(3-1-0)4
Exam Hrs.	3	Hours / Week	5
SEE	50 Marks	Total Hours	50
Course Objective: To learn the concepts of computer graphics to design a 2D and 3D scene using OpenGL. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
Course Contents:			
MODULE – 1			12 Hrs
Introduction: Applications of computer graphics; A graphics system; Images: Physical and synthetic; Imaging systems; The synthetic camera model; The programmer's interface; Graphics architectures; Programmable pipelines; Performance characteristics. Graphics Programming: The Sierpinski gasket; Programming two- dimensional applications. The OpenGL: The OpenGL API; Primitives and attributes; Color; Viewing; Control functions; The Gasket program; Polygons and recursion; The three-dimensional gasket. <i>Self Study:</i> Pen Plotter Model			
MODULE – 2			12 Hrs
Input and Interaction: Interaction; Input devices; Clients and servers; Display lists; Display lists and modeling; Programming event-driven input; Menus; Geometric Objects and Transformations – 1: Scalars, points, and vectors; Three-dimensional primitives; Coordinate systems and frames; Modeling a colored cube; Affine transformations; Rotation, translation and scaling. <i>Self Study:</i> Design of Interactive programs, Animating interactive programs.			
MODULE – 3			13 Hrs
Geometric Objects and Transformations (Continued): Transformations in homogeneous coordinates; Concatenation of transformations; OpenGL transformation matrices; Viewing: Classical and computer viewing; Viewing with a computer; Positioning of the camera; Simple projections; Projections in OpenGL; Hidden-surface removal; Interactive mesh displays; Parallel- projection matrices; Perspective-projection matrices; Projections and shadows. <i>Self Study:</i> Interactive mesh displays.			
MODULE – 4			13 Hrs
Lighting and Shading: Light and matter; Light sources; The Phong lighting model; Computation of vectors; Polygonal shading; Approximation of a sphere by recursive subdivisions; Light sources in OpenGL; Specification of materials in OpenGL; Shading of the sphere model; Global illumination. Implementation: Clipping; Line- segment clipping; Polygon clipping; Clipping of other primitives; Rasterization; Bresenham's algorithm; Polygon rasterization; Hidden-surface removal; Antialiasing; Display considerations. <i>Self Study:</i> Basic Implementation strategies, The major tasks.			
Text Book: 1. Edward Angel, “Interactive Computer Graphics A Top-Down Approach with OpenGL”, Addison-Wesley, 5th Edition, 2013. (Chapters 1, 2, 3, 4, 5, 6, 7)			

Reference Books:

1. F.S. Hill,Jr, “Computer Graphics Using OpenGL”, Pearson education,2nd Edition,2011.
2. James D Foley, Andries Van Dam, Steven K Feiner, John F Hughes, “Computer Graphics”, Addison-wesley.

MOOCs:

1. http://nptel.ac.in/keyword_search_result.php?word=computer+graphics?
2. <https://www.edx.org/course/computer-graphics-uc-san-diegox-cse167x-3>
3. <https://www.mooc-list.com/course/interactive-computer-graphics-coursera>

Activity:

1. To recursively subdivide a tetrahedron to form 3D Sierpinski gasket. The number of recursive steps is to be specified by the user
2. To draw a Rocket and allow the user to change the color.
3. To create a house like figure and rotate it about a given fixed point using OpenGL functions
4. To draw a color cube and spin it using OpenGL transformation matrices
5. To create a cylinder and a parallelepiped by extruding a circle and quadrilateral respectively. Allow the user to specify the circle and the quadrilateral
6. Using OpenGL functions draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the surfaces of the solid object used in the scene.
7. To fill any given polygon using scan-line area filling algorithm. (Use appropriate data structures.)
8. To display a set of values { f_{ij} } as a rectangular mesh.
9. To clip the line PQ against the window coordinates (0,0) and (10,10). P=(-8,2) and Q=(2,14) using Liang Barsky line clipping algorithm.
10. To clip the line segment A(-4,2) and B(-1,7) in a window defined by left bottom corner at (-3,1) and upper right corner at (2,6). Find the visible portion of the line segment using Cohen Sutherland line clipping algorithm.

Course Title	COMPUTER NETWORKS		
Course Code	20CS603	L-T-P-C	(4-0-0)4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: Students able to acquire knowledge of working mechanisms of different types of Networks, Address Mechanisms and Protocols.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Distinguish different types of networks and Connecting devices.	1, 12	-
2.	Recognize the importance of the Network Layer Services and Network addressing mechanisms.	2, 4	-
3.	Analyze the performance of Unicast and Multicast routing algorithms and their uses.	2	-
4.	Design the Transport Layer Protocols for different services	3	-
5.	Compare different QoS models and their applications	1	-
MODULE-1			13 Hrs
Wired and Wireless Networks: Telephone Networks, Cable Networks, Bluetooth, Wimax, Satellite Networks; Connecting Devices and Virtual LANs: Connecting devices and Virtual LANs; Network Layer: Network Layer Services, IPv4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, NAT			
MODULE-2			13 Hrs
Network Layer Protocols: Internetwork Protocol: Datagram format, Fragmentation, Options, Security of IPV4 Datagrams; ICMPv4: Messages, Mobile IP: Addressing, Agents, Three Phases, Inefficiency in Mobile IP; Unicast Routing: Introduction: General Idea, Least Cost Routing; Routing Algorithms: Distance Vector, Link-State Routing, Path-Vector Routing; Unicast Routing Protocols: Internet Structure, Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol Version 4 (BGP4).			
MODULE-3			12 Hrs
Multicast Routing: Introduction: Unicasting, Multicasting, Broadcasting; MULTICASTING BASICS: Multicast Addresses, Delivery at Data-Link Layer, Collecting Information about Groups, Multicast Forwarding, Two Approaches to Multicasting; INTRADOMAIN MULTICAST PROTOCOLS: Multicast Distance Vector (DVMRP), Multicast Link State (MOSPF) Protocol Independent Multicast (PIM); INTERDOMAIN MULTICAST PROTOCOLS: IGMP: Messages, Propagation of Membership Information, Encapsulation; Next Generation IP: IPV6 Addressing, The IPV6 Protocol; Transport Layer protocols: Introduction: Services, Port Numbers, User Datagram Protocol (UDP); User Datagram, UDP Services, UDP Applications; Transmission Control Protocol (TCP): TCP Services, TCP Features, Segment, A TCP Connection, Windows in TCP			
MODULE-4			12 Hrs
Transmission Control Protocol: Flow Control, Error Control, TCP Congestion Control; TCP Timer and Options; Stream Control Transmission Protocol (SCTP): Services, Features, Packet Format and Association; Quality of Services: Data Flow Characteristics; Flow Control to Improve QoS: Scheduling, Traffic Shaping or Policing, Resource Reservation, Admission Control; INTEGRATED SERVICES (INTSERV): Flow Specification, Admission, Service Classes, Resource Reservation Protocol (RSVP), Problems with Integrated Services; DIFFERENTIATED SERVICES (DFFSERV).			

Course Title	MOBILE APPLICATION DEVELOPMENT LABORATORY		
Course Code	20CS604	L-T-P-C	(0-0-1)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28
Course Objective: Design and develop apps for android devices.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop simple applications, using built-in widgets and components of android studio.	PO3 PO5, PO9, PO12	1
2.	Document the apps designed.	PO8, PO9, PO10	-
Course Contents:			
1. Develop an android application which accepts the SGPA of all the six semesters and displays your CGPA. 2. Develop an android application to login into a system which is redirected to the Home screen. The login should be successful on email: admin@example.com password: rtWi2p_10 If the email/password is invalid display a Toast with an error message 3. Assume you are accepting employee details: Name, Designation, Salary, Phone number. Develop app that displays an alert message if phone number entered is more than 10 digits. 4. Design an app that displays the names of all planets in our universe. Clicking on “Solar System” in first activity should display all the planet’s names in second activity and it should return the total number of planets to first activity. 5. Develop a QUIZ app that displays a question with four answers as options. Clicking an option should display whether the selected option is right or wrong. 6. Assume you need to accept order online for fast food items. Design an app such that it accepts the order for multiple items and displays the total amount to be paid on placing the order. 7. Design an app to display menu options on clicking a button “FILE”. The menu options are: New, Open, Save, Save as, And Print. Clicking on any option should display the relevant information. 8. Design an app to accept your name, roll number and branch programmatically. 9. Develop an android application to list all the engineering branches of MCE and displays a brief information of any department which the user clicks on in a separate page. 10. Consider a scenario where you need to send an email to multiple users. Design an app to implement the same. 11. Develop an android application to display a gallery view (Grid View) of at least 10 images. 12. Develop an android application to render the text data into Text View from the remoteserver. Show progress bar when the data is loading or Toast message if data fails to load.			

Course Title	SYSTEM SOFTWARE LABORATORY		
Course Code	20CS605	L-T-P-C	(0-0-1)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28
Course Objective: Implement shell script, Unix system Programs and make use of LEX and YACC to generate the grammar. Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop programs using Unix system calls and shell script.	PO1,PO2,PO3,PO12	
2.	Develop programs using LEX and YACC.	PO1,PO2,PO3,PO5	
3.	Document and present the executed programs.	PO8,PO9,PO10	
Course Contents:			
1.	a) Create an input text file in few lines which describes about your aim in life and develop a LEX program to count the number of characters, words, spaces & no. of lines in the input file. b) Create an input file which consists of a C program to find the area of a circle with comment lines and develop a LEX program to count the number of comment lines in the input file and also eliminate them and copy that program into separate file.		
2.	Develop a LEX program to recognize valid arithmetic expression and recognize the identifiers and operators present in the expression and print them separately.		
3.	a) Create a C program and for this file develop LEX program to recognize and count the number of identifiers in a given C program. b) Write a short note on Computer Science and Engineering and develop LEX program to find and replace the word Computer as CS.		
4.	a) Create a file which lists the latest open source application useful for Computer Science and Engineering and develop a LEX program to copy the content of this file with line numbers to another file. b) Check whether the dates are in valid format [DD/MM/YYYY] by developing LEX program.		
5.	Write and Execute YACC program to convert infix to postfix.		
6.	Develop YACC program to evaluate an arithmetic expression involving operators +, -, * and /.		
7.	a) Write and Execute YACC program to recognize the grammar ($a^n b$, $n \geq 10$). b) Write and Execute YACC Program to recognize the grammar ($a^n b^m c^k$, $m, n, k \geq 0$ and $m = n + k$).		
8.	Write a C/C++ program which demonstrates inter process communication between a reader process and a writer process. Use mkfifo, open, read, write and close APIs in your program.		
9.	Write a C/C++ program to illustrate the race condition.		
10.	Write a C/C++ POSIX compliant program to check the following limits: - No. of clock ticks - Max. no. of child processes - Max. path length - Max. no. of characters in a file name - Max. no. of open files/ process		
11.	Write a C/C++ program to implement the system function.		
12.	Write a C/C++ program to set up a real-time clock interval timer using the alarm API.		

13.	Write and Execute C program to do the following: 1. Using fork() create a child process. 2. The child process prints its own process-id and id of its parent and then exits. 3. The parent process waits for its child to finish (by executing the wait()) and prints its own process-id and the id of its child process and then exits.
-----	---

MINI PROJECT (Inter-Discipline)			
Course Code	20CS606	L-T-P-C	(0-0-2)2
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28
Course Objective : Identify, analyze and formulate problem statement for project work with systematic and comprehensive approach Course Outcomes (COs): Upon completion of course the students will be able to:			

- A team of TWO students must develop the mini project. However, during the final evaluation, each student must demonstrate the project individually. - The team may implement a mini project of their choice. - The team must submit a Brief Project Report (25 to 30 Pages) at the end which must include the following - Introduction - Requirements - Development Process and Models Adopted - Analysis and Design Models - Implementation - Testing - The project report will be evaluated for 25 marks, Demonstration for 50 marks and Viva Voce for 25 marks.

Rubrics for Evaluation of Mini Project (Inter-Discipline)					
Phase I (Project Proposal Submission and Evaluation Scheme):					
After finalizing the topic with the guidance of Supervisor, students should submit the project proposal along with Synopsis not exceeding 10 pages. Approval of synopsis is done for 15 marks by concerned project committee.					
Sl. No	Performance Indicators	Needs Improvement (0-1 mark)	Average (2-3 marks)	Good (4-5 marks)	Max marks
1	Literature Survey	Survey of literature is not recent or no literature survey	Survey of literature is not clear	Literature survey is sufficient.	5
2	Synopsis writing	Objective of the work is not identified.	Objective of the work is identified but no evidence of Inter disciplinary approach found.	Objective of the work is identified with evidence of Inter disciplinary approach found.	5
3	Presentation	Contents delivered not completely.	Contents not delivered clearly.	Contents delivered clearly with confidence.	5
Total					15

Phase II (Project Progress):					
Evaluation of project phase II is carried out by evaluation committee.					
Sl. No.	Performance Indicators	Needs Improvement (0-1 marks)	Average (2-3 marks)	Good (4-5 marks)	Max marks
1.	System design and development	System specification is not identified.	System specification is identified but not satisfactory.	System specification is identified correctly.	5
2.	Identification of appropriate tool for application	Application tools are not identified.	Application tools identified but not used.	Application tools identified and used.	5
3.	Oral presentation	Entire contents not delivered.	Contents not delivered clearly.	Contents delivered clearly with confidence.	5
Total					15
Phase III (Project Demonstration with Report):					
Evaluation of this phase is done by evaluation committee.					
Sl. No.	Performance Indicators	Needs Improvement (0-1 marks)	Average (2-3 marks)	Good (4-5 marks)	Total marks allocated
1.	Design and Implementation	Not done.	Incomplete.	Complete.	5
2.	Demonstration	Incomplete.	Complete but not satisfactory.	Complete and satisfactory	5
3.	Documentation	Organization and clarity of report and technical content is not clear and complete.	Organization and clarity of report and technical content is clear but not complete.	Organization and clarity of report and technical content is clear and complete.	5
4.	Oral presentation	Presentation with ppt is not clear.	Presentation with ppt is clear but not satisfactory.	Presentation with ppt is clear and satisfactory.	5
Total					20

Semester End Evaluation				
Evaluation committee consists of panel of examiners containing external as well as internal evaluators. This evaluation is carried out for 50 marks.				
Sl. No.	Performance Indicators		Marks allocated	Marks awarded
1.	Project execution	Project specification	5	
		Progress	5	
2.	Methodology /Result Analysis	System Design	5	
		System Implementation	5	
		System Testing	5	
3.	Project Report	Organization and Clarity	5	
		Technical content	5	
		Conclusion and Future work	5	
Final presentation			10	
Total Marks			50	
Rubrics for Semester End Exam				
Marks	Overall criteria			
48-50	Project is reaching professional standards.			
40-47	Project is excellent and may contain publishable material. Presentation is excellent.			
35-39	Project and presentation are very good. All design aims are met.			
30-34	Project and presentation are good. Most design aims are met.			
25-29	Minimum core of design aims has been met. Presentation is satisfactory.			
20-24	Design aims and implementation are met partially. Presentation is moderate.			
0-20	Most design aims are not met and implementation does not work. Presentation is not satisfactory.			

Course Title	MULTIMEDIA COMPUTING		
Course Code	20CS651	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To study the features of multimedia services and applications.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Differentiate the types of media and data streams.	1, 2	-
2.	Identify various video technologies, graphics and images.	2, 3	-
3.	Implement different types of Data compression techniques.	3, 4	-
4.	Compare the different data, file formats and storage media.	1, 2	-
5.	Design multimedia applications.	3, 4	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction, Media and Data Streams, Audio Technology: Multimedia Elements; Multimedia Applications; Multimedia Systems Architecture; Evolving Technologies for Multimedia Systems; Defining Objects for Multimedia Systems; Multimedia Data Interface Standards; The need for Data Compression; Multimedia Databases. Media: Perception Media, Representation Media, Presentation Media, Storage Media, Transmission Media, Information Exchange Media, Presentation Spaces & Values, and Presentation Dimensions; Key Properties of a Multimedia System: Discrete & Continuous Media, Independence Media, Computer Controlled Systems, Integration; Characterizing Data Streams: Asynchronous Transmission Mode, Synchronous Transmission Mode, Isochronous Transmission Mode; Characterizing Continuous Media Data Streams.			
MODULE – 2			10 Hrs
Data Compression: Storage Space; Coding Requirements; Source, Entropy, and Hybrid Coding; Basic Compression Techniques; JPEG: Image Preparation, Lossy Sequential DCT-based Mode, Expanded Lossy DCT- based Mode, Lossless Mode. H.261 (Px64) and H.263: Image Preparation, Coding Algorithms, Data Stream; MPEG: Video Encoding, Audio Coding, Data Stream.			
MODULE – 3			10 Hrs
Audio Technology: Sound: Frequency, Amplitude, Sound Perception and Psychoacoustics; Audio Representation on Computer. Graphics and Images, Video Technology, Computer-Based Animation Capturing Graphics and Images Computer Assisted Graphics and Image Processing; Reconstructing Images; Graphics and Image Output Options. Basics; Television Systems; Digitalization of Video Signals; Digital Television; Basic Concepts; Specification of Animations; Methods of Controlling Animation; Display of Animation.			
MODULE – 4			10 Hrs
Data and File Format Standards: Rich-Text Format; TIFF File Format; Resource Interchange File Format (RIFF);MIDI File Format; JPEG DIB File Format for Still and Motion Images; Multimedia Application Design: Multimedia Application Classes; Types of Multimedia Systems; Virtual Reality Design; Components ofMultimedia Systems; Organizing Multimedia Databases;			
Text Books :			
1. Ralf Steinmetz, Klara Narstedt, Multimedia Fundamentals: Vol 1-Media Coding and Content Processing, Pearson Education / PHI, 2012.			
2. Prabhat K. Andleigh, Kiran Thakrar, “Multimedia Systems Design”, PHI, 2013.			

Reference Books:

1. K.R Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic, Multimedia Communication Systems: Techniques, Standards and Networks, Pearson Education, 2012.
2. Nalin K Sharad, Multimedia information Networking, PHI, 2012.

MOOC:

1. <https://nptel.ac.in/courses/117/105/117105083/>

Activities:

Activities on signal, image and video processing techniques using MATLAB.

Course Title	PYTHON APPLICATIONS PROGRAMMING		
Course Code	20CS652	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Design and implement python application related to network programming, web services and databases.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe Regular expressions, networking, threads and web services	1	-
2.	Demonstrate the interactions among various components	1,2	1
3.	Analyze the various packages and modules of python language	1,2,3	1
4.	Design python applications for the given context	2, 3,4, 5	1,2
Course Contents:			
MODULE – 1			10 Hrs
Regular expressions: Introduction/Motivation, Special symbols and combination, Regexes and Python and Examples. Text Processing: Comma-Separated Values, Java Script Object Notation, Extensible Markup Language (EML).			
MODULE – 2			10 Hrs
Internet Programming: Introduction, What is client /server architecture? Sockets: Communication Endpoints, Network Programming in Python, the Socket Server Model, Transferring files. Multithreaded programming: Introduction/Motivation, threads and process, threads and pythons, the thread module, the threading module, comparing single and multithreaded execution.			
MODULE – 3			10 Hrs
GUI Programming: Tkinter, Introduction, Tkinter and Python programming, Tkinter examples, A Brief Tour of other GUIs, Related modules and Other GUIs. Web clients and server: Introduction, Python Web Clients tools, Web (HTTP Server), Related Modules.			
MODULE – 4			10 Hrs
Web Application Programming: Introduction, Helping Web Servers Process Client Data, Building CGI Application, Using Unicode with CGI. Web Frame Works: Django-Introduction Web Frameworks, Introduction to Django, Project and apps, your “Hello World Application” (A blog), creating a module to add data base service, A Python application shell.			
Text Book: 1. Core Python Application Programming, Wesley J Chun, 3 rd Edition, Pearson Publication, 2016.			
Reference Books: 1. Beginning Python: Using python 2.6 and Python 3.1, James Paynelives, Wiley Private limited, 2014 2. Learning Python, Fabrizio Romano, Packt publishing, 2 nd Edition, 2014.			
MOOC: 1. https://onlinecourses.nptel.ac.in/noc22_cs31			

Course Title	GRAPH THEORY AND COMBINATORICS		
Course Code	20CS653	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To design and perform abstract concepts of graph theory in modeling and solving non-trivial problems. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the concepts of graphs and counting principles.	1	-
2.	Apply the concepts of graphs and counting principles in solving real time applications.	1, 2	-
3.	Analyze various concepts of graph and counting techniques applied in solving real time applications.	1, 2	-
4.	Design solutions for real time problems adopting the concepts of graph and counting ideas.	1, 2, 3	-
Course Contents:			
MODULE – 1			10 Hrs
An Introduction to Graph theory: Definitions and examples, Sub graphs, Complements and Graph isomorphism, Vertex degree, Euler Trails and Circuits, Planar Graphs: Planar graphs, Hamilton paths and cycles.			
MODULE – 2			10 Hrs
An Introduction to Graph theory (conti.): Graph coloring, chromatic number, and chromatic polynomials. Optimization and Matching: Transport Networks: The Max-Flow Min-Cut Theorem, Matching Theory.			
MODULE – 3			10 Hrs
The Principles of Inclusion and Exclusion: The Principle of Inclusion and Exclusion, generalizations of the principle, derangements, Rook Polynomials, Arrangements with forbidden Positions. Generating function: Introductory examples, Definition and examples; Partitions of Integers.			
MODULE – 4			10 Hrs
Generating function (conti.): The exponential generating function, the Summation Operator. Recurrence relations: First-order and second order linear recurrence relations, with constant coefficients, The non- homogeneous recurrence relation, The Method of Generating Functions.			
Text Books : 1. Ralph P. Grimaldi: Discrete and Combinatorial Mathematics, 5th Edition, Pearson Education. 2004. Chapters 8, 9, 10, 11, 12. 2. Dr. D.S. Chandrashekar: Graph Theory and Combinatorics, 4th Edition, Prism, 2012 (Chapter 4)			
Reference Books: 1. Narsing Deo, Graph Theory with applications to Engineering and Computer Science, PHI Publications. 2. V Balakrishnan, Combinatorics, Schaum Series, Tata-McGraw Hill Publications			
MOOCs: 1. http://nptel.ac.in/courses/111106050/ 2. http://nptel.ac.in/courses/106108051/			
Activity: 1. Two cases of soft drinks, 24 bottles of one type and 24 of another are distributed among five surveyors who are conducting taste tests. In how many ways can the 48 bottles be distributed so that each surveyor gets (a) at least two bottles of each type? (b) At least two bottles of one particular type and at least three of the other? 2. How can Mary split up 12 hamburgers and 16 hot dogs among her sons Richard, Peter			

Christopher, and James in such a way that James gets at least one hamburger and three hot dogs, and each of his brothers gets at least two hamburgers but at most five hot dogs?

3. Sergeant bueti must distribute 40bullets (20 for rifkes and 20 for handguns) among four officers so that each officer gets at least two, but no more than seven, bullets of each type. In how many ways can he do this
4. Nineteen students in a nursery school play a game each day where they hold to hands to form a circle. For how many days can they do this with no students holding hands with the same playmate twice?
5. In each of the following “transport networks” two companies c1 and c2, produce a certain product that is used by two manufactures, m1 and m2. For the network shown in part(a) of Fig. 13.22, company c1 can produce 8 units and company c2 can produce 7 units; manufacturer m1 requires 7 units and manufacturerm2 needs 6 units. In the network shown in Fig 13.22 (b), each company can produce 7 units and each manufacturer needs 6 units. In which situation(s) can the producers meet the manufactures demands?
6. Fritz is in charge of assigning students to part-time jobs at the college where he works. He has 25 student applications, and there are 25 different part-time jobs available on the campus. Each applicant is qualified for at least four of the jobs, but each job can be performed by at most four of the applicants. Can Fritz assign all the students to jobs for which they are qualified? Explain. Characterize the type of graph in which an Euler trail (circuit) is also a Hamilton path (cycle).

Course Title	DATA MINING AND WAREHOUSING		
Course Code	20CS654	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To understand the concepts of data mining and to apply the same for a given application.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe the design of Data Warehousing.	1	-
2.	Compare and contrast different data mining tasks	1,2	-
3.	Analyze data related issues for successful data mining.	2	-
4.	Evaluate models/algorithms with respect to their accuracy.	1, 3,4	-
Course Contents:			
MODULE – 1			10 Hrs
Data Warehousing: Introduction, Operational Data Stores (ODS), Extraction Transformation Loading (ETL), Data Warehouses, Design issues, Guidelines for Data Warehouse Implementation, Data Warehouse metadata. Online Analytical Processing (OLAP): Introduction, Characteristics of OLAP systems, Multidimensional view and Data cube, Data cube implementations, Data cube operations, Implementation of OLAP.			
MODULE – 2			10 Hrs
Introduction to Data Mining: What is Data Mining? Motivating Challenges, The origins of data mining, Data Mining Tasks, Types of Data, Data Pre-processing, Measures of Similarity and Dissimilarity: Basics, Similarity and Dissimilarity between Simple Attributes, Dissimilarities between Data Objects, and Similarities between Data Objects.			
MODULE – 3			10 Hrs
Classification: Preliminaries; General approach to solving a classification problem; Decision tree induction; Rule-based classifier; Nearest-neighbor classifier, Association Analysis: Problem Definition; Frequent Item set generation; Rule Generation.			
MODULE – 4			10 Hrs
Association Analysis (cont...): FP-Growth algorithm, Evaluation of association patterns; Effect of skewed support distribution; Sequential patterns. Cluster Analysis: Overview, K-means, Agglomerative hierarchical clustering, DBSCAN.			
Text Books:			
1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar, Introduction to Data Mining, 1st Edition (Reprint) Pearson Education, 2014.			
2. G. K. Gupta: Introduction to Data Mining with Case Studies, 3rd Edition, PHI, New Delhi, 2009.			
Reference Books:			
1. Jiawei Han and Micheline Kamber, Data Mining – Concepts and Techniques, Morgan Kaufmann, 3rd Edition, 2012.			
2. K.P. Soman, Shyam Diwakar, V.Ajay, Insight into Data Mining – Theory and Practice, PHI, 2006			
MOOCs:			
1. http://nptel.ac.in/courses/110106064/			
2. http://nptel.ac.in/courses/106106093/			
3. https://www.edx.org/course/analytics-for-decision-making			

Course Title	PRINCIPLES OF PROGRAMMING LANGUAGES		
Course Code	20CS655	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To make the students analyze constructs of programming languages and apply in programming. Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Understand the preliminary concepts of principles of programming languages.	1	-
2.	Compare the concepts of data types, syntax and semantics, expressions of different programming languages.	1, 2	-
3.	Apply the concept of structured programming and procedures to develop programs.	1, 2, 3	1
4.	Apply the concept of OOP and exceptions handling in programming.	1, 2, 3	1
5.	Develop simple programs using functional and logical programming languages.	1, 2, 3	1
Course Contents:			
MODULE – 1			10 Hrs
Preliminary Concepts: Reasons for studying, concepts of programming languages, Programming domains, Language Evaluation Criteria, influences on Language design, Language categories, Programming Paradigms – Imperative, Object Oriented, functional Programming , Logic Programming. Programming Language Implementation – Compilation and Virtual Machines, programming environments. Syntax and Semantics: Expression notations, Abstract syntax trees, lexical syntax, context-free grammars, Grammars for expressions, Attribute grammars, de-notational semantics.			
MODULE – 2			10 Hrs
Data types: Introduction, primitive, character, user defined, arrays, record, union, pointers. Names, Variable, concept of binding, type checking, strong typing, type equivalence. Structured programming: The need for structured programming: static programs, dynamic computations, design principles for imperative languages, example, syntax-directed control flow: composition of statements, selection, looping constructs, design considerations: syntax, Handling special cases in loops.			
MODULE – 3			10 Hrs
Procedure Activations: Introduction to procedures, parameter passing methods, scope rules for names, nested scopes, activation records, Procedures as in C. Object-oriented programming and Concurrency: What is an object?, Inheritance, OOP in C++, Derived classes and information hiding. Concurrency: Subprogram level concurrency, semaphores, monitors, message passing.			
MODULE – 4			10 Hrs
Exception handling: Exceptions, exception Propagation, Exception handler in C++. Logic Programming Language: The basic elements of Prolog, applications of logic programming. Functional Programming with Lists: Scheme, A dialect of LISP, The structure of lists, List manipulation.			

Text Books :

1. Concepts of Programming Languages, Robert .W. Sebesta 11/e, Pearson Education,2014.(Chapters 1.1 to 1.5, 1.7, 1.8, 3.4.1 to 3.4.6, 3.5.2, 3.5.2.1, 5.2 to 5.4, 6.1 to 6.5, 6.12 to 6.14, 13.2 to 13.5, 14.1, 14.3,16.6, 16.8)
2. Programming Languages concepts & constructs, Ravi Sethi, Pearson, 2ndedition. (Chapters 2, 3.1 to 3.4,4.4, 4.5, 4.7, 5, 7.1, 7.3 to 7.5, 10.1 to 10.3)

Reference Books:

1. Programming Languages, 2nd Edition, A.B. Tucker, R.E. Noonan, TMH.
2. Programming Languages, K. C. Loudon, 2nd Edition, Thomson,2003.

MOOC:

1. <http://nptel.ac.in/courses/106102067/>

Course Title	INTRODUCTION TO CLOUD COMPUTING		
Course Code	20OEC61	L-T-P-C	(3-0-0)3
Exam.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will be able to find out cloud computing service models and applications.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge for the identification of architecture and infrastructure for Cloud Computing.	2, 4	-
2.	Assessment of the economics, financial, and technological implications for selecting cloud deployment model	2, 4	-
3.	Choose appropriate cloud model for a given application	3, 5	-
4.	Identify security management in cloud	6, 8	-
5.	Develop applications for cloud computing	5, 7	
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Cloud computing at a glance, historical developments, building cloud computing environments, computing platforms and technologies. Principles of parallel and Distributed computing: Eras of computing, parallel vs. Distributed computing, elements of parallel computing, elements of distributed computing, technologies for distributed computing.			
MODULE – 2			10 Hrs
Virtualization: Introduction, characteristics of virtualized environments, Taxonomy of virtualization techniques, virtualization and cloud computing, pros and cons of virtualization technology. Cloud Computing architecture: Introduction, Cloud reference model, types of clouds, economics of the cloud, open challenges.			
MODULE – 3			10 Hrs
Cloud platforms in industry: Amazon Web Services, Google AppEngine, Microsoft Azure. Advanced topics in cloud computing: Energy efficiency in clouds, Market based management of clouds, federated clouds/inter clouds, Third party cloud services.			
MODULE – 4			10 Hrs
Infrastructure security, IAM: Infrastructure security: network level, host level, application level, Identity and Access management: trust boundaries and IAM, why IAM? IAM challenges, IAM definitions, IAM architecture and practices, getting ready for cloud, IAM standards and protocols for cloud services, IAM practices in the cloud authorization management. Security management in the cloud: security management standards, security management in the cloud, availability management, Saas, Paas. Iaas availability management, access control, security vulnerability, patch and configuration management. Privacy: What is privacy? What is data life cycle? What are the key privacy concerns in cloud? Who is responsible for protecting privacy?			
Text Books:			
1. Mastering Cloud Computing, McGraw Hill publication, Rajkumar Buyya, Christian Vecchiola, S.ThamaraiSelvi			
2. Cloud security and privacy an enterprise perspective on risks and compliances,2013, Tin Mather, Subra kumarswamy, shahed Latif			

Reference Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescuc, first edition, MK publishers Nalin K Sharad, Multimedia information Networking, PHI, 2012.
2. Cloud Computing- A practical approach, McGraw Hill publication, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter

MOOCs:

1. <https://www.youtube.com/watch?v=Eg4AAGCE7X4>
2. <https://www.coursera.org/learn/cloud-computing>
3. <https://www.edx.org/course/introduction-cloud-computing-microsoft-cloud200x>

Activity:

Students are required to demonstrate the usage of various cloud deployment models.

Course Title	DATABASE FUNDAMENTALS		
Course Code	20OEC62	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Design a database and write SQL queries.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply knowledge of database concepts in designing database	1, 2	-
2.	Analyze a problem, in identifying appropriate computing requirements to get a solution.	1, 2	-
3.	Formulate SQL queries to perform database operations.	2	-
4.	Design a database for a given scenario using appropriate techniques.	1, 2	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Introduction; An example; Characteristics of Database approach; Actors on the screen; Workers behind the scene; Advantages of using DBMS approach; when not to use a DBMS. Data models, schemas and instances; Three-schema architecture and data independence; Database languages and interfaces; The database system environment; Centralized and client-server architectures; Classification of Database Management systems.			
MODULE – 2			10 Hrs
Entity-Relationship Model: Using High-Level Conceptual Data Models for Database Design; A sample Database Application; Entity Types, Entity Sets, Attributes and Keys. Relationship types, Relationship Sets, Roles and Structural Constraints; Weak Entity Types; ER Diagrams, Naming Conventions and Design Issues; Relationship types of degree higher than two.			
MODULE – 3			10 Hrs
Relational Model and Relational Algebra: Relational Model Concepts; Relational Model Constraints and Relational Database Schemas; Update Operations, Transactions and dealing with constraint violations; Unary Relational Operations: SELECT and PROJECT; Relational Algebra Operations from Set Theory; Binary Relational Operations: JOIN and DIVISION. SQL: SQL Data Definition and Data Types; Specifying basic constraints in SQL; Basic Retrieval queries in SQL; Insert, Delete and Update statements in SQL;			
MODULE – 4			10 Hrs
SQL: Additional features of SQL, More complex SQL Retrieval Queries; Views; Schema Change Statements in SQL. Database Design: Informal Design Guidelines for Relation Schemas; Functional Dependencies; Normal Forms Based on Primary Keys; General Definitions of Second and Third Normal Forms; Boyce-Codd Normal Form. Concurrency control techniques: Two-Phase Locking Techniques for Concurrency control; Concurrency Control Based on Timestamp Ordering.			
Text Books :			
1. Elmasri and Navathe, Fundamentals of Database Systems, Addison-Wesley, 7th Edition, 2015.			
2. Raghu Ramakrishnan and Johannes Gehrke, Database Management Systems, McGraw-Hill, 3rd Edition, 2007			

Reference Books:

1. Silberschatz, Korth and Sudharshan, Data base System Concepts, 5th Edition, Mc-GrawHill, 2006
2. C.J. Date, A. Kannan, S. Swamynatham, A Introduction to Database Systems, Pearson education, 8th Edition, 2006

MOOC:

1. <http://nptel.ac.in/courses/106106093>

VII Semester & VIII Semester
(FOURTH YEAR)
SYLLABUS

Scheme & Syllabus for IV Year

Semester VII							
Course Category	Course Code	Course Title	Hours			Credits	Contact Hours
			L	T	P		
PC-25	20CS701	Machine Learning	4	0	0	4	4
PROJ-2	20CS702	Mini Project	0	0	4	2	4
PC-26	20CS703	Network Security and CyberLaw	4	0	0	4	4
PC-27	20CS704	Cloud Computing	3	0	0	3	3
PC-28	20CS705	Machine Learning Laboratory	0	0	2	1	2
PC-29	20CS706	Networks Laboratory	0	0	2	1	2
PE-2	20CS75X	Elective - II	3	0	0	3	3
PE-3	20CS76Y	Elective - III	3	0	0	3	3
OE-3	20OECSXX	Open Elective - II	3	0	0	3	3
OE-4	20SW02	SWAYAM- II (Mandate Audit Course)	3	0	0	0	3
Total			23	0	8	24	31

Elective – II			Elective – III		
Sl. No.	Course Code	Course Title	Sl. No.	Course Code	Course Title
1	20CS751	Artificial Intelligence	1	20CS761	Internet of Things
2	20CS752	Advanced DBMS	2	20CS762	Advanced Computer Architecture
3	20CS753	Digital Image Processing	3	20CS763	Software Testing
4	20CS754	Big Data Analytics	4	20CS764	Software Architecture

Open Electives		
Sl. No.	Course Code	Course Title
1.	20OECS71	Introduction to Python Programming
2.	20OECS72	IoT and its Applications
3.	20OECS73	Big Data Analytics

4.	20OEC574	Web Technology
----	----------	----------------

VIII Semester							
Course Category	Course Code	Course Title	Hours			Total Credits	Contact Hours
			L	T	P		
SR	20CS801	Seminar on Advanced Topics	0	0	2	1	2
PROJ-3	20CS802	Project Work	0	0	40	9	40
IN	20CS803	Internship (Four Weeks)	0	0	25	2	25
PE-4	20CS88X	Elective –IV	3	0	0	3	3
Total			3	0	67	15	70

Elective -IV		
Sl. No.	Course Code	Course Title
1.	20CS881	C# Programming and .NET
2.	20CS882	Advanced Algorithms
3.	20CS883	Operations Research
4.	20CS884	Principles of Compiler Design
5.	20CS885	Storage Area Networks
6.	20CS886	Mobile Communications

Course Title	MACHINE LEARNING		
Course Code	20CS701	L-T-P-C	(4-0-0) 4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: To apply the techniques of machine learning for real time projects. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop a good understanding of fundamental principles of machine learning	1,2,3	-
2.	Formulation of a Machine Learning problem	1,2,4	-
3.	Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering	2,3,4	-
4.	Evaluate the performance of various machine learning algorithms on various data sets of a domain.	4,5	1
MODULE - 1			13 Hrs
Introduction: What Is Machine Learning? Examples of Machine Learning Applications, Learning Associations, Classification, Regression, Unsupervised Learning. Learning Problems and Concept Learning: Well Posed learning problems, Designing a Learning systems, Concept Learning Tasks, Search, Find-S, Version Spaces and Candidate Elimination Algorithm. Self Study: Reinforcement Learning.			
MODULE – 2			13 Hrs
Dimensionality Reduction: Introduction, Subset Selection, Principal Component Analysis, Singular Value Decomposition and Matrix Factorization. Supervised Learning: Decision Tree learning, Representation, Algorithm, Issues in decision tree learning. Self Study: Linear Discriminant Analysis.			
MODULE - 3			12 Hrs
Supervised Learning: Support Vector Machine, K-Nearest Neighbor Learning, Locally Weighted Regression, Radial Basis Functions. Artificial Neural Networks: Neural Network Representation, Problems for Neural Network learning, Perceptron's, Multilayer Networks and Back Propagation Algorithms. Self Study : Adaline Madaline.			
MODULE – 4			12 Hrs
Unsupervised Learning: Introduction, Hierarchical Clustering, k-Means Clustering. Bayesian learning: Introduction, Bayes theorem, Bayes theorem and concept learning, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. Self Learning: Problems on Hierarchical Clustering.			
Text Books: 1. Tom M. Mitchell, Machine Learning, McGraw-Hill Education (INDIAN EDITION), 2013. 2. Ethem Alpaydin, Introduction to Machine Learning, 2nd Ed., PHI Learning Pvt. Ltd., 2013 Reference Books: 1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson, 2019 2. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer; 1st edition, 2001 3. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006 4. Yegnanaravana B. Artificial Neural Netwroks PHI Learning Pvt., Ltd.			

Course Title	MINI PROJECT		
Course Code	20CS702	L-T-P-C	(0-0-2)2
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks		
Course Objective: Identify, analyze and formulate problem statement for project work with systematic and comprehensive approach. Course Outcomes (COs) : Upon completion of course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Identify a real-world problem and provide feasible solution as a team.	1,2,3,9,10	-
2.	Conduct experimental analysis of data to ensure conformance to technical specifications and user requirements as a team.	1,3,5,4,9	1,2
3.	Present the project work as a team.	9,10	-
4.	Document the project in phases of software development cycle.	8,9,10,11,12	-
Course Contents: - A team of TWO students must develop the mini project. However, during the evaluation, each student must demonstrate the project individually. - The team may implement a mini project of their choice. However, the project topic selected should broadly be in the area of Engineering. - The team must submit a Brief Project Report (25 to 30 Pages) at the end which must include the following: - Introduction - Requirements - Software Development Process Model Adopted - Analysis and Design Models - Implementation - Testing			

Evaluation Pattern:

Sl. No	Evaluation Phase	Marks
1	Phase -1	15
2	Phase -2	15
3	Phase -3	20
Total		50

Detailed Rubrics for Phase I, Phase II and Phase III

Project Phase I Evaluation Rubrics (15 Marks)

	Parameter	Good	Average	Poor	Score (15)
A	Identification of Problem statement	Detailed explanation and purpose of the project	Average explanation and purpose of the project	Minimal explanation of the purpose of the project	
	(3)	(3)	(2)	(1)	
B	Literature Review	Demonstrate superior use of research by referring 10 or more papers indexed in IEEE/springer/ACM/Scopus SCI indexed journals.	Demonstrate superior use of research by referring 5 or more papers indexed in IEEE/springer/ACM/Scopus SCI indexed journals.	Demonstrate the use of research by referring less than 5 papers with or without proper indexing.	
	(4)	(4)	(2-3)	(1)	
C	Objectives and Scope of the Proposed Work	All objectives of the proposed work are well defined; Scope to implement considering the societal issues are also well defined	Incomplete justification to the objectives and scope proposed	Objectives of the proposed work are either not identified or not defined	
	(4)	(4)	(2-3)	(1)	
D	Synopsis Report and Presentation	Presentation of the Synopsis according to the specified format	Presentation of the Synopsis with corrections suggested by evaluation panel.	Presentation of the synopsis with resubmission	
	(4)	(4)	(2-3)	(1)	

Project Phase II Evaluation Rubrics

	Parameter	Good	Average	Poor	Score(15)
A	Incorporation of suggestions from Phase 1	Changes are made to problem statement as per modification suggested during phase 1 and new innovations are added.	Few changes are made to problem statement as per the Modifications suggested during evaluation.	Suggestions given during phase I evaluation are not incorporated.	
	(2)	(2)	(1)	(0)	
B	Design	Design of system according to appropriate architectural model adhering to the SRS.	Partially incorporated the design but clearly able to demonstrate the design.	Does not match with the SRS. Incorrect design of modules.	
	(5)	(4-5)	(3)	(1-2)	
C	Modern Tool	Implementation is efficient using latest tools and technology	Partial implementation but not modularized the code.	Not started implementing the code.	
	(2)	(2)	(1)	(0)	
D	Work Progress	50% of the Objectives achieved	25% of the Objectives achieved as per time frame	Less than 25% objectives achieved as per timeframe	
	(3)	(3)	(02)	(01)	
E	Presentation	Contents of Presentations are aptly arranged, Proper eye contact with audience and clear voice with good spoken Language.	Presentations are not satisfactory and average demonstration.	Contents of presentations are not appropriate and poor delivery of presentation.	
	(3)	(3)	(2)	(1)	

Project Phase III Evaluation Rubrics

	Parameter	Good	Average	Poor	Score(20)
A	Presentation on Complete Implementation	Contents of Presentations are appropriate and well arranged, Proper eye contact with audience and clear voice with good spoken Language.	Presentations are not satisfactory and average demonstration.	Contents of presentations are not appropriate and poor delivery of presentation.	
	(5)	(5)	(3- 4)	(2-1)	
B	Demonstration of project output/ Implementation	Demonstrates all the defined objectives as per schedule.	Demonstrates few of the defined objectives.	Demonstrates very few defined objectives.	
	(5)	(5)	(3-4)	(2-1)	
C	Testing	Project developed is tested thoroughly for all test cases.	Project developed is tested for few test cases.	Project developed is not tested thoroughly for all test cases.	
	(2)	(2)	(1)	(0)	
D	Project Report	Project report is according to the specified format.	Project report is according to the specified format but has some mistakes.	Project report is not prepared according to the specified format.	
	(5)	(4-5)	(3)	(2-1)	
E	Paper Presented	Presented in international Conference journals with top indexing / project proposals	Presented in journals, conferences in UGC/SCOPUS	Paper Presented	
	(3)	(3)	(2)	(1)	

Semester End Examination

Evaluation committee consists of panel of examiners containing external as well as internal evaluators. This evaluation is carried out for 50 marks.

Sl. No	Performance Indicators		Marks Allotted
1.	Project Execution	Project Specification	5
		Progress	5
2.	Methodology/ Result Analysis	System Design	5
		System Implementation	5
		System Testing	5
3.	Project Report and Presentation	Organization and Clarity	5
		Technical Content	5
		Conclusion and Future work	5
4.	Final Presentation		10
Total Marks			50

Rubrics for Semester End Exam	
Marks	Overall criteria
48-50	Project is reaching professional standards.
40-47	Project is excellent and may contain publishable material. Presentation is excellent.
35-39	Project and presentation are very good. All design aims are met.
30-34	Project and presentation are good. Most design aims are met.
25-29	Minimum core of design aims has been met. Presentation is satisfactory.
20-24	Design aims and implementation are met partially. Presentation is moderate.
0-20	Most design aims are not met and implementation does not work. Presentation is not satisfactory.

Course Title	NETWORK SECURITY AND CYBER LAW		
Course Code	20CS703	L-T-P-C	(4-0-0) 4
Exam Hrs.	3	Hours / Week	4
SEE	50 Marks	Total Hours	50
Course Objective: Students will be able to apply cryptography techniques on malicious networks and cyber law, IPR, IT Act. Course Outcomes (COs): Upon the completion of the course the students will be able to:			
Course Contents:			
MODULE – 1			13 Hrs
Introduction: Security goals, Cryptographic attacks, Services and Mechanisms, Techniques for security goals implementation, Mathematics of cryptography: Integer Arithmetic, The Extended Euclidean Algorithm; Traditional Symmetric-Key Ciphers: Symmetric-Key Ciphers, Categories of traditional ciphers, stream and block ciphers. Self Study Component (Not included in SEE): Modular Arithmetic, Matrices and Linear Congruence.			
MODULE – 2			13 Hrs
Introduction to Modern Symmetric-Key Ciphers: Modern block ciphers, Components of modern block ciphers, Two classes of Product Ciphers, Attacks designed for block ciphers.; Data Encryption Standard: History and Data Encryption Standard, DES Structure, DES Analysis, Security of DES, Multiple DES-Conventional Encryption Algorithm, The CAST Block Cipher, Blowfish, IDEA Self Study Component (Not included in SEE):: Mathematics of Symmetric-Key cryptography: Field and GF (2n) Fields.			
MODULE – 3			12 Hrs
Advanced Encryption Algorithm: History and Advanced Encryption Algorithm, Transformation used by AES; Asymmetric Key cryptography: Difference between symmetric cryptography and asymmetric Key cryptography Cryptosystem, RSA cryptosystem, Rabin Cryptosystem ; Security at the Application Layer: E-mail System, Pretty Good Privacy(PGP), Security at the Transport Layer: Security Services at Transport layer, SSL Architecture. Self Study Component (Not included in SEE): Mathematics of Asymmetric-Key cryptography: Primes, Primality testing, Factorization, Chinese Remainder Theorem.			
MODULE – 4			12 Hrs
Security and Cyber Law: INTRODUCTION: Cyberspace , Cyber security, Cyber security Policy, Cyber Crime, Nature of Threat , Enabling People, Mission and Vision of Cyber security Program, OBJECTIVES : Emerging Trends of Cyber Law, Create Awareness, Areas of Development, International Network on Cyber security; Intellectual Property Rights: Types of Intellectual Property Rights, Advantages of Intellectual Property Rights, Intellectual Property Rights in India, Intellectual Property in Cyber Space;			

The information Technology Act - IT act aim and objectives, Scope of the act, Major Concepts, Important provisions, Attribution, acknowledgement, and dispatch of electronic records, Secure electronic records and secure digital signatures, Regulation of certifying authorities: Digital Signature certificates, Duties of Subscribers, Penalties and adjudication.
Text Books: 1. Behrouz A Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security” Third edition published by McGraw Hill Education-2017. 2. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition
Reference Books: 1. Hans Delfs, Helmut Knebl, “Introduction to Cryptography: Principles and Applications”, Springer 2. Neal Koblitz, “Number theory and cryptography”, Springer, 2007. 3. William Stallings: Cryptography and Network Security, Fifth Edition, Pearson Education-2013
MOOCs: 1. http://nptel.ac.in/courses/106105031/ 2. https://www.edx.org/learn/cybersecurit 3. https://www.tutorialspoint.com/information_security_cyber_law/index.htm

Course Title	CLOUD COMPUTING		
Course Code	20CS704	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will be able to find out cloud computing service models and applications.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Unveil history and leverage elements of cloud computing	1,2	-
2.	Recognize the different virtualization techniques, architecture and types of clouds	3,4	-
3.	Determine the cloud platforms and get exposed to new challenges for various organizations	4,7	-
4.	Integrate new standards for access management, security and privacy at different levels of cloud services	6,8	-
5.	Develop and deploy an application for cloud platform	2,3,5	1
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Cloud computing at a glance, historical developments, building cloud computing environments, computing platforms and technologies. Principles of parallel and Distributed computing: Eras of computing, parallel vs. Distributed computing, elements of parallel computing, elements of distributed computing, technologies for distributed computing.			
MODULE – 2			10 Hrs
Virtualization: Introduction, characteristics of virtualized environments, Taxonomy of virtualization techniques, virtualization and cloud computing, pros and cons of virtualization technology. Cloud Computing architecture: Introduction, Cloud reference model, types of clouds, economics of thecloud, open challenges.			
MODULE – 3			10 Hrs
Cloud platforms in industry: Amazon Web Services, Google AppEngine, Microsoft Azure. Advanced topics in cloud computing: Energy efficiency in clouds, Market based management of clouds,Federated clouds/Inter clouds, Third party cloud services.			
MODULE – 4			10 Hrs
Infrastructure security, IAM: Infrastructure security: network level, host level, application level, Identity and Access management: trust boundaries and IAM, why IAM? IAM challenges, IAM definitions, IAM architecture and practices, getting ready for cloud, IAM standards and protocols for cloud services, IAM practices in the cloud, cloud authorization management; Security management in the cloud: security management standards, security management in the cloud, availability management, Saas, Paas. Iaas availability management, access control, security vulnerability, patch and configuration management. Privacy: What is privacy?, what is data life cycle?, what are the key privacy concerns in cloud?, who is responsible for protecting privacy?			
Text Books:			
1. Mastering Cloud Computing, McGraw Hill publication, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi			
2. Cloud security and privacy an enterprise perspective on risks and compliances,2013, Tin Mather, Subra Kumarswamy, Shahed Latif			

Reference Books:

1. Cloud Computing: Theory and Practice, Dan C Marinescue, first edition, MK publishers.
2. Cloud Computing- A practical approach, McGraw Hill publication, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter.

MOOCs:

1. <https://www.youtube.com/watch?v=Eg4AAGCE7X4>
2. <https://www.coursera.org/learn/cloud-computing>
3. <https://www.edx.org/course/introduction-cloud-computing-microsoft-cloud200x>

Course Title	MACHINE LEARNING LABORATORY		
Course Code	20CS705	L-T-P-C	(0-0-1)1
Exam Hrs.	3	Hours/Week	2
SEE	50 Marks	Total Hours	28
Course Objective: Provide fundamental elements of Machine Learning algorithms and its applications.			
Course Outcomes(COs): Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design and implement Machine Learning concepts and algorithms	2,3,4,5	1
2.	Implement and document Machine Learning programs	10	-
Course Contents:			
Practice Programs			
1. Write a program to compute distance between two points taking input from the user. (Pythagorean Theorem) 2. Write a program that takes two numbers as command line arguments and prints its sum. 3. Write a Program for checking whether the given number is an even number or not. 4. Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4,..., 1/10. 5. Write a program to count the numbers of characters in the string and store them in a dictionary data structure. 6. Write a program to count frequency of characters in a given file. Use character frequency to tell whether the given file is a Python program file, C program file or a text file? 7. Find mean, median and mode for the given set of numbers in a list. 8. Write function to compute GCD, LCM of two numbers. 9. Write a program that defines a matrix and prints the same.			
Exercise Programs			
1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file. 2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples. 3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. 4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets. 5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a . CSV file. Compute the accuracy of the classifier, considering few test data sets. 6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in API can be used to write the program. Calculate the accuracy, precision, and recall for your data set. 7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart/ lung patients using standard disease Data Set. 8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. 9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions 10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.			

Activity:

1. Write a program to demonstrate the working of PCA.
2. Write a program to demonstrate the working of the SVD.
3. Write a program to demonstrate the working of the LDA.
4. Write a program to demonstrate the working of the SVM. Use an appropriate data set for building the SVM and apply this knowledge to classify a new sample.
5. Write a program to demonstrate the working of the Hierarchical Clustering. Use an appropriate data set for building the Hierarchical Clustering and apply this knowledge to cluster a new sample.

Course Title	NETWORKS LABORATORY		
Course Code	20CS706	L-T-P-C	(0-0-1)1
Exam Hrs.	3	Hours / Week	2
SEE	50 Marks	Total Hours	28
Course Objective: Students will be able to develop and analyze the various network topologies and protocols using a Network simulator. Course Outcomes (COs) : Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design and implement various networking algorithms, socket programming, protocols and local area network using network simulator.	1,2,3,5	1
2.	Documentation of implemented networking concepts.	10	-
Course Contents:			
Practice Programs			
1. Write and execute a program for error detecting code using CRC-CCITT (16- bits). 2. Write and execute a C/C++ program for hamming code. 3. Simulate a three nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets dropped. 4. Simulate a three nodes point – to – point network with duplex links between them. Set the queue size and vary the bandwidth and find the number of packets sent with different types of traffic.			
Exercise Programs			
1. Write and execute a program for distance vector algorithm to find the suitable path for transmission between sender and receiver. 2. Write and execute a program to find 16-bit and 32-bit checksum Fletcher and Adler checksum methods. 3. Using TCP/IP sockets, write a client – server program to make the client send the file name and to make the server send back the contents of the requested file if present. 4. Suppose Alice wants her friends to encrypt email messages before sending them to her. Write a program to help her friends to encrypt and decrypt the data. (RSA algorithm). 5. Implement three nodes point – to – point network with duplex links between them. Set the queue size, vary the bandwidth and find the number of packets dropped. 6. Simulate a four node point-to-point network with the links connected as follows: n0 – n2, n1 – n2 and n2 – n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/ UDP. 7. Simulate the transmission of ping messages over a network topology consisting of 6 nodes. 8. Simulate an Ethernet LAN using n nodes, change error rate and data rate and compare throughput. 9. Simulate an Ethernet LAN using n nodes and set multiple traffic nodes and plot congestion window for different source / destination. 10. Simulate simple ESS and with transmitting nodes in wire-less LAN by simulation and determine the performance with respect to transmission of packets.			

Course Title	ARTIFICIAL INTELLIGENCE		
Course Code	20CS751	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will be able to apply the concepts of Artificial Intelligence to construct knowledge-based.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Describe different types of Artificial Intelligence agents, search strategies.	1	-
2.	Analyze different search strategies for a given problem.	2	-
3.	Design simple knowledge-based systems using first-order logic.	2	-
4.	Analyze different learning techniques.	3	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction: What is AI? Intelligent Agents: Agents and environment; Good behavior: The Concept of Rationality; The nature of environment; The structure of agents. Problem-solving: Problem-solving agents. Example problems; Searching for solution; Uninformed search strategies: Breadth-first search, Uniform-cost search.			
MODULE – 2			10 Hrs
Uninformed search strategies: Depth-first search, Depth-limited search, Iterative deepening depth first search, Bidirectional search, Comparing uninformed search strategies; Informed (Heuristic) Search Strategies: Greedy best-first search, A* search, Optimality of A*, Memory-bounded heuristic search; Heuristic functions; Local Search Algorithms and Optimization Problems: Hill-climbing search, Simulated annealing, Local beam search, Genetic algorithms.			
MODULE – 3			10 Hrs
On-line search agents and unknown Environments: Online search problems, Online search agents, online local search, learning in online search, Logical Agents: Knowledge-based agents; The Wumpus world; First-Order Logic: Representation revisited; Syntax and semantics of first-order logic; Using first-order logic, Knowledge engineering in first-order logic.			
MODULE – 4			10 Hrs
Learning from Examples: Forms of Learning; supervised learning; Learning decision trees; Practical Machine Learning. Statistical and Reinforcement learning: Statistical learning, maximum likelihood parameter learning, Bayesian parameter, learning, passive reinforcement learning, active reinforcement learning.			
Text Book:			
1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Third edition, Pearson, 2014.			
Reference Books:			
1. Artificial Intelligence, Elaine Rich, Kevin Knight and Shivashankar B Nair, Third edition, McGraw-Hill Education, 2015.			
2. Introduction to Artificial Intelligence and Expert Systems, Dan W Patterson, Pearson, 2015.			

MOOCs:

1. <https://www.coursera.org/courses?query=artificial%20intelligence>
2. https://onlinecourses.nptel.ac.in/noc21_cs42/preview

Course Title	ADVANCED DATABASE MANAGEMENT SYSTEM		
Course Code	20CS752	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To build database management systems using advanced techniques.			
Course Outcomes (COs) : Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the role of database management system	1,2	-
2.	Recognize the different types of file structure and storage architecture	1,2	-
3.	Analyze and use emerging technologies to build the database	2,5	-
4.	Design, develop and implement mid-scale relational Databases, Object-Relational Databases and distributed databases for an application domain	2,5	-
Course Contents:			
MODULE – 1			10 Hrs
Review of Relational Data Model and Relational Database Constraints: Relational model concepts; Relational model constraints and relational database schemas; Update operations, anomalies, dealing with constraint violations, Types and violations. Object and Object-Relational Databases: Overview of Object Database Concepts, Object Database Extensions to SQL, The ODMG Object Model and the Object Definition Language ODL, Object Database Conceptual Design, The Object Query Language OQL, Overview of the C++ Language Binding in the ODMG Standard.			
MODULE – 2			10 Hrs
Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures: Introduction, Secondary Storage Devices, Buffering of Blocks, Placing File Records on Disk Operations on Files, Files of Unordered Records (Heap Files) , Files of Ordered Records (Sorted Files), Hashing Techniques, Other Primary File Organizations, Parallelizing Disk Access Using RAID Technology, Modern Storage Architectures. Distributed Database Concepts: Distributed Database Concepts, Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design, Overview of Concurrency Control and Recovery in Distributed Databases, Overview of Transaction Management in Distributed Databases, Query Processing and Optimization in Distributed Databases, Types of Distributed Database Systems, Distributed Database Architectures, Distributed Catalog Management.			
MODULE – 3			10 Hrs
NOSQL Databases and Big Data Storage Systems: Introduction to NOSQL Systems, The CAP Theorem, Document- Based NOSQL Systems and MongoDB, NOSQL Key-Value Stores, Column-Based or Wide Column NOSQL Systems, NOSQL Graph Databases and Neo4j. Big Data Technologies Based on MapReduce and Hadoop: What is Big Data? Introduction to MapReduce and Hadoop, Hadoop Distributed File System (HDFS), MapReduce: Additional Details Hadoop v2 alias YARN, General Discussion.			
MODULE – 4			10 Hrs
Data Mining Concepts: Overview of Data Mining Technology, Association Rules, Classification, Clustering, approaches to Other Data Mining Problems, Applications of Data Mining, Commercial Data Mining Tools.			

Overview of Data Warehousing and OLAP: Introduction, Definitions, and Terminology, Characteristics of Data Warehouses, Data Modeling for Data Warehouses, Building a Data Warehouse, Typical Functionality of a Data Warehouse, Data Warehouse versus Views, Difficulties of Implementing Data Warehouses.
Text Books: 1. Fundamentals of Database systems, Elmasri and Navathe, Pearson Education, 7th Edition. 2. Database Management Systems, Raghu Ramakrishnan and Johannes Gehrke ,McGraw –Hill, 3rd Edition , 2013.
Reference Book: 1. Database System concepts , Abraham Silberschatz , Henry F. Korth, S. Sudarshan McGraw –Hill, 3rd Edition , 2013

Course Title	DIGITAL IMAGE PROCESSING		
Course Code	20CS753	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective : To study the image fundamentals and mathematical transforms necessary for image processing along with image enhancement, restoration, compression and segmentation techniques Course Outcomes (COs) : Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explain the basic principles of Digital image processing	1,2	-
2.	Elucidate mathematical modeling of filtering and image restoration	2,3,5	-
3.	Apply concepts of Digital image processing using coloring model	2,3,4,5	-
4.	Analyze image processing algorithms	2,9,10,11	1
5.	Develop image processing application for real time problems	5,9,11	2
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Basic concepts, Examples of fields that use Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentals: Elements of visual perception. Image sensing and acquisition: Image sampling and quantization: Basic concepts in sampling and quantization, Representing digital images, Spatial and Intensity resolutions, some basic relationships between pixels: An Introduction to the Mathematical tools used in digital image processing.			
MODULE – 2			10 Hrs
Intensity Transformations and Spatial Filtering: Background: The basics of intensity transformations and spatial filtering, Some basic intensity transformation functions, Histogram Processing. Fundamentals of spatial filtering: The mechanics of spatial filtering, Spatial correlation and convolution. Image Restoration: A model of the image restoration/degradation process. Noise Models: Spatial and Frequency properties of Noise.			
MODULE – 3			10 Hrs
Image Restoration: Some important noise probability density functions, Periodic noise, Estimation of noise parameters, Restoration in the presence of Noise only- Spatial Filtering, Mean Filters. Color Image Processing: Color fundamentals, Color models: The RGB color model. Image Compression Fundamentals: Coding redundancy, Spatial and Temporal redundancy, Irrelevant information, Measuring image information, Fidelity Criteria.			
MODULE – 4			10 Hrs
Image Compression: Some basic compression methods: Arithmetic coding, LZW coding, Bit Plane coding, Digital image watermarking. Image Segmentation : Fundamentals, Point, Line, and Edge Detection, Background, Detection of Isolated Points, Line Detection, Edge Models, Basic Edge Detection: The Image Gradient and its Properties, Gradient Operators, Combining the Gradient with			

Thresholding, Thresholding: Foundation, The Basics of Intensity Thresholding, The Role of Noise in Image Thresholding, The Role of Illumination and Reflectance in Image Thresholding.

Text Book:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, 4th Edition, Pearson publications, 2018

Reference Books:

1. A.K. Jain, “Fundamentals of Digital Image Processing”, Pearson 2nd Edition, 2018.
2. B. Chanda, Dutta Majumder, “Digital Image Processing and Analysis”, Prentice-Hall of India Pvt.Ltd., 2nd Edition, 2011.
3. “Introduction to Digital Image Processing with Matlab”, Rafael C. Gonzales, Richard E. Woods, Steven L. Eddins, McGraw Higher Ed, 2nd Edition, 2010.

MOOC:

1. <http://nptel.ac.in/courses/106105032>

Course Title	BIG DATA ANALYTICS		
Course Code	20CS754	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Describe big data features on Hadoop platform.			
Course Outcomes (COs) : Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply basic Concepts of Big data Analytics	1,3	1
2.	Identify open-source technologies for big data	3	1
3.	Illustrate the processing of big data	3,5	-
4.	Describe the building blocks of Hadoop	1,2	1
5.	Use big data tools and techniques	4,5	1
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization. Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.			
MODULE – 2			10 Hrs
Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines. Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.			
MODULE – 3			10 Hrs
Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels. Map-Reduce and the New Software Stack 1: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.			
MODULE – 4			10 Hrs
Map-Reduce and the New Software Stack 2, Communication Cost Models: Algorithms Using Map- Reduce for Matrix multiplication, Relational Algebra operations, Workflow Systems. Recursive Extensions to Map-Reduce, Communication Cost Models: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate. Mining Data Streams, Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream , Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.			

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.
2. Michael Minelli, Michehe Chambers, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Business”, 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC

1. <https://nptel.ac.in/courses/106/104/106104189>

Course Title	INTERNET OF THINGS		
Course Code	20CS761	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Explore the interconnection and integration of the physical world and design IOT applications. Course Outcomes (COs) : Upon the completion of the course the students will be able to			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze the impact and challenges posed by IoT networks and compare IoT architectures	1,2	-
2.	Identify smart objects, connectivity and IoT Access Technologies	1,2	-
3.	Appraise the role of IoT protocols for efficient network communication	2,3	-
4.	Adopt Raspberry Pi interface to develop IoT modules	2,3	2
5.	Employ security structures for IoT systems	1,3	-
Course Contents:			
MODULE - 1			10 Hrs
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and OT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack.			
MODULE – 2			10 Hrs
Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: Communications Criteria, IoT Access Technologies – IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e			
MODULE – 3			10 Hrs
IoT Access Technologies – IEEE 1901.2a, IEEE 802.11ah, LoRaWAN IP as the IoT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances. Application Protocols for IoT: The Transport Layer			
MODULE – 4			10 Hrs
Application Protocols for IoT: IoT Application Transport Methods. IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, Exploring the RaspberryPi Board; Operating System setup on RaspberryPi, RaspberryPi commands, Programming RaspberryPi with Python. Securing IoT: A Brief History of OT Security, Common Challenges in OT Security, Formal Risk Analysis Structures: OCTAVE and FAIR			
Text Books:			
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743) 2. Srinivasa K G, Siddesh G M Hanumantha Raju R “Internet of Things”, CENGAGE Learning India, 2017.			

Reference Books:

1. Internet of Things - A Hands on Approach, Arshdeep Bahga and Vijay Madisetti Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.

MOOCs:

1. <https://www.edx.org/course/introduction-to-the-internet-of-things-iot>
2. http://nptel.ac.in/noc/individual_course.php?id=noc17-cs22

Course Code	ADVANCED COMPUTER ARCHITECTURE		
Course Code	20CS762	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50	Total Hours	40
Course Objective: To analyze the design techniques of parallelism in computer architecture.			
Course Outcomes (COs) : At the end of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Illustrate the organization of computer systems and Parallelism in it.	1,2	-
2.	Exploit and analyze instruction-level parallelism	1,2,3	-
3.	Explicate the memory architecture in multiprocessor systems and its performance issues	1,2	-
4.	Portray the need for multi-core architectures	1	-
Course Contents:			
MODULE – 1			10 Hrs
Fundamentals of Computer Design: Introduction; Classes of computers; Define Computer Architecture; Trends in Technology, power in Integrated Circuits and cost; Dependability; Quantitative Principles of computer design. Pipelining: Introduction; Pipeline hazards- structural hazard, data hazard; A simple implementation of MIPS; Basic pipeline for MIPS; What makes pipelining hard to implement?			
MODULE – 2			10 Hrs
Instruction –Level Parallelism: ILP: Concepts and challenges; Basic Compiler Techniques for exposing ILP; Overcoming Data hazards with Dynamic scheduling; Hardware-based speculation; Exploiting ILP using multiple issues and static scheduling; Exploiting ILP using dynamic scheduling; multiple issue and speculation; Advanced Techniques for instruction delivery and Speculation.			
MODULE – 3			10 Hrs
Multiprocessors and Thread –Level Parallelism: Introduction; Symmetric shared-memory architectures; Performance of symmetric shared-memory multiprocessors; Distributed shared memory and directory-based coherence. Review of Memory Hierarchy: Introduction; Cache performance; Six basic Cache Optimizations.			
MODULE – 4			10 Hrs
Introduction to Multicore Architecture: Motivation, Parallel Computing Platforms, Understanding Performance. System Overview of Threading: Defining threads, System View of threads, what happens when a thread is created? Threading on Intel Multi-core Processors: Hardware based Threading, Hyper-threading Technology, Multi-CORE Processors, Multiple Processor Interaction.			
Text Books:			
1. John L. Hennessey and David A. Patterson: Computer Architecture, A Quantitative Approach, 5th Edition, Elsevier, 2013.			
2. Shameen Akhter and Jason Roberts, Multi -CORE Programming Increasing Performance through software Multi-Threading, Intel Press, 2006.			

Reference Books:

1. Kai Hwang: Advanced Computer Architecture Parallelism, Scalability, Programmability, Tata Mc Grawhill, 2003.
2. David E. Culler, Jaswinder Pal Singh, Anoop Gupta: Parallel Computer Architecture, A Hardware /Software Approach, Morgan Kaufman, 1999.

MOOCs:

1. <http://www.nptelvideos.in/2012/11/computer-architecture.html>
2. https://onlinecourses.nptel.ac.in/noc21_cs47
3. <https://nptel.ac.in/courses/106/103/106103206/>

Course Title	SOFTWARE TESTING		
Course Code	20CS763	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Apply the concepts in software testing including software testing objective, process, criteria, strategies and methods. Course Outcomes (COs) : Upon the completion of the course the students will be able to :			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore fundamentals of testing software products	1,9	-
2.	Analyze software testing strategies	2,3	1
3.	Deploy suitable test generation techniques	3,11	-
4.	Illustrate various coverage criteria	1,3	-
5.	Design criteria for final certification of the software product	1,11	-
Course Contents:			
MODULE – 1			10 Hrs
Basics of Software Testing - 1: Human Errors and Testing; Software Quality; Requirements, Behavior and Correctness; Correctness versus Reliability; Testing and Debugging; Test Metrics. Basics of Software Testing – 2: Software and Hardware Testing; Testing and Verification; Defect Management; Execution History; Test-generation Strategies, Static Testing. Model-Based Testing and Model Checking; Control-Flow Graph; Types of Testing; The Saturation Effect.			
MODULE – 2			10 Hrs
Test Generation from Requirements – 1: Introduction; The Test-Selection Problem; Equivalence Partitioning; Boundary Value Analysis; Category-Partition Method. Test Generation from Requirements –2: Cause-Effect Graphing, Test Generation from Predicates.			
MODULE – 3			10 Hrs
Structural Testing: Overview; Statement testing; Branch testing; Condition testing, Path testing; Procedure call testing; Comparing structural testing criteria; The infeasibility problem. Dependence, Data Flow Models, and Data Flow Testing: Definition-Use pairs; Data flow analysis; Classic analyses; From execution to conservative flow analysis; Data flow analysis with arrays and pointers; Inter-procedural analysis; Overview of data flow testing; Definition-Use associations; Dataflow testing criteria; Data flow coverage with complex structures; The infeasibility problem.			
MODULE – 4			10 Hrs
Test Case Selection and Adequacy, Test Execution: Overview; Test specification and cases; Adequacy criteria; Comparing criteria; Overview of test execution; From test case specification to test cases; Scaffolding; Generic versus specific scaffolding; Test oracles; Self-checks as oracles; Capture and replay. Process: Test and analysis activities within a software process: The quality process; Planning and monitoring; Quality goals; Dependability properties; Analysis; Testing; Improving the process; Organizational factors. Integration and component-based software testing: Overview; Integration testing strategies; Testing components and assemblies. System, Acceptance and Regression Testing:			

Overview; System testing; Acceptance testing; Usability; Regression testing; Regression test selection techniques; Test case prioritization and selective execution.

Text Books:

1. Aditya P Mathur: Foundations of Software Testing, 2nd Edition, Pearson Education, 2014 (Chapters 1 excluding 1.15, 1.16, 1.17, 2, 6).
2. Mauro Pezze, Michal Young: Software Testing and Analysis – Process, Principles and Techniques, John Wiley & Sons, 2008 (Chapters 4, 6, 9, 12, 13, 17, 21, 22).

Reference Books:

1. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, 2nd Edition, Pearson, 2007.
2. Ron Patton: Software Testing, 2nd edition, Pearson, 2004.

MOOC:

1. <http://nptel.ac.in/courses/106105150>

Course Title	SOFTWARE ARCHITECTURE		
Course Code	20CS764	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Provide students with the principles and concepts of applying various design patterns in designing a wide variety of software system. Course Outcomes (COs) : Upon the completion of the course the students will be able to :			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the significance of software architecture.	1,2	-
2.	Apply quality attributes to create an architecture for the given application.	2,3	-
3.	Analyze the architectural pattern and build the system from components.	2,3	-
4.	Create documentation relevant to the chosen architecture.	1,10	-
Course Contents:			
MODULE – 1			10 Hrs
What Is Software Architecture? : What Software Architecture Is and What It Isn't; Architectural Structures and Views; Architectural Patterns; What Makes a "Good" Architecture? Why Is Software Architecture Important? Inhibiting or Enabling a System's Quality Attributes; Reasoning About and Managing Change ; Predicting System Qualities; Enhancing Communication among Stakeholders; Carrying Early Design Decisions ; Defining Constraints on an Implementation; Influencing the Organizational Structure ; Enabling Evolutionary Prototyping Improving Cost and Schedule Estimates ; Supplying a Transferable, Reusable Model; Allowing Incorporation of Independently Developed Components; Restricting the Vocabulary of Design Alternatives; Providing a Basis for Training; The Many Contexts of Software Architecture: Architecture in a Technical Context, Architecture in a Project Life-Cycle Context, Architecture in a Business Context, Architecture in a Professional Context, Stakeholders, How Is Architecture Influenced?, What Do Architectures Influence?, Quality Attributes Understanding Quality Attributes; Architecture and Requirements ; Functionality; Quality Attribute ; Considerations ; Specifying Quality Attribute; Requirements ; Achieving Quality Attributes through Tactics, Guiding Quality Design Decisions.			
MODULE – 2			10 Hrs
Availability: Availability General Scenario; Tactics for Availability; Modifiability: Modifiability General Scenario; Tactics for Modifiability Performance: Performance General Scenario; Tactics for Performance; Security: Security General Scenario; Tactics for Security ; Architectural Patterns – 1: Introduction; from mud to structure: Layers, Pipes and Filters.			
MODULE – 3			10 Hrs
Architectural Patterns – 2: Distributed Systems: Broker; Interactive Systems. Architectural Patterns – 3: Presentation-Abstraction-Control; Adaptable Systems: Microkernel;			

MODULE – 4	10 Hrs
Some Design Patterns: Structural decomposition: Whole – Part; Organization of work: Master – Slave; Access Control: Proxy. Designing and Documenting Software Architectures: Design Strategy; The Attribute-Driven Design Method; The Steps of ADD; Uses and Audiences for Architecture; Documentation; Notations for Architecture; Documentation; Views; Choosing the Views; Combining Views; Building the Documentation Package; Documenting Behavior; Architecture Documentation and Quality Attributes; Documenting Architectures That Change Faster Than You Can Document Them.	
Text Books: 1. Len Bass, Paul Clements, Rick Kazman: Software Architecture in Practice, 3rd Edition, Addison-Wesley, 2013. 2. Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, Michael Stal: Pattern-Oriented Software Architecture, A System of Patterns, Volume 1, John Wiley and Sons, 2009.	
Reference Books: 1. Mary Shaw and David Garlan: Software Architecture- Perspectives on an Emerging Discipline, PHI, 2008. 2. E. Gamma, R. Helm, R. Johnson, J. Vlissides: Design Patterns- Elements of Reusable Object-Oriented Software, Addison-Wesley, 1995.	
MOOCs: 1. http://www.hillside.net/patterns 2. http://www.nptel.ac.in/syllabus/106104027 3. https://www.mooc-list.com/course/software-architecture-coursera	

Course Title	INTRODUCTION TO PYTHON PROGRAMMING		
Course Code	20OECs71	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Acquire the basics of Python programming, design and implement programs using Python language.			
Course Outcomes (COs) : Upon Completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Comprehend the basics of python programming.	1	-
2.	Identify appropriate programming constructs to solve the given problem.	2	1
3.	Apply python knowledge in real time applications.	3,5	1
4.	Explore file structures and its applications	1	-
Course Contents:			
MODULE – 1			10 Hrs
Hello, Python: Installing Python, Simple program using Python, Expressions and Values, Variables and Computer Memory, error detection, Multiple line statements, Designing and using functions: functions provided by Python, Tracing function calls in memory model, Omitting return statement. Working with Text: Creating Strings of Characters, Using Special Characters in Strings, Creating a Multiline String, Printing Information, Getting Information from the Keyboard.			
MODULE – 2			10 Hrs
Making Choices: A Boolean Type, Choosing Statements to Execute, Nested If Statements , Remembering the Results of a Boolean Expression Evaluation , A Modular Approach to Program Organization: Importing Modules, Defining Your Own Modules, Testing Code Semi automatically Grouping Functions Using Methods: Modules, Classes, and Methods , Calling Methods the Object Oriented Way, Exploring String Methods, Underscores.			
MODULE – 3			10 Hrs
Storing Collections of Data Using Lists: Storing and Accessing Data in Lists, modifying Lists, Operations on Lists, Slicing Lists, Aliasing, List Methods, Working with a List of Lists. Repeating Code Using Loops: Processing Items in a List, Processing Characters in Strings, Looping Over a Range of Numbers, Processing Lists Using Indices, Nesting Loops in Loops, Looping Until a Condition Is Reached, Repetition Based on User Input, Controlling Loops Using Break and Continue.			
MODULE – 4			10 Hrs
Reading and Writing Files: Kinds of files, opening a File, Techniques for Reading Files, Files over the Internet, Writing Files, and Writing Algorithms That Use the File-Reading Techniques, Multiline Records. Storing Data Using Other Collection Types: Storing Data Using Sets, Storing Data Using Tuples, Storing Data Using Dictionaries, inverting a Dictionary, Using the In Operator on Tuples, Sets, and Dictionaries, Comparing Collections.			

Text Books:

1. Practical Programming: An introduction to Computer Science Using Python, second edition, Paul Gries, Jennifer Campbell, Jason Montojo, The Pragmatic Bookshelf.
2. Learning with Python: How to Think Like a Computer Scientist Paperback – Allen Downey, Jeffrey Elkner, 2012

Reference Books:

1. Introduction to Python for Computational Science and Engineering (A beginner's guide), Hans Fangohr.
2. Exploring Python, Timothy A. Budd, McGraw Hill Education.
3. Python for Informatics: Exploring Information, Charles Severance.
4. Learning Python, Fourth Edition, Mark Lutz, O'Reilly publication.

MOOCs:

1. <https://nptel.ac.in/courses/106106212>
2. <https://nptel.ac.in/courses/106106145>

Course Title	IOT AND ITS APPLICATIONS		
Course Code	20OEC572	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Explore the interconnection and integration of the physical world and design IOT applications. Course Outcomes (COs) : Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Analyze the impact and challenges posed by IoT networks and compare IoT architectures	1,2	-
2.	Identify smart objects, connectivity and IoT Access Technologies	1,2	-
3.	Appraise the role of IoT protocols for efficient network communication and Security in IoT network	2,3	-
4.	Adopt Raspberry Pi interface to develop IoT modules	2,3	2
5.	Employ security structures for IoT systems	1,3	-
Course Contents:			
MODULE – 1			10 Hrs
What is IoT, Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, IoT Data Management and Compute Stack.			
MODULE – 2			10 Hrs
Smart Objects: The “Things” in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: Communications Criteria, IoT Access Technologies.			
MODULE – 3			10 Hrs
IP as the IoT Network Layer: The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances. Application Protocols for IoT: The Transport Layer, IoT Application Transport Methods.			
MODULE – 4			10 Hrs
IoT Physical Devices and Endpoints - RaspberryPi: Introduction to RaspberryPi, Exploring the RaspberryPi Board; Operating System setup on RaspberryPi, RaspberryPi commands, Programming RaspberryPi with Python. Securing IoT: A Brief History of OT Security, Common Challenges in OT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.			
Text Books:			
1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743). 2. Srinivasa K G, Siddesh G M Hanumantha Raju R “Internet of Things”, CENGAGE Learning India, 2017.			

Reference Books:

1. Internet of Things - A Hands on Approach, Arshdeep Bahga and Vijay Madisetti Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, 2nd Edition, Wiley ISBN: 978-1-119-99435-0, 370 pages, January 2012.

MOOCs:

1. <https://www.edx.org/course/introduction-to-the-internet-of-things-iot>
2. http://nptel.ac.in/noc/individual_course.php?id=noc17-cs22

Course Title	BIG DATA ANALYTICS		
Course Code	20OEC573	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Describe big data features on Hadoop platform.			
Course Outcomes (COs) : Upon the completion of the course the students will be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply basic Concepts of Big data Analytics	1,3	1
2.	Identify open-source technologies for big data	3	1
3.	Illustrate the processing of big data	3,5	-
4.	Describe the building blocks of Hadoop	1,2	1
5.	Use big data tools and techniques	4,5	1
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Velocity, Variety, Veracity; Drivers for Big Data, Sophisticated Consumers, Automation, Monetization. Big Data Analytics Applications: Social Media Command Center, Product Knowledge Hub, Infrastructure and Operations Studies, Product Selection, Design and Engineering, Location-Based Services, Online Advertising, Risk Management.			
MODULE – 2			10 Hrs
Architecture Components: Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting; Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines. Advanced Analytics Platform: Real-Time Architecture for Conversations, Orchestration and Synthesis Using Analytics Engines, Entity Resolution, Model Management, Discovery Using Data at Rest, Integration Strategies.			
MODULE – 3			10 Hrs
Implementation of Big Data Analytics: Revolutionary, Evolutionary, or Hybrid, Big Data Governance, Integrating Big Data with MDM, Evolving Maturity Levels. Map-Reduce and the New Software Stack 1: Distributed File Systems. Physical Organization of Compute Nodes, Large-Scale File-System Organization, Map-Reduce features: Map Tasks, Grouping by Key, Reduce Tasks, Combiners, Map-Reduce Execution, Coping With Node Failures.			
MODULE – 4			10 Hrs
Map-Reduce and the New Software Stack 2, Communication Cost Models: Algorithms Using Map-Reduce for Matrix multiplication, Relational Algebra operations, Workflow Systems. Recursive Extensions to Map-Reduce, Communication Cost Models: Complexity Theory for Map-Reduce, Reducer Size and Replication Rate, Graph Model and Mapping Schemas, Lower Bounds on Replication Rate. Mining Data Streams, Stream Data Model and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows.			

Text Books:

1. Big Data Analytics: Disruptive Technologies for Changing the Game, Dr. Arvind Sathi, First Edition October 2012, IBM Corporation.
2. Mining of Massive Datasets, Anand Rajarama, Jure Leskovec, Jeffrey D. Ullman. E-book, 2013.

Reference Books:

1. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.
2. Michael Minelli, Michehe Chambers, “Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today’s Business”, 1st Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, 1st Edition, Wiley and SAS Business Series, 2012
4. Big Data Imperatives, Soumendra Mohanty, Madhu Jagadeesh, Harsha Srivatsa, Apress, e-book of 2012.

MOOC:

1. <https://nptel.ac.in/courses/106/104/106104189>

Course Title	WEB TECHNOLOGY		
Course Code	20OECS74	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Create web pages with client side and server-side scripting.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Apply the knowledge of HTML and CSS in designing webpage	1	2
2.	Develop dynamic web pages using JavaScript	3	2
3.	Develop client-side script to design webpage	3	2
4.	Design server-side script using PHP and MySQL	3,5	2
Course Contents:			
MODULE – 1			10 Hrs
Introduction to HTML , What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.			
MODULE – 2			10 Hrs
HTML Tables and Forms , Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks.			
MODULE – 3			10 Hrs
JavaScript and HTML Documents: The JavaScript execution environment; Element access in JavaScript; Events and event handling; Handling events from the Body elements, Button elements, Text box and Password elements; The navigator object. Dynamic Documents with JavaScript: Introduction to dynamic documents; Element positioning; Moving elements; Element visibility; Changing colors and fonts; Dynamic content; Stacking elements; Locating the mouse cursor.			
MODULE – 4			10 Hrs
XML: Introduction; Syntax; Document structure; Namespaces, XML schemas, Displaying raw XML documents; Displaying XML documents with CSS; XSLT style sheets. PHP: Origins and uses of PHP; Overview of PHP; General syntactic characteristics; Primitives, operations and expressions; Output; Control statements; Arrays; Functions; Pattern matching; Form handling; Files; Cookies; Session tracking; Database Access using PHP and MySQL.			

Text Books:

1. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", 1st Edition, Pearson Education India, 2016.
2. Robert W. Sebesta: Programming the World Wide Web, 8th Edition, Pearson Education, 2014.

Reference Books:

1. Deitel H.M. and Deitel P.J., "Internet and World Wide Web How to program", Pearson International, 2012, 4th Edition.
2. Randy Connolly, Ricardo Hoar, "Fundamentals of Web Development", Pearson, 2015.
3. SRD Group: Internet Technology and Web Design, Tata McGraw Hill Publishing Ltd, 2011.

MOOCs:

1. <https://www.mooc-list.com/course/programming-and-web-beginners-coursera>
2. <http://nptel.ac.in/courses/117105080/3>
3. <https://www.coursera.org/specializations/web-design>
4. <http://www.w3c.org>

Course Title	SEMINAR ON ADVANCED TOPICS		
Course Code	20CS801	L-T-P-C	(0-0-1)1
Exam Hrs.	3	Hours / Week	2
CIE	100 Marks	Total Hours	28
Course Objective: To read, understand and present a technical paper.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Organize a detailed literature survey and build a document with respect to technical publications	9,10	-
2.	Effective presentation and improve soft skills	10,12	-
Evaluation parameters:			
Sl. No.	Guidelines	Marks	
1.	Quality of the selected paper and synopsis	10	
2.	Presentation Slides	20	
3.	Oral presentation	30	
4.	Report	25	
5.	Viva-Voce	15	
	Total	100	
Rubrics:			
Criteria	Satisfactory	Good	Excellent
Quality of the selected paper/ Literature Review (10)	Mentions only the work done. (0-3)	Describes previous and related work. (4-5)	Concise description of recent trends. (6-10)
Presentation Slides (20)	Some problems in sequencing. (Lacks clear transitions ; incomplete or emphasis given to less important information) (0-5)	Most information presented in logical sequence. (Clear introduction; adequate background). (6-12)	Presented in logical Sequence. (Introduction, background, context; key points and conclusions are clear and well developed). (13-25)
Oral Presentation (Communication Skills) (30)	Difficult to hear; occasional eye contact; some mumbling, little or no expression;	Most of audience can hear presentation; eye contact most of the time; clear	Entire audience can hear presentation; maintains eye contact with audience; clear, Expressive voice;
Report (15)	According to the specified format but some mistakes. In-sufficient references and citations. All key concepts are not explained (0-10).	According to the specified format; references and citations are appropriate but not mentioned. (11-20)	According to the specified format; references and citations are appropriate and well mentioned; complete explanation of the key concepts (21-30).
Viva-Voce(15)	Does not answer. (0)	Competently defends by providing very helpful answers. (1-10)	Masterfully defends by providing clear and insightful answers to questions (11-15).

Course Title		PROJECT WORK		
Course Code	20CS802		L-T-P-C	(0-0-9)9
Exam Hours	3		Hours / Week	18
SEE	50 Marks		Total Hours	40
Course Objective: Develop technical skills, communication skills, managerial skills and team work.				
Course Outcomes (COs) : Upon completion of the course, students shall be able to:				
COs	Statement		Mapping to PO's	Mapping to PSO's
1.	Identify one's need for further knowledge and continuously develop one's own competencies.		1,12	1,2
2.	Illustrate data analysis within given constraints and independently analyze the problem statements.		1,2,4,9	2
3.	Demonstrate the complexity of problems within the technical area and implement relevant work.		1,3,4,5	1,2
4.	Document and present the work.		1,6,7,10	-
Phase – 1 (Synopsis Evaluation)				
During phase 1, the students will survey different research and journal papers to prepare the synopsis for their project proposal. This will be evaluated for 15 marks by the project committee.				
Planning:				
Performance Indicators	Level 0	Level 1	Level 2	Level 3
Planning	No evidence of planning.	Little planning or fore thought.	Moderate planning	Professional level of planning and time management.
Marks Allocated	0	1-2	3-4	5
Total Marks				5
Survey :				
Indicator	Level 0	Level 1	Level 2	Level 3
Literature Survey	No evidence of Survey	Insufficient survey	Moderate survey	Survey done sufficiently
Marks allocated	0	1-2	3-4	5
Total Marks				5
Synopsis Writing and Presentation:				
Indicator	Level 0	Level 1	Level 2	
Synopsis Writing	Synopsis idea not clear	Synopsis with problem statement to be refined.	Complete Synopsis and presentation.	
Marks allocated	0	1-3	4-5	
Total Marks				5

Phase – 2 (Mid-Term Evaluation)					
Mid-term progress evaluation for 15 marks.					
Progress :					
Progress Indicator	System requirement specification	Initial system development	System analysis specification & user interface specification	Employ appropriate analytical tools and/or software engineering techniques.	Oral presentation
Marks allocated	0-2	0-3	0-5	0-2	0-3
Total Marks					15
Phase – 3(Final Evaluation)					
The students will prepare a prototype of the proposed work. The team must submit a brief report (25 to 30 Pages) at the end of the semester. Final Evaluation for 20 marks will be done by the committee headed by the project coordinator in consultation with HOD.					
Project demonstration :					
Progress Indicator	Design and Implementation	Demonstration	Report writing	Oral presentation	
Marks allocated	0-5	0-5	0-5	0-5	
Total Marks				20	

Course Title		INTERNSHIP		
Course Code	20CS803	L-T-P-C		(0-0-2)2
Exam Hrs.	3	Hours / Week		4
CIE	100 Marks	Total Hours		16
Course Objective: To expose to a particular job and a profession or industry.				
Course Outcomes (COs): Upon completion of the course, students shall be able to:				
#	Course Outcomes		Mapping to POs	Mapping to PSOs
1.	Explore career alternatives prior to graduation.		12	-
2.	Integrate theory and practice.		5	1
3.	Develop work habits and attitudes necessary for job success		9,10,12	-
4.	Prepare and present the project work		9,10,11	-
Rubrics:				
Criteria	Excellent	Good	Average	Poor
Ability to apply domain knowledge (20M)	Apply domain knowledge for design and development of all issues (20M)	Apply domain knowledge for design and development of most issues (15M)	Apply domain knowledge for design and development of specific issues (10M)	Unable to apply complete domain knowledge for design and development issues (5M)
Ability to develop /implement the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/implement all the solutions with appropriate techniques, resources and contemporary tools (20M)	Able to develop/implement most of the solutions with appropriate techniques, resources and contemporary tools (15M)	Able to develop/implement specific solutions with appropriate techniques, resources and contemporary tools (10M)	Not confident to develop/implement solutions with appropriate techniques, resources and contemporary tools (5M)
Ability to work independently and in collaboration / multidisciplinary environment. (20M)	Able to work independently and in a collaboration/multidisciplinary environment. (20M)	Able to work independently with minimal guidance and in a collaboration/multidisciplinary environment. (15M)	Able to work independently with more guidance and in a collaboration/multidisciplinary environment. (10M)	Unable to work independently without guide support and in a collaboration/multidisciplinary environment. (5M)
Ability to allocate time effectively and manage to complete the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete all the work allotted within appropriate time. (15M)	Able to allocate time effectively and complete most of the work allotted within appropriate time. (10M)	Able to allocate time effectively and manage to complete the work allotted (5M)	Unable to use time effectively and complete the work allotted.(3M)
		Able to		

Ability to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (15M)	Able to effectively exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (15M)	moderately exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (10M)	Able to partially exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (6M)	Unable to exhibit integrity and ethical behaviour while carrying out the internship and for the preparation of internship report. (3M)
Ability to demonstrate effective oral and written communication skills (10M)	Able to demonstrate effective oral and written communication skills (10M)	Able to demonstrate oral and written communication skills moderately. (7M)	Able to demonstrate oral and written communication skills minimally. (5M)	Unable to demonstrate effective verbal and written communication skills (2M)

Course Title	C# PROGRAMMING AND .NET		
Course Code	20CS881	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students will be able to develop various console and windows applications.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop programs that use reusability properties and namespaces.	3	-
2.	Design applications using classes, methods, interfaces and inheritance techniques and manage exceptions.	1, 3	-
3.	Create delegates, packages and manage database.	2, 3	-
4.	Demonstrate windows application system and build their own applications	3	1
Course Contents:			
MODULE – 1			10 Hrs
Overview of C#: Introduction , A Simple C# Program, Namespaces , Adding Comments, Main Returning a Value, Using Aliases for Namespace Classes, Passing String Objects to WriteLine Method, Command Line Arguments, Main with a Class, Providing Interactive Input, Using Mathematical Functions, Multiple Main Methods, Compile Time Errors. Literals, Variables and Data Types: Introduction, Literals , Variables , Data Types , Value Types Reference Types, Declaration of Variables , Initialization of Variables , Default Values ,Constant Variables , Scope of Variables , Boxing and Unboxing. Operators and Expressions : Introduction, Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Increment and Decrement Operators, Conditional Operator, Bitwise Operators , Special Operators ,Arithmetic Expressions, Evaluation of Expressions ,Precedence of Arithmetic Operators, Type Conversions ,Operator Precedence and Associativity. Mathematical Functions. Decision Making and Branching: Introduction, Decision Making with if Statement, Simple if Statement, The if... else Statement, Nesting of if... else Statements, The else if Ladder, The Switch Statement The? : Operator. Decision Making and Looping: Introduction, The while Statement The do Statement, The for Statement, The foreach Statement. Methods in C#: Introduction, Declaring Methods, The Main Method, Invoking Methods, Nesting of Methods, Method Parameters, Pass by Value, Pass by Reference, The Output Parameters, Variable Argument Lists, Methods Overloading. Handling Arrays: One-Dimensional Arrays, Creating an Array, Two- Dimensional Arrays, Variable- Size Arrays, the System. Array Class. Manipulating Strings : Creating Strings, String Methods, Inserting Strings, Comparing Strings, Finding Substrings, Mutable Strings, Arrays of Strings			
MODULE – 2			10 Hrs
Classes and Objects : Introduction, Basic principles of OOP, Defining a Class, Adding Variables and Methods, Member Access Modifiers, Creating Objects, Accessing Class members, Constructors, Overloaded Constructors, Static Members, Static Constructors, Private Constructors, Copy Constructors, Destructors, Member Initialization. Inheritance and Polymorphism: Introduction, Classical Inheritance, Containment Inheritance, Defining a Subclass, Visibility Control, Defining Subclass Constructors, Multilevel Inheritance, Hierarchical Inheritance, Overriding Methods, Hiding Methods, Abstract Classes, Abstract Methods, Sealed Classes: Preventing Inheritance, Sealed Methods, The this reference, Nesting of Classes, Constant Members, Read-only Members, Properties, Indexers. Polymorphism, Interface: Multiple Inheritance, Multiple Inheritance: Introduction, Defining an Interface, Extending an Interface, Implementing Interfaces, Interfaces and Inheritance, Explicit Interface Implementation, Abstract Class and Interfaces.			

Operator Overloading: Introduction, Over loadable Operators, Need for Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Overloading Comparison Operators Delegates and Events: Introduction, Delegates, Delegate Declaration, Delegate Methods, Delegate Instantiation, Delegate Invocation, Using Delegates, Multicast Delegates, Events. Managing Errors and Exceptions: Introduction, What is Debugging? Types of Errors, Exceptions, Syntax of Exception Handling Code, Multiple Catch statements, The Exception Hierarchy, General Catch Handler, Using Finally statement, Nested Try Blocks, Throwing our Own Exceptions, Checked and Unchecked Operators, Using Exceptions for Debugging.	
MODULE – 3	10 Hrs
Understanding. NET: The C# Environment: Building a Better Window (Introducing Windows Forms): Overview of the System. Windows. Forms Namespace, Working with the Windows Forms Types, The Role of the Application Class ,The Anatomy of a Form, The Functionality of the Control Class, The Functionality of the Form Class, Building Windows Applications with Visual Studio 2005, Working with MenuStrips and ContextMenuStrips, Working with StatusStrips. Programming with Windows Forms Controls: The World of Windows Forms Controls, Adding Controls to Forms by and, Adding Controls to Forms Using Visual Studio 2005, Working with the Basic Controls, Configuring the Tab Order, Setting the Form’s Default Input Button, Working with More Exotic Controls, Building Custom Windows Forms Controls, Testing the CarControl Type, Building a Custom CarControl Form Host.	
MODULE – 4	10 Hrs
Data Access with ADO.NET: A High-Level Definition of ADO.NET, Understanding, DO.NET Data Providers, Additional ADO.NET Namespaces, The System. Data Types, Abstracting Data Providers Using Interfaces, Increasing Flexibility Using Application ,Configuration Files, The .NET 2.0 Provider Factory Model, The <connectionStrings> Element Installing the Cars Database, Understanding the Connected Layer of ADO.NET, Working with Data Readers, Modifying Tables Using Command Objects, Working with Parameterized Command Objects, Executing a Stored Procedure Using DbCommand, Asynchronous Data Access Under .NET 2.0, Understanding the Disconnected Layer of ADO.NET. ASP. NET Web Pages and Web Controls: The Role of HTTP, Understanding Web Applications and Web Servers, The Role of HTML, The Role of Client-Side Scripting, Submitting the Form Data (GET and POST), Building a Classic ASP Page, Problems with Classic ASP, The ASP.NET 2.0 Namespaces, The ASP.NET Web Page Code Model, Details of an ASP.NET Website Directory Structure, The ASP.NET 2.0 Page Compilation Cycle, The Inheritance Chain of the Page Type, Interacting with the Incoming HTTP Request, Interacting with the Outgoing HTTP Response, The Life Cycle of an ASP.NET Web Page, Understanding the Nature of Web Controls	
Text Books : 1. Andrew Troelsen , “Pro C# and the .NET 3, Special edition, A Press, 2012 2. E. Balagurusamy," Programming in C# A Primer", 3rd edition, TMH, 2010.	
Reference Book: 1. Tom Archer: Inside C#, WP Publishers, 2001.	
MOOCs: 1. https://www.udemy.com/course/c-net-for-beginners/ 2. https://www.udemy.com/course/aspnet-webforms/	

Course Title	ADVANCED ALGORITHMS		
Course Code	20CS882	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Students should be capable of designing algorithms using suitable algorithm design method and mathematically analyze it. Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Determine the asymptotic complexity of algorithms including solving of recurrence relations.	1, 2	-
2.	Explain advanced data structures.	1, 3	-
3.	Apply the dynamic programming concept, greedy approach, and the graph algorithms for problem solving.	2	-
4.	Develop algorithm for a given real life problem.	1,2	1
Course Contents:			
MODULE – 1			10 Hrs
Growth Functions: Asymptotic notations, standard notations and common functions, Summations: summations formulas and properties, bounding summations, recurrences: the substitution method, iteration method, master method. Hash tables: Direct- address tables, hash tables, hash functions, open addressing. Amortized analysis: The aggregate method, the accounting method, the potential method, dynamic tables			
MODULE – 2			10 Hrs
Definitions of B-trees, basic operations on B-trees, deleting a key from B-tree, Binomial heaps: binomial trees and binomial heaps, operations on binomial heaps, Fibonacci heaps: structure of Fibonacci heaps, mergeable-heap operations, decreasing a key and deleting a node, bounding the maximum degree			
MODULE – 3			10 Hrs
Sorting Networks: Comparison networks, the zero-one principle, a Bitonic sorting network, a merging network, a sorting network, Arithmetic circuits: combinational circuits, addition circuits, multiplication circuits. String matching: The naïve-string algorithm, the rabin-karp algorithm, string matching with finite automata, the Knuth morris-Pratt algorithm.			
MODULE – 4			10 Hrs
NP-Completeness :Polynomial time, polynomial-time verification, NP-Completeness and reducibility Approximation Algorithm: The vertex-cover algorithm, the travelling salesman problem, the set-covering problem, the subnet-sum problem.			
Text Book : 1. Thomas H Coreman, Charles E Leiserson, Ronald Rivest, “Introduction to Algorithms”, PHI India 2000, Chapters(2,3,4,12,18,19,20,21,28,29.1 to 29.3,34.1 to 34.4,36,37)			

Course Title	OPERATIONS RESEARCH		
Course Code	20CS883	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Solve optimization problems using various methods			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Develop mathematical model for a given problem.	1	-
2.	Apply techniques of Operations Research.	2	-
3.	Solve prediction and estimation problems.	1, 2	-
4.	Expose to the significance of various scientific tools.	5	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction : Introduction: The origin, nature and impact of OR; Overview of the Operations Research Modeling Approach: Defining the Problem and Gathering Data; Formulating a Mathematical Model; Deriving Solutions from the Model; Testing the Model; Preparing to Apply the Model; Implementation Linear Programming – 1 : Prototype example; The Linear Programming (LP) Model, Assumptions of LP, Additional Examples			
MODULE – 2			10 Hrs
Simplex Method - 1 : The Essence of the Simplex Method; Setting up the Simplex Method; The Algebra of the Simplex Method; The Simplex Method in Tabular Form; Tie Breaking in the Simplex Method Simplex Method – 2 : Adapting to other Model Forms; Post Optimality Analysis, Computer implementation			
MODULE – 3			10 Hrs
Revised Simplex Methods : Foundations of the Simplex Method, The revised simplex method, A Fundamental Insight Duality Theory: The Essence of Duality Theory; Economic Interpretation of Duality. Primal-Dual Relationships, Adapting to other primal forms, The role of duality in sensitive analysis; The essence of sensitivity analysis; Applying sensitivity analysis, The dual simplex method ; Parametric linear programming; The upper bound technique.			
MODULE – 4			10 Hrs
Transportation Model : Definition of the Transportation Model, Nontraditional Transportation Models, The Transportation Algorithm. Assignment Model and Network Models : The Assignment Model, CPM and PERT			
Text Books : 1. Frederick S. Hillier and Gerald J. Lieberman, “Introduction to Operations Research”, Tata McGrawHill, 9th Edition, 2012. (Chapters: 1.1 to 1.3, 2, 3.1 to 3.3, 4.1 to 4.7, 5, 6.1 to 6.7, 7.1) 2. Hamdy A Taha, “Operations Research: An Introduction”, Prentice Hall India, 8th Edition, 2005.(Chapters: 5, 6.4)			
Reference Book: 1. Wayne L. Winston, “Operations Research Applications and Algorithms”, Thomson Course Technology, 4th Edition 2003			

Course Title	PRINCIPLES OF COMPILER DESIGN		
Course Code	20CS884	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To provide students with the knowledge and abilities to design and implement compilers.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Design syntax directed translation schemes for a given context free grammar	1	-
2.	Explain various memory management issues while designing a compiler	1	-
3.	Construct the intermediate code representations for a given simple programming constructs	1	-
4.	Apply the optimization techniques to have a better code for code generation	1	-
Course Contents:			
MODULE – 1			10 Hrs
Syntax-Directed Translation : Syntax Directed definitions, Evaluation order for SDD's, Applications of Syntax- Directed translation, Syntax Directed Translation Schemes, Implementing L-attributes SDD's;			
MODULE – 2			10 Hrs
Run time environment: Storage Organization, Stack Allocation Space, Access to Non-Local Data on the stack, Heap Management, Introduction to Garbage Collection. Intermediate Code Generation : introduction, Variants of Syntax trees,			
MODULE – 3			10 Hrs
Intermediate Code Generation (Contd.): Three Address code, Types and Declarations; translation of expression, Type Checking, Control flow, Back patching. Switch statements; Intermediate Code for Procedures.			
MODULE – 4			10 Hrs
Code Generation: Issues in the design of code generation, the target language, Address in target code. Basic blocks and flow graphs, Optimization of basic blocks, A simple code generator, Peephole Optimization			
Text Book :			
1. Alfred V Aho, Ravi Sethi, Jeffrey D Ullman, “Compilers- Principles, Techniques and Tools”, 2nd Edition , Addison-Wesley, 2013			
Reference Books:			
1. Fischer, C. N. and LeBlanc, R. J., “Crafting a compiler with C”, Benjamin Cummings, 2003.			
2. Bennet, J.P., “Introduction to Compiler Techniques”, 2nd Edition, TMH, 2003			
3. Henk Alblas and Albert Nymeyer, “Practice and Principles of Compiler Building with C”, Prentice Hall of India, 2001			

Course Title	STORAGE AREA NETWORKS		
Course Code	20CS885	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours/Week	3
SEE	50 Marks	Total Hours	40
Course Objective: Analyze various Storage Area Networks.			
Course Outcomes(COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Demonstrate different RAID levels.	1,2	-
2.	Analyze the components of Storage Area Network (SAN).	1,2	2
3.	Explore Storage Area Network.	2	2
4.	Demonstrate Network Attached Storage.	1,2	2
Course Contents:			
MODULE – 1			10 Hrs
Introduction: Server Centric IT Architecture and its Limitations; Storage – Centric IT Architecture and its advantages, Case study: Replacing a server with Storage Networks, Architecture of Intelligent Disk Subsystems, Hard disks and Internal I/O Channels. Intelligent Disk Subsystem: JBOD, Storage virtualization using RAID, different RAID levels; Caching: Acceleration of Hard Disk Access; Instant copies, Remote mirroring, LUN masking, Availability of disk subsystems.			
MODULE – 2			10 Hrs
I/O Technique: The Physical I/O path from the CPU to the Storage System; SCSI; Fibre Channel Protocol Stack-links, ports, topologies, FC-0,FC-1,FC-2,FC-3, link services, FC-4. Fiber channel SAN, Network Attached Storage: Fiber Channel SAN-point-to-point topology, fabric topology, arbitrated loop topology, hardware components, IP Storage-IP storage standards: iscsi, iFCP, Mfcp, FCIP. The NAS hardware Architecture, The NAS Software Architecture, Network connectivity.			
MODULE – 3			10 Hrs
File System: Local File Systems; Network file Systems and file servers: basic principle, NAS, performance bottle necks, acceleration of network file systems, case study-DAFS; Shared Disk file systems; Comparison: NAS, fiber Channel SAN and iSCSI SAN. Storage Virtualization: Definition of Storage virtualization; Implementation Considerations; Storage virtualization on Block or file level; Storage virtualization on various levels of the storage Network; Symmetric and Asymmetric storage virtualization in the Network.			
MODULE – 4			10 Hrs
SAN Architecture and Hardware devices: Creating a Network for storage-The network part, The software -fabric OS services, The connectivity part- connecting server, connecting the storage, SAN Hardware devices- The fiber channel switch, Host Bus adaptors. Software Components of SAN: The switch's operating system, Device Drivers, The Supporting components.			
Text Books : 1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, Second Edition Wiley India, 2009 2. Robert Spalding: Storage Networks, The Complete Reference, Tata McGraw Hill, 2003. (Ch. 9, 13, 14, 15)			
Reference Book: 1. Richard Barker and Paul Massiglia: Storage Area Network Essentials A Complete Guide to understanding and Implementing SANs, John Wiley India, 2002			
MOOC: 1. https://onlinecourses.nptel.ac.in/noc18_cs50/preview			

Course Title	MOBILE COMMUNICATIONS		
Course Code	20CS886	L-T-P-C	(3-0-0)3
Exam Hrs.	3	Hours / Week	3
SEE	50 Marks	Total Hours	40
Course Objective: To apply knowledge of Mobile Communications and Technologies in real time applications.			
Course Outcomes (COs): Upon completion of the course, students shall be able to:			
#	Course Outcomes	Mapping to POs	Mapping to PSOs
1.	Explore the applications, marketing and reference model of Mobile communication system.	6,12	-
2.	Classify the different types of transmissions, medium access control techniques and satellite Systems.	1,2	-
3.	Differentiate and analyze the mobile networks and Other Networks.	1,3	-
4.	Analyze the process involved in Mobile IP and DHCP Server.	1,2	-
5.	Design the Protocols for mobile networks and file systems.	3,4	-
Course Contents:			
MODULE – 1			10 Hrs
Introduction to Mobile Communications: Applications, History of Wireless Communication, A Market for Mobile Communications, Some open research Topics, A simplified reference model. Wireless Transmission: Frequencies for Radio Transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Cellular Systems.			
MODULE – 2			10 Hrs
Medium Access Control: Motivation for a specialized MAC, TDMA, CDMA, Comparison of S/T/F/CDMA. Satellite Systems: History, Applications, Basics, Routing, Localizations, Handover; Broadcast Systems: Overview, Cyclical Repetition of data, DAB, DVB, Convergence of Broadcasting and Mobile communications.			
MODULE – 3			10 Hrs
Wireless LAN: Infrared versus radio transmission, Infrastructure and Adhoc Network, IEEE-802.11-System Architecture and Protocol Architecture. Mobile Network Layer: Mobile IP: Goals, assumptions and requirements, Entities and terminology, IP packet delivery, Agent discovery, Registration, Tunnelling and encapsulation, Optimizations; Dynamic host configuration protocol			
MODULE – 4			10 Hrs
Mobile ad-hoc networks: Routing, Destination sequence distance vector, Dynamic source routing, Alternative metrics , Overview ad-hoc routing protocols Mobile Transport Layer: Traditional TCP, Classical TCP improvements, TCP over 2.5/3G wireless networks, Performance enhancing proxies; Support for Mobility: File Systems, i-mode.			
Text Book: 1. Jochen Schiller, Mobile communications, Pearson Education, 2nd edition			
Reference Books: 1. Asoke K. Talkukder, Roopa R Yavagal: Mobile Computing – Technology, Applications and Service Creation, Tata McGraw Hill, 2012 2. Reza B'Far: Mobile Computing Principles – Designing and Developing Mobile Applications with UML and XML, 5th Edition, Cambridge University press, 2013			