Silicon Institute of Technology
| An Autonomous Institute |

Curriculum Structure and Detailed Syllabus

Master in Computer Application
(Two-Year Post-Graduate Program)

Silicon
...beyond teaching

Department of Computer Application
Silicon Institute of Technology
Silicon Hills, Patia, Bhubaneswar - 751024

Effective From Academic Year 2022-23

Version: 2.10 (Build: 22-12-2022)

Approval History

ACM#	Date	Resolutions
AC-8	13/08/2022	The curriculum structure and detailed syllabus of 1st and 2nd years as proposed by the Boards of Studies is approved by the Academic Council.

Program Outcomes

Graduates Attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The National Board of Accreditation (NBA) has defined Program Outcomes (POs) for UG Engineering programmes, but not for the MCA programme. Silicon Institute of Technology has defined POs for MCA programme in line with NBA, so that the outcomes can be assessed in a similar manner to UG programmes. The Program Outcomes for MCA programme are given below:

PO1. Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.

PO2. Design and develop applications to analyze and solve all computer science related problems.

PO3. Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.

PO4. Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.

PO5. Integrate and apply efficiently the contemporary IT tools to all computer applications.

PO6. Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

PO7. Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.

PO8. Communicate effectively and present technical information in oral and written reports.

PO9. Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

PO10. Appreciate the importance of goal setting and to recognize the need for life-long learning.

Program Educational Objectives (PEOs)

PEO1. Develop software solutions to problems across a broad range of application domains through analysis and design.

PEO2. Work professionally and communicate effectively in interdisciplinary environment, either independently or in team, and demonstrate leadership in academia and industry.

PEO3. Utilize computational techniques and develop software by integrating existing technologies and adapt to new technologies for building rich software applications for benefit of the society.

Program Specific Outcomes (PSOs)

PSO1. Understand the concepts and applications in various fields of Computer Application like Web designing and development, Mobile application development, and Network & communication technologies.

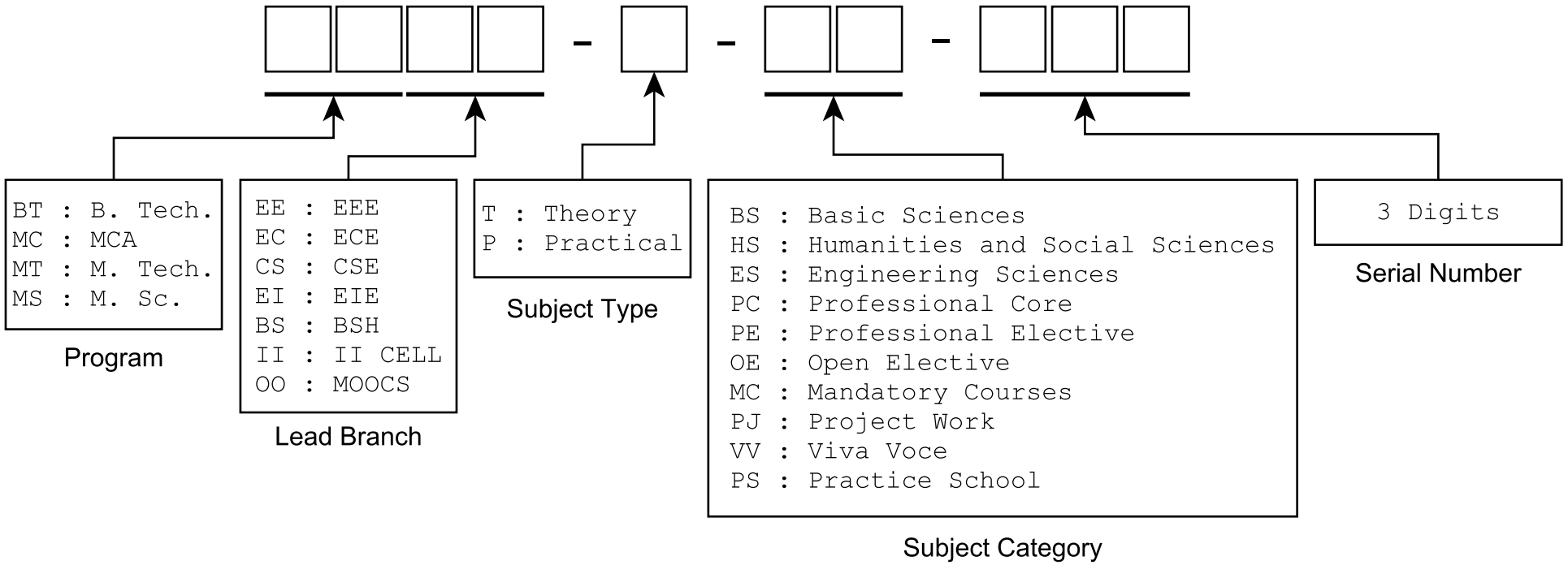
PSO2. Apply standard practices and strategies in software development & project development using open-ended programming environments to deliver quality applications for business success.

PSO3. Employ modern computer languages, technologies, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.

Course Types & Definitions

L	Lecture
T	Tutorial
P	Practical / Sessional
WCH	Weekly Contact Hours
BS	Basic Sciences
HS	Humanities & Social Sciences (including Management)
ES	Engineering Sciences
PC	Professional Core
PE	Professional Elective
OE	Open Elective
MC	Mandatory Course
PJ	Project Work
VV	Viva Voce

Subject Code Format



Contents

Part I

1st Year MCA

Curriculum Structure

Semester I								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
BS	MCBS-T-BS-002	Mathematics for Computer Applications	3	1	0	3	1	0
PC	MCCS-T-PC-006	Operating Systems	3	0	0	3	0	0
PC	MCCS-T-PC-007	Computer Networks	3	0	0	3	0	0
PC	MCCS-T-PC-001	Problem Solving & Programming Using C	3	0	0	3	0	0
PC	MCCS-T-PC-002	Computer Organization & Architecture	3	0	0	3	0	0
HS	MCBS-T-HS-003	Language & Communication Skills	3	0	0	3	0	0
PRACTICAL								
PC	MCCS-P-PC-003	C Programming Lab	0	0	4	0	0	2
PC	MCCS-P-PC-010	Operating Systems Lab	0	0	2	0	0	1
HS	MCBS-P-HS-004	Language & Communication Skills Lab	0	0	2	0	0	1
		SUB-TOTAL	**18**	**1**	**8**	**18**	**1**	**4**
		TOTAL	**27**			**23**		

Semester II								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
PC	MCCS-T-PC-004	Data Structures	3	1	0	3	1	0
PC	MCCS-T-PC-005	OOP using Java	3	0	0	3	0	0
PC	MCCS-T-PC-011	Database Management Systems	3	1	0	3	1	0
PC	MCCS-T-PE-026	Software Engineering & UML	3	0	0	3	0	0
PC	MCCS-T-PC-041	E-Commerce & Knowledge Management	3	0	0	3	0	0
PRACTICAL								
PC	MCCS-P-PC-008	Data Structures Lab	0	0	4	0	0	2
PC	MCCS-P-PC-009	OOP using Java Lab	0	0	2	0	0	1
PC	MCCS-P-PC-022	Database Management Systems Lab	0	0	2	0	0	1
PC	MCCS-P-PC-036	Software Engineering & UML Lab	0	0	2	0	0	1
HS	MCBS-P-HS-007	Personality Development & Soft Skills Lab	0	0	2	0	0	1
		SUB-TOTAL	**15**	**2**	**12**	**15**	**2**	**6**
		TOTAL	**29**			**23**		

Type	Code	Mathematics for Computer Applications	L-T-P	Credits	Marks
BS	MCBS-T-BS-002		3-1-0	4	100

Objectives	The objective of this course is to familiarize the students with mathematical logic, counting techniques, graphs and provide a foundation of probability distributions.
Pre-Requisites	Basic knowledge of sets, matrices and elementary calculus are required
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Propositions, Logical operations, Logical equivalences, Predicate and quantifiers, Nested quantifiers, Rules of inference, Methods of proving.	**8 Hours**
Module-2	Proofs and proof strategies, Conjecture, Proof and counter examples, Summation of sequences, Mathematical induction.	**8 Hours**
Module-3	Basics of counting techniques, Pigeonhole principle, Generalized permutations and combinations, Generating functions, Recurrence relation and its solutions, Principle of inclusion and exclusion and its applications.	**10 Hours**
Module-4	Graphs, Paths and connectivity in a graph, Graph isomorphism, Matrices of graphs, Euler graph, Hamilton Graph, Planar graph, Graph coloring and Trees.	**10 Hours**
Module-5	Probability, Conditional Probability, Bayes' Rule, Concept of a random variable, Discrete and Continuous probability distribution functions, Joint Distribution, Mean, Variance and Co-Variance of random variables.	**10 Hours**
Module-6	Binomial distribution, Poisson distribution, Hyper geometric distribution, Geometric distribution, Uniform distribution, Exponential distribution, Normal distribution.	**10 Hours**
	Total	**56 Hours**

Text Books:

T1. K. H. Rosen, ***Discrete Mathematics and its Application***, 7th Edition, McGraw-Hill, 2017.
T2. R. E. Walpole, R. H. Myers, S. L. Myers, and K. E. Ye, ***Probability & Statistics for Engineers & Scientists***, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. C. L. Liu, ***Elements of Discrete Mathematics***, 2nd Revised Edition, Tata McGraw-Hill, 1985.
R2. T. Koshy, ***Discrete Mathematics and Applications***, 1st Edition, Academic Press (Elsevier), 2003.
R3. R. A. Johnson, I. Miller, and J. E. Freund, ***Probability and Statistics for Engineers***, 9th Edition, Pearson Education, 2016.

Online Resources:

1. https://nptel.ac.in/courses/111/105/111105035/
2. https://nptel.ac.in/courses/122/104/122104017/
3. https://nptel.ac.in/courses/122/102/122102009/
4. http://freevideolectures.com/Course/2267/Mathematics-I/22
5. https://nptel.ac.in/courses/111106086/
6. https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/lecture-notes/
7. http://www.math.uvic.ca/faculty/gmacgill/guide/index.html
8. https://nptel.ac.in/courses/106106094/
9. https://nptel.ac.in/courses/111105041/
10. https://nptel.ac.in/courses/111105090/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Define & describe various logical connectives and expressions along with rules of inferences.
CO2	Apply various methods of proofs and proof strategies.
CO3	Model counting techniques using recurrence relations & generating functions for applications.
CO4	Develop the concepts and applications of graphs in various computer science problems.
CO5	Solve engineering problems involving probability of discrete nature.
CO6	Solve engineering problems involving probability of continuous nature.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	3	1						3	1	1
CO2	3	3	2	3	1						2	1	1
CO3	3	3	2	2	2						3	1	1
CO4	3	2	2	2	2						2	1	1
CO5	3	2	1	1	1						3	2	1
CO6	3	2	1	1	1						3	2	1

Type	Code	Operating Systems	L-T-P	Credits	Marks
PC	MCCS-T-PC-006		3-0-0	3	100

Objectives	The objective of this course is to introduce the fundamentals of operating systems, services, processes, process scheduling and synchronization, principles of primary, secondary and virtual memory management, and basics of structure & organization of file system & disk scheduling methods.
Pre-Requisites	Fundamentals of computer, data structures, programming knowledge in C or C++ is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	**Introduction**: concept of operating system, origin and evolution, types, resources managed, services provided, system calls and their types, system structure of operating system.	**6 Hours**
Module-2	**Process Management**: process concepts, states, PCB, types of schedulers, operations on process, inter-process communication, concept of buffering, thread overview, user & kernel threads, multi-threading models, issues with multi-threading; CPU Scheduling: scheduling criteria, scheduling algorithms: FCFS, SJF, SRTF, RR, Priority Scheduling, MLQ, MLQ with Feedback Scheduling.	**10 Hours**
Module-3	**Inter-Process Synchronization**: Bounded-buffer problem, shared-memory solution to producer-consumer problem; Critical section problem: Peterson's solution, synchronization hardware, Semaphores; Classical problems of synchronization: Bounded-Buffer problem, Readers-Writers Problem, Dining-Philosophers Problem, Sleeping Barber problem, monitors, Deadlock: characterization, prevention, avoidance, Banker's algorithm, deadlock detection and recovery.	**10 Hours**
Module-4	**Memory Management**: Logical and physical address space, dynamic loading and linking, swapping, contiguous memory allocation, dynamic storage allocation problem, overlays, paging and segmentation; Virtual Memory Management: Demand paging, page fault, basic page replacement policy, Page Replacement Algorithms: FIFO, OPT, LRU, LRU-Approximation, LFU, MFU, Thrashing, working-set model.	**9 Hours**
Module-5	**Secondary Storage Structure**: Overview of mass storage structure, disk structure; Disk Scheduling: FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, RAID structure; Filie System: access methods, directory structure, access control list, I/O System: polling, interrupts, DMA, Case studies: The LINUX System.	**7 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Silberschatz, P. B Galvin, and G Gagne, ***Operating Systems Principles***, 7th Edition, Wiley India, 2006.

T2. M. Milenkovic, ***Operating Systems: Concepts & Design***, 2nd Edition, McGraw-Hill Education, 2001.

Reference Books:

R1. A. S. Tanenbaum, ***Modern Operating Systems***, 3rd Edition, PHI Learning, 2007.

R2. P. B. Prasad, ***Operating Systems and System Programming***, 2nd Edition, SciTech Publishres, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106106144/
2. https://nptel.ac.in/courses/106108101/
3. http://web.stanford.edu/~ouster/cgi-bin/cs140-spring14/lectures.php
4. https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explore principles behind various types of operating systems, system components, system calls, protection mechanisms and services.
CO2	Understand the benefits of thread over process, importance of inter-process communication, analyze various CPU scheduling algorithms and design new scheduling algorithms.
CO3	Understand the significance of process synchronization and get acquainted with various deadlock handling mechanisms.
CO4	Describe the working principle of main memory, cache memory & virtual memory, and solve memory allocation related problems.
CO5	Acquire knowledge on secondary storage management, performance of disk scheduling algorithms, identify issues in file structures, and protection & security mechanisms.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2								2	2	1
CO2	3	3	3	2							3	1	1
CO3	3	3	3	2	1	1					3	1	1
CO4	3	3	3	2	1	1					3	1	1
CO5	2	2	3	2	1	1					3	1	1

Type	Code	Computer Networks	L-T-P	Credits	Marks
PC	MCCS-T-PC-007		3-0-0	3	100

Objectives	The objective of this course are to develop an understanding of modern network architectures from a design and performance perspective, introduce the major concepts involved in WANs, LANs, and WLANs, and provide fundamental knowledge on network programming & WLAN measurement.
Pre-Requisites	Basic knowledge of Computer Organization, Operating Systems, and programming using C language is required.
Teaching Scheme	Regular classroom lectures with use of PPTs as and when required; sessions are planned to be interactive with focus on problem solving and programming.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Data communication Components: Representation of data and its flow Networks , Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.	**8 Hours**
Module-2	Data Link Layer and Medium Access Sub Layer: Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple Access Protocols. Pure ALOHA, Slotted ALOHA, CSMA, CSMA-CD and CSMA-CA.	**10 Hours**
Module-3	Network Layer: Switching, Logical addressing – IPV4, IPV6; Error reporting and Management protocols: ICMP, IGMP. Address mapping – ARP, RARP, Bootstrap protocol and DHCP–Delivery, Forwarding and Unicast Routing protocols.	**9 Hours**
Module-4	Transport Layer: Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	**9 Hours**
Module-5	Application Layer: Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), World Wide Web, HTTP, SNMP. Basic concepts of Bluetooth, Firewalls and Cryptography.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. B. A. Forouzan, ***Data Communication and Networking***, 4th Edition, Tata McGraw–Hill, 2011.
T2. L. L. Peterson and B. S. Davie, ***Computer Networks: A Systems Approach***, 5th Edition, Morgan Kaufmann Publishers, 2011.

Reference Books:

R1. J. F. Kurose and K. W. Ross, ***Computer Networking - A Top-Down Approach Featuring the Internet***, 5th Edition, Pearson Education, 2009.
R2. Y. D Lin, R. H Hwang, and F.Baker, ***Computer Networks: An Open Source Approach***, 1st Edition, McGraw-Hill, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105081/
2. http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
3. https://www.geeksforgeeks.org/computer-network-tutorials

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Correlate the functionalities of the different layers of OSI and TCP/IP model.
CO2	Design functional blocks of Wide-Area Networks (WANs), Local Area Networks (LANs) & Wireless LANs (WLANs) and define the functions of each block.
CO3	Classify the routing protocols and assign the IP addresses for a given network using static and dynamic addressing techniques.
CO4	Simulate different transport layer protocols using network programming and develop client-server applications.
CO5	Analyze the features and operations of various application layer protocols such as HTTP, FTP, DHCP, RTP , SMTP and others.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	1	2	2							3	1	3
CO2	1	1	2	2							3	1	3
CO3	1	1	1	3					2	1	2	1	3
CO4	1	2	2	2					1	1	3	1	3
CO5	1	2	2	2					2	3	3	1	2

Type	Code	Problem Solving & Programming Using C	L-T-P	Credits	Marks
PC	MCCS-T-PC-001		3-0-0	3	100

Objectives	The course aims to provide exposure to problem-solving through programming and train the students on the basic concepts of the C-programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to computers, basic organization of a computer, number system and conversion, algorithm, flowchart, structure of C program, character set, identifier, keywords, constants, variables, data types, expression, statements, operators, operator precedence and associativity, type conversion; Decision making and branching: if, if-else, nested if-else, else-if ladder, switch statement; Loop constructs: while, for, do-while, nested loops, jump statements (break, continue, goto), exit statement.	**10 Hours**
Module-2	Functions: monolithic vs modular programming, user defined function vs library function, introduction to function, function prototype, function definition, function call, parameter passing, recursion, storage classes (auto, register, static, extern); Arrays: declaration and initialization of arrays, accessing array elements, basic operation on arrays,multidimensional array, array and function.	**7 Hours**
Module-3	String: declaration and initialization, manipulation, string handling functions: strlen, strcpy, strcat, strcmp; Pointers: concepts of pointer, declaration and initialization of pointer variable, accessing variable through pointer, pointer arithmetic, pointer expression, chain of pointers, using pointer with arrays and string, array of pointers, pointer to an array, pointer as function argument, function returning pointer, pointer to function.	**7 Hours**
Module-4	Structures: declaration and definition, initialization, accessing members of structure, copying and comparing structure variables, nested structures, array of structure, structure and function, pointer to structure, self-referential structure, union; Dynamic Memory Management using the malloc, calloc, realloc and free functions.	**8 Hours**
Module-5	File Handling: concept of files, text vs binary file, data file manipulation, file opening and closing, standard and formatted input/output operation on files, random access on files using functions ftell, fseek, and rewind; Command-line arguments, typedef, bit-field, enumerated data type, pre-processor directives, macros, file inclusion.	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. E. Balagurusamy, ***Programming in ANSI C***, 4th Edition, Tata McGraw-Hill, 2008.
T2. Y. Kanetker, ***Let Us C***, 15th Edition, BPB Publications, 2016.

Reference Books:

R1. B. W. Kernighan and D. M. Ritchie, ***The C Programming Language***, 2nd Edition, PHI, 1988.
R2. H. M. Deitel and P. J. Deitel, ***C : How to Program***, 3rd Edition, Pearson Education Asia.
R3. B. S. Gottfried, ***Programming with C***, 2nd Edition, Tata McGraw-Hill.
R4. H. Schildt, ***C: The Complete Reference***, 4th Edition, Tata McGraw-Hill.
R5. R. Thareja, ***Programming in C***, 1st Edition, Oxford University Press.

Online Resources:

1. http://www.princeton.edu/~achaney/tmve/wiki100k/docs/C_%28programming_language%29.html
2. http://www.stat.cmu.edu/~hseltman/c/CTips.html
3. http://www.c-faq.com/
4. http://www.learn-c.org/
5. https://www.javatpoint.com/c-programming-language-tutorial

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop simple C programs using data types, variables, operators and control transfer statements.
CO2	Design C programs to handle similar data items using arrays and construct modular programs.
CO3	Use string and pointer to design efficient C programs for manipulating real life situations.
CO4	Manipulate memory during run time and handle heterogeneous data items using structure and union.
CO5	Design C programs to create and manipulate files. Write efficient C programs using command line arguments, macros and pre-processor directives.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2		1					2	3	1	2
CO2	3	3	3		3					2	3	1	2
CO3	3	3	3		3					2	3	1	2
CO4	3	3	3		3					2	3	1	2
CO5	3	2	3		2					2	2	1	2

Type	Code	Computer Organization & Architecture	L-T-P	Credits	Marks
PC	MCCS-T-PC-002		3-0-0	3	100

Objectives	The objective of this course is to familiarize students about hardware design including logic design, basic structure and behaviour of the various functional modules of the computer and how they interact to provide the processing needs of the user.
Pre-Requisites	Knowledge of Basic Digital Electronics and computer fundamentals.
Teaching Scheme	Regular classroom lectures with use of ICT wherever required, and planned interactive sessions with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Basic structure of Computer: Functional Units & Operation concepts, Bus Structures, Performance, Multiprocessors and Multi computers, Memory Location and Address, Memory Operations, Register Transfer Notation, Assembly Language Notation, Basic Instruction Types, Addressing Modes, Basic I/O Operation, Subroutines.	**9 Hours**
Module-2	Binary Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of positive numbers, Signed Operand Multiplication, Fast multiplication, Integers Division, Floating–Point numbers representation, Floating – Point numbers operations.	**8 Hours**
Module-3	Memory System: Basic Concepts, Semiconductor RAM memories, ROM, Speed size and cost, Cache Memory concepts, Cache Memory mapping techniques, Performance consideration, Virtual Memory concepts, Translation Look-aside Buffer, Replacement techniques, Secondary Storage.	**9 Hours**
Module-4	Basic Processing Unit: Fundamental Concepts, Execution of Complete Instruction, Multi-bus Organization, Hardwired control, Micro-programmed control. I/O Interface, Isolated vs Memory Mapped I/O, Mode of transfer: Programmed I/O, interrupt I/O, DMA.	**8 Hours**
Module-5	Pipelining: Basic Concepts, Parallel Processing, Pipeline Hazards, Data Hazard, Structural Hazard, Control Hazard, Super Scalar Operation, Case Study: Ultra Sparc II.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. C. Hamacher, Z. Vranesic, and S. Zaky, ***Computer Organization***, 5th Edition, TMH, 2011.
T2. M. M. Mano, ***Computer System Architecture***, 3rd Edition, PHI, 2003.

Reference Books:

R1. B. Govindarajalu, ***Computer Architecture and Organization***, 5th Edition, TMH, 2004.
R2. N. Carter, ***Schaum's Outline of Computer Architecture***, TMH, 2002.

Online Resources:

1. https://nptel.ac.in/courses/106/103/106103068/
2. https://nptel.ac.in/courses/106/106/106106166/
3. https://nptel.ac.in/courses/106/105/106105163/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Identify and describe the functionality of various functional units of digital computer. Compare different addressing modes, instruction formats and their implementation in programming.
CO2	Perform various binary arithmetic operations using different techniques. Represent floating point numbers and perform various operations on them.
CO3	Describe the working principle of Main Memory, Cache Memory and Virtual Memory organization and solve numerical problems based on memory management.
CO4	Identify the components of single & multi bus organization and describe execution of complete instruction. Compare different modes of data transfer techniques.
CO5	Describe the working principle of pipeline and identify various pipeline hazards. Explain the principle behind super scalar operation.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	3	1					1	2		3
CO2	2	2	3	3	1					1	2	1	2
CO3	3	3	3	2	2					1	2	1	2
CO4	2	2	2	1	1					1	3	2	3
CO5	3	3	3	3	1					1	1		1

Type	Code	Language & Communication Skills	L-T-P	Credits	Marks
HS	MCBS-T-HS-003		3-0-0	3	100

Objectives	To develop the students' communication proficiency with an emphasis on Language Skills, make them aware of the importance of cross–cultural communication, help them read and comprehend texts of different genres, and compose effective business messages with the correct use of English Grammar.
Pre-Requisites	Basic knowledge of English grammar and the ability to read and write using the English language.
Teaching Scheme	Regular classroom lectures with use of PPTs as and when required; sessions are planned to be interactive with a focus on improving spoken and written communication skills in English.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Communication Process and Types; Process and factors involved: code, channel, message, context, feedback; Importance of communication; differences between General and Technical communication; Communication across cultures; Barriers to effective communication; Verbal and Non-verbal communication.	**7 Hours**
Module-2	Language Skills and Usage: Four skills of language (L, S, R, W); Importance of a common language; Importance of communication through English; Language functions (Speech Acts); Art of Public Speaking: Styles and techniques (assertiveness, convincing, argumentation, negotiation); Presentation skills: The four Ps' (Plan, Prepare, Practice, Present), Content development, Clarity of speech, Non-verbal gestures.	**9 Hours**
Module-3	Sounds of English: An introduction to English phonology; Consonants; Vowels and Diphthongs; Consonant clusters and Problem sounds; Phonemic Transcriptions; Syllabic Division; Stress; Intonation.	**6 Hours**
Module-4	Reading Skills: Importance of reading; Sub Skills of Reading; Reading Comprehension; Techniques of Summarizing and Note making; Introduction to genres of short stories; Short Stories 1 – 4; Critical analysis of the prescribed texts.	**11 Hours**
Module-5	Effective Formal Writing Skills: Difference between Speech and Writing; Elements of effective Business Writing; Basic understanding of the English Verb system; Identifying the common errors; Process Writing; Writing a paragraph; Writing an essay: descriptive, informative; Letter writing: formal and informal; Memo and email; Report Writing.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. M. A. Rizvi, ***Effective Technical Communication***, Tata McGraw-Hill.
T2. T. Balasubramaniam, ***English Phonetics for Indian Students***, Trinity Press.

T3. M. Raman, S. Sharma, ***Technical Communication: Principles and Practice***, Oxford University Press.
T4. D. K. Das, A. Kumari, and K. K. Padhi, ***Anthology of Modern English Prose***, Triniti Press.

Reference Books:

R1. S. Samantray, ***Business Communication and Communicative English***, S. Chand.
R2. J. Seeley, ***The Oxford Guide to Writing and Speaking***, Oxford University Press.
R3. B. K. Mitra, ***Communication Skills for Engineers***, Oxford University Press, 2011.
R4. B. K. Das, ***An Introduction to Professional English and Soft Skills***, Cambridge University Press, 2009.

Online Resources:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business
3. https://steptest.in
4. https://www.coursera.org/specializations/business-english
5. http://www.academiccourses.com/Courses/English/Business-English

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand the process and types of communication, and the nuances of communication across cultures.
CO2	Understand and apply the skills of language in day-to-day communication as well as in public speaking.
CO3	Understand the sounds of the English language and be able to check their pronunciation through phonemic transcriptions in order to speak with a neutral accent.
CO4	Enhance their reading skills and be able to critically analyse texts of various kinds.
CO5	Compose different types of business correspondences effectively with a proper use of grammar.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						2		3		2	1	1	3
CO2						1	1	3		2		1	1
CO3						1	1	3		2			3
CO4						1	1	3		2	2	2	2
CO5						2	2	3		2	1	1	3

Type	Code	C Programming Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-003		0-0-4	2	100

Objectives	Formulate problems and implement algorithms using C programming language. The students will be able to enhance their analyzing and problem solving skills and use the same for writing programs in C.
Pre-Requisites	Basic knowledge of computers and knowledge of C programming language.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Linux operating system, Linux commands, using the VI Editor.
2	Compilation and execution of simple C programs with arithmetic operators.
3	Programs using relational and logical operators.
4	Formulate problems on Decision making statements using if-else and nested if-else
5	Implement decision making statements using switch-case constructs.
6,7	Implement loop-control structures using while and do-while.
8	Programs on loop-control structures using for loops and nested for loops.
9	Programs on control transfer statement using break, continue, goto.
10	Programs on 1-dimensional array operations.
11	Programs on 2-dimensional array operations.
12	Programs on use of pointers with variables of different data-types.
13	Programs on array operations using pointers.
14	Programs on functions using call by value and call by reference.
15	Programs on functions using recursion.
16	Programs on storage classes and study of their effects.
17	Programs on creating and using strings.
18	Programs on string manipulation functions in C.
19	Programs on string manipulation using pointers.
20	Programs on creating and using simple structures & nested structures.
21,22	Programs on array of structures and pointers to structures.
23	Programs on creating and using unions.
24,25	Programs on dynamic memory management (malloc, calloc, realloc, free).
26	Programs on command-line arguments, pre-processor directives.
27	Programs on use of enumeration.
28	Programs on various operations on text files.

Text Books:

T1. E. Balagurusamy, ***Programming in ANSI C***, 7th Edition, McGraw-Hill Education, 2017.
T2. M. Sprankle, ***Programming and Problem Solving***, 9th Edition, Pearson Education, 2011.

Reference Books:

R1. B. W. Kernighan and D. M. Ritchie, ***The C Programming Language***, 2nd Edition, PHI, 2012.
R2. H. M. Deitel and P. J. Deitel, ***C How to Program***, 3rd Edition, Pearson Education Asia,2001.
R3. H. Schildt, ***C: The Complete Reference***, 4th Edition, McGraw-Hill Education, 2017.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105171/: by Prof. A. Basu, IIT Kharagpur
2. https://nptel.ac.in/courses/106/102/106102066/: by Prof. S. A. Kumar, IIT Delhi
3. https://nptel.ac.in/courses/106/104/106104074/: by Prof. D. Gupta, IIT Kanpur
4. http://www.stat.cmu.edu/~hseltman/c/CTips.html
5. http://www.c-faq.com/
6. http://www.learn-c.org/
7. https://www.javatpoint.com/c-programming-language-tutorial

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct C programs for mathematical operations using control statements.
CO2	Develop C programs for Array and String manipulation.
CO3	Construct modular programs for better maintenance and reusability.
CO4	Manipulate heterogeneous data using structure & union and apply dynamic memory management techniques to solve different problems.
CO5	Create and manipulate files and use command line arguments in C programs.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2		2					2	3	1	2
CO2	3	2	2		2					2	3	1	2
CO3	3	2	2		2					2	3	1	2
CO4	2	2	2		3					2	2	1	1
CO5	2	2	3		2					2	2	1	2

Type	Code	Operating Systems Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-010		0-0-2	1	100

Objectives	The objectives of this course is to introduce the students to linux programming environment & UNIX shell scripts, and practical experience of designing & implementing concepts of operating systems using C programming language.
Pre-Requisites	Knowledge of data structures, analysis of algorithms, and programming in C or C++ is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Linux OS and basic VI editor commands.
2	Linux File Structure and advanced Linux commands like grep, pipe, cut etc.
3	Introduction to UNIX Shell Script: Arithmetic Expressions, Relational & Conditional Operators.
4	UNIX Shell Script: Looping, Case structure.
5	Process Creation, process handing, process signaling through fork(), exec().
6	CPU Scheduling (Non-Pre-emptive) FCFS, SJF, Priority.
7	CPU Scheduling (Pre-emptive) SRTF, RR, Priority-based preemptive scheduling
8	Multi-Threaded application using POSIX threads.
9	Synchronization using Semaphore (Producer- Consumer, Reader-Writer).
10	Message passing: Pipe and Signals.
11	Deadlock implementation: Banker's Algorithm.
12	Implementation of different Page Replacement Algorithms.
13,14	Implementation of various Disk scheduling Algorithms.

Text Books:

T1. V. Mukhi, ***The C Odyssey: UNIX***, 1st Edition, BPB Publications, 2004.
T2. A. Silberschatz, P. B Galvin, and G Gagne, ***Operating Systems Principles***, 7th Edition, Wiley India, 2006.

Reference Books:

R1. A. S. Tanenbaum, ***Modern Operating Systems***, 3rd Edition, PHI Learning, 2007.
R2. P. B. Prasad, ***Operating Systems and System Programming***, 2nd Edition, SciTech Publishres, 2015.

Online Resources:

1. https://nptel.ac.in/courses/106106144/
2. https://nptel.ac.in/courses/106108101/
3. http://web.stanford.edu/~ouster/cgi-bin/cs140-spring14/lectures.php
4. https://www.cl.cam.ac.uk/teaching/1011/OpSystems/os1a-slides.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Carry out basic and advanced UNIX commands for system administration as well as write shell scripts for real life applications.
CO2	Simulate various CPU scheduling algorithms like FCFS, RR, SJF, Priority and Multilevel Queue etc.
CO3	Implement various program on process creation, inter-process communication and synchronization.
CO4	Execute Banker's algorithm for handling situations of deadlock.
CO5	Implement different page replacement algorithms like FIFO, LRU, LFU and OPTIMAL etc.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2									1
CO2	3	3	3	2							2		
CO3	3	2	2	3							2		1
CO4	3	3	3	3							2		
CO5	3	3	3	3							2		1

Type	Code	Language & Communication Skills Lab	L-T-P	Credits	Marks
HS	MCBS-P-HS-004		0-0-2	1	100

Objectives	This laboratory course is designed to make students effective communicators, by addressing issues like speaking inhibitions. This is accomplished by individual and team activities based on the four skills of language (LSRW).
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and write using the English language is required.
Teaching Scheme	Various tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	JAM: Just-A-Minute sessions to develop fluency in speaking using various topics of discussion.
2	Chart-work or Poster presentation on the Process of Communication.
3	Non-verbal Communication: Conducting role plays to understand the practical applications of non-verbal cues and body language.
4	Cross-cultural Communication: dealing with the nuances of this communication type through case studies, videos and discussions.
5	Listening Comprehension: Listening for specific information, ear training and for pronunciation practices.
6	Sounds of English: practice sessions on vowels, consonants and diphthongs; problem sounds and consonant clusters.
7	Transcriptions: the use of IPA symbols for transcribing words.
8	Stress and Syllable Division: Word stress, sentence stress, contrastive stress, rules of stress & syllable division through practice sessions and use of dictionaries.
9	Sentence Rhythm: through recitation of poems, read-aloud sessions and pronunciation practices.
10	Oral presentation–I: Power-point presentations on selected technical or non-technical topics of relevance.
11	Oral presentation–II: Power-point presentations on selected technical or non-technical topics of relevance.
12	Reading Comprehension: reading of various business & non-technical passages of relevance.
13	Writing Practice-I: memo and letters
14	Writing Practice-II: report writing

Text Books:

T1. M. A. Rizvi, ***Effective Technical Communication***, 2nd Edition, McGraw-Hill Education, 2017.
T2. T. Balasubramaniam, ***English Phonetics for Indian Students***, 2nd Edition, Macmillan Publishers, 2012.
T3. M. Raman and S. Sharma, ***Technical Communication: Principles and Practice***, 2nd Edition, Oxford University Press, 2011.

Reference Books:

R1. S. Samantray, ***Business Communication and Communicative English***, Sultan Chand.
R2. J. Seeley, ***The Oxford Guide to Effective Writing and Speaking***, 2nd Edition, Oxford University Press, 2005.
R3. B. K. Mitra, ***Communication Skills for Engineers***, Oxford University Press, 2011.
R4. B. K. Das, K. Samantray, R. Nayak, S. Pani, and S. Mohanty, ***An Introduction to Professional English and Soft Skills***, Cambridge University Press, 2009.

Online Resources:

1. https://nptel.ac.in/courses/109104031/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop listening comprehension and overcome their inhibitions to speak in public.
CO2	Communicate properly as an engineer in cross-cultural contexts.
CO3	Develop their English pronunciation skills through practice.
CO4	Work effectively as a team member or as a leader of the team.
CO5	Develop writing skills for effective communication in corporate environment.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						1	2	3		2	2	1	2
CO2						2	1	3		2	2	1	2
CO3						1	2	3		2		1	2
CO4						1	3	3		2	1	1	3
CO5						1	2	3		2	2	2	3

Type	Code	Data Structures	L-T-P	Credits	Marks
PC	MCCS-T-PC-004		3-1-0	4	100

Objectives	To understand the abstract data types, solve problems using data structures such as linear lists, stacks, queues, hash tables, binary trees, heaps, binary search trees and graphs.
Pre-Requisites	Knowledge of programming using C language is essential.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with programming and problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to data structures, classification of data structures, algorithms, time and space analysis of algorithms, asymptotic notation, abstract data types, Arrays - introduction, basic operations, row and column major representation, sparse matrix. Linked list- single linked list, double linked list, circular linked list.	**12 Hours**
Module-2	Representation of polynomial and its operations. Stack- representation using array and linked list, basic operations, applications - recursion, polish notation (conversion of infix to post fix expression and evaluation of postfix expression). Queue- representation using array and linked list, basic operations, circular queue.	**10 Hours**
Module-3	Tree - terminology, representation, binary tree - tree traversal algorithms with and without recursion. Binary search tree, Height balanced tree (AVL tree), m-way search trees, B-trees, applications of tree. Graph- terminology, representation, path matrix, graph traversal (BFS, DFS), all pair shortest path, topological sort.	**12 Hours**
Module-4	Searching and sorting techniques: linear and binary search, bubble sort, insertion sort, selection sort, quick sort, merge sort, radix sort.	**10 Hours**
Module-5	Introduction to heap, priority queue, applications of priority queue. Hashing- hash functions and hashing techniques. collision resolution techniques - linear probing, quadratic probing, chaining.	**12 Hours**
	Total	**56 Hours**

Text Books:

T1. A. Tenenbaum, ***Data Structures Using C***, 3rd Edition, Pearson Education 2007.
T2. E. Horowitz, S. Sahni, and S. Anderson-Freed, ***Fundamentals of Data Structures in C***, 2nd Edition, Universities Press, 2008.

Reference Books:

R1. M. Weiss, ***Data Structures and Algorithm Analysis in C***, 2nd Edition, Pearson Education, 2002.
R2. J. P. Tremblay and P. G. Sorenson, ***An Introduction to Data Structures with Applications***, 2nd Edition, Tata McGraw-Hill, 1981.
R3. S. Lipchitz, ***Data Structures***, 1st Edition, Tata McGraw-Hill, 2005.

Online Resources:

1. http://nptel.ac.in/courses/106102064/1
2. http://www.nptelvideos.in/2012/11/programming-and-data-structure.html
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. https://www.coursera.org/learn/data-structures

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Compare different programming methodologies and define asymptotic notations to analyze performance of algorithms and get acquainted with array and linked list.
CO2	Extrapolate the concepts of polynomial and use appropriate data structures like arrays, linked list, stacks and queues to solve real world problems efficiently.
CO3	Represent and manipulate data using nonlinear data structures like trees and graphs to design algorithms for various applications.
CO4	Apply the knowledge of different searching and sorting techniques to real-life problems.
CO5	Appreciate different memory management techniques, their significance and illustrate various hashing methods.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	2						1	3		3
CO2	3	3	2	2						1	3		3
CO3	3	3	2	2						1	3		3
CO4	3	3	3	2						1	3		3
CO5	3	3	2	2						1	3		3

Type	Code	OOP Using Java	L-T-P	Credits	Marks
PC	MCCS-T-PC-005		3-0-0	3	100

Objectives	The objective of this course is to introduce the key concepts of object-oriented programming (OOP) using Java as the programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with a programming language will be beneficial.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Object oriented concepts: Object oriented systems development life cycle, Unified Modeling Language, UML class diagram, Use-case diagram; Java Overview: Java Virtual Machine, Java buzz words, Data types, Operators, Control statements, Class fundamentals, Objects, Methods, Constructors, Overloading, Access modifiers.	**9 Hours**
Module-2	Inheritance: Basics of Inheritance, using super and final keyword, method overriding, Abstract classes, defining and importing packages, access protection, interfaces; Exception handling: Exception fundamentals, types, understanding different keywords (try, catch, finally, throw, throws), User defined exception handling.	**8 Hours**
Module-3	Input/Output: Files, stream classes, reading console input; Threads: thread model, use of Thread class and Runnable interface, thread synchronization, multithreading, inter thread communication.	**8 Hours**
Module-4	String manipulation: Basics of String handling, String class, StringBuilder, StringBuffer, StringTokenizer. Applet basics and life cycle; Event Handling: delegation event model, event classes, sources, listeners, Adapter class.	**8 Hours**
Module-5	Introduction to GUI Programming: working with windows, frames, graphics, color, and font. AWT Control fundamentals. Swing overview; JavaFX overview; Java database connectivity: JDBC overview, creating and executing queries, dynamic queries.	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. H. Schildt, ***Java: The Complete Reference***, 10th Edition, McGraw-Hill, 2017.
T2. Y. D. Liang, ***Introduction to Java Programming***, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. B. Bates, K. Sierra, ***Head First Java***, 2nd Edition, O'Reilly Media, 2005.
R2. T. Budd, ***An Introduction to Object-Oriented Programming***, 3rd Edition, Pearson Education, 2009.
R3. I. Horton, ***Beginning Java***, 7th Edition, Wrox Publications, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105191/
2. https://docs.oracle.com/javase/tutorial/
3. http://www.javatpoint.com/java-tutorial
4. http://www.w3schools.in/java/
5. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply object oriented principles in software design process to develop Java programs for real life applications.
CO2	Employ inheritance and exception handling techniques for developing robust and reusable software.
CO3	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CO4	Design applications for text processing using String class and develop user interactive applications using event handling.
CO5	Design database driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	1	2	1				2	3		3
CO2	3	2	2	1	2	1				2	3		3
CO3	3	3	2	2	2	1				2	3	1	3
CO4	3	3	3	1	2	1				2	3	1	3
CO5	3	3	3	2	2	1				2	3	2	3

Type	Code	Database Management Systems	L-T-P	Credits	Marks
PC	MCCS-T-PC-011		3-1-0	4	100

Objectives	The objective of this course is to learn principles of systematically designing and using large scale database management systems for various real-world applications.
Pre-Requisites	Basic knowledge of data structures and algorithms is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Database Systems, 3-level schema architecture, Database System Architecture; Data Models: Entity Relationship Model, Network and Object Oriented data models, Extended Entity Relationship Model, Mapping of E-R model to Relational schema.	**12 Hours**
Module-2	Query Language: Relational Algebra, Tuple & Domain Relational Calculus; Storage Strategies: File Organizations & Indexes, Ordered Indexes, B+ Tree Index Files, Hashing.	**10 Hours**
Module-3	Database Design: Functional dependency, Normalization, Normal forms: 1NF, 2NF, 3NF & BCNF, Multi-valued Dependencies, 4NF & 5NF; Query Processing and Optimization: Evaluation of Relational Algebra expressions, Query Optimization, Query Cost Estimation.	**14 Hours**
Module-4	Transaction Processing and Concurrency Control: Transaction concepts, ACID properties of transaction, Serializability; Concurrency Control Schemes: Locking and Timestamp schemes, Deadlock detection and recovery.	**10 Hours**
Module-5	Database Recovery System: Types of Database failures, Recovery techniques; Distributed Databases: Distributed database system, homogeneous distributed databases, distributed data storage, data replication and fragmentation, data transparency.	**10 Hours**
	Total	**56 Hours**

Text Books:

T1. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts***, 6th Edition, McGraw-Hill, 2013.
T2. R. Elmasri and S. B. Navathe, ***Fundamentals of Database Systems***, 7th Edition, Pearson Education, 2016.

Reference Books:

R1. R. Ramakrishnan and J. Gekhre, ***Database Management Systems***, 3rd Edition, McGraw-Hill, 2003.
R2. R. P. Mahapatra and G. Verma, ***Database Management Systems***, 1st Edition, Khanna Publishing, 2013.
R3. C. J. Date, ***Introduction to Database Systems***, 8th Edition, Pearson Education, 2003.

Online Resources:

1. https://nptel.ac.in/courses/106106093/
2. https://nptel.ac.in/courses/106105175/
3. https://cs145-fa18.github.io/
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-830-database-systems-fall-2010/lecture-notes/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Analyze the significance of database management system in an organization and explore its various functional components and design E-R model for real life problems.
CO2	Construct queries using Relational Algebra and Relational Calculus. Investigate storage architecture, and access methods using Order Indices, B+ Tree & Hashing.
CO3	Create effective database designs using different normalization techniques and devise optimal query execution strategies.
CO4	Understand transaction processing concepts and Solve the concurrent access problems by using various concurrency control mechanisms.
CO5	Explore various database recovery techniques and advance database concepts like Distributed Database. Compare between centralized and distributed databases.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	1		1				2	2		1
CO2	3	2	2	3						3	2		1
CO3	3	3	3	2		1			1	3	1		1
CO4	1	2		2			2			1	1		1
CO5	1	2		2		2	1			1	2		2

Type	Code	Software Engineering & UML	L-T-P	Credits	Marks
PC	MCCS-T-PE-026		3-0-0	3	100

Objectives	The objective of this course is to provide fundamentals of software engineering, software development life cycle & project management, object-oriented software design, development, testing and quality assurance.
Pre-Requisites	Knowledge of computers, logical & analytical ability, exposure to procedural and object oriented programming languages is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Software Engineering: Evolution and Emergence of Software Engineering; Software Life Cycle Models: Classical Waterfall Model, Iterative Waterfall Model, V-Model, Prototyping Model, Incremental Development Model, Evolutionary Model, RAD model, Agile development models & Spiral model.	**8 Hours**
Module-2	Software Project Management: Project Planning, Metrics for Project Size Estimation, Project Estimation Techniques, COCOMO model, Halstead's Software Science, Scheduling, Staffing, Risk Management; Requirements Analysis & Specification: Requirements Gathering and Analysis, SRS, Formal System Specification.	**8 Hours**
Module-3	Software Design: Overview of the Design Process, Cohesion and Coupling, Layered Arrangement of Modules, Approaches to Software Design; FOD: SA/SD Methodology, DFD, Structured Design and Detailed Design.	**8 Hours**
Module-4	Object Modelling Using UML: Object-Orientation Concepts, Unified Modelling Language (UML); UML Models: Use Case Model, Class Diagram, Interaction Diagrams, Activity Diagram, State Chart Diagram, Package, Component and Deployment Diagrams; Object-Oriented Software Development: OOAD Methodology.	**8 Hours**
Module-5	Coding & Code Review; Testing: Basic Concepts, Black-box and White-box Testing, Debugging, Integration Testing, Testing Object-Oriented Programs, Integration Testing, System Testing; Software Reliability, Software Quality, QMS, SEI CMM, Six Sigma; CASE, Software Maintenance, Emerging Trends.	**10 Hours**
	Total	**42 Hours**

Text Books:

T1. R. Mall, ***Fundamentals of Software Engineering***, 4th Edition, PHI Learning, 2014.
T2. C. Larman, ***Applying UML and Patterns***, 3rd Edition, Pearson Education, 2015.

P.T.O

Reference Books:

R1. I. Somerville, ***Software Engineering***, 9th Edition, Pearson Education, 2013.
R2. R. S. Pressman, ***Software Engineering - A Practitioner's Approach***, 7th Edition, McGraw Hill Education, 2010.

Online Resources:

1. https://nptel.ac.in/courses/106105182/: by Prof. Rajib Mall, IIT Kharagpur.
2. https://nptel.ac.in/courses/106101061/: by Prof. N. L. Sharda, IIT Bombay.
3. https://www.tutorialspoint.com/software_engineering/software_engineering_tutorial.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe fundamentals of software engineering and life cycle models.
CO2	Conduct requirements analysis, estimation, planning, scheduling, and other software project management activities.
CO3	Create high-level & detail-level design of a software using various design methodologies.
CO4	Visualize object oriented approach for software design using Unified Modeling Language.
CO5	Code, review, test and maintain software products confirming to quality standards.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	1	1		2		1	2	1		1	1	3
CO2	3	2	2		2		3	3	2		3	1	3
CO3	2	3	2		2		2	2	2		3	2	3
CO4	2	3	3		2		2	2	2		3	1	3
CO5	2	3	3		3		1	2	1		3	3	2

Type	Code	E-Commerce & Knowledge Management	L-T-P	Credits	Marks
PC	MCCS-T-PC-041		3-0-0	3	100

Objectives	The objective of this course is to introduce the fundamentals of e-commerce and its impact, infrastructure, business strategies, revenue models, building web presence, hardware and software technologies for e-commerce and knowledge management.
Pre-Requisites	Basic knowledge of Internet Web Technology, World Wide Web, Databases and Client-Server technologies is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to E-Commerce: E-Commerce and E-Business, Introduction to Business Models and Revenue Models, Business Processes, Impacts, Advantages and Disadvantages of E-Commerce, International Nature of E-Commerce; Technology Infrastructure: The Internet and the World Wide Web, Internet Protocols, Markup Languages, Intranets and Extranets; The Environment of E-Commerce: Legal, Ethical, and Tax Issues.	**8 Hours**
Module-2	Revenue Models in detail, Revenue Models in Transition, Revenue Strategy Issues, Creating an Effective Web Presence, Web Site Usability, Connecting with Customers; Marketing on the Web: Web Marketing Strategies, Communicating with Different Market Segments, Beyond Market Segmentation: Customer Behavior and Relationship Intensity, Advertising On The Web, E-Mail Marketing, Technology-Enabled CRM, Creating and Maintaining Brands on the Web, Search Engine Positioning and Domain Names.	**10 Hours**
Module-3	Business-to-Business Activities: Purchasing, Logistics, and Support Activities, Electronic Data Interchange, Supply Chain Management Using Internet Technologies, Electronic Marketplaces and Portals, Social Networking, Mobile Commerce, and Online Auctions.	**8 Hours**
Module-4	Web Server Hardware and Software: Web Server Basics, Software for Web Servers, E-Mail, Web Server Hardware.	**8 Hours**
Module-5	Electronic Commerce Software: Web Hosting, Basic and advanced Functions of Electronic Commerce Software, Electronic Commerce Software for Small, Midsize and Large Companies, Knowledge Management, Knowledge Management technologies and Software.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. G. P. Schneider, ***Electronic Commerce***, 9th Edition, Cengage Learning, 2010.

Reference Books:

R1. R. Kalakota, A. B. Whinston, ***Frontiers of Electronic Commerce***, 1st Edition, Addision Wesley, 2002.
R2. C. V. S Murthy, ***E-commerce: Concepts, Models & Strategies***, 1st Edition, Himalaya Publishing, 2018.

Online Resources:

1. https://nptel.ac.in/courses/110105083/: by Prof. M. Jenamani, IIT Kharagpur.
2. https://warwick.ac.uk/fac/soc/wbs/conf/olkc/archive/oklc3/papers/id240.pdf: by R. McLean and N. M. Blackie, University of Salford, UK.
3. https://www.researchgate.net/publication/240790062_Knowledge_Management_in_an_E-commerce_System: by Oklahoma State University, USA

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the fundamentals of e-commerce and its relevance to society.
CO2	Explain various e-commerce revenue models and online marketing strategies.
CO3	Discuss B2B activities, Electronic Data Interchange, Supply Chain Management, Mobile Commerce and e-Logistics.
CO4	Explain technical aspects of e-commerce with respect to Hardware and Software components.
CO5	Compare available e-commerce solutions and knowledge management technologies.

Program Outcomes Relevant to the Course:

PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1			2		2	3			2		2	1	
CO2			2		1	2			2		2	2	1
CO3			1		3	2			3		2	1	1
CO4			2		3	1			2		2	2	1
CO5			2		3	2			2		2	1	

Type	Code	Data Structures Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-008		0-0-4	2	100

Objectives	Formulate problems and implement algorithms using the C programming language, to enhance their analysis and problem-solving skills and use the same for developing C programs for the computer.
Pre-Requisites	Basic knowledge of computers and knowledge of C programming language.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Design, develop and implement insert operation on array
2	Design, develop and implement delete operation on array
3	Develop a program for triplet representation of sparse matrix
4	Develop a program for transpose of sparse matrix
5, 6	Develop programs on structure, pointer and dynamic memory allocation
7, 8	Create a single linked-list and perform different operations on single linked-list
9, 10	Create a double linked-list and perform different operations on double linked-list
11, 12	Create a circular linked-list and perform different operations on circular linked-list
13	Develop a program to implement polynomial addition using linked-list
14, 15	Design, develop and implement stack using array and linked list
16, 17	Write programs to implement different applications of stack
18	Develop program to implement of queue using array
19	Develop program to implement queue using linked list
20	Write a program for implementation of circular queue
21, 22	Write program to implement of BST
23	Design, develop and implement graph traversal algorithms
24	Implementation of linear search and binary search
25	Implementation of bubble and selection sort
26, 27, 28	Implementation of insertion sort, quick sort, and merge sort

Text Books:

T1. A. Tenenbaum, ***Data Structures Using C***, 3rd Edition, Pearson Education, 2007.
T2. E. Horowitz, S. Sahni, S. Anderson-Freed, ***Fundamentals of Data Structures in C***, 2nd Edition, Universities Press, 2008.

Reference Books:

R1. M. Weiss, ***Data Structures and Algorithm Analysis in C***, 2nd Edition, Pearson Education, 2002.

R2. J. P. Tremblay and P. G. Sorenson, ***An Introduction to Data Structures with Applications***, 2nd Edition, Tata McGraw-Hill, 1981.
R3. S. Lipchitz, ***Data Structures***, 1st Edition, Tata McGraw-Hill, 2005.

Online Resources:

1. http://nptel.ac.in/courses/106102064/1
2. http://www.nptelvideos.in/2012/11/programming-and-data-structure.html
3. https://www.tutorialspoint.com/data_structures_algorithms/index.htm
4. https://www.coursera.org/learn/data-structures

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Implement various operations on array and Sparse matrix.
CO2	Design functions to implement basic operations on stack and Queue. Apply the concept of stack and queue for solving real world problems.
CO3	Implement various operations of single, double and circular linked list and apply them in various real life applications.
CO4	Construct binary search tree and perform traversal, insertion, deletion, and search operations on it.
CO5	Compare between BFS and DFS traversal operations in a graph and implement various sorting and searching techniques.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	2	2						1	3		3
CO2	3	3	3	2						1	3		3
CO3	3	3	3	2						1	3		3
CO4	3	3	3	2						1	3		3
CO5	3	3	3	2						1	3		3

Type	Code	OOP Using Java Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-009		0-0-2	1	100

Objectives	The objective of the course is to apply object oriented programming principles and implement object oriented programming using JAVA language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other object oriented programming language will be beneficial.
Teaching Scheme	Regular laboratory classes with the use of ICT whenever required, demonstration through practical simulation of code using IDE.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Understanding Java platform, compilation, and execution of a java program.
2	Overview of Eclipse IDE.
3	Use of class, use of control statements, data types, operators.
4	Implement class, object, constructor, methods, and other OOP features.
5	Inheritance Basics, more uses of constructor, method overriding, use of final.
6	Object class, practical use of abstract class.
7	Using Interface for achieving multiple inheritance, implementation of package.
8	Exception handing fundamentals, java built-in exceptions, Use of Scanner class for console input, use of own Exception subclass.
9	Java thread life cycle model and implementation approach, thread priority, implementation of synchronization.
10	I/O Basics, byte stream and character streams, reading and writing files.
11	Applet life cycle implementation, text processing using Java predefined String, StringBuilder and StringBuffer classes.
12	GUI basics and Window fundamentals, working with different Component, Container and Layout Managers.
13	Event handling for interactive GUI application.
14	Java database connectivity using JDBC, steps and use of different drive types.

Text Books:

T1. H. Schildt, ***Java: The Complete Reference***, 9th Edition, McGraw-Hill, 2011.
T2. Y. D. Liang, ***Introduction to Java Programming***, 9th Edition, Pearson Education, 2012.

Reference Books:

R1. B. Bates, K. Sierra, ***Head First Java***, 2nd Edition, O'Reilly Media, 2005.
R2. T. Budd, ***An Introduction to Object-Oriented Programming***, 3rd Edition, Pearson Education, 2009.
R3. I. Horton, ***Beginning Java***, 7th Edition, Wrox Publications, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105191/
2. https://docs.oracle.com/javase/tutorial/
3. http://www.javatpoint.com/java-tutorial
4. http://www.w3schools.in/java/
5. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-00-introduction-to-computer-science-and-programming-fall-2008/video-lectures/lecture-14/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply object oriented principles in software design process and develop Java programs for real-life applications.
CO2	Employ inheritance and exception handling techniques for developing robust, reusable software.
CO3	Develop programs using stream classes for various I/O operations and design concurrent programs using threads to maximize the use of processing power.
CO4	Design applications for text processing using String class and develop user interactive applications using event handling.
CO5	Design database driven GUI applications using AWT, Swing and JDBC.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	1	2				3	3		3
CO2	3	2	2	1	1	2				3	3		3
CO3	3	1	2	2	1	2				3	3	1	3
CO4	3	2	3	1	1	2				3	3	1	3
CO5	3	2	3	2	1	2				3	3	2	3

Type	Code	Database Management Systems Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-022		0-0-2	1	100

Objectives	The objective of this lab course is to provide a hands-on practice on database design, creation, data storage, and data manipulation including advanced database programming concepts to groom the students into well-informed database programmers and data-driven application developers.
Pre-Requisites	Basic analytical skills and knowledge of programming language are required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Oracle databases, simple queries for data retrieval.
2	Using single-row functions and group function in SQL queries for data retrieval.
3	Writing complex queries using sub-queries
4	Use DDL and various constraints for design of tables
5	Data manipulation using various DML statements.
6	Retrieve data from multiple tables using various types of JOIN operations.
7	Create, alter, and manage Views from single & multiple base tables.
8	Create and use other data base objects like sequence, indexes, and synonyms.
9	Introduction to PL/SQL, identifiers, literals, and keywords
10	Write PL/SQL block by using conditional statements and expressions.
11	Using different types of Loops in a PL/SQL block.
12	Implement Exception Handling in a PL/SQL block.
13	Write PL/SQL block to retrieve data using CURSORs
14	Introduction to Stored Procedures, Write PL/SQL block using procedures.

Text Books:

T1. K. Loney, ***Oracle Database 11g - The Complete Reference (Oracle Press)***, 1st Edition, McGraw-Hill Education, 2009.
T2. I. Bayross, ***Teach Yourself SQL/PL SQL Using Oracle 8i and 9i with SQLJ***, BPB Publications, 2010.

Reference Books:

R1. S. Feuerstein, ***Oracle PL/SQL Programming***, 6th Edition, O'Reilly, 2014.
R2. A. Silberschatz, H. F. Korth, and S. Sudarshan, ***Database System Concepts***, 6th Edition, McGraw-Hill Education, 2013.

P.T.O

Online Resources:

1. https://docs.oracle.com/cd/E11882_01/server.112/e40402.pdf
2. https://docs.oracle.com/cd/B28359_01/server.111/b28286/toc.htm
3. https://www.tutorialspoint.com/oracle_sql/index.asp
4. https://www.javatpoint.com/oracle-tutorial

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Construct queries using SQL and retrieve data from a database using single/multi-row functions, and sub-queries.
CO2	Design relational tables imposing integrity constraints, operate on table using DDL/DML statements and share data using join.
CO3	Create other database objects like views, sequences and indices.
CO4	Write PL/SQL programs including control structures, and loops for real-world applications.
CO5	Implement the techniques using exception handling Procedures, and Functions, Parameters in PL/SQL.

Program Outcomes Relevant to the Course:

PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1		2		2	2					1	1		3
CO2		2		2	2					1	1		3
CO3			2	2	2					1	1		3
CO4		2		2	2					1	1		3
CO5		2		1	2					1	1		3

Type	Code	Software Engineering & UML Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-036		0-0-2	1	100

Objectives	The objective of this lab course is to apply software engineering principles for development of a software product starting with creation of SRS, function and object oriented design using UML and CASE tools, coding and testing.
Pre-Requisites	Basic analytical and logical ability with fundamental knowledge of procedural & object oriented programming is required. Topics taught in the theory class are essential to do the assignments.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of design, modelling, programming, and testing assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to the complete objectives of the course & CASE tool. Assignment of case study projects to student groups.
2	Requirement Analysis of the assigned case study project.
3	Requirement Specification of the assigned case study project.
4	Function Oriented Design Phase: Creation of structure chart and Level-0 DFD.
5	Function Oriented Design Phase: Creation of DFD Level-1, 2 etc.
6	Object Oriented Design Phase: Creation of Use Case UML model.
7	Object Oriented Design Phase: Creation of Class UML diagram.
8	Object Oriented Design Phase: Creation of Activity and Sequence UML diagrams.
9	Object Oriented Design Phase: Creation of Collaboration, Statechart UML diagrams.
10	Object Oriented Design Phase: Creation of Component and Deployment UML diagrams.
11	Development of User Interface of the case study project.
12	Development and Unit testing of the case study project using programming language of choice (Java, C++, .NET etc.) - Part 1.
13	Development and Unit testing of the case study project using programming language of choice (Java, C++, .NET etc.) - Part 2.
14	Testing of the case study project (Integration, System test).

Text Books:

T1. R. Mall, ***Fundamentals of Software Engineering***, 4th Edition, PHI Learning, 2014.
T2. C. Larman, ***Applying UML and Patterns***, 3rd Edition, Pearson Education, 2015.

P.T.O

Reference Books:

R1. I. Somerville, ***Software Engineering***, 9th Edition, Pearson Education, 2013.
R2. R. S. Pressman, ***Software Engineering - A Practitioner's Approach***, 7th Edition, McGraw Hill Education, 2010.

Online Resources:

1. https://nptel.ac.in/courses/106105182/: by Prof. Rajib Mall, IIT Kharagpur.
2. https://nptel.ac.in/courses/106101061/: by Prof. N. L. Sharda, IIT Bombay.
3. https://training-course-material.com/training/UML_Analysis_and_Design: by NobleProg on UML models
4. https://www.visual-paradigm.com/tutorials/data-flow-diagram-dfd.jsp: by Visual Paradigm on DFDs
5. https://www.tutorialspoint.com/software_engineering/software_engineering_tutorial.pdf

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Perform requirement analysis and prepare SRS document for a software product.
CO2	Design a software using FOD methodology and create the Structure Charts & DFDs.
CO3	Design a software using OOD methodology and create UML models using a CASE tool.
CO4	Develop the design of User Interfaces of a software using principles of a good design.
CO5	Develop a software using a high-level programming language or tool and test the product.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1		2		2	3			3	1	3
CO2	2	3	2		2		2	3			3	2	3
CO3	2	3	2		3		2	3			3	2	3
CO4	2	3	2		3		2	3			3	2	3
CO5	2	3	3		3		2	1			3	2	3

Type	Code	Personality Development & Soft Skills Lab	L-T-P	Credits	Marks
HS	MCBS-P-HS-007		0-0-2	1	100

Objectives	The objective of this course is to help students work on their personality development through an understanding of Soft skills, participate in Group Discussions (GD), present their views in public, perform well in Personal Interviews, and become successful in a corporate scenario.
Pre-Requisites	Basic knowledge of English grammar and the ability to speak, read and write using the English language is required.
Teaching Scheme	Ample tasks designed to facilitate communication through pair work, group/team work, individual and group presentations, discussions, role plays, listening to audios, watching videos, business writing and vocabulary enhancement.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Introduction to Group Discussions (GD)
2	Mock GD 1.
3	Mock GD 2.
4	Mock GD 3.
5	Interview skills: Preparing for interviews through mock interview session.
6	Writing a good and effective C.V. and SWOC presentation.
7	Assertiveness and EI: Theory inputs and activities.
8	Conducting Mock Interviews.
9	Team work activity: building blocks of a team - discussion & activity.
10	Panel Discussion.
11	Verbal Ability – I: synonyms, antonyms, homonyms, one word substitutes.
12	Verbal Ability – II: jumbled paragraphs, error corrections.
13	Summarizing and note making: techniques and important tips.
14	Personality assessment: conducting an MBTI (Myers Bigiggs Type Indicator) test, self-assessment and discussion.

Text Books:

T1. M. A. Rizvi, ***Effective Technical Communication***, 2nd Edition, McGraw-Hill Education, 2017.
T2. T. Balasubramaniam, ***English Phonetics for Indian Students***, 2nd Edition, Macmillan Publishers, 2012.
T3. M. Raman and S. Sharma, ***Technical Communication: Principles and Practice***, 2nd Edition, Oxford University Press, 2011.

P.T.O

Reference Books:

R1. S. Samantray, ***Business Communication and Communicative English***, Sultan Chand.
R2. J. Seeley, ***The Oxford Guide to Effective Writing and Speaking***, 2nd Edition, Oxford University Press, 2005.
R3. B. K. Mitra, ***Communication Skills for Engineers***, Oxford University Press, 2011.
R4. B. K. Das, K. Samantray, R. Nayak, S. Pani, and S. Mohanty, ***An Introduction to Professional English and Soft Skills***, Cambridge University Press, 2009.

Online Resources:

1. https://nptel.ac.in/courses/109104107/
2. https://nptel.ac.in/courses/109104031/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Participate effectively in Group Discussions.
CO2	Work on their own personality through self-assessment by SWOC and MBTI.
CO3	Perform well in Personal Interviews.
CO4	Develop Vocabulary Skills.
CO5	Work effectively both as a team leader and a team member.

Program Outcomes Relevant to the Course:

PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1						1	2	3		2	2	1	2
CO2						1	2	3		2	2	1	2
CO3						1		3		2		1	2
CO4						2	3	3		2	1	1	3
CO5						1	3	3		2	2	2	3

Part II

2nd Year MCA

Curriculum Structure

Semester III								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
PC	MCCS-T-PC-012	Design & Analysis of Algorithms	3	0	0	3	0	0
PC	MCCS-T-PC-027	Web Application Development	3	1	0	3	1	0
PE		Professional Elective - I	3	0	0	3	0	0
PE		Professional Elective - II	3	0	0	3	0	0
PE		Professional Elective - III	3	0	0	3	0	0
MC	MCBS-T-MC-008	Universal Human Values & Professional Ethics	2	0	0	0	0	0
PRACTICAL								
PC	MCCS-P-PC-023	Design & Analysis of Algorithms Lab	0	0	2	0	0	1
PC	MCCS-P-PC-024	Python Programming Lab	0	0	4	0	0	2
PC	MCCS-P-PC-027	Web Application Development Lab	0	0	4	0	0	2
PJ	MCII-P-PJ-002	Summer Internship	0	0	0	0	0	1
		SUB-TOTAL	**17**	**1**	**10**	**15**	**1**	**6**
		TOTAL	**28**			**22**		

Semester IV								
Type	**Code**	**Course Title**	**WCH** L-T-P			**Credits** L-T-P		
THEORY								
OO		MOOC	0	0	0	3	0	0
PRACTICAL								
PJ	MCCS-P-PJ-038	Project Work / Industry Internship	0	0	24	0	0	12
VV	MCCS-P-VV-040	Comprehensive Viva	0	0	0	0	0	1
MC	MCBS-P-MC-043	Yoga/NCC/NSS	0	0	2	0	0	0
		SUB-TOTAL	**0**	**0**	**26**	**3**	**0**	**13**
		TOTAL	**26**			**16**		

		GRAND TOTAL (4 SEMESTERS)	**108**			**84**		

Note:

1. *MOOC - Massive Open Online Course.*
2. *Approved list of courses for MOOC (self study) shall be published by the department.*
3. *Courses offered under each elective are given in "List of Electives" on Page 43.*

List of Electives

Code	Elective # and Subjects
Professional Elective-I	
MCCS-T-PE-017	Artificial Intelligence
MCCS-T-PE-014	Theory of Computation
MCCS-T-PE-035	Software Testing
MCCS-T-PE-033	Internet of Things
Professional Elective-II	
MCCS-T-PE-042	Machine Learning
MCCS-T-PE-018	Compiler Design
MCCS-T-PE-021	Cloud Computing
MCCS-T-PE-031	Cryptography & Internet Security
Professional Elective-III	
MCCS-T-PE-016	Soft Computing
MCCS-T-PE-019	Data Warehousing & Business Intelligence
MCCS-T-PE-028	Software Project Management
MCCS-T-PE-030	Mobile Computing

Type	Code	Design & Analysis of Algorithms	L-T-P	Credits	Marks
PC	MCCS-T-PC-012		3-0-0	3	100

Objectives	The objective of this course is to study the classic algorithms in various domains, techniques for designing efficient algorithms, apply different algorithm design techniques to solve complex problems, and analyze the complexities of the solutions.
Pre-Requisites	Knowledge of Discrete Mathematics and Data Structures is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction, Definition, Characteristics of algorithms, Growth of Functions, Asymptotic analysis, Standard notations and common functions, Recurrences, Solution of recurrences by iterative, Recursion tree, Substitution and Master method; Algorithm design techniques, Divide and conquer strategy, Merge Sort, Quick Sort.	**10 Hours**
Module-2	Heaps, Types of Heap, Maintaining the heap property, Building a Heap, The Heap-sort algorithm, Priority Queue; Lower bounds of sorting; Dynamic Programming, Elements of dynamic programming, Matrix chain multiplication, Longest Common Subsequence, Assembly-Line Scheduling.	**8 Hours**
Module-3	Greedy algorithms, Elements of Greedy strategy, Activity selection problem, Fractional Knapsack problem, Huffman codes; Backtracking and Branch & Bound techniques (n-Queen, Knapsack and Travelling Salesman Problem); Data structure for disjoint sets, Disjoint set operations.	**8 Hours**
Module-4	Graph algorithms and their characteristics, Breadth-first and Depth-first search, Minimum spanning trees, Kruskal and Prim's algorithms, Single-source shortest path algorithms (Bellman-Ford, Dijkstra), All-pair shortest path algorithm (Floyd-Warshall) with their analysis; Maximum flow problem, Ford-Fulkerson algorithm and its analysis.	**8 Hours**
Module-5	String matching algorithms (Naive, Rabin-Karp, Knuth-Morris-Pratt algorithm); NP completeness (Polynomial time, Polynomial time verification, NP completeness and reducibility), Cook's Theorem (without proof), Vertex cover, Ham-cycle, TSP; Approximation algorithm characteristics, Travelling Salesman Problem.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. T. H.Cormen, C. E.Leiserson, R. L.Rivest, and C. Stein, ***Introduction to Algorithms***, 3rd Edition, PHI Learning, 2014.

T2. E. Horowitz, S. Sahni, and S. Rajasekaran, ***Fundamentals of Computer Algorithms***, 2nd Edition, University Press, 2015.

Reference Books:

R1. J. Kleinberg and E. Tardos, ***Algorithm Design***, 1st Edition, Pearson Education, 2013.
R2. M. T. Goodrich and R. Tamassia, ***Algorithm Design : Foundations, Analysis, and Internet Examples***, 1st Edition, John Wiley & Sons, 2001.
R3. U. Manber, ***Introduction to Algorithms : A Creative Approach***, 1st Edition, Addison-Wesley, 1989.

Online Resources:

1. https://nptel.ac.in/courses/106101060/
2. https://nptel.ac.in/courses/106106131/
3. http://www.cs.virginia.edu/~robins/CS_readings.html
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain and analyze complexities of algorithms and apply divide & conquer strategy for sorting problems.
CO2	Compare different sorting algorithms and use dynamic programming technique for solving optimization problems.
CO3	Apply various algorithm design techniques such as greedy, backtracking, and branch-and-bound in real life problems.
CO4	Model an engineering problem using graphs and develop algorithms to solve the problem.
CO5	Compare various pattern matching algorithms, understand NP complete problems, and design approximation algorithms for some of these problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	1	2	1					2	3		2
CO2	3	2	3	3	1	2				1	3		2
CO3	3	3	3	3	1	2				1	3		2
CO4	3	2	3	3	1	2				1	3		2
CO5	2	2	2	3	1	1				2	3		2

Type	Code	Web Application Development	L-T-P	Credits	Marks
PC	MCCS-T-PC-027		3-1-0	4	100

Objectives	The objective of this course is to introduce the background, terminologies and fundamental concepts needed to build modern database driven web applications using full stack technology on open source platforms.
Pre-Requisites	Knowledge of programming, object orientation & database concepts are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with programming activities and case studies.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Web Design Principles: Basic principles involved in developing a website, Planning process, Five Golden Rules of web designing; HTML and CSS: Introducing Bootstrap, Working with Layouts & Containers, Inserting rows and columns to layout, Using Responsive Utility Classes, Working with Content – Headings, Paragraphs, Lists, Tables, Forms, Typography, Components – Button, Labels, Checkbox and Radio buttons, Inline Forms, Using Cards in layout, Adding Breadcrumbs, Using Pagination component.	**10 Hours**
Module-2	JavaScript: Working with Data types and Variables, Conditional and Looping statements, Arrays; jQuery: Adding jQuery to a page, DOM, Page Elements – Selectors, Filters, Setting and Removing Attributes, Events – Mouse, Document, Form and Keyboard events, jQuery Event concepts, jQuery Effects, Form Validation; Ajax: The basics, Ajax the Query way – load, get and post, JSON – Accessing JSON data.	**10 Hours**
Module-3	Angular JS: Introduction to Angular JS, Directives, Expressions, Controllers, Filters, Services, Events, Forms, Validations; Node JS: Introduction, Event-driven programming, Node.js Modules, Node.js File Module, Node.js Events; React JS: Introduction, Obstacles and Roadblocks, Keeping up with the changes, Working with the Files, Pure React, Page Setup, The Virtual DOM, React Elements, React DOM, Children, Constructing Elements with Data, React Components, DOM Rendering, Factories.	**12 Hours**
Module-4	PHP: Introduction – Variables, Constants, Operators and Conditionals, Arrays, Strings, Numbers, Functions, Date and Time, Validating Form Data; Objects – Classes and Objects, Inheritance, Introspection, Dynamic PDF files creation.	**12 Hours**
Module-5	MySQL: Naming Database Elements, Choosing Column Types and Properties, Accessing MySQL; Using PHP with MySQL – Connecting to MySQL, Executing and Retrieving Query Results, Updating Records with PHP, Paginating Query Results, Making Sortable Displays, Using Cookies and Sessions.	**12 Hours**
	Total	**56 Hours**

Text Books:

T1. J. C. Jackson, ***Web Technologies – A Computer Science Perspective***, 1st Edition, Pearson Education, 2006.
T2. S. Seshadri and B. Green, ***Angular JS: Up and Running - Enhanced Productivity with Structured Web Apps***, 1st Edition, O'Reilly Media, 2014.
T3. L. Ullman, ***PHP and MySQL for Dynamic Web Sites***, 5th Edition, Peachpit Press, 2017.
T4. A. Fedosejev, ***React.js Essentials: A Fast-paced Guide to Designing and Building Scalable and Maintainable Web Apps with React.js***, 1st Edition, Packt Publishing, 2015.

Reference Books:

R1. A. Banks and E.Porcello, ***Learning React: Functional Web Development with React and Redux***, 1st Edition, O'Reilly Media, 2017.
R2. R. W. Sebesta, ***Programming the World Wide Web***, 4th Edition, Pearson Education, 2007.

Online Resources:

1. https://nptel.ac.in/courses/106105084
2. https://www.w3schools.com/react/default.asp
3. https://nodejs.dev/learn/introduction-to-nodejs

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Design responsive web pages using HTML, CSS, and Bootstrap.
CO2	Add front-end functionality to web pages using javascript, jQuery, and Ajax.
CO3	Create controllers and display data using Angular Js and Nested Forms.
CO4	Develop web applications using server side scripting using PHP.
CO5	Develop interactive and dynamic database driven web applications using PHP & MySQL.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	1	3	1				2	1		
CO2	3	2	2	1	3	1				2	1		
CO3	3	1	2	2	3	1				1	1	1	2
CO4	3	2	3	1	3	1				1	2	2	1
CO5	3	2	3	1	3	1				1	2	1	2

Type	Code	Artificial Intelligence	L-T-P	Credits	Marks
PE	MCCS-T-PE-017		3-0-0	3	100

Objectives	The objective of the course is to present an insight of Artificial Intelligence (AI) concepts, principles and approaches used to develop intelligent agents for various computer applications.
Pre-Requisites	Knowledge of computer programming, data structures & algorithms, discrete mathematics and probability theory are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Artificial Intelligence: Introduction, Intelligent Agents - Agents and Environment, Good Behavior, Nature of Environments, Structure of Agents; Problem Solving: Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Searching with Partial Information.	**8 Hours**
Module-2	Informed Search and Exploration: Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search Algorithms & Optimization Problems; Constraint Satisfaction Problems (CSPs): Introduction, Backtracking Search for CSPs, Local Search for CSPs; Adversarial Search: Games, Optimal Decisions in Games, Alpha-Beta Pruning.	**9 Hours**
Module-3	Knowledge & Reasoning: Knowledge-Based Agents, The Wumpus World; Logic: Propositional Logic & Reasoning Patterns; First-Order Logic: Syntax and Semantics, Using FOL, Knowledge Engineering in FOL; Inference in FOL: Propositional vs. FOL, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution; Knowledge Representation: Ontological Engineering, Categories & Objects, Semantic Networks, Frames.	**9 Hours**
Module-4	Planning: The Planning Problem, Planning with State-Space Search, Partial-Order Planning, Planning Graphs; Uncertain Knowledge & Reasoning: Acting under Uncertainty, Basic Probability Notations, Bayes' Rule and its use; Probabilistic Reasoning: Representing Knowledge in an Uncertain Domain, Semantics of Bayesian Networks.	**8 Hours**
Module-5	Learning: Learning from Observations, Forms of Learning, Inductive Learning, Learning Decision Trees; Statistical Learning Methods: Instance Based Learning, Neural Networks; Reinforcement Learning: Passive and Active Reinforcement Learning; Communication: Communication as Action, A Formal Grammar for a Fragment of English, Syntactic & Semantic Analysis; Expert Systems: Introduction, Architecture, Representations.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. S. J. Russell and P. Norvig, ***Artificial Intelligence - A Modern Approach***, 3rd Edition, Pearson Education, 2016.
T2. D. W. Patterson, ***Introduction to Artificial Intelligence & Expert Systems***, Pearson Education, 2015.

Reference Books:

R1. E. Rich, K. Knight, and S. B. Nair, ***Artificial Intelligence***, 3rd Edition, McGraw Hill, 2017.
R2. G. F. Luger, ***Artificial Intelligence***, 5th Edition, Pearson Education, 2009.
R3. M. Negnevitsky, ***Artificial Intelligence: A Guide to Intelligent Systems***, 2nd Edition, Pearson Education, 2008.
R4. N. J. Nilson, ***Principles of Artificial Intelligence***, 1st Edition, Narosa, 2002.
R5. E. Charniak and D. McDermott, ***Introduction to Artificial Intelligence***, 1st Edition, Addison-Wesley, 1985.

Online Resources:

1. https://nptel.ac.in/courses/106105077/: by Prof. S. Sarkar & Prof. A. Basu, IIT Kharagpur
2. https://nptel.ac.in/courses/106105079/: by Prof. P. Mitra, IIT Kharagpur
3. https://nptel.ac.in/courses/106106140/: by Prof. D. Khemani, IIT Madras

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explore agents and working environments with utilization of uninformed techniques in state space search.
CO2	Apply search techniques for Game playing and solving constraint satisfaction problems.
CO3	Interpret logic & inference rules for decision making & knowledge representation.
CO4	Apply planning and reasoning to handle uncertainty in real life problems.
CO5	Use learning to solve complex real-life problems and design of expert systems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	3						1	2	1	1
CO2	2	3	2	3						1	3	1	2
CO3	3	2	2	3						1	3	1	1
CO4	3	2	2	2		1				1	3	1	1
CO5	2	2	2	2		2				1	3	1	2

Type	Code	Theory of Computation	L-T-P	Credits	Marks
PE	MCCS-T-PE-014		3-0-0	3	100

Objectives	The objective of this course to study the mathematical foundations of computation including Automata theory, formal languages and grammars, concept of algorithms, decidability, complexity, and computability.
Pre-Requisites	Basic knowledge of discrete mathematics is required.
Teaching Scheme	Regular classroom lectures with use of ICT as required; sessions are planned to be interactive with focus on problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Automata Theory, Computability theory, Complexity theory, Mathematical notations & terminology; Alphabet, String, Languages & operations on strings; Formal definition of DFA, Transition function, Transition table, State transition diagram, Extended transition function, Language of DFA, Design of DFA; Finite Automata (Non-deterministic): Formal definition, Extended transition function, Language of NFA, Equivalence of DFA and NFA, NFA with ϵ-transition: Formal definition of NFA (ϵ), Extended transition function, Language of NFA (ϵ), Eliminating ϵ-transitions from NFA, conversion from ϵ-NFA to DFA, Minimization of DFA.	**9 Hours**
Module-2	Moore Machines, Mealy Machines; Regular Expressions: Operators in Regular Expressions (RE) and their precedence, Definition of RE, Building REs, From DFA to RE, RE to DFA, Arden's theorem, Pumping Lemma for Regular languages, Closure properties of Regular languages.	**8 Hours**
Module-3	Introduction to Grammars: Definition, Derivation of string, Leftmost and Rightmost derivation; Definition of Left and right linear grammars, Regular grammars; Context free grammars: Definition, Derivation of string, Language of CFG, Parse Tree, Ambiguity in Grammar, Elimination of ambiguity; Normal Forms of CFG: Chomsky and Greibach Normal Forms, Converting CFG to CNF & GNF, Cook, Younger, Kasami Algorithm, Closure properties of context free languages.	**9 Hours**
Module-4	Push Down Automata: Basic Model, Components, Moves of a PDA, ID of a PDA, Design of a PDA, PDA to CFG and CFG to PDA conversion, Pumping Lemma for CFL; Turing Machines: Model, Components, Move of a TM, ID of TM, Design of a TM, Variation of Turing Machine model, Universal Turing Machine and Undecidable problems.	**8 Hours**

Cont'd...

Module-#	Topics	Hours
Module-5	Church Turing hypothesis, Recursive & recursively enumerable sets, Chomsky's hierarchy of languages; Undecidability of Post Correspondence problem; Linear Bounded Automata & Context Sensitive languages, Primitive Recursive functions: μ-Recursive functions, Ackermann's function, Excursiveness of Ackermann and Turing computable functions, Cantor & Godel numbering; NP Completeness: P and NP, NP complete and NP Hard problems.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. J. E. Hopcroft, R. Motwani, and J. D. Ullman, ***Introduction to Automata Theory, Languages and Computation***, 3rd Edition, Pearson Education, 2007.
T2. P. Linz, ***An Introduction to Formal Languages and Automata***, 4th Edition, Jones & Bartlett Learning, 2006.

Reference Books:

R1. M. Sipser, ***Introduction to the Theory of Computation***, 3rd Edition, Cengage Learning, 2012.
R2. J. C. Martin, ***Introduction to Languages and the Theory of Computation***, 4th Edition, Tata McGraw-Hill, 2010.
R3. K. L. P. Mishra, and N. Chandrasekaran, ***Theory of Computer Science: Automata, Languages and Computation***, 3rd Edition, PHI, 2012.

Online Resources:

1. https://nptel.ac.in/courses/111/103/111103016/: by Dr. K.V. Krishna and Dr. D. Goswami, IIT Guwahati
2. https://nptel.ac.in/courses/106/106/106106049/: by Prof. K. Krithivasan, IIT Madras
3. https://nptel.ac.in/courses/106/105/106105196/: by Prof. S. Mukhopadhyay, IIT Kharagpur
4. https://www.ics.uci.edu/~goodrich/teach/cs162/notes/: by Prof. M. T. Goodrich, University of California, Irvine, USA

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop and implement mathematical models with DFA, NFA for regular languages and grammar for real life applications.
CO2	Design and implement grammar and PDA for context free languages and demonstrate their properties.
CO3	Construct Turing machines for context sensitive and un-restricted languages.
CO4	Describe the Chomsky hierarchy of Formal Languages and Grammar.
CO5	Illustrate the relevance of the Church-Turing thesis, explain the concept of decidability & recursive enumerability, and classify a given language to the P, NP or NPC complexity classes.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.

Cont'd...

PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	1					2	3		3
CO2	3	2	3	1	3					2	3		2
CO3	3	3	3	2	3					2	3		2
CO4	2	3	2	2						2	3		2
CO5	2	2	2	3							3		2

Type	Code	Software Testing	L-T-P	Credits	Marks
PE	MCCS-T-PE-035		3-0-0	3	100

Objectives	The objective of this course is to introduce the fundamental concepts, processes, and systematic methodologies of Software Testing and their implications on different stages of software development & maintenance.
Pre-Requisites	Basic programming knowledge, understanding of databases / data modeling and adequate knowledge of software engineering are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Testing as an Engineering Activity, Role of Process in Software Quality, Testing as a Process, TMM Overview, Basic Definitions, Software Testing Principles - The Tester's Role, Origins of Defects, Defect Classes, The Defect Repository and Test Design Defect Examples, Developer/Tester Support for Developing a Defect Repository.	**8 Hours**
Module-2	Test Case Design: Testing Design Strategies, The Smarter Tester, Test-Case Design Strategies, Using Black-Box Approach to Test-Case Design, Random Testing, Equivalence Class Partitioning, Boundary Value Analysis, Other Black Box Test Design Approaches, Decision Tables, Requirements based Testing, Positive and Negative Testing, Compatibility Testing, User Documentation Testing, Domain Testing, Using the White Box Approach to Test Design, Test Adequacy Criteria, Coverage and Control Flow Graphs, Covering Code Logic, Paths Testing, Data Flow and White Box Test Design, Loop Testing, Mutation Testing, Evaluating Test Adequacy Criteria.	**11 Hours**
Module-3	Levels of Testing: The Need for Levels of Testing, Unit Test - Functions, Procedures, Classes, and Methods as Units, The Need for Preparation, Unit Test Planning, Designing the Unit Tests, The Class as a Testable Unit, The Test Harness, Running the Unit Tests and Recording Results; Integration Test - Goals, Integration Strategies for Procedures, Functions, and Classes, Designing Integration Tests, Integration Test Planning; System Test - Functional Testing, Performance Testing, Stress Testing, Configuration Testing, Security Testing, Recovery Testing, Regression Testing, Alpha, Beta, and Acceptance Tests.	**11 Hours**
Module-4	Test Management: People Issues in Testing, Organization structures for Testing Teams (Single Product and Multi-Product Companies), Testing Services Organization, Test Planning, Test Plan Components, Test Management, Test Process, Test Reporting, Software test automation, Skills needed for Automation, Scope of Automation, Design and Architecture for Automation, Requirements for a Test Tool, Challenges in Automation.	**6 Hours**

Cont'd...

Module-#	Topics	Hours
Module-5	Control, Monitoring, and Quality Assurance: Measurements and Milestones (Testing Status, Tester Productivity, Testing Costs, Errors, Faults & Failures, Test Effectiveness), Criteria for Test Completion, Types of Reviews, Review Metrics; Quality Control, Operational Profiles and Usage Models, Support for Quality Control, Statistical Testing, Software Reliability, Measurements for Software Reliability, Reliability, Quality Control, and Stop-Test Decisions, Applying Reliability Models, Internationalization Testing, Ad-hoc Testing, Testing OO-systems, Usability and Accessibility Testing.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. I. Burnstein, ***Practical Software Testing***, 1st Edition, Springer, 2003.
T2. S. Desikan and G. Ramesh, ***Software Testing - Principles and Practices***, 1st Edition, Pearson Education, 2006.

Reference Books:

R1. A. P. Mathur, ***Foundations of Software Testing***, 2nd Edition, Pearson Education, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105150/: by Prof. R. Mall, IIT Kharagpur
2. https://nptel.ac.in/courses/106101163/: by Prof. M. D'Souza, IIIT Bangalore.
3. https://www.softwaretestingmaterial.com/manual-testing-tutorial/
4. https://www.guru99.com/software-testing.html

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the relevance of testing as an engineering activity and realize the defects that are inherent to software applications.
CO2	Explain different testing strategies and select appropriate strategy for software testing.
CO3	Analyze different levels of testing in the perspective of product requirements and delivery.
CO4	Develop understanding of the test management procedures & create test plans for test automation.
CO5	Practice quality aspects, standards & models required to deliver software of assured quality.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3			2	1		1	2		1	2		2
CO2	3			2	3		2	2		1	1	1	3
CO3	2			2	3		3	1		1	2		2
CO4	1			2	3		3	3		2	2		3
CO5	1			2	1		3	3		1	2		3

Type	Code	Internet of Things	L-T-P	Credits	Marks
PE	MCCS-T-PE-033		3-0-0	3	100

Objectives	The objective of this course is to study different security goals and mechanisms with primary focus on cryptography techniques used to protect from various security threats in computer networks and Internet.
Pre-Requisites	Basic knowledge of computer networks, sensor network, micro-processor and micro-controllers is required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as needed, sessions are planned to be interactive with examples, programming, and idea generation activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to IoT: Definition, Characteristic, Components of IoT, Design of IoT systems, Technology and systems implementing IoT, Levels of IoT, Sensors, Actuators, Power Supply.	**8 Hours**
Module-2	IoT Network Model: OSI reference model, Layers in IoT; Protocols: MAC based Protocols, IP based Protocols, Simple Network Management Protocol (SNMP), NetConf, Yang.	**10 Hours**
Module-3	M2M: IoT vs M2M, Software Defined Networking, Network Function Virtualization; IoT Platform Design: IoT Design Methodology, Resource Management in IoT, Data Synchronization.	**9 Hours**
Module-4	Devices: Zigbee, Bluetooth, Wi-fi, RFID, Cloud Computing, Big Data.	**9 Hours**
Module-5	Case Studies: IoT in Smart Home, Smart Grid, Agriculture, Healthcare, Smart Industry, Environment, Smart Cities.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Bahga, V. Madisetti, ***Internet of Things : A Hands-on Approach***, 1st Edition, University Press, 2018.
T2. O. Hersent, D. Boswarthick, and O. Elloumi, ***The Internet of Things : Key Applications and Protocols***, Student Edition, Wiley, 2016.

Reference Books:

R1. D. Uckelmann, M. Harrison, and F. Michahelles, ***Architecting the Internet of Things***, 1st Edition, Springer, 2011.
R2. R. Buyya and A. V. Dastjerdi, ***Internet of Things : Principles and Paradigms***, 1st Edition, Elsevier, 2016.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105166/: by Prof. S. Misra, IIT Kharagpur
2. https://nptel.ac.in/courses/108/108/108108098/: by Prof. T. V. Prabhakar, IISc Bangalore

P.T.O

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe basic concepts of IoT, its architecture and system design.
CO2	Visualize the communication mechanisms between sensors and systems using various protocols and network models.
CO3	Explain IoT with respect to machine to machine and design IoT systems with data synchronization and resource manipulation.
CO4	Describe advanced IoT concepts applied in various devices prevalent in the market.
CO5	Envisage and compare real-world applications of IoT in different domains.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3		1			1			1	2	3	1	3
CO2	2		3			2			2	2	2	1	3
CO3	3		3			2			2	2	2	1	3
CO4	2		3			2			2	2	2	1	2
CO5	3		3			2			2	3	3	1	3

Type	Code	Machine Learning	L-T-P	Credits	Marks
PE			3-0-0	3	100

Objectives	The objective of this course is to introduce fundamental concepts and methods for machine learning along with analysis of large data sets.
Pre-Requisites	Basic knowledge of probability and statistics is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Overview of supervised learning, K-nearest neighbour, Multiple linear regression, Shrinkage methods (Ridge regression, Lasso regression), Subset selection, Linear Discriminant Analysis, Logistic regression.	**9 Hours**
Module-2	Bias, Variance, and model complexity, Cross-validation, Bootstrap methods, Regression and classification trees, Boosting methods, AdaBoost and Random forest.	**8 Hours**
Module-3	Generative model for discrete data (Bayesian concept learning, Naïve Bayes classifier), SVM for classification, Reproducing Kernels, SVM for regression.	**8 Hours**
Module-4	Clustering (K-means, spectral clustering), Feature Extraction (Principal Component Analysis (PCA), kernel based PCA, Independent Component Analysis (IDA), Non-negative matrix factorization).	**9 Hours**
Module-5	Introduction to Reinforcement learning, Single State Case: K-Armed Bandit, Elements of Reinforcement Learning, Model-Based Learning (Value Iteration, Policy Iteration).	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. T. Hastie, R. Tibshirani, and J. Friedman, ***The Elements of Statistical Learning - Data Mining, Inference, and Prediction***, 2nd Edition, Springer, 2009.
T2. S. Haykin, ***Neural Networks and Learning Machines***, 3rd Edition, Pearson Education, 2009.

Reference Books:

R1. Y. G. James, D. Witten, T. Hastie, and R. Tibshirani, ***An Introduction to Statistical Learning with Applications in R***, 1st Edition, Springer, 2013.
R2. T. M. Mitchell, ***Machine Learning***, 1st Edition, McGraw Hill Education, 2013.
R3. C. M. Bishop, ***Pattern Recognition and Machine Learning***, 1st Edition, Springer, 2006.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105152/: by Prof. S. Sarkar, IIT Kharagpur.
2. https://nptel.ac.in/courses/106/106/106106139/: by Prof. B. Ravindran, IIT Madras.
3. https://nptel.ac.in/courses/106/106/106106202/: by Prof. C. G. Jansson, IIT Madras.

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply supervised learning to solve related real-life problems.
CO2	Analyze a problem and select the most suitable supervised model for the same.
CO3	Apply classification & regression models such as SVM and decision models.
CO4	Preform clustering of given data with extraction of important features.
CO5	Apply the concepts of reinforcement learning to solve relevant real-life problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	3	1						1	3	1	2
CO2	3	2	3	1						1	3	1	3
CO3	3	3	3	2						1	3	1	3
CO4	3	2	2	2						1	3	1	3
CO5	2	3	2	2						1	3	1	3

Type	Code	Compiler Design	L-T-P	Credits	Marks
PE	MCCS-T-PE-018		3-0-0	3	100

Objectives	The objective of this course is to study the different phases of compiler, techniques for designing efficient parser, generation of the intermediate code, and code optimization techniques in different language constructs to generate efficient machine code.
Pre-Requisites	Knowledge of data structures and theory of computation is required.
Teaching Scheme	Regular classroom lectures with use of ICT as required, sessions are planned to be interactive with focus on algorithms, problem solving, and examples.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Overview of Compilation: Structure of a compiler, Applications of compiler technology; Lexical analysis - The role of a lexical analyzer, specification of tokens, recognition of tokens, LEX, examples of LEX programs.	**6 Hours**
Module-2	Introduction to Syntax Analysis: Role of a parser, Use of context-free grammars (CFG) in the specification of the syntax of programming languages, techniques for writing grammars (removal of left recursion, etc.), non context-free constructs, parse trees and ambiguity, examples of programming language grammars.	**7 Hours**
Module-3	Top-down Parsing: FIRST & FOLLOW sets, LL(1) conditions, Predictive parsing, Recursive descent parsing, Error recovery; LR-parsing: Handle pruning, Shift-reduce parsing, Viable prefixes, Valid items, LR(0) automaton, LR-parsing algorithm, SLR(1), LR(1), and LALR(1) parsing; YACC, Error recovery with YACC, Examples of YACC specifications.	**10 Hours**
Module-4	Syntax-directed Definitions (Attribute Grammars): Synthesized and inherited attributes, Examples of SDDs, Evaluation orders for attributes of an SDD, Dependency graphs, S-attributed and L-attributed SDDs; Semantic Analysis: Symbol tables and their data structures, Representation of "scope", Semantic analysis of expressions, Assignment and control-flow statements, Declarations of variables and functions, Function calls, etc.	**7 Hours**
Module-5	Intermediate Code Generation: Different intermediate representations – Quadruples, Triples, Trees Translation of expressions and assignment statements; Translation of Control-flow Statements: if-then-else, while-do, and switch; Short-circuit code, Back patching.	**6 Hours**
Module-6	Run-time Environments: Stack allocation of space and activation records, Access to non-local data on the stack in the case of procedures with and without nesting of procedures; Introduction to machine code generation and optimization: Simple machine code generation, examples of machine-independent code optimization.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. A. V. Aho, M. S. Lam, R. Sethi, and J. D. Ullman, ***Compilers: Principles, Techniques and Tools***, 2nd Edition, Pearson Education, 2009.
T2. K. D. Cooper and L. Torczon, ***Engineering a Compiler***, 2nd Edition, Morgan Kaufmann, 2011.

Reference Books:

R1. K. C. Louden, ***Compiler Construction - Principles and Practice***, 1st Edition, Cengage Learning, 1997.
R2. D. Brown, J. Levine, and T. Mason, ***LEX and YACC***, O'Reilly Media, 1992.

Online Resources:

1. https://nptel.ac.in/courses/106/108/106108113/: by Prof. Y. N. Srikanth, IISc Bangalore
2. https://nptel.ac.in/courses/128/106/128106009/: from IIT Madras
3. https://nptel.ac.in/courses/106/105/106105190/: by Prof. S. Chattopadhyay, IIT Kharagpur
4. https://nptel.ac.in/courses/106/104/106104123/: by Prof. S. K. Aggarwal, IIT Kanpur
5. http://openclassroom.stanford.edu/MainFolder/VideoPage.php?course=Compilers&video=01-01-introduction&speed=100

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain different phases of compilation and finite automaton for compiler design.
CO2	Explore syntax-directed translation schemes, methods and strategies for parsing.
CO3	Design and develop different parsers to meet the particular language constructs.
CO4	Apply language constructs using semantic analysis techniques and use of symbol tables.
CO5	Generate intermediate code using various translation schemes for optimality and performance.
CO6	Visualize run-time environments and apply code optimization techniques.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	1	1	3				1	3	3		2
CO2	3	3	1	2					1	3	3		2
CO3	3	2	3	3	3				3	3	3		2
CO4	3	3	2	2	1				1	3	3		2
CO5	3	3	1	1	1				1	3	3		3
CO6	3	3	1	3	1				3	3	3		2

Type	Code	Cloud Computing	L-T-P	Credits	Marks
PE	MCCS-T-PE-021		3-0-0	3	100

Objectives	The objective of this course is to study the fundamental concepts of cloud computing along with a broad coverage of the cloud platforms, security issues, and performance of applications on the cloud.
Pre-Requisites	Knowledge of computer networking, client-server concepts, internet & web technologies are essential for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with examples and case-study activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Client/Server systems, Thin & Thick Clients, Centralized Computing, Parallel & Distributed Computing, Amdahl's Law, P2P Computing, Cluster Computing, Grid Computing, Utility Computing, Autonomic Computing, Hosting, Data Center, Convergence of Technologies, Cloud Computing, NIST definition, Characteristics, Service Models, Deployment Models, Cloud Service Examples, Cloud-based Services & Applications.	**9 Hours**
Module-2	Cloud Concepts & Technologies: Virtualization, Load Balancing, Scalability & Elasticity, Deployment, Replication, Monitoring, Software Defined Networking (SDN), Network Function Virtualization, MapReduce, Identity & Access Management, Service Level Agreements (SLA), Billing.	**9 Hours**
Module-3	Cloud Services & Platforms: Compute Services, Storage Services, Database Services, Application Services, Content Delivery Services, Analytics Services, Deployment & management Services, Identity & Access Management Services, Open Source Private Cloud Software - CloudStack, Eucalyptus, OpenStack.	**8 Hours**
Module-4	Cloud Application Design: Considerations for scalability, reliability, availability, security, maintenance and upgradation, performance; Reference Architecture for Cloud Applications, Cloud Application Design Methodologies, Data Storage Approaches; Cloud Application Benchmarking & Tuning, Workload Characteristics, Application Performance Metrics, Benchmarking Tools, Deployment Prototyping, Load Testing & Bottleneck Detection.	**9 Hours**
Module-5	Cloud Security: Introduction, Security Issues in the Cloud, Components of Security, Attacks & classes of Threats, CSA Security Architecture, Authentication, Authorization, Identity & Access Management, Infrastructure Security, Data Security, Key Management, Auditing & Compliance.	**7 Hours**
	Total	**42 Hours**

Text Books:

T1. A. Bahga and V. Madisetti, ***Cloud Computing : A Hands-On Approach***, 1st Edition, Orient Blackswan, 2014.
T2. K. Hwang, G. C. Fox, and J. J. Dongarra, ***Distributed and Cloud Computing - From Parallel Processing to the Internet of Things***, 1st Edition, Elsevier, 2012.
T3. T. Mather, S. K. Swamy, and S. Latif, ***Cloud Security and Privacy : An Enterprise Perspective on Risks and Compliance***, 1st Edition, O'Reilly Media, 2009.

Reference Books:

R1. A. T. Velte, T. J. Velte, and R. Elsenpeter, ***Cloud Computing : A Practical Approach***, 1st Edition, McGraw Hill Education, 2017.
R2. B. Sosinsky, ***Cloud Computing Bible***, 1st Edition, Wiley-India, 2011.
R3. T. Erl, Z. Mahmood, and R. Puttini, ***Cloud Computing : Concepts, Technology & Architecture***, 1st Edition, Pearson India Education, 2014.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105167/: by Prof. S. K. Ghosh, IIT Kharagpur.
2. https://nptel.ac.in/courses/106/104/106104182/: by Prof. R. Misra, IIT Kanpur.
3. https://www.coursera.org/learn/cloud-computing: Prof. Indranil Gupta, Department of Computer Science, University of Illinois at Urbana-Champaign.
4. http://web.mit.edu/6.897/www/readings.html: by Prof. Hari Balakrishnan, MIT

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe computing paradigms and explain standard cloud computing models.
CO2	Explain key concepts along with the enabling technologies of cloud computing.
CO3	Appreciate various types of cloud computing services and user-access management.
CO4	Visualize design principles and methodologies for developing applications on the cloud.
CO5	Assess the importance of security & privacy of data in cloud environment.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2		1		1			1	1		1		1
CO2	2		1		2			1	1	1	1		1
CO3	2		3		2			1	1	1	1		2
CO4	2		3		2			1	2	1	2		2
CO5	2		3		2			1	1	1	2	2	1

Type	Code	Cryptography & Internet Security	L-T-P	Credits	Marks
PE	MCCS-T-PE-031		3-0-0	3	100

Objectives	The objective of this course is to study different security goals and mechanisms with primary focus on cryptography techniques used to protect from various security threats in computer networks and Internet.
Pre-Requisites	Knowledge of computer networks and internet technologies are required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Computer Security Concepts, Security Attacks, Security Services and Mechanisms, Symmetric Cipher model, Cryptography & Cryptanalysis, Substitution Techniques: Caesar cipher, Monoalphabetic cipher, Playfair cipher, Hill Cipher, Polyalphabetic ciphers: Vignere cipher, Vernam cipher, Transposition cipher.	**8 Hours**
Module-2	Integer and Modular Arithmetic, Euclidean and Extended Euclidean Algorithms, Concept of groups, rings, and fields, Difference between GF(p) and GF(2m), Block cipher principles, Data Encryption Standard (DES), Advanced Encryption Standard (AES)	**9 Hours**
Module-3	Fermat's and Euler's Theorem, Chinese Reminder Theorem, Integer factorization, Discrete Logarithms, Public Key Cryptography: RSA, ElGamal , Diffie-Hellman Key Exchange, Elliptic Curve Cryptography : Introduction to elliptic curve, arithmetic, application,	**9 Hours**
Module-4	Message Integrity and Authentication, Cryptographic Hash Functions: MD5, SHA family, Digital Signature and applications-ElGamal.	**7 Hours**
Module-5	Key Distribution, Certificate Authority, X.509, Kerberos, E-mail security: PGP, S/MIME, Security at the Transport Layer: SSL/TLS, Security at Network Layer: IPSec, Malicious Software, Firewall, Intrusion Detection	**9 Hours**
	Total	**42 Hours**

Text Books:

T1. W. Stallings, ***Cryptography and Network Security : Principle and Practice***, 7th Edition, Pearson Education, 2017.

Reference Books:

R1. B. A. Forouzan and D. Mukhopadhaya, ***Cryptography and Network Security***, 2nd Edition, McGraw Hill, 2010.
R2. C. P. Pfleeger, S. L. Pfleeger, and J. Margulies, ***Security in Computing***, 5th Edition,PHI, 2015.
R3. C. Kaufman, R. Perlman, and M. Speciner, ***Network Security : Private Communication in a Public World***, 2nd Edition, PHI, 2002.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105031/: by Dr. D. Mukhopadhyay, IIT Kharagpur
2. https://nptel.ac.in/courses/106/105/106105162/: by Prof. S. Mukhopadhyay, IIT Kharagpur

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Describe the security objectives and security threats that affect our sensitive data.
CO2	Acquire a mathematical foundation of cryptography through modular arithmetic, number theory, integer factorization, and discrete logarithms.
CO3	Analyze and compare traditional and modern symmetric key cryptography algorithms.
CO4	Explain public key cryptography algorithms and their applications and use of hash functions in message integrity and authentication.
CO5	Apply cryptography techniques for securing data on the Internet and realize the need of firewall & IDS technology.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1	1							3		3
CO2	3	3	1	1							3		3
CO3	3	3	3	2		2					3		2
CO4	3	3	3	2		2					3		3
CO5	1	3	3	3		2					3		3

Type	Code	Soft Computing	L-T-P	Credits	Marks
PE	MCCS-T-PE-016		3-0-0	3	100

Objectives	The objective of this course is to study the fundamentals of non-traditional computing techniques and approaches to solve complex real-life problems with approximate models. The course will also cover different aspects of hybridization along with some case studies.
Pre-Requisites	Knowledge of linear algebra, algorithm design, and data structures is required for this course.
Teaching Scheme	Regular classroom lectures with use of ICT as needed, sessions are planned to be interactive with examples, problem solving and programming activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Fuzzy Logic: Basic definition and terminology of fuzzy set, set theoretic operations, T-norm, T-conorm, Membership function formulation and parameterization, Extension Principle, Fuzzy relations, Linguistic variables, fuzzy if-then rules, Compositional rule of inference, fuzzy reasoning, fuzzy inference systems, Mamdani fuzzy models, Defuzzification, Sugeno fuzzy models, Tsukamoto fuzzy models.	**10 Hours**
Module-2	Genetic Algorithm: Introduction to Genetic Algorithm, Working cycle of a GA, Binary Coded GA, GA-parameter setting, Constraint Handling GA, Advantages & disadvantages of GA, Specialized GAs – Real Coded GA.	**8 Hours**
Module-3	Neural Network-I: Introduction, Models of a neuron, Network Architecture, Knowledge Representation; Learning Process, Error correction learning, Memory based learning, Hebbian learning, Competitive learning, Boltzmann learning, Learning with a teacher, Learning without a teacher; Single layered learning – Least Mean Square Algorithm, Perceptron, Perceptron Convergence algorithm.	**10 Hours**
Module-4	Neural Network-II: Multilayer perceptron – Back-propagation algorithm, XOR Problem, Heuristics for Back-Propagation algorithm; Self-organizing maps – Two basic feature mapping models, SOM algorithm.	**8 Hours**
Module-5	Hybrid Systems: Combination of Genetic Algorithms with Fuzzy Logic or Neural Networks, Combination of Neural Network and Fuzzy Logic.	**6 Hours**
	Total	**42 Hours**

Text Books:

T1. J. Shing, R. Jang, C. T. Sun, and E. Mizutani, ***Neuro Fuzzy And Soft Computing - A Computational Approach to Learning and Machine Intelligence***, 3rd Edition, Pearson Education, 2008.
T2. D. K. Pratihar, ***Soft Computing***, 2nd Edition, Narosa Publishing House, 2009.
T3. S. Haykin, ***Neural Network - A Comprehensive Foundation***, 2nd Edition, Pearson Education, 2006.

Reference Books:

R1. T. Munakata, ***Fundamentals of the New Artificial Intelligence - Neural, Evolutionary, Fuzzy and More***, 2nd Edition, Springer, 2014.
R2. F. O. Karray and C. De Silva, ***Soft Computing and Intelligent System Design - Theory, Tools and Applications***, 1st Edition, Pearson Education, 2009.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105173/: by Prof. D. Samanta, IIT Kharagpur.
2. http://cse.iitkgp.ac.in/~dsamanta/courses/sca/index.html: by Prof. D. Samanta, IIT Kharagpur.

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Apply fuzzy logic and fuzzy inference system concepts to design automation systems for real life problems.
CO2	Apply the concepts of genetic algorithm to solve engineering optimization problems.
CO3	Use the concepts of ANNs to solve real life engineering and societal problems.
CO4	Appreciate the use of advanced ANN concepts and self-organizing maps to solve a variety of engineering problems.
CO5	Envisage the need of hybridization, and to develop hybrid models for solving complex problems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	3	2	3					3	3	1	2
CO2	3	3	3	2	3					2	3	1	2
CO3	3	3	3	2	3					2	3	1	2
CO4	3	3	3	2	3					2	3	2	3
CO5	3	3	3	2	3					3	3	1	3

Type	Code	Data Warehousing & Business Intelligence	L-T-P	Credits	Marks
PE	MCCS-T-PE-019		3-0-0	3	100

Objectives	The objective of this course is to critically assess the methodologies and techniques pertaining to implementing data warehouse and business intelligence solutions in order to develop effective decision support strategies in disparate business contexts.
Pre-Requisites	Basic knowledge of database management systems and algorithms is required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required; sessions are planned to be interactive with focus on problem solving & analysis.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Data warehousing: Introduction, Difference between operational databases and data warehouses, Three tier architecture of data warehouse, Data marts, Data staging area, Metadata.	**8 Hours**
Module-2	OLAP in the Data Warehouse: Demand for online analytical processing, need for multidimensional analysis, fast access and powerful calculations, limitations of other analysis methods, OLAP definitions and rules, OLAP characteristics, major features and functions, general features, Dimensional analysis, Hypercubes, Drill-down and Roll-up, Slice-and-dice or Rotation, OLAP models, MOLAP and ROLAP models.	**8 Hours**
Module-3	Data Mining Basics: Introduction, application areas in data mining, KDD process, Getting to know your data: Data Objects and Attributes types, Data Pre-processing: Why pre-process data? Data cleaning, Data integration, Data transformation and Reduction.	**10 Hours**
Module-4	Mining Frequent Patterns, Associations and Correlations: Introduction, Market Basket Analysis, Frequent Item-set Generation using Apriori algorithm, Rule generation, Alternative methods for generating Frequent Item-sets using FP-Growth Algorithm, Evaluation of Association Patterns, from Association Analysis to Correlation Analysis.	**8 Hours**
Module-5	Business Intelligence: Definition, Business Intelligence Decision Support Initiative, Development approaches, Engineering stages and the development steps, Business Intelligence project team structure, managing a Business Intelligence project, Project planning activities, Deliverables, General business requirements, the interviewing process, Data analysis, Data cleaning.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. R. Thareja, ***Data Warehousing***, 1st Edition, Oxford University Press, 2009.
T2. J. Han, M. Kamber, and J. Pei, ***Data Mining: Concepts and Techniques***, 3rd Edition, Morgan Kaufmann, 2011.

T3. E. Turban, R. Sharda, and D. Delen, ***Decision Support and Business Intelligence Systems***, 9th Edition, Pearson Education, 2013.

Reference Books:

R1. A. Berson and S. J. Smith, ***Data Warehousing, Data Mining & OLAP***, 1st Edition, McGraw Hill Education, 2017.
R2. P. Ponniah, ***Data Warehousing Fundamentals***, 2nd Edition, Willey India, 2010.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105174/: by Prof. P. Mitra, IIT Kharagpur
2. http://infolab.stanford.edu/~ullman/mining/2003.html: notes by Stanford University

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain the need of data warehousing and the building blocks of a data warehouse.
CO2	Apply the different models of multidimensional data analysis.
CO3	Examine and pre-process, transform, integrate and reduce the data as per the needs.
CO4	Generate frequent item-sets for pattern mining and frame association rules.
CO5	Comprehend the significance of business intelligence and decision support systems.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	1						2	3	1	1
CO2	3	2	2	1						2	3	1	1
CO3	3	3	3	1						2	3	1	1
CO4	3	2	3	1						2	3	1	1
CO5	2	2	2	1						2	3	1	1

Type	Code	Software Project Management	L-T-P	Credits	Marks
PE	MCCS-T-PE-028		3-0-0	3	100

Objectives	The objective of this course is to introduce various activities involved in managing software projects including product life cycle, umbrella activities like project planning, quality assurance, risk management, tracking, closure and various other activities during different phases of software development.
Pre-Requisites	Knowledge of software engineering and programming languages is required.
Teaching Scheme	Regular classroom lectures with use of ICT as required and interactive sessions with focus on case studies & different scenarios faced by project managers.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction: Product Life Cycle - Idea generation, Prototype Development Phase, Alpha Phase, Beta Phase, Production and Maintenance Phase. Project Life Cycle Models - Water fall Model, Prototype Model, RAD and Spiral Model. Process Models.	**8 Hours**
Module-2	Umbrella Activities: Metrics – roadmap, Strategy, Targets and tracking, Acting on data; Software Configuration Management - Process and activities of SCM, Configuration audit, Metrics in SCM, Tools and automation; Software Quality Assurance - Quality Control and Assurance, Cost and benefits of quality, Tools and automation, SQA role; Risk Management - Risk Management Cycle, Risk Identification, Quantification, Monitoring, Mitigation, Metrics in Risk Management.	**9 Hours**
Module-3	Project Management Processes and Activities: Project Life Cycle In-Stream activities, Project initiation - Activities, Outputs, Quality Records, Completion criteria, Project Planning and Tracking - Components, Activities specific to project tracking, Project Closure - Effective closure Process, Issues, Metrics for Project Closure.	**9 Hours**
Module-4	Engineering Activities in Project Lifecycle: Software requirement gathering - Inputs and start criteria, Dimensions, Steps, Output and Quality records, Skill sets, Challenges, Metrics for Requirement Phase. Estimation –Three Phases of Estimation, Methodology, Formal models for size estimation, Challenges, Metrics for Estimation Process. Design and Development Phases – Features, Reusability, Testability and Maintainability. Project Management in Testing and Maintenance Phases.	**8 Hours**
Module-5	Emerging Trends: Globalization Issues in Project management - Evolution, Challenges and Models. Impact of the internet on Project Management - Effect of internet on Project Management, Managing project for internet, Effects on Project Management activities. People Focused Process Models - People centric models, P-CMM, Other people focused models.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. R. Gopalaswamy, ***Managing Global Software Projects***, 17th Edition, McGraw-Hill Education, 2016.
T2. B. Hughes and M. Cotterell, ***Software Project Management***, 5th Edition, Tata McGraw-Hill, 2011.

Reference Books:

R1. R. S. Pressman, ***Software Engineering - A Practitioner's Approach***, 7th Edition, McGraw-Hill Education, 2010.
R2. R. Mall, ***Fundamentals of Software Engineering***, 4th Edition, PHI Learning, 2014.

Online Resources:

1. https://nptel.ac.in/courses/106/105/106105218/: by Prof. R. Mall, IIT Kharagpur.
2. https://www.tutorialspoint.com/software_engineering/software_project_management.htm
3. https://www.stellman-greene.com/about/applied-software-project-management/applied-software-project-management-slides/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain Product Life Cycle Phases and Project Life Cycle Models like Water fall Model, Prototype Model, RAD and Spiral Model.
CO2	Analyze and plan various umbrella Activities like Metrics target setting and tracking, Software Configuration Management, Software Quality Assurance and Risk Management.
CO3	Model Project Management Processes such as Project Life Cycle In-Stream activities, Project Planning and Tracking and Project Closure.
CO4	Execute Project Management activities in Software requirement gathering, Estimation, Design, Development, Testing and Maintenance Phases.
CO5	Realize the Emerging Trends in Project Management like Globalization Issues, Impact of the internet on Project Management, People Focused Process Models and P-CMM.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	1	3	3	1	2	2	2	1	1	1	1		1
CO2	2	1	1	1	3	1	3	2	1	1	1	1	1
CO3	2	2	1	2	3	1	2	2	1	1	1	1	1
CO4	3	2	2	3	2	2	2	2	1	1	1	2	1
CO5	1	1	1	1	3	1	2	1	1	1	1	1	1

Type	Code	Mobile Computing	L-T-P	Credits	Marks
PE	MCCS-T-PE-030		3-0-0	3	100

Objectives	The objective of the course is to study the concepts and technologies for transmission of various types of data over wireless mediums and introduce computing on mobile devices.
Pre-Requisites	Fundamental knowledge of networking and signal transmission are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with problem solving activities.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	Introduction to Personal Communication System (PCS), Evolution of Wireless Technologies, Signals and Frequency, Cellular system – Structure, Cluster, Frequency Reuse and Splitting, MAC mechanisms - SDMA, TDMA, CDMA, GSM Technology - Architecture, Channels & Bands, GSM Architecture, Mobility Management, Handover Detection and Management; GPRS - Architecture, Interfaces, Network Protocols.	**8 Hours**
Module-2	WLAN IEEE 802.11 System Architecture, Ad-Hoc and Infrastructural Mode, MAC Frame format, Bluetooth - Introduction, Piconet, Scatternet, Protocol stack, Profile; WAP - Architecture and Components, WAP Gateway and Protocol stack; WML Script - Variables, Control structure and Functions, IMT 2000 standards, WCDMA and CDMA 2000.	**9 Hours**
Module-3	MobileIP - Goals, Requirements, Entities, Agent Advertisement and Discovery, Registration, IP packet Delivery, Tunneling and Encapsulation; IPv6, DHCP, ICMP, Routing, Introduction to Wireless Local Loop (WLL), Wireless Enterprise Networks.	**9 Hours**
Module-4	Satellite Network Technology - Global Mobile Satellite system (HEO, LEO, MEO), Satellite system architecture, satellite constellation for satellite phone, Case studies: Iridium, GLOBALSTAR, GLONASS; Virtual Private Network - Features and Goals, Remote Access VPN, Site to Site VPN, VPN Protocol and Requirements, Security Issues in Mobile Computing, Algorithms and Implementation.	**8 Hours**
Module-5	VoIP and Real Time protocols, Multimedia content delivery in Mobile Network, Mobile OS - Android, iOS, Application development for Mobile platforms, Android Studio and Java Programming Language, 3-tier Architecture for Mobile Computing, Design and computing through Internet, Internet of Things, Current trends and Research.	**8 Hours**
	Total	**42 Hours**

Text Books:

T1. J. Schiller, ***Mobile Communication***, 2nd Edition, Pearson Education, 2004.
T2. A. K. Talukder, H. Ahmed, and R. Yavagal, ***Mobile Computing***, 2nd Edition, McGraw Hill, 2017.

T3. Y-B. Lin, I. Chlamtac, ***Wireless and Mobile Network Architectures***, 1st Edition, Wiley, 2008.

Reference Books:

R1. V. K. Garg, ***Wireless Communication and Networks***, 2nd Edition, Pearson Education, 2003.
R2. U. Hansmann, L. Merk, M. Nicklous, and T. Stober, ***Principles of Mobile Computing***, 2nd Edition, Springer, 2006.

Online Resources:

1. http://alphace.ac.in/downloads/notes/cse/10cs831.pdf
2. https://www.tutorialspoint.com/mobile_computing/mobile_computing_overview.htm

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain current technological implementation in GSM network.
CO2	Assess the capabilities of GSM and wireless technologies in network design and operation.
CO3	Evaluate network protocols, routing algorithms, connectivity methods and characteristics.
CO4	Describe wireless network topologies, wireless connectivity and characteristics, and the significance of security & Internet communications.
CO5	Apply appropriate wireless technologies in commercial & enterprise applications.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3			2	2					1	3		3
CO2	1	2		2	3					1	3		3
CO3	1		3	3	2					1	3		3
CO4	3	2	2		3					1	3	1	3
CO5	1	3	2	1	3					1	3	2	3

Type	Code	Universal Human Values & Professional Ethics	L-T-P	Credits	Marks
MC	MCBS-T-MC-008		2-0-0	0	100

Objectives	The objective of this course is to enable the students to become aware of professional ethics and universal human values. It will instill moral and social values and loyalty to appreciate the rights of others. This course also provides the basis for deciding whether a particular action is morally good or bad.
Pre-Requisites	Elementary idea on Psychology, sensitivity to professionalism with respect to morality, judgment, and commitment are required.
Teaching Scheme	Regular classroom lectures with use of ICT as and when required, and planned interactive sessions.

Evaluation Scheme

Teacher's Assessment			Written Assessment		Total
Quiz	Surprise Test(s)	Assignment(s)	Mid-Term	End-Term	
05	05	05	25	60	100

Detailed Syllabus

Module-#	Topics	Hours
Module-1	**Introduction to Value Education**: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfill the Basic Human Aspirations.	**6 Hours**
Module-2	**Harmony in the Human Being**: Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.	**6 Hours**
Module-3	**Harmony in the Family and Society**: Harmony in the Family – Family as the Basic Unit of Human Interaction, Values in Human-to-Human Relationship, 'Trust' – the Foundational Value in Human Relationship, 'Trust Deficit' - the concept and its dimensions and implications, 'Respect' as the Right Evaluation, Understanding Harmony in the Society, Vision for the Universal Human Order.	**6 Hours**
Module-4	**Harmony in the Nature or Existence**: The Four Orders of Nature, Understanding Harmony in the Nature, Interconnectedness, Self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at all Levels, The Holistic Perception of Harmony in Existence.	**4 Hours**
Module-5	**Implications of the Holistic Understanding – A Look at Professional Ethics**: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.	**6 Hours**
	Total	**28 Hours**

Text Books:

T1. R. R. Gaur, R. Asthana, and G. P. Bagaria, ***A Foundation Course in Human Values and Professional Ethics***, 2nd Edition, Excel Books, 2019.

T2. A. Nagaraj, ***Jeevan Vidya : Ek Parichaya***, Jeevan Vidya Prakashan, 1999.

Reference Books:

R1. A. N. Tripathi, ***Human Values***, 3rd Edition, New Age International Publishers, 2019.

R2. M. K. Gandhi, Translated by (from Gujarati) M. Desai, ***The Story of My Experiments with Truth***, 1st Edition, FingerPrint Publishing, 2009.

Online Resources:

1. http://hvpe1.blogspot.com/2016/06/notes-human-values-and-professional.html
2. https://examupdates.in/professional-ethics-and-human-values
3. http://www.storyofstuff.com
4. https://aktu.ac.in/hvpe/ResourceVideo.aspx

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Explain human aspirations and understand the role of value education in engineering.
CO2	Attain living in harmony with self and other human beings with due self-regulation.
CO3	Sincerely evaluate their interactions with their family, friends, and society as a whole.
CO4	Experience living in harmony with nature and realize co-existence at all levels.
CO5	Act professionally with desired levels of ethics for a prosperous society.

Program Outcomes Relevant to the Course:

PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO7	Function effectively both as a team leader and team member on multi disciplinary projects to demonstrate computing and management skills.
PO8	Communicate effectively and present technical information in oral and written reports.
PO9	Ability to understand the impact of system solutions in a contemporary, global, economical, environmental, and societal context for sustainable development.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1			2			1	1	1				1	1
CO2			1			1	1	2	1	1		1	1
CO3			1			1		2		1			
CO4			1			1	2	1	1				
CO5			1			1	1	1	1	1			

Type	Code	Design & Analysis of Algorithms Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-023		0-0-2	1	100

Objectives	The objective of this course is To implement various algorithms under different categories, analyze algorithms & their complexities, and implement approximation algorithms for NP hard problems.
Pre-Requisites	Basic knowledge of C Programming and Data Structures is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Design C programs using structure to implement insertion, deletion, BST.
2	Sort a given set of elements using the Quick-sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted.
3	Implement Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted.
4	Implement Heap Sort algorithm to sort a given set of elements and determine the time required to sort the elements.
5	Obtain the Topological ordering of vertices in a given digraph.
6	Implement 0/1 Knapsack problem using Dynamic Programming.
7	Implement BFS algorithm in a diagraph and check whether a given graph is connected or not using DFS method.
8	Implement Dijkstra's algorithm to find the shortest path in weighted connected graph.
9	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
10	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
11	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this Algorithm.
12	Implement N Queen's problem using Back Tracking.
13, 14	Design an algorithm to find the optimal solution for the TSP and then solve the same problem using any approximation algorithm and determine the error in the approximation.

Text Books:

T1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, ***Introduction to Algorithms***, 3rd Edition, PHI Learning, 2014.
T2. A. Levitin, ***Introduction to the Design and Analysis of Algorithms***, 3rd Edition, Pearson, 2012.

Reference Books:

R1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, ***Data Structures and Algorithms***, 3rd Edition, Pearson Education, 2006.
R2. D. E. Knuth, ***The Art of Computer Programming - Volumes 1 & 3***, Pearson Education, 2009.
R3. S. S. Skiena, ***The Algorithm Design Manual***, 2nd Edition, Springer, 2008.

Online Resources:

1. https://nptel.ac.in/courses/106101060/
2. https://nptel.ac.in/courses/106106131/
3. http://www.cs.virginia.edu/~robins/CS_readings.html
4. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-042j-mathematics-for-computer-science-fall-2010/video-lectures/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Design C programs using structure to implement insertion, deletion, searching of a BST.
CO2	Implement comparison-based sorting algorithms and computing the time required.
CO3	Construct C programs for algorithms based on Divide & Conquer, Dynamic Programming and Greedy techniques.
CO4	Design C program for Graph traversal algorithms.
CO5	Implement N-Queen using Backtracking.
CO6	Implement a scheme to find the solution of Travelling Salesman Problem.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO4	Analyze and review literature to invoke the research skills to design, interpret and make inferences from the resulting data.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	3	2	1	2						3		3
CO2	3	3	3	3							3		3
CO3	3	2	3	3	3						3		2
CO4	3	3	2	2	2						3		2
CO5	3	3	3	3	3						3		3
CO6	2	2	2	1							3		3

Type	Code	Python Programming Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-024		0-0-4	2	100

Objectives	The objective of the course is to give the students hands-on practice on Using Python programming language from fundamentals to advanced programming and solving problems using the Python programming language.
Pre-Requisites	Basic analytical and logical understanding including basic knowledge of Python is required.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Compilation and execution of simple python programs.
2	Programs using data types and operators.
3	Formulate problems using Sting handling operators and functions.
4	Programs using Input and Output statements.
5	Programs on decision making using if else, nested if else and else if ladder.
6	Implement loop-control structures using for and while loops.
7, 8	Programs using python built in data structures(List, Dictionary, tuple, set).
9	Develop programs using functions.
10	Programs using recursive function.
11	Formulate problems and write programs using modules.
12	Develop programs using random and time module.
13	Develop programs using Packages.
14, 15	Programs on creating and using Class and Object.
16, 17	Formulate problems on Inheritance and write programs.
18	Programs on Exception Handling.
19	Formulate problems on file handling and develop programs.
20	Write programs to perform file Input/Output operations.
21, 22	Programs on database Connectivity.
23	Programs on Regular expression.
24, 25	Develop programs using CGI.
26, 27, 28	Develop GUI programs using Tkinter.

Text Books:

T1. P. Barry, ***Head First Python***, 2nd Edition, O'Reilly Media, 2010.
T2. A. B. Downey, ***Think Python: How to Think Like a Computer Scientist***, 2nd Edition, O'Reilly Media, 2012.

Reference Books:

R1. J. Zelle, ***Python Programming: An Introduction to Computer Science***, 3rd Edition, Franklin, Beedle & Associates, 2016.
R2. L. Ramalho, ***Fluent Python***, 1st Edition, O'Reilly Media, 2015.
R3. A. Downey, ***Programming Python***, 4th Edition, O'Reilly Media, 2011.

Online Resources:

1. https://nptel.ac.in/courses/106105166/26
2. https://nptel.ac.in/courses/117106113/34
3. https://help.uis.cam.ac.uk/service/help-support/training/downloads/course-files/programming-student-files/python-courses/

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Develop simple real life application in python using operators and control statements.
CO2	Use python data structure and function to develop application.
CO3	Interpret object orient concept and use it for software development.
CO4	Conveniently use file handling and database connectivity concept.
CO5	Become familiar with CGI and develop real-life web application.

Program Outcomes Relevant to the Course:

PO1	Apply knowledge of computing fundamentals, mathematics and domain knowledge appropriate for computing models from defined problems and requirements.
PO2	Design and develop applications to analyze and solve all computer science related problems.
PO3	Design applications for any desired needs with appropriate considerations for any specific need on societal and environmental aspects.
PO5	Integrate and apply efficiently the contemporary IT tools to all computer applications.
PO6	Solve and work with a professional context pertaining to ethics, social, cultural and cyber regulations.
PO10	Appreciate the importance of goal setting and to recognize the need for life-long learning.

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	2	1		1	1					3	3	3
CO2	1	2	1		1	1					3	3	3
CO3	1	2	1		1	1				1	3		3
CO4	1	2	1		1	2				1	3		3
CO5	2	2	1		1	1				1	3	3	3

Type	Code	Web Application Development Lab	L-T-P	Credits	Marks
PC	MCCS-P-PC-027		0-0-4	2	100

Objectives	The objective of this course is to provide hands-on exposure and practice on building modern full stack web applications compatible with mobile devices and multiple screen resolutions.
Pre-Requisites	Knowledge of HTML, CSS, and Java Script along with concepts of PHP and MySQL taught in the theory class are required for the experiments.
Teaching Scheme	Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments.

Evaluation Scheme

Attendance	Daily Performance	Lab Record	Lab Test/ Mini Project	Viva-voce	Total
10	30	15	30	15	100

Detailed Syllabus

Experiment-#	Assignment/Experiment
1	Web Browsers - Internet Explorer, Chrome, Mozilla Firefox; Browser Settings and options, Security features, Cookies, Temporary files, etc
2	Hypertext skeleton structure and HTML Elements.
3	HTML Form Elements, Frames and Box Layout Design.
4	Creating Web Forms and Use of HTTP GET and POST Methods.
5	Embedding audio and video on web page, Image Map and Anchor Tag.
6	CSS - Introduction to Style Sheets.
7	Use of CSS for User interface design.
8	Use of CSS2, CSS3, DIV and SPAN tags.
9	JavaScript - Introduction to Client side Script, Document Object Model (DOM).
10	JavaScript - Use of Different Elements of DOM.
11-14	Regular Expressions in JavaScript, Form Validation, Errors and User Control.
15	Create Registration and Login forms with validation.
16	Jscript to retrieve information from database using database connectivity.
17-18	Angular Js data binding, directives and events
19	Using angular Js fetching data from MySQL.
20	Simple programs in PHP by installing and configuring XAMPP.
21	Server Side Validation and Page Redirection In PHP.
22	PHP Database connectivity with MYSQL.
23	File Handling and Image Uploading in PHP.
24	Design a Sign In, Sign Up and Forgot Password Page with BOOTSTRAP. Use PHP and MYSQL to store Sign Up data in Database.
25	Create a simple Shopping Cart with REACT and Node.js
26-28	Mini Project

Text Books:

T1. S. Holzner, ***The PHP Complete Reference***, 1st Edition, McGraw Hill Education, 2007.
T2. S. Seshadri and B. Green, ***Angular JS: Up and Running Enhanced Productivity with Structured Web Apps***, 1st Edition, O'Reilly, 2014.
T3. A. Fedosejev, ***React.js Essentials: A Fast-paced Guide to Designing and Building Scalable and Maintainable Web Apps with React.js***, 1st Edition, Packt Publishing, 2015.

Reference Books:

R1. L. Beighley and M. Morrison, ***Head First PHP & MySQL***, 1st Edition, O'Reilly Media, 2009.
R2. R. W. Sebesta, ***Programming the World Wide Web***, 4th Edition, Pearson Education, 2007.

Online Resources:

1. https://www.php.net/manual/en/langref.php: PHP Language Reference
2. https://www.w3schools.com/html/: W3Schools HTML Tutorials
3. https://www.w3schools.com/css/: W3Schools CSS Tutorials
4. https://www.w3schools.com/php/: W3Schools PHP Tutorials
5. https://www.php.net/manual/en/index.php: PHP Reference Manual
6. https://dev.mysql.com/doc/refman/8.0/en/: MySQL Reference Manual
7. https://angular.io/guide/architecture: Angular JS Documentation
8. https://reactjs.org/docs/getting-started.html: React JS Documentation

Course Outcomes: *At the end of this course, the students will be able to:*

CO1	Understand basic concepts of web and Design web pages using HTML & CSS.
CO2	Develop web applications using modern scripting languages & frameworks.
CO3	Apply object-oriented concepts to develop reusable object libraries for complex web applications.
CO4	Apply Angular JS to fetch & display data from database server.
CO5	Understand web servers and develop server-side application using PHP & MySQL.

Program Outcomes Relevant to the Course:

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CO2	3	2	2	1	3	1				2	1		
CO3	3	1	2	2	3	1				1	1	1	2
CO4	3	2	3	1	3	1				1	2	2	1
CO5	3	2	3	1	3	1				1	2	1	2

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