राष्ट्रीय प्रौद्योगिकी संस्थान अगरतला

NATIONAL INSTITUTE OF TECHNOLOGY, AGARTALA

COURSE STRUCTURE AND DETAILED SYLLABUS

FOR B. TECH DEGREE IN COMPUTER SCIENCE & ENGINEERING

(3RD TO 8TH SEMESTER)

National Institute of Technology, Agartala

Proposed Course-Structure: B. Tech. Computer Science & Engineering

THIRD SEMESTER THEORY

Course Code	Subject Name	L	T	P	Total Credits
UCS03B07	DATA COMMUNICATION	**3**	**0**	**0**	**3**
UCS03B08	DATA STRUCTURE AND PROGRAMMING METHODOLOGY	**3**	**1**	**0**	4
UCS03B09	DIGITAL CIRCUIT AND LOGIC DESIGN	**3**	**0**	**0**	**3**
UCS03B10	DISCRETE MATHEMATICAL STRUCTURES	**3**	**0**	**0**	**3**
UCS03C16	ENGINEERING MATHEMATICS - III	**3**	**0**	**0**	**3**
UCS03B11	INTRODUCTION TO GRAPH THEORY	**3**	**1**	**0**	**4**
Total 3rd Semester Theory Credit					**20**

THIRD SEMESTER LABORATORY

Course Code	Subject Name	L	T	P	Total Credits
UCS03P13	DATA STRUCTURE & PROGRAMMING METHODOLOGY LABORATORY	**0**	**0**	**3**	**2**
UCS03P11	DIGITAL CIRCUIT AND LOGIC DESIGN LABORATORY	**0**	**0**	**3**	**2**
Total 3rd Semester Laboratory Credit					**4**
Total 3rd Semester Theory Credit					**20**
Total 3rd Semester Credit					**24**

National Institute of Technology, Agartala

Proposed Course-Structure: B. Tech. Computer Science & Engineering

FOURTH SEMESTER THEORY

Course Code	Subject Name	L	T	P	Total Credits
UCS04C17	FORMAL LANGUAGE AND AUTOMATA HEORY	**3**	**0**	0	**3**
UCS04C15	DESIGN AND ANALYSIS OF ALGORITHM	**3**	**1**	0	**4**
UCS04B06	ENGINEERING MATHEMATICS – IV	**3**	**0**	**0**	**3**
UCS04B05	MICROPROCESSOR & MICROCONTROLLER	**3**	**0**	**0**	**3**
UCS04C18	OBJECT ORIENTED PROGRAMMING	**3**	**1**	**0**	**4**
Total 4th Semester Theory Credit					**17**

FOURTH SEMESTER LABORATORY

Course Code	Subject Name	L	T	P	Total Credits
UCS04P13	DESIGN AND ANALYSIS OF ALGORITHM ABORATORY	**0**	**0**	**3**	**2**
UCS04P14	OBJECT ORIENTED PROGRAMMING ABORATORY	**0**	**0**	**3**	**2**
Total 4th Semester Laboratory Credit					**4**
Total 4th Semester Theory Credit					**17**
Total 4th Semester Credit					**21**

National Institute of Technology, Agartala

Proposed Course-Structure: B. Tech. Computer Science & Engineering

FIFTH SEMESTER THEORY

Course Code	Subject Name	L	T	P	Total Credits
UCS05B10	COMPUTER ARCHITECTURE AND RGANIZATION	**3**	**0**	**0**	**3**
UCS05B11	DATA BASE MANAGEMENT SYSTEM	**3**	**1**	**0**	**4**
UCS05C03	ENGINEERING ECONOMICS AND COSTING	**3**	**0**	**0**	**3**
UCS05B12	OPERATING SYSTEM	**3**	**1**	**0**	**4**
	ELECTIVE – I	**3**	**0**	**0**	**3**
	Total 5th Semester Theory Credit				**17**

FIFTH SEMESTER LABORATORY

Course Code	Subject Name	L	T	P	Total Credits
UCS05P05	COMPUTER ARCHITECTURE AND RGANIZATION LABORATORY	**0**	**0**	**3**	**2**
UCS05P06	DATA BASE MANAGEMENT SYSTEM ABORATORY	**0**	**0**	**3**	**2**
UCS05P07	OPERATING SYSTEM LABORATORY	**0**	**0**	**3**	**2**
UCS06P08	SEMINAR	**0**	**0**	**2**	**1**
Total 5th Semester Laboratory Credit					**7**
Total 5th Semester Theory Credit					**17**
Total 5th Semester Credit					**24**

National Institute of Technology, Agartala

Proposed Course-Structure: B. Tech. Computer Science & Engineering

SIXTH SEMESTER THEORY

Course Code	Subject Name	L	T	P	Total Credits
UCS06B13	ARTIFICIAL INTELLIGENCE	**3**	**1**	**0**	**4**
UCS06B14	COMPILER DESIGN	**3**	**1**	**0**	**4**
UCS06B15	COMPUTER NETWORK	**3**	**1**	**0**	**4**
UCS06C04	MANAGEMENT AND MANAGERIAL ECONOMICS	**3**	**0**	**0**	**3**
UCS06B16	SOFTWARE ENGINEERING	**3**	**0**	**0**	**3**
	ELECTIVE – II	**3**	**0**	**0**	**3**
	Total 6th Semester theory Credit				**21**

SIXTH SEMESTER LABORATORY

Course Code	Subject Name	L	T	P	Total Credits
UCS06P09	COMPILER DESIGN LABORATORY	**0**	**0**	**3**	**2**
UCS06P10	COMPUTER NETWORK LABORATORY	**0**	**0**	**3**	**2**
UCS06P11	SOFTWARE ENGINEERING ABORATORY	**0**	**0**	**3**	**2**
Total 6th Semester Laboratory Credit					**6**
Total 6th Semester theory Credit					**21**
Total 6th Semester Credit					**27**

National Institute of Technology, Agartala

Proposed Course-Structure: B. Tech. Computer Science & Engineering

SEVENTH SEMESTER THEORY

Course Code	Subject Name	L	T	P	Total Credits
UCS07B01	MACHINE LEARNING	**3**	**1**	**0**	**4**
UCS07B02	INTELLECTUAL PROPERTY RIGHTS (IPR)	**1**	**0**	**0**	**0**
	ELECTIVE – III	**3**	**0**	**0**	**3**
	ELECTIVE – IV	**3**	**0**	**0**	**3**
Total 7th Semester Theory Credit					**10**

National Institute of Technology, Agartala

Proposed Course-Structure: Computer Science & Engineering

SEVENTH SEMESTER (For Project & Training**)**

Course Code	Subject Name	L	T	P	Total Credits
UCS07P12	PROJECT – I	0	0	4	2
UCS07P13	INDUSTRIAL TRAINING	0	0	0	1
Total 7th Semester Project & Training Credit					**3**
Total 7th Semester theory Credit					**10**
Total 7th Semester Credit					**13**

National Institute of Technology, Agartala					
Proposed Course-Structure: B. Tech. Computer Science & Engineering					
EIGHTH SEMESTERTHEORY					
Sl. No.	**Subject Name**	**L**	**T**	**P**	**Total CR**
1	ELECTIVE – V	**3**	**0**	0	3
2	ELECTIVE – VI	**3**	**0**	0	3
3	ELECTIVE – VII	**3**	**0**	0	3
	Total 8th Semester Credit				**9**

National Institute of Technology, Agartala					
EIGHTH SEMESTER (For Project Work & Viva)					
Course Code	**Subject Name**	**L**	**T**	**P**	**Total CR**
UCS08P15	Project-II	**0**	**0**	**9**	**3**
UCS08P16	Comprehensive Viva Voce	**0**	**0**	**-**	**1**
Total 8th Semester Credit (For Project Work & Viva)					**4**
Total 8th Semester theory Credit					**9**
Total 8th Semester Credit					**13**

National Institute of Technology, Agartala		
EIGHTH SEMESTER (Only For Students Who Will Do Project Work In Industry)		
SL NO.	**Subject Name**	**Total CR**
1	PROJECT	**10**
2	PROJECT SEMINAR RESENTATION	**02**
3	COMPREHENSIVE VIVA VOCE	**01**
Total 8th Semester Credit		**13**

Total Course Credit	
Total credit : 3rd semester to 8th semester	**122**
Total credit : 1St semester to 2nd semester **(**Common to all existing branches of NIT, Agartala)	**43**
Total Course credit : 1St semester to 8th semester	**165**

LIST OF SUBJECTS FOR ELECTIVE -I

COURSE CODE	COURSE NAME	L	T	P	CREDITS
UCS05E01	COMPUTER GRAPHICS	3	0	0	3
UCS05E02	DIGITAL IMAGE PROCESSING	3	0	0	3
UCS05E03	FOUNDATION OF CRYPTOGRAPHY	3	0	0	3

LIST OF SUBJECTS FOR ELECTIVE -II

COURSE CODE	COURSE NAME	L	T	P	CREDITS
UCS06E04	COMPUTER AND NETWORK SECURITY	3	0	0	3
UCS06E05	DATA WAREHOUSING AND DATA MINING	3	0	0	3
UCS06E06	MOBILE COMPUTING	3	0	0	3

LIST OF SUBJECTS FOR ELECTIVE –III & IV (Inhouse)

COURSE CODE	COURSE NAME	L	T	P	CREDITS
UCS07E07	BIG DATA ANALYTICS	3	0	0	3
UCS07E08	CLOUD COMPUTING	3	0	0	3
UCS07E09	INFORMATION RETRIEVAL	3	0	0	3
UCS07E10	PATTERN RECOGNITION	3	0	0	3

UCS07E11	SOFT COMPUTING	3	0	0	3
UCS07E12	UNIX SYSTEM PROGRAMMING	3	0	0	3

LIST OF SUBJECTS FOR ELECTIVE –V, VI & VII (Inhouse)

COURSE CODE	COURSE NAME	L	T	P	CREDITS
UCS08E13	DEEP LEARNING	3	0	0	3
UCS08E14	EMBEDDED AND REAL TIME SYSTEM	3	0	0	3
UCS08E15	HUMAN COMPUTER INTERACTION	3	0	0	3
UCS08E16	NATURAL LANGUAGE PROCESSING	3	0	0	3
UCS08E17	PRINCIPLES OF PROGRAMMING LANGUAGE	3	0	0	3
UCS08E18	WEB TECHNOLOGY	3	0	0	3
UCS08E19	WIRELESS SENSOR NETWORK	3	0	0	3

LIST OF OPEN ELETIVE FOR B.TECH 8TH SEMESTER

COURSE CODE	COURSE NAME	L	T	P	CREDITS
UCS08E20	APPLICATION OF MACHINE LEARNING IN TIME SERIES ANALYSIS	3	0	0	3

LIST OF PROPOSED ELECTIVE-III & IV SUBJECTS (MOOCS-NPTEL)

Sl. No.	**Course ID**	**Course Name**	**Offered Institute**	**Duration**
1	noc18_cs34	Programming, data structures and algorithms using Python	CMI	8 weeks
2	noc18_cs35	The Joy of Computing using Python	IITRopar	12 Weeks
3	noc18_cs39	Scalable Data Science	IIT Kharagpur	8 weeks
4	noc18_cs40	Introduction to Machine Learning	IIT Kharagpur	8 weeks
5	noc18_cs52	Introduction to R Software	IITK	8 weeks

6	noc18_cs41	Deep Learning	IITM	12 Weeks
7	noc18_cs42	Software testing	IIITB	12 Weeks
8	noc18_cs44	Cloud Computing	IIT Kharagpur	8 weeks

LIST OF PROPOSED ELECTIVE-V, VI &VII SUBJECTS (MOOCS-NPTEL)

Sl. No.	Course ID	Course Name	Offered Institute	Duration
1	noc18_cs45	Cloud Computing and Distributed Systems	IITK	8 weeks
2	noc18_cs46	Introduction to Internet of Things	IIT Kharagpur	12 Weeks
3	noc18_cs51	Artificial Intelligence Search Methods for problem Solving	IITM	12 Weeks
4	noc18_cs47	Blockchain Architecture Design and Use Cases	IITKGP & IBM	12 Weeks
5	noc18_cs48	Hardware Modeling using Verilog	IIT Kharagpur	8 Weeks
6	noc18_cs49	Model Checking	CMI	12 Weeks
7	noc18_cs50	Multi-Core Computer Architecture – Storage and Interconnects	IITG	8 weeks
8	noc18_cs54	Embedded Systems-- Design Verification and Test	IITG	12 Weeks
9	noc18_cs55	Introduction to parallel Programming in Open MP	IITD	4 Weeks
10	noc18_cs56	Social Networks	IIT Bhilai & IIT Ropar	12 weeks
11	noc18_cs57	Design and pedagogy of the introductory programming course	IITB	4 Weeks

Link for all above courses: https://docs.google.com/spreadsheets/d/e/2PACX-1vQrnLO4ocWndT-busWy_e9cpujxYGg3Cc3THic_EB4EG6wvTx4yFpYxmzrl0BQ_rbrMEpL3jz8wvKMH/pubhtml

NOTE: The course list may vary according to the NPTEL certification course update.

DETAILED SYLLABUS

for

BACHELOR OF TECHNOLOGY

in

Department of Computer Science and Engineering

राष्ट्रीय प्रौद्योगिकी संस्थान अगरतला

National Institute of Technology Agartala

Agartala, Jirania– 799046

Third Semester
Detailed Syllabus

DATA COMMUNICATION	UCS03B07
L T P 3 -0 -0 : 3 Credits	Prerequisites: *None*

Course Objective:

1. To learn the basic concepts of data communication.
2. To learn digital and analog signal transmission, encoding techniques, multiplexing techniques.
3. To comprehend the use of different types of transmission media and network devices.
4. To learn the concepts and techniques in error detection and correction in transmission of data.
5. To understand the concept of flow control, error control, LAN architecture, audio and video compression and streaming.

Course Description:

This course will give a prologue to the field data communications, network topologies, Layered design of LAN, MAN and WAN, fundamentals of signaling, basic transmission concepts, error detection and correction etc.

MODULE - I
Basic goals of communication, Data flow, protocol and standards; Data and Signals: Analog and Digital signals, Periodic analog signals, Transmission Impairment, data rate limits and performance. Fourier series, Fourier transform frequency spectrum, filtering and bandwidth.

MODULE - II
Digital Transmission: digital to digital conversion – line coding, block coding and scrambling. Analog to digital conversion – PCM, DM. Transmission modes: Serial and Parallel. Analog Transmission: digital to analog conversion: ASK, FSK, PSK, QAM. Analog to analog conversion: AM, FM, PM. Bandwidth utilization: Multiplexing – FDM, WDM, synchronous and statistical TDM. Principles of Spread spectrum communication - DSSS, FHSS. Transmission media: Guided media – twisted pair cable, coaxial cable, fiber optic cable. Unguided media – radio waves, micro waves, infrared.

MODULE - III
Error detection and correction: redundancy, forward error correction versus retransmission. Block coding: hamming distance. Error detection and correction in a frame: LRC, VRC. Cyclic code: CRC. Checksum. Data link control: fixed size and variable size framing. Flow and error control. Noiseless channels: stop-and-wait protocol. Noisy channels: Stop-and-wait ARQ, Go-Back-N ARQ.

MODULE - IV
Wired LANs: standard ethernet – MAC and physical layer. Changes in standard – bridged, switched and full duplex ethernet. Wireless LANs: IEEE 802.11, Bluetooth.
Multimedia: Digitizing audio and video, audio and video compression, streaming stored and live audio/ video, RTP, RTPCP, Voice Over IP.

Text Books:

1. B.A. Forouzan, "*Data Communications and Networking*", 4th edition, Tata McGraw Hill, 2003.

2. W. Stallings, "*Data and Computer Communications*", 6th edition, Pearson education Asia (IPE), 2000. Social Media Mining.

Reference Books:

1. S. Haykin, "*Communication Systems*", 3rd edition, John Wiley, 1994.
2. H. Taub and D. Schilling, "*Principles of Communication Systems*", 3rd edition, Tata McGraw Hill.
3. F. Halshall, "*Data Communications, Computer networks and Open Systems*", 4th edition, Pearson Education Asia (IPE), 1996.
4. D. Bertrekas and R. Gallagar, "*Data Networks*", 2nd edition, Prentice Hall (EEE), 1992.
5. J.Proakis and M.Salehi, "*Communication System Engineering*", Prentice Hall, 1995 Schiller, "Mobile Communications", Pearson Education Asia, 2000.

Course Outcome:

C01: Understand the basics of data communication, relationship between data which are created by a device and electromagnetic signals which are transmitted over a medium.
C02: Students will be able to understand digital and analog transmission, conversion of digital or analog data to digital or analog signals, use of available bandwidth efficiently through multiplexing and various types of transmission media.
C03: Determine the various error detection and correction techniques and their application in communication systems along with the concept of flow and error control
C04: Differentiate wired and wireless local area networks. Understand compression and streaming of audio/video.

To establish the correlation between CO and PO

Table 1

Course Outcome No.	Course Outcome
CO1	Understand the basics of data communication, relationship between data which are created by a device and electromagnetic signals which are transmitted over a medium.
CO2	Students will be able to understand digital and analog transmission, conversion of digital or analog data to digital or analog signals, use of available bandwidth efficiently through multiplexing and various types of transmission media.
CO3	Determine the various error detection and correction techniques and their application in communication systems along with the concept of flow and error control
CO4	Differentiate wired and wireless local area networks. Understand compression and streaming of audio/video.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	1	2	1	2	1
CO2	3	3	3	3	3	3	1	1	1	3	3	2
CO3	3	3	3	3	3	3	1	1	2	3	3	3
CO4	1	1	2	3	3	2	1	1	1	1	1	1
TOTAL	10	10	11	12	12	11	5	4	6	8	9	7
AVG	2.5	2.5	2.75	3	3	2.75	1.25	1	1.5	2	2.25	1.75
Eq AVG Attainment	3	3	3	3	3	3	1	1	2	2	2	2

To establish the correlation between CO and PSO

Table 3

CO	PSO1	PSO2
CO1	1	1
CO2	3	2
CO3	3	3
CO4	3	3
TOTAL	10	9
AVG	2.5	2.25
Eq AVG Attainment	3	2

DATA STRUCTURES & PROGRAMMING METHODOLOGY	UCS03B08
L T P 3 - 1 - 0 :4 Credits	Prerequisites: *None*

Course Objective:

1. Be familiar with basic techniques of algorithm analysis and in writing recursive methods.
2. Master the implementation of linked data structures such as linked lists and binary trees.
3. Be familiar with advanced data structures such as balanced search trees, hash tables and priority queues.
4. Be familiar with several sub-quadratic sorting algorithms including quick sort, merge sort and heap sort
5. Be familiar with some graph algorithms such as shortest path and minimum spanning tree
6. Master analyzing problems and writing program solutions to problems using the above techniques

Course Contents:

UNIT-I

INTRODUCTION:

Basic concepts and notations: data structures and data structure operation, Interrelationship of Data structure

and algorithms. Asymptotic complexity analysis, Abstract Data Types, Recursive programming and recurrence relations.

ARRAYS:

Different representation of Array, Sparse matrix - its implementation and usage, Array representation of polynomials, Circular arrays.

UNIT -II

STACKS and QUEUES:

Fundamental of stacks, Operations on stacks, Evaluation of postfix and prefix expressions, conversion from infix to postfix representation, implementing recursive functions, Application of Stack. Fundamental of Queues, Representation with arrays, Operation on Queues, Circular queue, multiple queues dynamics, Dequeues.

UNIT -III

LINK LISTS:

Singly linked list and their manipulation, doubly linked list, Circular linked list, Circular doubly linked list, Dynamic storage management, Garbage collection, generalized list, Linked stacks and queues.

TREES:

Binary trees and its representation arrays, Tree traversals (Preorder, Inorder and Postorder), Threaded binary tree, Binary tree representation of tree, Binary search trees, Balanced binary search trees, heaps,Height balanced binary tree ,AVL tree,B- Trees.

UNIT -IV

SORTING AND SEARCHING:

Searching –linear search, binary search, Different algorithms for sorting – Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Heap sort, Radix sort.

UNIT -V

GRAPH REPRESENTATION:

Graph definitions and concepts. Graph Traversal Techniques: Breadth First Search (BFS) and Depth First Search (DFS), Applications of BFS and DFS, Minimum Spanning Trees (MST), Prim’s and Kruskal’s algorithms for MST.

HASHING AND HEAPS:

Comparing direct address tables with hash tables, hash functions, concept of collision and its resolution using open addressing and separate chaining, double hashing, rehashing. Representing a heap in memory, operations on heaps, application of heap in implementing priority queue.

Text Books:

An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill.

Data Structures: A Pseudo-code approach with C -By Gilberg & Forouzan Publisher-Thomson Learning.

Reference Books:

M. Tenenbaum and Augestien, "Data Structures using C", Pearson Education.
J.P. Tremblay and P.J. Sorenson, "An Introduction to Data Structures With Applications", Tata Mcgraw Hill.
S. Horowitz and S. Sahani "Fundamentals of Data Structures", Computer Science Press.

Course Outcomes:

CO1	Student will be able to choose appropriate data structure as applied to specified problem definition.
CO2	Student will be able to handle operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
CO3	Students will be able to use linear and non-linear data structures like stacks, queues, linked list etc.
CO4	Students will be able to implement arrays, linked structures, stacks, queues, trees, graphs with memory representation and algorithmic analysis.
CO5	Students will be able to implement abstract data types using arrays and linked list.
CO6	Students will be able to understand and analyse the various sorting and searching algorithms.

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	--	--	--	2	--	2	--	--	--	2
CO2	3	3	2	2	3	--	1	--	--	2	1	2
CO3	3	3	2	2	3	2	1	2	2	3	2	1
CO4	3	3	3	2	3	2	2	2	2	2	2	1
CO5	3	3	3	3	3	2	2	2	1	2	2	1
CO6	3	3	3	3	3	2	2	2	1	2	2	1
Total	18	18	13	12	15	10	8	10	6	11	9	8
Average	3	3	2.16	2	2.5	1.66	1.33	1.66	1	1.83	1.5	1.33
Eq. Average Attainment	3	3	2	2	3	2	1	2	1	2	2	1

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	3
CO5	2	3
CO6	2	3
Total	16	11
Average	2.66	1.83
Eq. Av Attainment	3	2

DIGITAL CIRCUIT & LOGIC DESIGN	**UCS03B09**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: *None*

Course Objective:

1. To introduce the concept of digital and binary systems
2. To be able to design and analyze combinational logic circuits.
3. To be able to design and analyze sequential logic circuits.
4. To understand the basic software tools for the design and implementation of digital circuits and systems.
5. To reinforce theory and techniques taught in the classroom through experiments and projects in the laboratory.

Course Content:

UNIT I

Number System & Codes:

Number Systems: Binary, Decimal, Octal and Hexadecimal, Number Base conversion, Subraction using Complements, Binary Codes, Binary Logic.

Boolean Algebra & Logic Gates:

Basic Definitions: Axiomatic definition of Boolean algebra, basic theorems and properties of Boolean algebra, Boolean functions, canonical & standard forms, Digital logic Families: Operation, characteristics of digital logic family.

The Karnaugh map method, The tabulation method or Quine McCluskey Method, Determination of prime implicants, selection of prime-implicants.

UNIT II

Combinational Logic UNITs and their applications:

Arithmetic UNITs- adders, Subtractors, Comparators and ALU, Design examples.

Decoders, Three-State Buffers. Encoders, Multiplexer, Demultiplexer, Exclusive OR Gates and Parity Generator and Checker, Documentation Standards, Circuit Timing. Combinational PLDs; PLAs; PALs; GALs; Bipolar PLD Circuits.

UNIT III

Synchronous Sequential Logic:

Definition of state machines, state machine as a sequential controller; Basic sequential circuits- latches and flip-flops: SR-latch, D-latch, D flip-flop, JK flip-flop, T flip-flop;

Timing hazards and races; Analysis of state machines using D flip-flops and JK flipflops; Design of state machines - state table, state assignment, transition/excitation table, excitation maps and equations, logic realization; Design examples.

Asynchronous Sequential Logic:

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards, Counters, Shift Registers, Iterative versus Sequential Circuits, Synchronous Design Methodology.

UNIT IV

Memory and Programmable Logic:

Memory: Read-Only Memory, Read/Write Memory, Static RAM, Dynamic RAM.

Programmable Logic Devices: PLAs, PALs and their applications; Sequential PLDs and their applications; State machine design with sequential PLDs; Introduction to field programmable gate arrays (FPGAs).

Digital Integrated Circuits:

Introduction to digital logic families, RTL and DTL circuits, integrated injection –logic, transistor logic, emitter coupled, Metal Oxide Semiconductor, complementary MOS.

Study to different types of analog to digital & digital to analog converters and their resolution, conversion time, sensitivity, accuracy and other parameters.

Text Books:

1. Digital Logic and Computer Design by M. Morris Mano, Prentice Hall of India
2. Digital Electronics Principles by D.P. Malvino and Leach, McGraw Hill Inc.

Reference Books:

3. Digital Electronic Circuits by T.C. Bartee, Mcgraw Hill Inc.
4. Digital Design Principles and Practices by John F Wakerly, Pearson Education.

5. Modern Digital Electronics by R. P. Jain, Mcgraw Hill Education.
6. Fundamentals of Digital Analysis by Sandige, Richard S., Mcgraw Hill Inc.

Course Outcome(COs):

1. Apply knowledge of number systems, codes and Boolean algebra to the analysis and design of digital logic circuits.
2. Identify, formulate, and solve engineering problems in the area of digital logic circuit design.
3. Use the techniques, skills, and modern engineering tools such as logic works necessary for engineering practice.
4. Function on multi-disciplinary teams through digital circuit experiments and projects.
5. Design a digital system, components or process to meet desired needs within realistic constraints.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	1	2	2	1	2	3
CO2	3	3	3	3	2	3	2	1	3	1	3	3
CO3	3	3	3	3	3	2	2	1	3	2	3	3
CO4	3	3	2	3	3	2	0	3	3	2	2	3
CO5	3	3	3	3	3	1	3	2	2	3	3	3
Total	**15**	**15**	**14**	**15**	**13**	**10**	**8**	**9**	**13**	**9**	**13**	**15**
Eq. Av Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**3**

Table 1: CO-PO Mapping:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	2	2
CO4	2	3
CO5	2	2
Total	12	7
Average	2.4	1.4
Eq. Av Attainment	2	1

DISCRETE MATHEMATICAL STRUCTURES	UCS03B10
L T P 3 - 0 - 0 :3 Credits	Prerequisites: *None*

Course Objective:

1. To teach the students the art of reasoning.
2. To teach the techniques for constructing mathematical proofs, some fundamental mathematical concepts and terminology; sets, functions, relations, orders, and sequences.
3. To understand the principles of mathematical logic, and some discrete structures is discussed.
4. To understand the basic properties of ring and field theory.

Course Content:

UNIT I
SET THEORY:
Basic concepts – Notations – Subset – Algebra of sets – The power set – Ordered pairs and Cartesian product – Relations on sets –Types of relations and their properties – Relational matrix and the graph of a relation – Partitions – Equivalence relations – Partial ordering – Poset – Hasse diagram – Lattices and their properties – Sublattices – Boolean algebra – Homomorphism.

UNIT II
FUNCTIONS:
Definitions of functions – Classification of functions - Composition of functions – Inverse functions – Binary and n-ary operations – Characteristic function of a set – Hashing functions – Recursive functions – Permutation functions.

UNIT III
PROPOSITIONAL CALCULUS:
Propositions – Logical connectives – Compound propositions – Conditional and biconditional propositions – Truth tables – Tautologies and contradictions – Contrapositive – Logical equivalences and implications – DeMorgan's Laws - Normal forms – Principal conjunctive and disjunctive normal forms – Rules of inference – Arguments - Validity of arguments.

UNIT IV
PREDICATE CALCULUS:
Predicates – Statement function – Variables – Free and bound variables – Quantifiers – Universe of discourse – Logical equivalences and implications for quantified statements – Theory of inference – The rules of universal specification and generalization – Validity of arguments.

UNIT V
GROUPS AND RINGS:
Algebraic systems – Definitions – Examples – Properties – Semigroups – Monoids – Homomorphism – Sub semigroups and Submonoids - Cosets and Lagrange's theorem – Normal subgroups – Normal algebraic

system with two binary operations - Codes and group codes – Basic notions of error correction - Error recovery in group codes.

MONOIDS AND GROUPS:
Groups Semigroups and monoidsCyclicsemigraphs and submonoids, Subgroups and Cosets. Congruence relations on semigroups.Morphisms.Normal subgroups. Structure of Cyclic groups permutation groups, dihedral groups Elementary applications in coding theory. Rings and Boolean algebra: Rings Subrings morphism of rings ideals and quotient rings. Euclidean domains Integral domains and fields Boolean Algebra direct product morphisms Boolean sub-algebra Boolean Rings Application of Boolean algebra in logic circuits and switching functions.

Text Book: Seymour Lipschutz , Marc Lipson ,Schaum's Outline of Discrete Mathematics, 3rd Edition

Recommended Books:

1. Kenneth H.Rosen, "Discrete Mathematics and its Applications", Fifth Edition, Tata McGraw – Hill
Swapan Kumar Chakraborty, BikashKanthiSarkar, Discrete Mathematics, Oxford , 1st Edition

Course Outcomes (CO):

Table1

CO1	Understand the basic principles of sets and operations in sets.
CO2	Write an argument using logical notation and determine if the argument is or is not valid.
CO3	Be able to specify and manipulate basic mathematical objects such as sets, functions, and elations and will also be able to verify simple mathematical properties that these objects ossess
CO4	Understand the importance of algebraic properties with regard to working within various umber systems.
CO5	Students will be able to define ring, subrings, ideals, integral domain and field

CO-PO Mapping:

Table2

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	3	1	1	3	3	3
CO2	3	3	3	3	3	3	3	1	1	3	3	3
CO3	3	2	2	3	3	3	2	1	1	3	3	3
CO4	2	2	1	2	2	2	2	0	1	3	2	2

CO5	2	1	0	0	1	0	0	0	0	0	0	1
Total	13	11	10	11	12	11	10	3	4	12	11	12
Average Attainment	2.6	2.2	2.0	2.2	2.4	2.2	2.0	0.6	0.8	2.4	2.2	2.4
Equivalent Average Attainment	3	2	2	2	2	2	2	0	1	2	2	2

CO – PSO Mapping:

Table 3

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PSO1	PSO2
CO1	2	1
CO2	3	3
CO3	3	2
CO4	3	3
CO5	3	3
TOTAL	14	12
AVG	2.8	2.4
Eq AVG Attainment	3	2

ENGINEERING MATHEMATICS III	**UCS03C16**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: *None*

Course Objectives:

1 The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science like disease modelling, climate prediction and computer networks etc.
2 Apply probability theory via Bayes' Rule.
3 Describe the properties of discrete and continuous distribution functions.
4 Use method of moments and moment generating functions
5 Apply the Central Limit Theorem.
6 Use statistical tests in testing hypotheses on data.
7 Introduce students to partial differential equations, and to solve linear Partial Differential with different methods
8 Introduce students to some physical problems in Engineering and Biological models that results in partial differential equations.

9 Introduce the Fourier series and its application to the solution of partial differential equations.

Course Contents:

Unit-1: Probability and Random Variable: Axioms of probability, Conditional probability, Independent events, Baye's Theorem, Random variables, Probability mass function, Probability density function - properties, Moments, Moment generating functions and their properties.

Unit-2: Standard Distributions: Binomial, Poisson Normal distribution and their properties, function of random variables.

Unit-3: Two-dimensional random variables: Joint distribution, Marginal and conditional distribution, covariance, correlation and regression, Transformation of random variables, Central limit theorem.

Unit-4:. Testing of hypothesis: Sampling distribution, Testing of hypothesis of mean, variance, proportion and differences using Normal, t and Chi-square.

Unit-5: Fourier Series: Periodic functions, Fourier series, Dirichlet's conditions, function defined in two or more sub-ranges, discontinuous functions, even function, odd function, half range series, change of interval.

Unit-6: Partial Differential Equations: Order, Method of forming Partial Differential Equations, Solution of Equation by Direct Integration, Lagrange's Linear equation, Method of Multipliers, Partial Differential equations non-linear in p,q, Charpits Method, Linear Homogeneous Partial Differential equation, Non-Homogeneous Linear Equations, Method of Separation of variables, Equation of vibrating string, Solution of wave equation by D'Alembert's method, One dimensional heat flow, Two dimensional Heat flow.

Introduction of the Course: Engineering Mathematics is a branch of applied Mathematics concerning mathematical methods and techniques that are typically used in engineering and industry. Engineering Mathematics-III is an interdisciplinary subject consisting with probability theory, statistics, Fourier series and partial differential equation, and is motivated to deal with uncertainties, and also to deal with different models involving partial differential equations.

Probability theory and statistics are the branches of mathematics that deals with modeling uncertainty. It is important because of its direct application in areas such as engineering, finance and management. It also forms the fundamental basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. This course provides an introduction to probability theory, random variables and hypothesis testing. Topics covered are: probability axioms, conditional probability; Bayes' theorem; discrete random variables, moments, axiomatic probabilities, probability generating functions, standard discrete distributions; continuous random variables, uniform, binomial, Poisson, normal, exponential, and chi-square distributions; bivariate distributions, marginal and conditional distributions, independence, covariance and correlation, linear combinations of two random variables, the central limit theorem.

Partial differential equations describe relations between continuously changing quantities which depend on two or more variables (e.g., time and one or several space coordinates). A major part of physics and its applications in engineering sciences is based on models involving partial differential equations. To acquire basic understanding of the most common partial differential equations, and to learn some methods for solving them, therefore should be importance in engineering programmes, in particular such programmes which are directed towards fundamental technology and physics. The main goal of the course is that the student, after finished studies, should be able to solve boundary value problems for Laplace's equation, the heat equation, the wave equation and the Schrödinger equation by separation of variables, in cartesian, polar, spherical and cylindrical coordinates.

Text Books:

i. Advanced Engineering Mathematics: H.K. Dass.
ii. Higher Engg. Mathematics: B.V. Ramana.
iii. Advanced Engg. Mathematics: E. Kreyszig.

Reference Books:

i. Ordinary Differential Equation: M.D. Raisinghania.
ii. Mathematical Analysis: Malik & Arora.
iii. Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor.

Course Outcomes:

At the end of the course, students will be able to

1. Understand the basic concepts of probability, random variables, probability distribution, and moments and moment generating functions.
2. Definethe basic discrete and continuous distributions such as normal, binomial, Poisson, and make be able to apply them and simulate them in simple cases.
3. Explain the concepts of two dimensional random variables, independence, jointly distributed random variables and conditional distributions, and use generating functions to establish the distribution of linear combinations of independent random variables. Also State the central limit theorem, and apply it.
4. Explain the concepts of random sampling, statistical inference and sampling distribution, and state and use basic sampling distributions. Hypothesis testing and its application in real life problems.
5. Find the Fourier series representation of a function of one variable, and find the solution of the wave, diffusion and Laplace equations using the Fourier series.
6. Students familiarize with the fundamental concepts of Partial Differential Equations (PDE) which will be used as background knowledge for the understanding of specialized courses in Engineering. Students will master how solutions of PDEs are determined by conditions at the boundary of the spatial domain and initial conditions at time zero.

Mapping of units with COs

Unit wise CO mapping (Put ✓):

CO's AIMED	CO 1	CO 2	CO 3	CO 4	CO 5	CO6
UNIT 1	✓					
UNIT 2		✓				
UNIT 3			✓			
UNIT 4				✓		
UNIT 5					✓	
UNIT 6						✓

1. Mapping of Course Outcomes with Program Outcomes & Program Specific Outcomes:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO 1	3	3	2	1	-	-	-	-	-	1	1	2
CO 2	2	2	2	1	2	-	-	-	-	1	1	1
CO 3	3	2	3	2	1	1	-	-	-	-	1	1
CO 4	3	3	2	2	3	1	-	1	1	1	1	2
CO 5	2	2	2	1	1	1	-	-	-	1	1	1
CO 6	3	2	2	2	1	1	-	-	1	1	1	1

To establish the correlation between COs & PSOs

Table-3

CO	PSO1	PSO2
UCE03C01.1	2	2
UCE03C01.2	1	1
UCE03C01.3	2	1
UCE03C01.4	1	2
UCE03C01.5	1	2
UCE03C01.6	2	2
Total	**9**	**10**
Average	**1.5**	**1.67**
Eq. Average Attainment	**2**	**2**

INTRODUCTION TO GRAPH THEORY	UCS03B11
L T P 3 - 1 - 0 : 4Credits	Prerequisites: *None*

Course Objectives

1. To clarify the different concepts in Graph Theory.
2. To recognize the categories of graphs to understand various real world problems.
3. To understand various basic terminologies and theorems associated with different types of graphs.
4. To opt suitable graphs for representing several situations in numerous areas of computer science & engineering.

Course Content

UNIT I

Introduction: Graphs and their applications, graph theoretic terms: incidence, adjacency, degree, null graph, walk, trail, path, circuit, connected and disconnected graphs, various operations on graphs, isomorphism, Euler's graphs, Hamiltonian graphs, directed graph and its uses.

UNIT II

Trees and Fundamental circuits: Properties of trees, Jordan's Theorem, rooted trees, binary trees, counting trees, Cayley's theorem, spanning trees, matrix-tree theorem, fundamental circuits.

UNIT III

Connectivity: Cut set & its properties, Vertex and edge connectivity, Menger's theorem, 1-Isomorphism and 2-isomorphism.

Planer graphs: Planer graphs and their representation, detection of planarity, Geometric dual, thickness and crossing.

UNIT IV

Matrix representation: Different matrix and their representation in directed and undirected graphs.
Coloring, matching and covering: Chromatic number, Chromatic partitioning, Chromatic polynomial, bipartite graph, matching and Hall's theorem, Covering, four-color and five-color theorem.

UNIT V

Graph Theoretic Algorithms: Prim's &Kruskal's algorithm, Dijkstra's algorithm, Bellman-Ford Algorithm, Floyd-Warshall algorithm, Ford-Fulkerson Algorithm.

Text Book:

1. Graph Theory with applications to Engineering and Computer Science; N. Deo., 3rd Edition, PHI Learning.
2. Introduction to Graph Theory: Douglas West, 2nd Edition, Pearson Publisher.

Reference Book:

1. Graph Theory with Applications: C. Vasudev, 1st Edition, New Age International Publisher.
2. Graph Theory: F. Harary, 3rd Edition, Addison-Wesley Publisher.
3. Algorithmic Graph Theory: Alan Gibbons, 6th Edition, Cambridge University Press.

CourseOutcomes

CO1	Understanding the basic graph based terminologies and their use in the formation of different types of Graphs.
CO2	Understanding the concepts of Trees and their uses in various computer based applications.
CO3	Identification of different phenomenon like: isomorphism, planarity, connectivity, duality and their effect on different types of graphs.
CO4	Understanding the concepts of matrix representation in directed and undirected graphs.
CO5	Explain the use of coloring and partitioning concepts for solving various graph based problems.

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	1	-	1	2	3	2	2
CO2	3	3	3	3	2	2	2	1	2	3	3	3
CO3	2	2	2	2	2	3	3	1	2	2	3	2
CO4	3	3	3	3	2	2	2	-	3	2	2	2
CO5	3	3	3	3	2	3	3	2	2	3	2	3
Total	14	13	13	14	9	11	10	5	11	13	12	12
Average	2.8	2.6	2.6	2.8	1.8	2.2	2.0	1.0	2.2	2.6	2.4	2.4
Eq. Average Attainment	3	3	3	3	2	2	2	1	2	3	2	2

To establish the correlation between COs & PSOs

Table 3: CO-PSO Mapping

CO	PSO1	PSO2
UCS03B11.1	**2**	**3**
UCS03B11.2	**3**	**2**
UCS03B11.3	**2**	**2**
UCS03B11.4	**3**	**2**
UCS03B11.5	**2**	**2**
Total	**12**	**11**
Average	**2.4**	**2.2**
Eq. Average Attainment	**2**	**2**

DATA STRUCTURE & PROGRAMMING METHODOLOGY LABORATORY	UCS03P13
L T P 0 - 0 - 3 : 2 Credits	Prerequisites: *None*

Course Objective:

1. To analyze the time and space complexities and efficiency of various algorithms.
2. Be familiar with basic techniques of programming and algorithm analysis in writing methods.
3. To understand the practical application of linear and nonlinear data structures.
4. Understand basic data structures such as arrays, linked lists, stacks, queues, trees and graphs.
5. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data

Course Content:

UNIT I

Introduction to Data Structure using C, implementation of 1D Array, perform different operations on 1D Array like insert, delete, search etc, implementation of matrix using 2D Array, perform different operations on 2D Array like insert, delete, search etc, implementation of sparse matrix, implementation of Polynomials.

UNIT II

Implementation of Stack using Array, different operations on Stack, evaluation of postfixes and prefix expressions, implementing recursive functions, implementation of Queue using Array, Operations on Queues, implementation of circular Queue.

UNIT III

Implementation of Linked list using Array, Practicing types of Linked list (double, circular, circular double), Different operations on Linked list, Implementation of Stack using Linked list, Implementation of Queue using Linked list.

UNIT IV

Implementation of Binary tree, implementation of Binary tree traversal methods: Pre-order, In-order, Post-ordered traversal, implementation of Binary Tree using Recursion, implementation of Binary search tree operation-search, addition, deletion.

UNIT V

Implementation of different searching technique, implementation of Bubble sort, Selection sort, Insertion sort, Merge sort, Quick sort, Heap sort, Radix sort, implementation of graph and different Graph Traversal Techniques.

Text Book:

1. Robert Kruse & Bruce Leung, "Data Structures & Program Design in C", Pearson Education.

Reference Books:

1. Ellis Horowitz, SatrajSahni and Susan Anderson-Freed, "Fundamentals of Data Structures in C", W. H. Freeman and Company.
2. E. Balaguruswamy, "Programming in ANSI C", Tata McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall of India.

Course Outcome:

Table 1

CO-1	Student will be able to choose appropriate data structure as applied to specified problem definition.
CO-2	Students will be able to understand the parameters to analyze the performance of an algorithm.
CO-3	Students will be able to design algorithms and programs to perform operations with Linear and Nonlinear data structures
CO-4	Students will be having the idea about various technique for searching, sorting.
CO-5	Students will have practical knowledge on the applications of data structures so that the real world problems can be solved.

CO-PO Mapping:

Table 2

Levels: 1: Slight(LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	3	1	2	1	3	3	2	3
CO-2	2	2	2	1	1	2	2	2	2	3	3	2
CO-3	3	2	2	1	3	2	2	2	2	2	1	2
CO-4	2	1	3	1	2	1	1	1	3	2	2	3
CO-5	3	3	3	2	3	3	2	3	2	3	3	3
Total	13	11	12	7	12	9	9	9	12	13	11	13
Average Attainment	2.6	2.2	2.4	1.4	2.4	1.8	1.8	1.8	2.4	2.6	2.2	2.6
Equivalent Average Attainment	3	2	2	1	2	2	2	2	2	3	2	3

Table 3: To establish the correlation between COs & PSOs

CO	PSO-1	PSO-2
CO-1	2	2
CO-2	3	2
CO-3	3	3
CO-4	2	3
CO-5	4	3
Total	14	13
Avg	2.8	2.6
Eq. Avg. Attainment	3	3

DIGITAL CIRCUIT & LOGIC DESIGN LABORATORY	UCS03P11
L T P 0 - 0 - 3 : 2 Credits	Prerequisites: *None*

Course Objective:

1. To hands-on practice the concept of digital and binary systems
2. To hands-on design and analyse combinational logic circuits.
3. To hands-on design and analyse sequential logic circuits.
4. To understand and hands-on practice the basic software tools for the design and implementation of digital circuits and systems.
5. To hands-on practice the reinforce theory and techniques taught in the classroom through experiments and projects in the laboratory.

LIST OF EXPERIMENTS:

EXPERIMENT NO 1: Addition using registers and storing result in registers.

EXPERIMENT NO.2: Addition of numbers stored in memory and storing result in register.

EXPERIMENT NO.3: Write a program for the addition of three 8-bit numbers with carry.

EXPERIMENT NO.4: Write a program to subtract two 8-bit numbers using 8085 (without borrow)

EXPERIMENT NO.5: Write a program to subtract two 8-bit numbers using 8085 (with borrow)

EXPERIMENT NO.6: Multiplication of two 8-bit numbers (without carry)

EXPERIMENT NO.7: Multiplication of two 8-bit numbers (with carry)

EXPERIMENT NO.8: Multiplication of three 8-bit numbers (without carry)

EXPERIMENT NO.9: Write a program to divide two 8-bit numbers.

EXPERIMENT NO.10: Write a program to find the largest number in an array

EXPERIMENT NO.11: Write a program to find the smallest number in an array.

EXPERIMENT NO.12: Write a program to search an 8-bit number in an array.

EXPERIMENT NO.13: Write a program to store array elements in ascending order.

EXPERIMENT NO.14: Write a program to store array elements in descending order

Text Book:

Instruction Manual and class notes

Course Outcomes:

CO1: Apply knowledge of number systems, codes and Boolean algebra to the analysis and design of digital logic circuits.

CO2: Identify, formulate, and solve engineering problems in the area of digital logic circuit design.

CO3: Use the techniques, skills, and modern engineering tools such as logic works necessary for engineering practice.

CO4: Function on multi-disciplinary teams through digital circuit experiments and projects.

CO5: Design a digital system, components or process to meet desired needs within realistic constraints.

Table 1: CO-PO Mapping:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	1	2	2	1	2	3
CO2	2	3	3	3	2	3	2	1	3	2	3	3
CO3	3	3	3	3	3	2	3	1	3	2	3	3
CO4	3	3	2	3	3	2	0	3	3	2	3	3
CO5	3	3	3	3	3	1	3	2	2	3	3	3
Total	**14**	**15**	**14**	**15**	**14**	**10**	**9**	**9**	**13**	**10**	**14**	**15**
Eq. Av Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**3**

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	2	2
CO4	2	3
CO5	2	2
Total	12	7
Average	2.4	1.4
Eq. Av Attainment	2	1

Fourth Semester

Detailed Syllabus

FORMAL LANGUAGE AND AUTOMATA THEORY	UCS04B06
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS04C17

Course Objective:

1. Explain and manipulate the different concepts in automata theory and formal languages.
2. Construct and explain different types of grammar and languages.
3. Design automata for different kind of languages.
4. Explain and discuss various limitations of different automata and languages.
5. Explain different category and level of problems.

Course content:

Unit I:
Finite Automata-Deterministic, non-deterministic and equivalence - Equivalence of regular expressions and FA - Moore and Mealy machines.

Unit II:
Regular Languages-Pumping lemma of regular sets - MyhillNerode theorem - Minimization of finite automata - Chomsky hierarchy of languages.

Unit III:
Text-Free Language- Context-free grammar - Derivation trees - Ambiguity simplification - Normal forms - Applications.

Unit IV:
Pushdown Automata- Definitions - Context free languages - Construction of PDA for simple CFLs - Linear bounded automata.

Unit V:
Turing Machines-The Turing machine, programming techniques for Turing machine, extensions to the basic Turing machine, restricted Turing Machines, Turing machines and Computers, Undecidable Problem about Turing Machine, Post's Correspondence Problem.

Reference Book:

1. Introduction to languages and the theory of computation by John C. Martin
2. Theory of Computer Science: Automata, Languages and Computation, by Mishra K.L.P., Chandrasekaran N., PHI publication.
3. An introduction to Automata Theory & Formal Languages, Adesh K. Pandey, Katson Books publication.

Course outcomes:

1. Understanding of the needs of Formal Language and Automata theory.
2. Understanding of the different types of grammar and formal languages.
3. Understanding of the different types of automata.
4. Ability to apply the concept of grammar and formal language to design them.
5. Ability to design different types of automata for different languages.

To establish the correlation between COs & Pos

Table 1

COURSE OUTCOME NO	COURSE OUTCOME
UCS04B06 1	Understanding of the needs of Formal Language and Automata theory..
UCS04B06 2	Understanding of the different types of grammar and formal languages.
UCS04B06 3	Understanding of the different types of automata.
UCS04B06 4	Ability to apply the concept of grammar and formal language to design them.
UCS04B06 5	Ability to design different types of automata for different languages.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS04B06 1	3	2	2	1	1	3		1	3	3	1	2
UCS04B06 2	3	2	2	1	1	3	-	1	3	3	1	2
UCS04B06 3	3	2	2	2	2	3	-	1	3	3	1	2
UCS04B06 4	3	2	2	2	2	3	-	1	3	3	1	3
UCS04B06 5	3	2	2	2	2	3	-	1	3	3	1	3
Total	15	10	10	8	8	15	-	5	15	15	5	12
Avg	3	2	2	1.6	1.6	3	-	1	3	3	1	2.4
Eq Av attainment	3	2	2	2	2	3	-	1	3	3	1	2

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCS04B06 1	1	1
UCS04B06 2	1	2
UCS04B06 3	3	3
UCS04B06 4	3	3
UCS04B06 5	3	3
Total	11	12
Average	2	2.4
Eq. Av Attainment	2	2

DESIGN AND ANALYSIS OF ALGORITHM	UCS04C15
L T P 3 - 1 - 0 : 4 Credits	Prerequisites: UCS03B02, UCS03B05

Course Objective:

1. To provide elementary introduction to algorithm design and analysis.
2. To develop proficiency in problem solving and programming.
3. To be able to carry out the analysis of various algorithms for mainly Time and Space Complexity.

Course Content:

UNIT I

Foundation: Asymptotic Notation: Big-oh, Big-omega, Theta, Little-oh, Little-omega, Complexity Analysis (Best, Worst and Average Case).

UNIT II

Algorithm Design and Analysis Techniques:

Divide and Conquer Method: Long Integer Multiplication, Strassen's matrix multiplication, Recurrences, Master method.

Greedy Method: Activity Selection Problem, Huffman Codes and Knapsack fractional.

Dynamic Programming Method: Knapsack 0 – 1, Matrix Chain Multiplication, Optimal Binary Search Tree and Longest Common Subsequence.

UNIT III

Graph Algorithms: Graph Representation.

Graph Traversal: Breadth First Search, Depth First Search.

Growing of a minimum spanning tree: Kruskal and Prim's algorithm.
Single Source Shortest Paths: Bellman Ford and Dijkstra's algorithm.
All Pairs Shortest Paths: Floyd Warshall algorithm.
Maximum Flow: Ford Fulkerson method.

UNIT IV
Miscellaneous Algorithms: Multithreaded algorithms, Polynomial Multiplication, Fast Fourier Transform, Extended Euclid Algorithm.
String Matching: Naïve's algorithm, Rabin Karp algorithm and string matching with finite automata.
Finding the convex hull: Graham's Scan and Jarvi's March method, finding the closest pair of points.

UNIT V
Computational Complexity:
Backtracking: N Queen Problem, Sum of Subset, Graph Coloring, Hamiltonian Cycle Problem.
Branch & Bound: 15 – Puzzle Game, Assignment Problem, Travelling Salesman and Knapsack Problem.
NP Completeness: The classes P and NP, NP Hard and NP Complete Problems.
Approximation Algorithms: vertex-cover, travelling-salesman, set-covering, subset-sum Problem.

Text Books:
1. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, PHI.

Reference Books:
1.Computer Algorithms by E. Horowitz, S. Sahni& S. Rajsekaran, Galgotia Publications (P) Ltd.
2.Fundamentals of Algorithmics by Brassard and Bratley, PHI
3.The Design and Analysis of Computer Algorithms by Alfred V. Aho, John E. Hopcroft and J. D. Ullman, Addison Wesley Publishing Company

Course Outcomes (CO):

- **CO1:** Given an English language problem description, define the problem precisely with input/output requirements, examine its inherent complexity and develop a generic or set of initial solutions (which can be explored for various design options) and justify their correctness.
- **CO2:** Given an algorithm description, analyze the time and space complexity of the algorithm in the worst cases, average case and amortized scenario as needed in terms of asymptotic orders of complexity.
- **CO3:** Given a problem definition, explore different alternative algorithmic solutions, compare them with respect to time and space complexity and choose the design schemes and/or design parameters and data structures appropriately to obtain the best possible choice(s) that can be converted to an executable program.
- **CO4:** Design and analyze algorithms using the methods studied to solve problems in important applications including those related to sorting, searching, strings, graphs, matrices, data structuring and combinatorial optimization.
- **CO5:** Examine and prove whether a problem is of polynomial complexity, hard (NP complete) or otherwise and develop optimal and approximation algorithms for them as applicable.

Table: CO-PO Matrices :

1: Slight

	CO-PO Mapping of Design and Analysis of Algorithm											
COs	Program Outcomes(Pos)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	0	1	2	1	2	3
CO2	3	3	3	3	2	3	2	0	3	1	3	3
CO3	3	3	3	3	3	2	1	1	3	2	2	3
CO4	3	3	3	3	3	2	0	2	2	2	2	3
CO5	3	3	3	3	3	1	2	2	2	3	3	3
Total	**15**	**15**	**15**	**15**	**13**	**10**	**5**	**6**	**12**	**9**	**12**	**15**
Average	**3**	**3**	**3**	**3**	**2.6**	**2**	**1**	**1.2**	**2.4**	**1.8**	**2.4**	**3**
Eq. Average Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1.2**	**2**	**2**	**2**	**3**

(LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION

Table 2: CO PSO Mapping

CO	**PSO1**	**PSO2**
CO1	3	2
CO2	2	_
CO3	2	2
CO4	2	3
CO5	3	_
Total	12	7
Average	2.4	1.4
Eq. Av Attainment	2	1

ENGINEERING MATHEMATICS IV	UCS04B06
L T P 3- 0 - 0 : 3 Credits	Prerequisites: *None*

Course Objective:

1. To impart knowledge in concepts and tools of Operations Research.
2. To understand mathematical models used in Operations Research.
3. To apply these techniques constructively to make effective business decisions.

4. To provide the students with numerical methods of solving the non-linear equations, interpolation, differentiation, integration, and also to improve the student's skill in numerical methods by using the numerical analysis software and computer facilities.
5. The limitation of analytic methods for the solution of algebraic and transcendental equations has necessitated the use of iterative methods in numerical analysis.
6. The main aim of studying curve fitting is to find a curve that could best indicate the trend of a given set of data whereas interpolation is to connect discrete data points so that one can get reasonable estimates of data points between the given points.

Course Content:

Unit-1: Operation Research: Recapitulation of n-tuples of real nos, addition and scalar multiplication of vectors, Convex combination, Linearly dependence and independence, basis and dimension. Linear programming, Simplex method, Duality, Two-phase method, Big-M method, Dualsimplex method, Transportation and Assignment models, Game theory and solution.

Unit-2: Numerical Analysis: Solution of algebraic and transcendental equations by bisection method, iteration method, Regular-Falsi (False position) method, Newton-Raphson method, Solution of Simultaneous linear equations by Gauss Elimination and Gauss-Seidal method.

Unit-3: Interpolation: Concept of interpolation, difference operators, divided difference interpolation, Newton's forward, backward interpolation, Lagrange's interpolation, Starling and Bessel's interpolation, Numerical differentiation (1st and 2nd order), Numerical integration (Trapezoidal, Simpson's one-third, Weddle's rule).

Unit-4: Numerical Solution of Ordinary differential equation: Taylor's method, Picard's method, Runge's method, Runge-Kutta's method, Euler's method and Euler's modified method, Predictor-corrector method.

Reference Books:

1. Linear programming problem, Chakraborty & Ghosh.
2. Advanced Engineering Mathematics: H.K.Dass.
3. Advanced Engineering Mathematics: E. Kreyszig.
4. Numerical Analysis, S.A.Molla.
5. Numerical Analysis, Datta& Jana

Course Outcome:

CO-1	Identify & develop operational research models from the verbal description of the real system and understand the mathematical tools that are needed to solve engineering decision-making and optimisation problems.
CO-2	Numerical differentiation and integration is the process of computing the value of the derivative of a function whose analytic expression is not available.
CO-3	Most problems arising from the engineering and applied sciences required the solution of systems of linear algebraic equations and computations of eigen values and eigen vectors of a matrix.

CO-4	There exist large numbers of ordinary differential equations whose solution cannot be obtained in closed form by using the well known analytic methods.

Mapping with the POs/ PEOs: Matrix formation for attainments

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PEO-1	PEO-2	PEO-3
CO-1	3	2	2	-	2	1	2	-	-	-	2	-	2	3	2
CO-2	3	2	1	2	3	-	-	-	-	2	2	-	-	-	-
CO-3	3	1	1	1	1	-	1	-	-	2	1	-	-	-	-
CO-4	3	2	2	2	2	-	-	-	-	1	1	-	-	-	-

To establish the correlation between COs & PSOs

2: Slight (Low) 3: Moderate (Medium) 4: Substantial (High) and for No Correlation "-"

CO	PSO-1	PSO-2	PSO-3
CO-1	3	4	4
CO-2	2	3	2
CO-3	3	3	4
CO-4	3	2	3

MICROPROCESSOR AND MICROCONTROLLER	UCS04B05
L T P 3-0-0 : 3 Credits	Prerequisites: UCS03B03

Course Objective:

1. To introduce students with the architecture and operation of microprocessors and microcontrollers.

2. To know the internal organization, addressing modes and instruction sets of 8085 and 8086 processors.
3. Know the various functional units of 8051 microcontrollers.
4. To familiarize the students with the programming and interfacing of microprocessors and microcontrollers.
5. To provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Course Content:

UNIT I

INTRODUCTION to 8085 :

Evolution of 8085,Pin Description of 8085,Instructions of 8085,

UNIT II

8086 based systems :

The 8086 Microprocessor Bus Interface Unit, Execution Unit, Pin configuration of 8086, Pin details of 8086 ,Memory Organisation of 8086.8086 Minimum Mode Configuration, Demultiplexing of the Multiplexed buses , Transceiver 8286, Generations of Control Signals, Maximum Mode Configuration of 8086,Bus Cycles of 8086.Minimum Mode Bus Cycles, Maximum Mode Bus Cycles , Bus request and Bus Grant Timing in Minimum and Maximum Mode system.

UNIT III

ASSEMBLER DIRECTIVES

Assembly Languages , TASM Assembler, MASM Assembler,

Instructions Set and Programming of 8086

Addressing Modesof8086,Data addressing Modes ,Address addressing Modes, Instruction Format, Instructions format, Instructions template, Instrction set of 8086,Interrupts of 8086,

IO and Memory Interfacing

IO Devices and their Interfacing, Interfacing of IO devices with Microprocessor, Interfacing of Input and output Device ,Basic concepts in Memory interfacing ,Memory Organization of 8086 .

UNIT IV:

DMA Controller 8257 and 8237 :

Introduction, DMAcontroller,opereation of DMA cycle,Programable interface Unit.

Basic Assembly Language Programming Concepts:

The Assembly Language Programming Process, Programming Tools and Techniques, . Data Transfer and Logical Instructions.

Arithmetic Operations, Decimal Arithmetic.Jump and Call Instructions, Further Details on Interrupts.

UNIT V

The 8051 Architecture:

Block Diagram of Microcontroller, Special Function Registers, Instructions set of Microcontroller 8051, Addressing modes of 8051.

Programming and Interface of 8051:

Introduction, General Programming concept, Timer/Counter programming concept.

Text Books:

1. Microprocessor Architecture, programming and Applications with the 8085 by Ramesh Gaonkar

2. Fundaments of Microprocessor and Microcontroller by B.Ram

3. Microprocessor and Microcontrollers by Sunil Mathur ,PHI Publisher

Course Outcome:

Table 1

CO-1	Describe microprocessor 8085/8086 architecture with explanation.
CO-2	Identify a detailed software & hardware structure of the Microprocessor.
CO-3	Construction of a maintainable assembly language program for an algorithm.
CO-4	Design Memory Interfacing circuits and illustrate how different peripherals are nterfaced with Microprocessor.
CO-5	Design and implement 8051 microcontroller based systems.

CO-PO Mapping:

Table 2

Levels: 1: Slight(LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	-	1	1	-	2	2	2	3
CO-2	2	1	1	2	1	1	2	1	2	2	3	3
CO-3	2	2	2	3	2	2	2	1	3	3	3	3
CO-4	2	3	1	3	2	2	3	2	3	2	3	3

CO-5	3	3	3	2	3	3	3	2	3	2	3	3
Total	12	11	8	11	8	9	11	6	13	11	14	15
Average Attainment	2.4	2.2	1.6	2.2	1.6	1.8	2.2	1.2	2.6	2.2	2.8	3
Equivalent Average Attainment	2	2	2	2	2	2	2	1	3	2	3	3

Table 3: To establish the correlation between COs & PSOs

CO	PSO-1	PSO-2
CO-1	2	2
CO-2	2	2
CO-3	3	3
CO-4	3	2
CO-5	3	2
Total	13	11
Avg	2.6	2.2
Eq. Avg. Attainment	3	2

OBJECT ORIENTED PROGRAMMING	UCS04C18
L T P 3 - 1 - 0 : 4 Credits	Prerequisites: *None*

Courses objective:

1. The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism.
2. Fundamental features of an object oriented language like C++: object classes and interfaces, exceptions and libraries of object collections.
3. How to take the statement of a business problem and from this determine suitable logic for solving the problem.

Course content:

UNIT-I Object oriented programming concepts – objects – classes – methods and messages –abstraction and encapsulation – inheritance – abstract classes – polymorphism. Introduction to C++ – classes – access specifiers – function and data members – defaultarguments – function overloading – friend functions – const and volatile functions –staticmembers – Objects – pointers and objects – constant objects – nested classes – localclasses

UNIT-II
Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor – destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion – explicit constructor

UNIT-III
Function and class templates - Exception handling – try-catch-throw paradigm –exception specification – terminate and Unexpected functions – Uncaught exception.

UNIT-IV
Inheritance – public, private, and protected derivations – multiple inheritance–virtualbase class – abstract class – composite objects Runtime polymorphism – virtualfunctions – pure virtual functions.

UNIT-V
Streams and formatted I/O – I/O manipulators - file handling – random access – object serialization – namespaces - std namespace – ANSI String Objects – standard template library.

Text Books:

1. The Complete Reference, by Herbert Schildt
2. Object-Oriented Programming with C++yby Balaguruswamu

References:

C++ Primer by Stanley Lippman (Author), Josée Lajoie (Author), Barbara Moo (Author)

Course outcome:

1. Distinguish between top-down and bottom-up programming approach and apply bottom-up approach to solve real world problems
2. Interpret the difference between static and dynamic binding. Apply both techniques to solve problems
3. Analyse generic data type for the data type independent programming which relate it to reusability.
4. Interpret and design the Exception Handling Techniques for resolving run-time errors and handle large data set using file I/O
5. Analyzing a problem written in English language and apply the methods to code it according to the knowledge provided.

To establish the correlation between COs & POs

Table 1

COURSE OUTCOME NO	COURSE OUTCOME
UCS04B09.1	Distinguish between top-down and bottom-up programming approach and apply bottom-up approach to solve real world problems
UCS04B09 .2	Interpret the difference between static and dynamic binding. Apply both techniques to solve problems

UCS04B09 .3	Analyse generic data type for the data type independent programming which relate it to reusability.
UCS04B09 .4	Interpret and design the Exception Handling Techniques for resolving run-time errors and handle large data set using file I/O
UCS04B09 .5	Analyzing a problem written in English language and apply the methods to code it according to the knowledge provided.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS04B09 .1	3	2	2	1	1	3	-	3	1	3	1	2
UCS04B09 .2	3	2	2	1	1	3	-	3	1	3	1	1
UCS04B09 .3	3	2	2	1	1	3	1	3	1	3	1	-
UCS04B09 .4	3	2	2	1	1	3	2	3	1	3	1	1
UCS04B09 .5	3	2	2	2	1	3	2	3	1	3	1	1
Total	15	10	10	6	5	15	5	15	5	15	5	5
Avg	3	2	2	1.2	1	3	1	3	1	3	1	1
Eq Av attainment	3	2	2	1	1	3	1	3	1	3	1	1

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCS04B09 .1	1	1
UCS04B09 .2	1	2
UCS04B09 .3	2	2
UCS04B09 .4	3	3
UCS04B09 .5	3	3
Total	10	11
Average	2	2.5
Eq. Av Attainment	2	2

DESIGN AND ANALYSIS OF ALGORITHM LABORATORY	UCS04P13
L T P 0 - 0 - 3 : 2 Credits	Prerequisites:

Course Objective:

1. To provide elementary introduction to algorithm design and analysis.

2. To develop proficiency in problem solving and programming.
3. To be able to carry out the Analysis of various Algorithms for mainly Time andSpace Complexity.

Course Content:

1. Implementation of various sorting and searching algorithms with complexity analysis.
2. Topological sorting Graph: Shortest path by BFS, DFS.
3. Shortest path in edge-weighted case algorithms of greedy and dynamic paradigm and computation of strongly connected components and emphasis on correctness proof of the algorithm and time/space analysis.
4. Introduction to divide and conquer approach, relation between the time complexities of basic matrix operations.
5. Linear Programming: Geometry of the feasibility region and Simplex algorithm
6. Decision Problems: P, NP, NP Complete, NP-Hard, NP Hard with Examples.

Text Book:

1. Introduction to Algorithms by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, PHI.

Reference Books:

1. Computer Algorithms by E. Horowitz, S. Sahni& S. Rajsekaran, Galgotia Publications (P) Ltd.
2. Fundamentals of Algorithmics by Brassard and Bratley, PHI

3.The Design and Analysis of Computer Algorithms by Alfred V. Aho, John E. Hopcroft and J. D. Ullman, Addison Wesley Publishing Company

4. Algorithm Design by J. Kleinberg and É. Tardos, Addison-Wesley

Course Outcomes (CO):

CO1: Given an English language problem description, define the problem precisely with input/output requirements, examine its inherent complexity and develop a generic or set of initial solutions (which can be explored for various design options) and justify their correctness.

CO2: Given an algorithm description, analyze the time and space complexity of the algorithm in the worst cases, average case and amortized scenario as needed in terms of asymptotic orders of complexity.

CO3: Given a problem definition, explore different alternative algorithmic solutions, compare them with respect to time and space complexity and choose the design schemes and/or design parameters and data structures appropriately to obtain the best possible choice(s) that can be converted to an executable program.

CO4: Design and analyze algorithms using the methods studied to solve problems in important applications including those related to sorting, searching, strings, graphs, matrices, data structuring and combinatorial optimization.

CO5: Examine and prove whether a problem is of polynomial complexity, hard (NP complete) or otherwise and develop optimal and approximation algorithms for them as applicable.

	CO-PO Mapping of Design and Analysis of Algorithm Lab											
Cos	Program Outcomes(POs)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	0	1	2	1	2	3
CO2	3	3	3	3	2	3	2	0	3	1	3	3
CO3	3	3	3	3	3	2	1	1	3	2	2	3
CO4	3	3	3	3	3	2	0	2	2	2	2	3
CO5	3	3	3	3	3	1	2	2	2	3	3	3
Total	**15**	**15**	**15**	**15**	**13**	**10**	**5**	**6**	**12**	**9**	**12**	**15**
Average	**3**	**3**	**3**	**3**	**2.6**	**2**	**1**	**1.2**	**2.4**	**1.8**	**2.4**	**3**
Eq. Average Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1.2**	**2**	**2**	**2**	**3**

Table 1

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION

Table 2: CO PSO Mapping

CO	**PSO1**	**PSO2**
CO1	3	2
CO2	2	_
CO3	2	2
CO4	2	3
CO5	3	_
Total	12	7
Average	2.4	1.4
Eq. Av Attainment	2	1

OBJECT ORENTED PROGRAMMING LABORATORY	UCS04P14
L T P 0 - 0 - 3 :2 Credits	Prerequisites: *None*

Courses objective:

1. The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
2. Fundamental features of an object oriented language like C++: object classes and interfaces, exceptions and libraries of object collections
3. How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.

Course content:

Unit- 1
Introduction
Revision of Important Concepts in C Introduction & Overview from C to C++ Principles of OOP

Unit 2
Classes
Introduction, Operator Overloading, Constructors & Destructors, Predefined C++ Classes in iostream.h, The Copy constructor.

Unit – 3
Data Abstraction
Public, Private and Protected Building Objects with Classes Defining Operations on Objects

Unit – 4
Inheritance, Derived Classes and Class Hierarchies Multiple Inheritance Name Spaces

Unit – 5
Polymorphism Static & Dynamic Binding Virtual Functions Using Polymorphism

Course outcome:

1. Write codes using c++ basic statements
2. Create Class and objects
3. Implement Constructor and Destructors, Polymorphism
4. Write codes for inheritance
5. Use template and analyse a given problem and write codes.

To establish the correlation between COs & POs
Table 1

COURSE OUTCOME NO.	COURSE OUTCOME
UCS04P04.1	Write codes using c++ basic statements
UCS04P04.2	Create Class and objects
UCS04P04.3	Implement Constructor and Destructors, Polymorphism
UCS04P04.4	Write codes for inheritance
UCS04P04.5	Use template and analyse a given problem and write codes.

TABLE 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS04P04.1	3	1	1	2	1	-	-	3	1	3	2	2
UCS04P04.2	3	2	2	3	1	3	-	3	1	3	1	1
UCS04P04.3	3	2	2	3	1	3	1	3	1	3	1	-
UCS04P04.4	3	1	2	3	1	2	2	-	1	-	1	1
UCS04P04.5	3	2	2	3	1	2	2	3	1	2	1	1
Total	15	8	9	14	5	10	5	12	5	11	6	5
Avg	3	1.6	1.8	2.4	1	2	1	2.4	1	2.2	1.2	1
Eq Av Attainment	3	2	2	2	1	2	1	2	1	2	1	1

To establish the correlation between COs & PSOs
Table 3

CO	PSO1	PSO2
UCS04P04.1	1	1
UCS04P04.2	1	2
UCS04P04.3	2	2
UCS04P04.4	3	3
UCS04P04.5	3	3
Total	10	11
Avg	2	2.5
Eq Av attainment	2	2

Fifth Semester
Detailed Syllabus

COMPUTER ARCHITECTURE AND ORGANIZATION	UCS05B10
L T P 3- 0 - 0 : 3 Credits	Prerequisites: UCS03B03

PEOs (Program Educational Objectives):

PEO-1	To produce graduates having a strong background of basic science, Mathematics &Engineering, and ability to use these tools.
PEO-2	Comprehend, understand, and analyze Computer Science and Engineering problems and relate them with real life scenario.
PEO-3	Develop skills as computer scientists with an ability to solve a widespread range of computational problems in industry, government, or other work environments.
PEO-4	Retain the ability to think rationally and the capacity to understand technical problems with computational systems.
PEO-5	Achieve the ability to familiarize quickly to new environments and technologies, integrate new information, and work in multi-disciplinary areas with a strong focus on innovation and entrepreneurship.

PSOs (Program Specific Objectives):

Students will be able to

PSO-1	To understand, analyze and develop real-world computational systems of varying complexity that are sustainable and economically viable.
PSO-2	To understand the evolutionary changes in computing, apply standard practices and strategies in software project development, and develop platforms in creating innovative career paths and meet future challenges

Course Content:

UNIT-I

The Concept of Computer Architecture – Architecture at Micromachine (for Microprogrammed processors), processor, and computer system levels – Abstract (or logical) and concrete (or physical) architectures.

UNIT-II

Instruction-level parallel (IPL) processors – Dependencies between instructions – Pipelined.

Data-Parallel Architectures – The concept of Data-parallel computation – Connectivity: Near-neighbor, Tree, Pyramid, and Hypercube networks – Classes of Data-Parallel Architectures: SIMD, Systolic.MIMD

Architectures – Distributed Memory and Shared-memory systems – Lack of scalability of sharedmemory systems – Concept of multi-threaded Architectures.

UNIT-III

RISC – Characteristics of CISC Processors – The RISC concept – Hardwired control.

PART-II

UNIT-IV

CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU - registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study - instruction sets of some common CPUs.

Arithmetic operations-- construction of ALU, different implementation techniques for Adders, Subtractors.Multiplication and division -- different algorithms and their implementation.Implementation of floating point arithmetic.

UNIT-V

Hardware Description Language—Concepts and Principles Datapath and control unit—construction of data paths, Single and multi-cycle implementation, Hardwired and Microprogrammed control units. Bit slice processor design

UNIT-VI

Memory Hierarchy-- Cache and its Performance Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policy.

I/O interfacing—types and characteristics of I/O devices. Buses. Interfacing I/O devices to memory and processor, Design of I/O system.

Recommended Books:

1. Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability and Programmability, McGraw-Hill 1993, pp. 770, ISBN 0-07-113342-9.
2. David A. Patterson and John L. Hennessy, Computer Architecture: A Quantitative Approach, Harcourt Asia PTE Ltd. 2000, pp. 760, ISBN 981-4033-227.
3. Daniel Tabak, Advance Microprocessors, McGraw-Hill 1995, pp. 523, $18.50, ISBN 0-07-113715-7.
4. James L. Antonakos, The Pentium Microprocessor, Prentice-Hall Inc. 1997, pp. 539, ISBN 0-02-303614-1.
5. J.P. Hayes ,Computer Architecture &Organization,McGraw-Hill.
6. Computer Organization,5th Ed.-Carl Hamacher et. Al. McGraw-Hill.
7. P .Pal Chowdhury, Computer Organization andDesign.PHI Publication.
8. Computer Organization And Architecture-Stallings Publisher:Pearson Education

Course Outcome:

CO-1	To understand the structure, function and characteristics of computer systems and Differentiate the concepts of Computer Architecture and Computer Organization.
CO-2	Understand the theory, the architecture and functionality of central processing unit.
CO-3	To identify the elements of modern instructions sets and their impact on processor design.
CO-4	Exemplify in a better way the I/O and memory organization to explain the function of each element of a memory hierarchy.
CO-5	Learn the concepts of parallel processing, pipelining and interprocessor communication.

CO-PO Mapping:

Levels: 1: Slight (LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	1	-	-	1	1	1	2
CO2	3	3	1	2	2	-	2	1	2	2	1	1
CO3	2	1	3	2	1	-	1	1	1	1	2	2
CO4	3	2	3	2	-	1	2	-	2	2	1	2
CO5	3	2	3	3	1	1	-	1	2	-	2	3
Total	14	11	11	10	4	3	5	3	8	6	7	10
Average Attainment	2.8	2.2	2.2	2.0	0.8	0.6	1.0	0.6	1.6	1.2	1.4	2.0
Equivalent Average Attainment	3	2	2	2	1	1	1	1	2	1	1	2

To establish the correlation between COs & PSOs

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	PSO-1	PSO-2
CO-1	**2**	**1**
CO-2	**2**	**1**
CO-3	**2**	**2**
CO-4	**2**	**2**
CO-5	**2**	**3**
Total	**10**	**9**
Average Attainment	**2.0**	**1.8**
Equivalent Average Attainment	**2**	**2**

DATABASE MANAGEMENT SYSTEM	UCS05B11
L T P 3 - 1 - 0 : 4 Credits	Prerequisites: None

Courses objective:

1.Design, manipulate and manage database
2.Successfully operate transactions
3.Recover a database from failure state

Course content:

UNIT I
Introduction to database: Data Abstraction, Data `Models, Basic concepts of database: Data Independence DML, DCL, DDL and structure of Data Base Management System. Entity relationship diagram: Basic and Advanced Concepts Application of ER diagram in designing database system. Relational Algebra, Tuple Relational Calculus

UNIT II
SQL, QUEL, Domain relational calculus, Integrity, Referential, Domain constraints, functional dependency, Assertions, Triggers, Query processing and Query optimization and Embedded and Dynamic SQL

UNIT III
Database design issues, Normalization 1NF, 2NF, 3NF, 4NF, BCNF and 5NF, live database design problem. Security and Integrity: Use of SQL for specifying Security and integrity. Authorization, view, Encryption. Storage structure indexing and hashing. Different type of file organization.

UNIT IV
Transaction & concurrency control, Schedules, testing, serializability, Lock based Protocol, Time stamp protocol, validation technique, Multiple granularity, Multi-version scheme Insert and delete operation, Crash recovery, Log based recovery, buffer management checkpoints, shadow paging. Object oriented databases.

Text Books:

1. Database System Concept By Henry F. Korth Abraham Silber Schatz ; McGraw-Hill Publication
2. Elmsari and Navathe, “Fundamentals of Database Systmes”, 4th Ed., A. Wesley, 2004

References:

1. Database System Concept by C.J. Date.

2. Database Management System, by Raghu Ramakrishnan ,Johannes Gehrke.

Course outcome:

1. An understanding of the needs for and uses of database management systems.
2. An understanding of the context, phases and techniques for designing and building database information systems.
3. Apply the concepts of Normalization and design database which possess no anomalies.

4. An ability to correctly use the techniques, components and tools of a typical database management system to build a comprehensive database information system.
5. Develop database programming skills in SQL and able to write application programs considering the issues like concurrency control, recovery and security.

To establish the correlation between COs & POs

Table 1

COURSE OUTCOME NO	COURSE OUTCOME
UCS05B11.1	An understanding of the needs for and uses of database management systems.
UCS05B11 .2	An understanding of the context, phases and techniques for designing and building atabase information systems.
UCS05B11 .3	Apply the concepts of Normalization and design database which possess no anomalies.
UCS05B11 .4	An ability to correctly use the techniques, components and tools of a typical database anagement system to build a comprehensive database information system.
UCS05B11 .5	Develop database programming skills in SQL and able to write application programs onsidering the issues like concurrency control, recovery and security.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS05B11 .1	3	2	2	1	1	3	-	3	1	3	1	2
UCS05B11 .2	3	2	2	1	1	3	-	3	1	3	1	1
UCS05B11 .3	3	2	2	1	1	3	-	3	1	3	1	-
UCS05B11 .4	3	2	2	1	1	3	2	3	1	3	1	1
UCS05B11 .5	3	2	2	2	1	3	3	3	1	3	1	1
Total	15	10	10	6	5	15	5	15	5	15	5	5
Avg	3	2	2	1.2	1	3	1	3	1	3	1	1
Eq Av attainment	3	2	2	1	1	3	1	3	1	3	1	1

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCS04B09 .1	**1**	**1**
UCS04B09 .2	**1**	**2**
UCS04B09 .3	**2**	**2**
UCS04B09 .4	**3**	**3**
UCS04B09 .5	**3**	**3**
Total	**10**	**11**
Average	**2**	**2.5**
Eq. Av Attainment	**2**	**2**

ENGINEERING ECONOMICS AND COSTING	**UCS05C03**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: *None*

Purpose of the inclusion of the subject: This subject will help the engineering students to understand the basic concepts of Economics and Costing. It will also be providing the idea related to engineering economic analysis and its role in engineering decision making in executing any project for a company, the engineer needs knowledge besides technical aspects on markets and its agents. The project will be successful only if it is commercially viable.

Courses objective:

1. To make the Engineering student know about the basic concepts and law of Economics and their application to understand the behaviour of agents present in the market. The subject will address the requirement of evaluating the commercial viability of projects undertaken by graduate engineers

2. To make the Engineering student know about the basic concepts of cost and costing, Accounts and financial statements and their application to understand the issue of commercial viability of any projects.

Course content:

Unit- 1

Engineering Economics- meaning, nature, scope and subject matter

Unit 2

Utility- definition, total, marginal and average; cardinal utility theory; indifference curves theory; **Demand**- factors effecting demand, elasticity of demand- different types of elasticity, classification of goods based on various elasticity of demand

Unit – 3

Production- Production function; Iso-quant; returns to scale; Total, Average & Marginal Product; law of variable proportions; Cobb-Douglas production function; Iso-cost curve; Derivation of cost curve from production function; Production optimization; expansion path

Unit – 4

Cost- short run and long run cost (the 'Envelope Curve'); shape of different types of cost curves; **Revenue-** total revenue and marginal revenue, relation between marginal revenue and price elasticity of demand

Unit – 5

Firm- different types of firm and its characteristics; traditional theory of firm; objectives of firm.

Unit – 6

Introduction to Accounting- Definition of Accounting and accountancy, objectives of accounting, users of accounting information, Double Entry system of Book-Keeping, Journal and Ledger, Cash book, Trial balance.

Unit – 7

Final Accounts- Basic concepts, uses and preparation of Trading account; Profit and Loss account; and Balance Sheet. Issue and Forfeiture of Share and Re-Issue of Company.

Unit – 8

Introduction to Costing- Elements of Cost, Direct Materials, Direct Labour, Direct Expenses, Overheads, Production, Office and Administration, Selling and Distribution, Allocation of overhead, machine hour rate, labour hour rate, practical problems.

References:

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2002.

2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002

3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984

4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.

5. Smith, G.W., "Engineering Economy", Lowa State Press, Iowa, 1973.

Course outcome:

1. Be able to identify and explain economic concepts and theories related to the behavior of economic agents present in market.
2. Be able to analyse the impact of various government policies in production and profitability of the company.

3. Be able to identify the basic features of alternative representations of human behavior in economics.
4. Be able to understand the impact various decisions or transactions will have on the company's statements and financial health.
5. Be able to comfortably communicate with senior financial and non-financial leaders about financial statement issues and the financial impact of business decisions.

Table 1

1: Slight (low), 2: Moderate (MEDIUM)

3: Substantial (HIGH) and for NO CORELATION { -}

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	2	2	2	3	2	3	2
CO2	-	-	-	-	1	3	3	2	3	2	3	1
CO3	1	-	-	-	1	1	1	3	3	1	3	1
CO4	-	-	1	-	1	3	3	2	2	2	3	1
CO5	-	-	1	-	1	1	1	1	2	2	3	2
Total	1	-	2	-	5	10	10	10	13	9	15	7
Average	1	-	1	-	1	2	2	2	2.6	1.8	3	1.4

PEOs (Program Educational Objectives):

1. To develop a sound knowledge in the field of basic sciences and communication to serve as a competent engineer.
2. To acquire the skill and techniques to apply in the industrial fields.
3. To be acquainted with the latest technology so as to be placed in the best devices in the country and abroad.
4. To develop a sound knowledge in hardware and software fields related to electronics and communication to prove the ability to work in any interdisciplinary ares.
5. To acquire a strong sound knowledge in the mathematical theory and related computation using recent softwares.

PSOs(Program Specific Objectives):

1. To create powerful competent engineers acceptable to any relevant industry all over the world.
2. To acquire sound knowledge in more than one sub-areas of electronics and communication engineering to pursue higher studies.

To establish the correlation between Cos & PSOs

Table 2

CO	PSO1	PSO2
CO1	3	**2**
CO2	2	2
CO3	3	2
CO4	3	1
CO5	2	1
Total	13	8
Average	2.6	1.6

OPERATING SYSTEM	**UCS05B12**
L T P 3 -1 -0 : 4 Credits	Prerequisites: *None*

Course Objective:

1. To provide knowledge about the services rendered by operating systems
2. To provide a detailed discussion of the various memory management techniques
3. To discuss the various file-system design and implementation issues
4. To discuss how the protection domains help to achieve security in a system.

UNIT–1

Introduction: What is an Operating System, The need for Operating System, Evolution of Operating System, Types of Operating System: batch, multi-programmed, time-sharing, real-time, distributed, parallel ,Goals of an Operating System, Operating System Architectures .

UNIT-2

Processes management: Fundamentals of Process Management, Implicit/System and Non–implicit/User Process, Life cycle of a process, Process State and State Transitions, Suspended Process and Their State Transition, Process Control Block, Context Switching, Process Switching .

Processes scheduling: Introduction, Scheduling types, Scheduling Levels, Pre-emptive & Non-preemptive Scheduling, Scheduling Algorithm-(FIFO, SJF, SRTN, SRRN, RR and Multilevel Queue).

UNIT- 3

Process communication and synchronization:

Introduction, Concurrent Process, Critical section, Algorithm Approach to CS Implementation –Two Process Solution, Dekker's Solution , Peterson's Solution ,Semaphore ,Solution of Producer –Consumer , Solution of Reader –writer Problem, Monitor.

Deadlocks: Introduction**,** Definition of Deadlock ,Modelling Of Deadlock, Conditions for Deadlock , Dealing With Deadlock, Deadlock Prevention, Deadlock Avoidance- Dijkstra's Bankers Algorithm , Deadlock detection , Recovery from Deadlock, Starvation.

Thread: Introduction, Threading issues, Thread Control Block , Types of Threads-User Threads, Kernel Threads, Hybrid Threads , Linux Threads, Java Threads.

UNIT-4

Memory management:

Introduction, logical vs. physical address space, Swapping, Contiguous memory allocation, Non - Contiguous memory allocation , Paging Concept , Page Table Structure , Segmentation.

Virtual memory: Introduction, Need for Virtual Memory, Demand Paging, Page Replacement Algorithm-FIFO Page-replacement Algorithm, Optimal Page-replacement Algorithm, Least Recently Page-replacement Algorithm, Thrashing.

UNIT-5

I/o and file systems: File concept, Access methods, Directory structure , File Attributes, File Operation, file system hierarchy**,** Types Of I/O , Input-Output Software, Kernel I/O Sub-Syatem

Disk management: Disk Structure, Disk Scheduling (FCFS, SSTF, SCAN, C-SCAN), RAID Structure.

Security: Security Problem,User Authentication , Security Levels, Computer-Security Classifications

BOOKS RECOMMENDED:

1. Operating System Concepts By: Abraham Silberschatz, Peter Baer Galvin & Greg Gagne. John Wiley & Sons, Inc.
2. Operating System By: H M Deitel Pearson Education, LPE.
3. An Introduction to Operating System Concepts & Practice By: Pramod Chandra P Bhatt; PHI Pvt Ltd.
4. Operating Systems : A Design Oriented Approach By – Crowley; TMH

Course Outcome

CO1	To understand the services provided by and the design of an operating system
CO2	To understand the structure and organization of the file system
CO3	To understand what a process is and how the processes are synchronized and scheduled
CO4	To understand different approaches to memory management
CO5	Students should able to use system calls for managing processes .memory and file system
CO6	Students should understand the data structure and algorithms used to implement an OS

CO-PO Mapping:

Levels: 1: Slight(LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	0	0	0	0	0	0	0
CO2	3	3	3	2	2	2	2	0	0	0	1	0
CO3	3	3	3	2	2	2	2	0	1	0	2	0
CO4	3	3	3	3	2	2	2	0	1	2	1	0
CO5	3	3	3	1	3	1	1	0	2	2	1	0
CO6	3	3	2	2	2	1	1	0	2	2	1	0
Total	18	18	16	12	13	8	8	0	6	6	6	0
Average Attainment	3.0	3.0	2.6	2.0	2.2	1.3	1.3	0.0	1.0	1.0	1.0	0.0
Equivalent Average Attainment	3	3	3	2	2	1	1	0	1	1	1	0

CO-PSO Matrices

CO	PSO-1	PSO-2
CO-1	2	2
CO-2	3	2
CO-3	4	3
CO-4	2	2
CO-5	3	2
CO-6	2	2
Total	16	13
Avg	2.6	2.1
Eq. Avg. Attainment	3	2

COMPUTER ARCHITECTURE AND ORGANIZATION LABORATORY	**UCS05P05**
L T P 0 - 0 - 3 : 2 Credits	Prerequisites: None

Programme to implement the following:

1. Write a program for addition of two 8 bit numbers using registers and storing result in registers.
2. Write a program for addition of two 8 bit numbers using memory and storing result in registers.
3. Write a program for addition of two numbers in memory and storing the result in memory.
4. Write a program for the addition of three 8-bit numbers using register (without carry)
5. Write a program for the addition of three 8-bit numbers using memory Location (With Carry)

6. Write a program to subtract two 8-bit numbers using 8085 from memory (without borrow)
7. Write a program to subtract two 8-bit numbers using 8085 from memory ((using borrow))
8. Write a program to Subtraction of two 8-bit numbers using 2'complement method
9. Write a program for multiplication of two 8-bit numbers (without carry)
10. Write a program for multiplication of two 8-bit numbers (with carry)
11. Write a program for multiplication of three 8-bit numbers (without carry)
12. Write a program to divide two 8-bit numbers using registers.
13. Write a program to divide two 8-bit numbers using memory location.
14. Write a program to find the largest number in an array
15. Write a program to find the smallest number in an array.
16. Write a program to search an 8-bit number in an array.
17. Write a program to store array elements in ascending order.
18. Write a program to store array elements in descending order.

Course Outcome:

CO-1	Study basic computer organization, design and micro operations
CO-2	Understand CPU functioning and computer arithmetic
CO-3	Learn various methods and techniques of memory organization
CO-4	To understand basic idea of instruction format, the structure, function and addressing modes of assembly language programming.
CO-5	To apply the assembly language programming to develop small real life embedded application.

CO-PO Mapping:

1. Levels: 1: Slight (LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	-	1	-	2	1	1	1	-	2
CO2	3	3	2	2	2	-	2	1	2	2	2	1
CO3	2	3	3	2	2	1	2	1	1	1	2	2
CO4	3	2	-	3	3	2	2	1	1	2	-	2
CO5	3	3	1	3	1	3	1	3	3	-	3	3
Total	14	12	9	10	9	6	9	10	8	6	7	10
Average Attainment	2.8	2.4	1.8	2.0	1.8	1.2	1.8	2.0	1.6	1.2	1.4	2.0
Equivalent Average Attainment	3	2	2	2	2	1	2	1	2	1	1	2

To establish the correlation between COs & PSOs

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	PSO-1	PSO-2
CO-1	**1**	**1**
CO-2	**2**	**2**
CO-3	**2**	**2**
CO-4	**2**	**2**
CO-5	**3**	**3**
Total	**10**	**10**
Average Attainment	**2.0**	**2.0**
Equivalent Average Attainment	**2**	**2**

DATABASE MANAGEMENT SYSTEM LABORATORY	**UCS05P06**
L T P 0 - 0 - 3 : 2 Credits	Prerequisites: None

Courses objective:

1. Introduce ER data model, database design and normalization
2. Learn SQL basics for data definition and data manipulation

Course content:

Experiment 1: Student should decide on a case study and formulate the problem statement.

Experiment 2: Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.) Note: Student is required to submit a document by drawing ER Diagram to the Lab teacher.

Experiment 3: Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, represent attributes as columns, identifying keys) Note: Student is required to submit a document showing the database tables created from ER Model

Experiment 4: Normalization -To remove the redundancies and anomalies in the above relational tables, Normalize up to Third Normal Form

Experiment 5: Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables (along with Primary and Foreign keys), Altering Tables and Dropping Tables

Experiment 6: Practicing DML commands- Insert, Select, Update, Delete

Experiment 7: Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc.

Experiment 8: Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).

Experiment 9: Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping.

Experiment 10: Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger

Experiment 11: Procedures- Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure.

Experiment 12: Cursors- Declaring Cursor, Opening

Course outcome:

1. Apply the basic concepts of Database Systems and Applications.
2. Use the basics of SQL and construct queries using SQL in database creation and interaction.
3. Design a commercial relational database system (Oracle, MySQL) by writing SQL using the system.
4. Analyze and Select storage and recovery techniques of database system.

COURSE OUTCOME NO.	COURSE OUTCOME
UCS05P06.1	Apply the basic concepts of Database Systems and Applications.
UCS05P06.2	Use the basics of SQL and construct queries using SQL in database creation and nteraction.
UCS05P06.3	Design a commercial relational database system (Oracle, MySQL) by writing SQL sing the system.
UCS05P06.4	Analyze and Select storage and recovery techniques of database system.

To establish the correlation between COs &PO)Table 1

TABLE 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS05P06.1	3	1	1	2	1	-	-	3	1	3	2	2
UCS05P06.2	3	2	2	3	1	3	-	3	1	3	1	1
UCS05P06.3	3	2	2	3	1	3	3	3	1	3	1	-
UCS05P06.4	3	1	2	3	1	2	3	-	1	-	1	1
Total	12	6	7	11	4	8	6	9	4	9	5	4
Avg	3	1.6	1.8	2.4	1	2	1.5	2.4	1	2.2	1.2	1
Eq Av Attainment	3	2	2	2	1	2	2	2	1	2	1	1

To establish the correlation between COs & PSOs
Table 3

CO	PSO1	PSO2
UCS05P06.1	1	1
UCS05P06.2	1	2
UCS05P06.3	2	2
UCS05P06.4	3	3
Total	7	9
Avg	2	2.5
Eq Av attainment	2	2

OPERATING SYSTEM LABORATORY	UCS05P07
L T P 0 -0 -3 : 2 Credits	Prerequisites: None

Course Objective

This course will introduce the basic principles in Operating System and providing error detection methods. It will cover all the management modules present in the OS like process management, Memory management, File management, Disk management, Network management, I/O management.

LIST OF EXPERIMENTS:

(Implement the following on LINUX or other Unix like platform. Use C for high level language implementation)

1.Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close, stat, opendir, readdir

2.Write programs using the I/O system calls of UNIX operating system (open, read, write, etc)

3.Write C programs to simulate UNIX commands like ls, grep, etc.

4.Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)

5.Given the list of processes, their CPU burst times and arrival times, display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time. (2 sessions)

6.Developing Application using Inter Process communication (using shared memory, pipes or message queues)

7.Implement the Producer – Consumer problem using semaphores (using UNIX system calls).

8.Implement some memory management schemes – I

9.Implement some memory management schemes – II

10.Implement any file allocation technique (Linked, Indexed or Contiguous)

Course outcome

CO1	Experiment with Unix commands and shell programming
CO2	Build 'C' program for process and file system management using system calls
CO3	Choose the best CPU scheduling algorithm for a given problem instance
CO4	Identify the performance of various page replacement algorithms
CO5	Develop algorithm for deadlock avoidance, detection and file allocation strategies

CO-PO Mapping:

Levels: 1: Slight (LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	1	-	-	1	1	1	2
CO2	3	3	-	2	2	-	2	1	2	2	-	1
CO3	2	2	2	2	2	3	1	1	1	1	2	2
CO4	2	3	2	2	3	2	2	-	2	2	1	2
CO5	3	2	2	2	1	2	-	1	2	-	-	3
Total	13	12	8	11	9	8	5	3	8	6	4	10
Average Attainment	2.6	2.4	1.6	2.2	1.8	1.6	1.0	0.6	1.6	1.2	0.8	2.0
Equivalent Average Attainment	3	1	2	2	2	2	1	1	2	1	2	2

CO PSO Mapping

CO	PSO1	PSO2
CO1	3	3
CO2	2	-
CO3	3	2
CO4	2	3
CO5	2	2
Total	12	10
Average	2.4	2
Eq. Av Attainment	2	2

Departmental Elective Subjects in Fifth Semester

COMPUTER GRAPHICS	UCS05E01
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objective:

1. Introduction of the basic concepts of 2-D and 3-D modeling graphical software packages and graphics systems.
2. To study fundamental computer graphics algorithms.
3. Understanding of the process of modeling and generating images of objects.
4. Studying the basic process of drawing primitive objects on a display.
5. Building two and three dimensional mathematical models.
6. Ability to manipulating and combining different models.

Course Content

Unit I

Development of Computer Graphics: Basic graphics systems and standards. Raster Sean and random Sean graphics, Continual refresh and Storage displays, display processors, Color display techniques, frame buffer and bit operations, concepts in raster graphics.

Unit II

Output Primitives: Points and lines, Line drawing algorithms, circle and ellipse/generation algorithms, Conic sections, Polynomials and Spline curve, polygon filling. Ant aliasing.

Unit III

Two Dimensional Geometric Transformation: Basic transformation, Matrix representations and homogeneous coordinates, composite transformations, Transformation between coordinates system, Transformation functions. Raster methods for transformations.

Unit IV

Two Dimensional viewing: The viewing pipeline viewing coordinates reference frame, Window to view port coordinate transformation, Two-dimensional viewing function, clipping operations. Points, line. Polygon and character clipping.

Unit V

Three Dimensional Concept :3-D representation and transformations,3-D viewing, Algorithm for 3-D volumes, Fractal geometric method.

Unit VI

Rendering:A simple illustration model, Determining surface normal, Determining the reflection vector, transparency, lights, colors and shading.

Unit VII-

Hidden lines and surfaces: Back-face removal, depth comparisons, Z-Buffer algorithms, scan-line algorithms, floating horizon

Unit VIII

Computer animation: Types of animation, animation language, methods of controlling animation.

Unit IX

Brief Introduction to Graphic Processors.Introduction to Graphical Input Devices and Input Handling Algorithms.

Text Book:

1. Computer graphics by Hearn & Baker, PHL Ltd.

Reference Books:

1. Principle of interactive computer graphics by Newman & Sprout, McGraw Hill. I.E.
2. Procedural Elements for computer graphics by D.F.Rogers,McGrawHill,I.E.

Course outcomes:

1. Understanding the concept of multi-dimensional objects, graphical system and software packages.
2. Ability of drawing primitive objects.
3. Building two and three dimensional mathematical models of more complex objects.
4. Ability to manipulating and combining models.
5. Ability of projecting the models onto a two dimensional image space

To establish the correlation between COs & Pos

Table 1

COURSE OUTCOME NO	COURSE OUTCOME
UCS05E01. 1	Understanding the concept of multi-dimensional objects, graphical system and software packages.
UCS05E01.2	Ability of drawing primitive objects.
UCS05E01.3	Building two and three dimensional mathematical models of more complex objects.
UCS05E01.4	Ability to manipulating and combining models.
UCS05E01.5	Ability of projecting the models onto a two dimensional image space.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS05E01.1	3	2	2	1	1	2	-	1	3	3	1	2
UCS05E01.2	3	2	2	1	2	2	-	1	3	3	2	2
UCS05E01.3	3	2	2	2	3	2	1	1	2	2	2	2
UCS05E01.4	2	2	2	3	3	2	2	1	2	2	2	3
UCS05E01.5	2	2	2	3	3	2	2	1	2	2	3	3
Total	13	10	10	10	12	10	5	5	12	12	10	12
Avg	2.4	2	2	2	2.4	2	1	1	2.4	2.4	2	2.4
Eq Av attainment	2	2	2	2	2	2	1	1	2	2	2.4	2

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCS05E01.1	1	1
UCS05E01.2	1	2
UCS05E01.3	2	2
UCS05E01. 4	3	3
UCS05E01.5	3	3
Total	10	11
Average	2	2.3
Eq. Av Attainment	2	2

DIGITAL IMAGE PROCESSING	**UCS05E02**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objective:

1. Describe and explain basic principles of digital image processing.
2. Design and implement algorithms that perform basic image processing (e.g., noise removal and image enhancement).
3. Design and implement algorithms for advanced image analysis (e.g., image compression, image segmentation).
4. Assess the performance of image processing algorithms and systems.

Course Content

UNIT I:

Introduction -Fundamental steps in image processing; digital image representation; Image acquisition and storage.

Visual Perception – Basic concepts; Structure of human eye; Image formation in eye; Discrimination of brightness and adaptation; Sampling and quantization.

UNIT II :

Image transforms – Overview of Fourier Transform, DFT, 2D Fourier Transform, Convolution and correlation; FFT ; Inverse FFT ; Walse, Hadamard and K-L transforms ; Single value decomposition.

Image enhancement – Fundamental concepts; Enhancement by point processing; Intensity transform; Histogram processing; Spatial filtering: smoothening, median, sharpening and derivative filters; enhancement in frequency domain; Low-pass and High-pass filtering.

UNIT III:

Image restoration – Degradation model: continuous and discrete; Inverse filtering; removal of blur caused by uniform linear motion.

UNIT IV:

Image Compression – Lossy and loss-less compression techniques; Feature extraction. **Image segmentation** – Edge detection techniques; edge linking and boundary detection: local and global approaches; Thresholding; Region-oriented segmentation: Region growing split and mergetechniques.Object recognition and identification – Case study of various applications.

Text Books:

1. R.C.Gonzalas and R.E.Woods, Digital Image Processing, Prentice Hall, 3rd Ed.

Reference Books:

1. A.K.Jain, Fundamentals of Digital Image Processing, Prentice Hall.
2. S.Sridhar, Digital Image Processing, Oxford University Press.
3. S Jayaraman,SEsakkiranjan and T Veerrakumar Digital Image Processing, McGraw Hill Education Pvt Ltd.

Course Outcome

CO1	Review the fundamental concepts of a digital image processing system.
CO2	Analyze images in the frequency domain using various transforms.
CO3	Evaluate the techniques for image enhancement and image restoration.
CO4	Categorize various compression techniques.
CO5	Interpret Image compression standards.
CO6	Interpret image segmentation and representation techniques.

CO-PO Mapping:

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	--	2	--	2	--	2	--	--	--	2
CO2	3	3	2	2	3	--	1	--	--	1	1	1
CO3	3	3	2	2	3	1	1	2	1	2	2	1
CO4	3	3	3	2	3	1	1	2	1	2	2	1
CO5	3	3	3	2	3	2	1	1	1	2	2	1
CO6	3	3	2	2	2	2	2	1	1	2	2	1
Total	18	18	12	12	14	8	6	8	4	9	9	7
Average	3	3	2	2	2.3	1.3	1	1.3	.6	1.5	1.5	1.1
Eq. Average Attainment	3	3	2	2	2	1	1	1	1	2	2	1

CO-PSO Matrices

CO	PSO1	PSO2
CO1	3	3
CO2	2	2
CO3	2	2
CO4	2	3
CO5	2	-
CO6	2	3
Total	13	13
Average	2.1	2.1
Eq. Av Attainment	2	2

FOUNDATION OF CRYPTOGRAPHY	**UCS05E03**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objectives:

This course provides an idea to cryptography, its mathematical foundations, and its relation to security. It covers classical cryptosystems, private-key cryptosystems (including DES and AES), hashing and public-key cryptosystems (including RSA). The course also provides an inside to data integrity and authentication.

Course Content:

Unit 1: Introduction to Cryptography

This unit provides an overview of cryptography, the study of information-hiding and verification. Cryptography insures the confidentiality/privacy, message integrity, authentication, and non-repudiation of information. This unit will also go over the basics of information theory to get a feel for message encoding before addressing various classical ciphers, which can now be easily cryptanalyzed and broken. Lastly, various methods and techniques used to cryptanalyze any algorithm that enciphers text.

Unit 2: Classical Cryptography

Describe and analyze various classical ciphers like Affine, Caesar, Columnar Transposition, Hill, Playfair, Rail-fence, Simple Substitution, Vigenere, Autokey, Enigma ciphers etc. These ciphers are intuitively easy to understand and seem to encrypt the message well, but they have many shortcomings, which will be discussed. Shannon's perfect security.

Unit 3: Symmetric-Key Cryptography

Substitution-permutation network, modern block ciphers, modern stream ciphers which works through the series of linked mathematical operations. This unit also uses the complete mathematical algorithm to describe the data encryption standard before finishing with a description of the advanced encryption standard for a symmetric-key encryption.

Unit 4: Asymmetric-Key Cryptography

In this unit, will learn the basic idea behind public key cryptography and explain in detail RSA as the most important example of public key cryptography. Next, discuss the algorithms used to determine whether an input number is prime. This unit will present the mathematical background you need in order to understand these algorithms and in turn get a better picture of public key cryptography.

Unit 5: Hash Functions with Digital Signature and Authentication Protocols

This unit will introduce the concept of "hash" and then present the important MD5 and SHA-1 hash functions. It a gives a general discussion of key exchange methods, or methods designed to distribute keys securely so that they be later used in a cryptographic algorithm. This unit also explains the Digital signature process, services and applicati along with various entity authentication protocols.

Course Outcomes:

CO1	Students will be able to corelate with the notion of CIA (Confidentiality, Integrity, Authentication) with real world applications.
CO2	Students will be able to understand the classical and modern concepts related to cryptology.
CO3	Students will be able to know the mathematical support for cryptography and learn methods for modern cryptography techniques under the category of stream and block cipher.
CO4	Students will be able to analyze and implement of some of the prominent techniques for symmetric-key encryption schemes like DES, AES etc..
CO5	Students will be able to describe and implement of some of the prominent techniques for public-key cryptosystems and digital signature schemes (e.g. RSA, DSA)
CO6	Students will be able to understand the inner workings of Authentication schemes and the notions of digital signatures and certificates to correctly use them in real-world applications.

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	--	--	--	2	--	2	--	--	--	2
CO2	3	3	2	2	3	--	1	--	--	1	1	1
CO3	3	3	2	2	3	1	1	2	1	2	2	1
CO4	3	3	2	2	3	1	1	2	1	2	2	1
CO5	3	3	3	2	3	2	1	1	1	2	2	1
CO6	3	3	3	2	3	2	2	1	1	2	2	1
Total	18	18	12	10	15	8	6	8	4	9	9	7
Average	3	3	2	1.6	2.5	1.3	1	1.3	.6	1.5	1.5	1.1
Eq. Average Attainment	3	3	2	2	3	1	1	1	1	2	2	1

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	2	-
CO2	2	-
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2
Total	16	8
Average	2.6	1.3
Eq. Av Attainment	3	1

Sixth Semester
Detailed Syllabus

ARTIFICIAL INTELLIGENCE	UCS06B13
L T P 3 - 1 - 0 : 4 Credits	Prerequisites: None

Course Objective:

1. To have an appreciation for and understanding of both the achievements of AI and the theory underlying those achievements.
2. To have an appreciation for the engineering issues underlying the design of AI systems.
3. To have a basic proficiency in a traditional AI language including an ability to write simple to intermediate programs and an ability to understand code written in that language.
4. To have an understanding of the basic issues of knowledge representation and blind and heuristic search, as well as an understanding of other topics such as minimax, resolution, etc. that play an important role in AI programs.

Course Contents:

UNIT-I :

Introduction to AI

Definition of Artificial Intelligence, Foundation of AI and Expert Systems, Approaches to AI, Brief History; Intelligent Agents, Different Agent Architectures, Stimulus Response Agents, State Based Agents, Goal-Directed Agents, Utility-based Agents

UNIT-II:

Problem Solving Using Search

State Space Search, N Queens Problem, 8-Puzzle; Uninformed Search, DFS, BFS, Iterative Deepening Search, Bidirectional Search; Informed Search, Heuristic Function, A*, Greedy, Uniform Cost Search, IDA*; Two Players Games - Two Players Search, Game Trees, Minimax Search, HeuristicMinimax Search, Heuristic Evaluation Function, Behavior of Heuristic Evaluation Function; Alpha Beta Search, Alpha Beta Pruning.

UNIT-III:

Constraint Satisfaction Problem:

Different Types of Constraints, CSP, DSP, Forward Checking, Intelligent Backtracking, Logic, Propositional Calculus and First Order Calculus

UNIT-IV:

Knowledge Representation and Logic:

Propositional Logic, Interpret a Propositional Logic, Compound Proposition; Interface in Propositional Logic, First Order Logic;First Order Logic, Reasoning Using First Order Logic, Resolution in FOPL.

UNIT-V:

Rule Based System and Semantic Net:

Rule Based System, Semantic Net, Reasoning in Semantic Net, Frames.

UNIT-VI:

Planning Problems

Introduction to Planning Problems, Formulate Planning Problem, Casting Planning Problem, Search in Plan Space, Forward Search, Backward Search, Strips Planning, Partial Order Planning, Graph Plan Algorithm

UNIT-VII:

Probability and Fuzzy

Rule Based Expart System, Certainty Factor; Reasoning with Uncertainty, Bayes' Rule;

Fuzzy Reasoning, Its Application.

UNIT-VIII:

Learning:

Introduction to Learning, Definition of Machine Learning, Types of Learning and notations, applications of Machine Learning, inductive learning Hypothesis,

UNIT-IX:

Neural Networks:

Learning Using Neural Networks-Introduction, Linear threshold unit of perceptron, representation power of perceptron, how to train a perceptron, Single layer percptron network, multi-layer perceptron network, sigmoid unit;

UNIT-X:

Robotics

Introduction to Robotics, Robot Hardware, Robot perception, Planning a move ,Robotic Software Architecture .

Text Book:

1. Artificial Intelligence by E Rich and K Knight, McGraw-Hill.
2. Artificial Intelligence a Modern Approach-Stuart Russell, Peter Norvig, PHI

Reference Books:

1. Artificial Intelligence by E Rich and K Knight, McGraw-Hill.
2. Artificial Intelligence (3rd Ed) Russell Norvig, Pearson.
3. Introduction of Artificial Intelligence and expert systems by DW Patterson, PHI.
4. Artificial Intelligence and Soft Computing by A. Konar, CRC Press 2000.

Course Outcomes:

CO-No.	Course Outcome	Module Covered
CO1	Solve basic AI based problems and construct logical building blocks for problem formulation.	**I,II**
CO2	Acquaint with Knowledge Representation and decision under uncordiality.	**II, III,IV,V**
CO3	Apply Optimization and inferencing with available knowledge.	**VII**
CO4	Pragmatic approach of Machine learning and fuzzy knowledge representation.	**VIII,IX,X**
CO5	Apply AI techniques to real-world problems to develop intelligent systems.	**IV,V,VIII**
CO6	Select appropriately from a range of techniques when implementing intelligent system	**V,VI**

Table: CO-PO Matrices:

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	--	--	--	2	--	2	--	--	--	2
CO2	2	2	2	2	3	--	1	--	--	2	2	1
CO3	3	3	2	2	2	2	2	3	2	2	2	1
CO4	3	3	2	2	3	1	2	3	1	2	2	1
CO5	3	3	2	3	3	2	3	2	2	2	2	2
CO6	3	2	3	3	3	3	2	3	2	2	2	1
Total	17	16	11	12	14	10	10	13	7	10	10	8
Average	2.83	2.66	1.83	2	2.33	1.66	1.66	2.16	1.83	1.66	1.66	1.33
Eq. Average Attainment	3	3	2	2	2	2	2	2	2	2	2	1

Table 2: CO - PSO Mapping

CO	PSO1	PSO2
CO1	3	-
CO2	3	2
CO3	2	2
CO4	2	3
CO5	2	3
CO6	2	3
Total	14	13
Average	2.33	2.16
Eq. Av Attainment	2	2

COMPILER DESIGN	**UCS06B14**
L T P 3 - 1 - 0 :4 Credits	Prerequisites: UCS04B06

Course Objectives:

1. To provide an understanding of the fundamental principles in compiler design
2. To provide the skills needed for building compilers for various situations that one may encounter in a career in Computer Science.
3. To learn the process of translating a modern high-level language to executable code required for compiler construction.

Course Content

UNIT I: Introduction:

Introduction to Compiler, Single and Multi Pass Compilers, Translators, Phases of Compilers, Compiler writing tools, Bootstrapping.

UNIT II: Lexical Analysis:

Role of Lexical Analyzer, Specification of tokens, Recognition of tokens, lexems and patterns, Regular expression, Finite automata from regular expression to finite automata, transition diagrams, Implementation of lexical analyzer, Tool for lexical analyzer – LEX, Error reporting.

UNIT III: Syntax Analysis and Parsing Techniques:

Context free grammars, ambiguity, precedence, Bottom-up parsing and top down parsing, Top down parsing: elimination of left recursion, recursive descent parsing, Predictive parsing; Bottom Up Parsing: Operator precedence parsing, LR parsers, Construction of SLR, canonical LR and LALR parsing tables, the parser generator – YACC, error recovery in top down and bottom up parsing.

UNITIV : Syntax Directed Translation & Type Checking :

Inherited attributes, dependency graph, Construction of syntax trees, bottom up and topdown evaluation of attributes, S-attributed and L-attributed definitions.

Type Checking: Static vs. Dynamic Checking, Type expression, Type Checking, Type Equivalence, Type Conversion.

Symbol Tables: Structure of Symbol Table, Simple Symbol Table (Linear Table, Ordered List, Tree, Hash Table), Scoped Symbol Table (Nested Lexical Scoping, One Table per Scope, One Table for all Scopes).

UNIT V: Intermediate Code Generation:

Intermediate Language, Intermediate representation Technique, Three-address code, quadruples and triples, Translation of assignment statements, Boolean expressions, Control Flow, Case Statement, and Function Call.

UNIT VI:Runtime Environment:

Storage organization, activation tree, activation record, allocation strategies, Parameter passing, dynamic storage allocation.

Unit-VII :Code Generation& Code Optimization :

Factors affecting code generation, Basic Block, Code generation for tree, Register Allocation and assignment, DAG representation, Code generation using dynamic programming.

Code Optimization: Need for optimization, Optimization of Basic Blocks, Loops in flow graph, Optimizing transformation ,Compile time evaluation, common sub-expression elimination, Dead code optimization, peep hole optimization, Local Optimization, Global Optimization,loops, global dataflow analysis,solution to iterative dataflow equations.

Text Books:

1. Compiler-Principles, Techniques and Tools by Alfred V.Aho, Ravi Sethi and J. D.Ullman, Addison Wesley.

Reference Books:

1. Compiler Design by Santanu Chattopadhyay, PHI.
2. Kenneth C. Louden, Compiler Construction –Principles and Practice,Cengage Learning Indian Edition.
3. Tremblay and Sorenson, The Theory and Practice of Compiler Writing, Tata McGraw Hill & Company.

Course Outcomes(CO):

1. CO1: Understand fundamentals of compiler and identify the relationships among different phases of the compiler.
2. CO2: Understand the application of finite state machines, recursive descent, production rules, parsing, and language semantics.

3. CO3: Analyze & implement required module, which may include front-end, back-end, and a small set of middle-end optimizations.
4. CO4: Use modern tools and technologies for designing new compiler.
5. CO5: Apply optimization techniques to intermediate code and generate machine code for high level language program.

Table: CO-PO Matrices :

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	CO-PO Mapping of Design and Analysis of Algorithm											
COs	Program Outcomes(Pos)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	0	1	2	1	2	3
CO2	3	3	3	3	2	3	2	0	3	1	3	3
CO3	3	3	3	3	3	2	1	1	3	2	2	3
CO4	3	3	3	3	3	2	0	2	3	2	3	3
CO5	3	3	3	3	3	1	2	2	2	3	3	3
Total	**15**	**15**	**15**	**15**	**13**	**10**	**5**	**6**	**13**	**9**	**13**	**15**
Average	**3**	**3**	**3**	**3**	**2.6**	**2**	**1**	**1.2**	**2.6**	**1.8**	**2.6**	**3**
Eq. Average Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1.2**	**3**	**2**	**3**	**3**

Table 2: CO PSO Mapping

CO	**PSO1**	**PSO2**
CO1	**2**	**2**
CO2	**3**	**3**
CO3	**2**	**2**
CO4	**3**	**3**
CO5	**3**	**3**
TOTAL	**13**	**13**
AVG	**2.6**	**2.6**
Eq AVG Attainment	**3**	**3**

COMPUTER NETWORKS	**UCS06B15**
L T P 3 - 1 - 0 :4 Credits	Prerequisites: UCS03B01

Course Objective:

This course provides an idea to build a strong understanding of the fundamental concepts of computer networking. Modern routing algorithms are introduced in this course. Deep understanding on Data link, Network and Transport Layer providing more focus on Internet and network performance.

Course Content

Unit 1: Introductory Concepts
Goals and Applications of Networks, LAN, WAN, MAN, Wireless network, Network software: Protocol hierarchies, design issues of layers, Interfaces and services. Reference Model: The OSI reference model, TCP/IP reference model, Example networks: Novell Netware, The ARPANET, The Internet, X-25 Networks, network standards.

Unit 2: Physical and Data Link Layers:
Guided and Unguided media, Wireless transmission, ISDN and ATM, Virtual circuits, Circuit switching, Communication satellite, Data link layer design issues, services provided to network layers, Framing, Error control, Flow control, Sliding Window, Stop & wait protocols, Error detection mechanism, VRC, LRC, CRC, Automatic Repeat Request (ARQ), Stop-and Wait , Go-back-n, Selective repeat.

Medium Access Control:
Static and dynamic allocation in LAN and MAN, Multiple Access protocols, ALOHA, Slotted ALOHA, CSMA, CSMA/CD, Ethernet, Token Ring, CSMA/CA.

Unit 3: Network Layer
Network Layer design issue, Routing algorithms, Congestion Control Algorithms, Internetworking.

Unit 4: Transport layer
Basics of TCP and UDP, Connection establishment and termination, Flow control, Retransmission, TCP extensions, Introduction to quality of service.

Unit 5: Session, Presentation and Application Layer
Session Layer - Design issues, remote procedure call.
Presentation Layer - Design issues, Data compression techniques.
Application Layer - File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other applications,
Example Networks - Internet and Public Networks.

References

1. J. Kurose and K.W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Addison-Wesley.
2. Data Communication and Networking, 4th Edition, McGraw-Hill, Behrouz Forouzan.
3. A. S. Tanenbaum, "Computer Networks", 5th Ed., Pearson Education.
4. Dr. Douglas Comer, "Computer Networks and Internets", Pearson Education; 6th edition
5. Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach"; Elsevier.

Course Outcomes:

CO1	Students will be able to understand the principles and concepts on computer networks.
CO2	Students will be able to master the terminology and concepts of the OSI reference model and the TCP-IP Reference model.
CO3	Students will be able to know the network structure, various protocols of the Internet and how these protocols address the standard problems of networking and the Internet.
CO4	Students will be able to gain expertise in some specific areas of networking such as the design and maintenance of individual networks.
CO5	Students will be able to describe and implement a simple LAN with hubs, bridges and switches and the concept on how packets in the Internet are delivered.
CO6	Students will be able to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	1	--	1	--	1	1	1	1	--	1
CO2	3	3	2	2	2	1	1	--	1	1	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	1
CO4	3	3	2	2	3	2	2	1	2	2	2	1
CO5	3	3	3	2	3	2	1	1	1	1	1	1
CO6	3	3	3	2	3	2	2	1	1	2	1	1
Total	18	18	14	11	15	9	9	5	8	9	7	6
Average	3	3	2.3	1.8	2.5	1.5	1.5	.8	1.3	1.5	1.1	1
Eq. Average Attainment	3	3	2	2	3	2	2	1	1	2	1	1

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	3	2
CO2	2	1
CO3	2	2
CO4	2	2
CO5	3	2
CO6	3	2
Total	15	11
Average	2.5	1.8
Eq. Av Attainment	3	2

MANAGEMENT AND MANAGERIAL ECONOMICS	**UCS06C04**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: *None*

Purpose of the inclusion of the subject: This subject will help the engineering students to understand the basic concepts of Management and Managerial Economics. It will also be providing the idea related to management and managerial techniques in engineering decision making. While working in a company, the engineer needs to monitor and control a large number of variables present in environment where business is taking place. The subject equips a graduate engineer to carry out all the responsibilities successfully.

Courses objective:

1. To make the Engineering student know about the basic concepts, functions, principles and techniques of management and their application, which complement the technical skills to execute their capabilities successfully.
2. To make the Engineering student know about the basic concepts of finance in carrying out any project

Course content:

Unit- 1

Basic Concepts and functions of management: planning, nature, purpose and objective of planning; organizing: nature and purpose, authority and responsibility, staff bug; supply of human resources, performance appraisal. Controlling: system and process of controlling, control techniques.

Unit 2

Human resource Management and Marketing Management: nature and scope of human resource of planning, planning and development, recruitment and selection, career growth, grievances, motivation and its type, needs for motivation, reward and punishment, models of motivation. Leaders: kinds of leaders, leadership styles, roles and functions of leader; conflict management: kinds and causes of conflict, settlement of conflict, Group and team working, organizational design and development.

Unit – 3

Financial Management: Need of finance, kinds and sources of capital shares and debentures, fixed and working capital , capital structure of a firm, operating and financial leverage, EBIT and EPS analysis, financial ratio analysis : uses and natures, liquidity coverage ratios, practical problems.

Unit – 4

Investment decisions and forecasting of working capital: Kinds of capital Budgeting decisions, evaluation of proposals, capital discounting and non discounting based methods. Practical problems. Definition and importance of working capital. Working capital operating cycle, factors affecting Working capital, inventory management

Unit – 5

Cost Analysis and Cost Control: elements of cost, types of cost, direct and indirect, variable and fixed, labour cost, material cost, overhead cost, cost control techniques. Budget: meaning, kinds, budgetary controls, break even analysis, practical problems.

Unit – 6

Perfect Competition- Perfect Competition, Features; Short run and long run equilibrium of firm and industry, shut down point

Unit – 7

Monopoly- features, monopoly power, pricing under monopoly, price discrimination.

Unit – 8

Oligopoly- Features, kincked demand Curve, Cournot'sDuoploy Model Cartels, Price leadership.

Unit – 9

Monopolistic Competition- Features, Pricing under monopolistic competition, Product differentiation.

Unit – 10

Macroeconomics- Inflation; Function of Central & Commercial Banks

References:

1. M. Adhikari, Business Economics, Excel Books, 2004

2. S. K. Misra & V.K.Puri, Economic Environment of Business, HPH, 2003

3. L.M.Prasad, Priciples and Practice of Management, S.Chand & Sons.

4. P.Chandra, Financial Management Theory and Practice (3/e), TMH, 2004.

Course outcome:

1. Be able to understand the principles of management and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
2. Be able to make a plan how to organize, control and motivate people.
3. Be able to understand the Cost analysis in the context of short and long term decision making and the use of discounted cash flow analysis.

4. Be able to identify and explain economic concepts and theories related to the markets, industry and firm structures.
5. Be able to pursue the larger objectives of the firm besides profit maximization.

Table 1

1: Slight (low), 2: Moderate (MEDIUM)

3: Substantial (HIGH) and for NO CORELATION {-}

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	1	3	2	2	2	2	2	2
CO2	-	-	1	-	-	2	2	2	1	2	3	1
CO3	-	-	-	-	1	3	2	3	2	1	3	2
CO4	-	1	-	-	1	1	2	2	3	1	2	3
CO5	-	-	-	-	-	1	1	1	2	1	1	2
Total	-	1	1	-	3	10	9	10	10	7	11	10
Average	-	1	1	-	1	2	1.8	2	2	1.4	2.2	2

To establish the correlation between Cos & PSOs

Table 2

CO	PSO1	PSO2
CO1	3	**2**
CO2	2	1
CO3	2	1
CO4	3	2
CO5	3	1
Total	13	7
Average	2.6	1.4

SOFTWARE ENGINEERING	**UCS06B16**
L T P 3 -0 -0 : 3 Credits	Prerequisites: None

Course Objective:

Software affects us to an ever-increasing extent, both within industry and in our daily lives. Software Engineering deals with the design and development of high-quality software systems and is thus an increasingly important area of computer science. The six-month course block in Software Engineering gives you knowledge and practical skills in the development of software systems of high quality, which is invaluable for software architects, project managers and technical specialists. The demand for

knowledgeable experts in software engineering is steadily increasing, which makes you very competitive nationally as well as internationally, both in industry and in academic research.

Course Content:

UNIT I

Introduction: Evolving role of software, classification and characteristics of software, software applications, software crisis and myths, software vs. system engineering, different lifecycle models, and comparative study of various development models.

UNIT II

Software Requirement Specifications (SRS): Feasibility study, functional and non-functional requirements. Requirement engineering process: specification, validation and management.

UNIT III

Software Design: Software design process: design principles, coupling vs cohesion, software architecture design methodologies and function oriented vs object oriented design, structured design methodology. Coding: coding principles and methodology, code verification and documentation.

UNIT IV

Software testing and quality management: Different types of testing, verification vs validation, system testing, debugging, black-box testing & white-box testing, control flow graphs – cyclomatic complexity. Software quality factors, quality assurance, quality standards: CMM, ISO, software reliability, software maintenance and reengineering.

UNIT V

Software Maintenance and project management: Principles of SPM, team Structure & scheduling, project planning, Total Quality Management (TQM), various cost estimation methods, COCOMO Model, WBS, configuration management, risk management, different project management tools.

Object oriented approach: Conventional vs. OO approaches in design and coding, architectural patterns, UML and different diagrams to represent OO approach, object oriented testing.

Text Books:

1. Rajib Mall, "Fundamentals of Software Engineering", PHI.
2. Roger S.Pressman, "Software Engineering- A Practitioners approch", McGrawHill;

Reference Books:

1. K.K. Aggarwal&Yogesh Singh, "Software Engineering", Third Edition, New Age International Publishers
2. Waman S Jawadekar, "Software Engineering-Principles and Practice", Mcgraw Hill companies.
3. Deepak Jain "Software Engineering-Principles and Practices", Oxford

Course Outcome:

CO-1	Explain various software characteristics and analyze different software Development Models
CO-2	Demonstrate the contents of a SRS and apply basic software quality assurance practices to ensure that design, development meet or exceed applicable standards

CO-3	Compare and contrast various methods for software design.
CO-4	Formulate testing strategy for software systems, employ techniques such as unit testing, Test driven development and functional testing
CO-5	Manage software development process independently as well as in teams and make use of various software management tools for development, maintenance and analysis.

Mapping with the POs/ PEOs: Matrix formation for attainments

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**	**PEO-1**	**PEO-2**	**PEO-3**	**PEO-4**	**PEO-5**
CO-1	**1**	**3**	**1**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**3**	**1**	**3**	**2**	**1**	**-**
CO-2	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**-**	**2**
CO-3	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**1**	**-**	**2**	**2**	**2**	**2**	**2**
CO-4	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**1**	**2**	**1**
CO-5	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**-**	**1**	**2**	**2**	**3**	**2**	**1**	**2**	**2**
Total	**10**	**12**	**13**	**10**	**11**	**8**	**7**	**7**	**9**	**5**	**7**	**8**	**11**	**10**	**8**	**7**	**7**
Average Attainment	**2**	**2.4**	**2.6**	**2**	**2.2**	**1.6**	**1.4**	**1.4**	**1.8**	**1**	**1.4**	**1.6**	**2.2**	**2**	**1.6**	**1.4**	**1.4**
Equivalent Average Attainment	**2**	**2**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**

To establish the correlation between COs & PSOs

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	**PSO-1**	**PSO-2**
CO-1	**1**	**1**
CO-2	**2**	**1**
CO-3	**1**	**3**
CO-4	**2**	**1**
CO-5	**2**	**3**
Total	**8**	**9**
Average Attainment	**1.6**	**1.8**
Equivalent Average Attainment	**2**	**2**

COMPILER DESIGN LABORATORY	UCS06P09
L T P 0 - 0 - 3 : 2 Credits	Prerequisites: *None*

Course Objectives:

1. To learn hands on practice for understanding of the fundamental principles in compiler design.
2. To learn hands on practice skills needed for building compilers for various situations that one may encounter in a career in Computer Science.
3. To learn hands on practice process of translating a modern high-level language to executable code required for compiler construction.

Sl. No.	List of Experiments
1	Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2	* Write a C program to identify whether a given line is a comment or not.
3	*Write a C program to recognize strings under 'a', 'a*b+', 'abb'.
4	*Write a C program to test whether a given identifier is valid or not.
5	*Write a C program to simulate lexical analyzer for validating operators.
6	Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools.
7	Write a C program for implementing the functionalities of predictive parser for the mini language specified in Note 1.
8	a) *Write a C program for constructing of LL (1) parsing. b) *Write a C program for constructing recursive descent parsing.
9	Write a C program to implement LALR parsing.
10	a) *Write a C program to implement operator precedence parsing. b) *Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value.
11	Convert the BNF rules into Yacc form and write code to generate abstract syntax tree for the mini language.
12	Write a C program to generate machine code from abstract syntax tree generated by the parser.

Course Outcomes(CO):

CO1: Understand fundamentals of compiler and identify the relationships among different phases of the compiler.

CO2: Understand the application of finite state machines, recursive descent, production rules, parsing, and language semantics.

CO3: Analyze& implement required module, which may include front-end, back-end, and a small set of middle-end optimizations.

CO4: Use modern tools and technologies for designing new compiler.

CO5: Apply optimization techniques to intermediate code and generate machine code for high level language program.

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION"--"

	CO-PO Mapping of Compiler Design Laboratory											
COs	Program Outcomes(Pos)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	3	2	2	1	1	3	1	3	3
CO2	2	3	3	2	2	3	2	2	2	1	3	2
CO3	3	2	3	2	3	3	2	2	3	2	3	3
CO4	2	3	3	3	3	2	0	2	2	3	3	2
CO5	3	3	3	3	3	1	2	2	3	3	3	3
Total	**13**	**13**	**15**	**13**	**13**	**11**	**7**	**8**	**13**	**10**	**15**	**13**
Average	**2.6**	**2.6**	**3**	**2.6**	**2.6**	**2.2**	**1.4**	**1.6**	**2.6**	**2**	**3**	**2.6**
Eq. Average Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**3**	**3**

Table 2: CO PSO Mapping

CO	**PSO1**	**PSO2**
CO1	**1**	**2**
CO2	**3**	**3**
CO3	**2**	**1**
CO4	**3**	**1**
CO5	**3**	**3**
TOTAL	**12**	**10**
AVG	**2.4**	**2**
Eq AVG Attainment	**2**	**2**

COMPUTER NETWORK LABORATORY	UCS06P10
L T P 0 - 0 - 3 : 2 Credits	Prerequisites: *None*

Course Objectives

The objective of this lab course is to get practical knowledge of working principles of various communication protocols and understand the functionalities of various layers of OSI model.

CO1	Ability to understand computer network basics, network architecture, TCP/IP.
CO2	Identify and understand various techniques and modes of transmission and the working knowledge of datagram and internet socket programming.
CO3	Ability to analyze, specify and design the topological and routing strategies for an IP based networking infrastructure
CO4	Have a knowledge to describe and implement a simple LAN with hubs, bridges and switches and the concept on how packets in the Internet are delivered.
CO5	Students will be able to implement client/server communication

List of Experiments:

Packet Tracer:

1. What is Topology? Draw different types of topologies using Packet tracer.
2. How to create a LAN using a hub in Packet tracer.
3. How to create a LAN using a switch in Packet tracer.
4. Create Local area network using 3 routers in Cisco Packet Tracer.
5. What is the use of Repeater? Setup a local area network using Repeater.
6. Router DHCP Configuration with Packet Tracer.
7. Wireless router configuration using packet tracer

Socket Programming:

1. Write a socket program for implementation of echo.
2. Write a client-server application for chat using TCP
3. To Perform File Transfer in Client & Server Using TCP/IP.
4. Write a program to trace IP address of another system.
5. Write a program to implement simple client-server application using UDP.
6. Write a program to implement Address Resolution Protocol.
7. Write a socket program for implementation of TCP module.

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	2	1	2	2	2	2
CO2	3	3	2	2	3	1	1	1	1	1	--	1
CO3	2	3	2	1	2	2	2	1	--	1	2	1
CO4	3	3	3	3	2	1	2	2	2	1	1	2
CO5	3	3	3	2	3	2	2	1	1	2	1	1
Total	14	15	12	10	11	8	9	6	6	7	6	7
Average	2.8	3	2.4	2	2.2	1.6	1.8	1.2	1.2	1.4	1.2	1.4
Eq. Average Attainment	3	3	2	2	2	2	2	1	1	1	1	1

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	2	1
CO2	1	2
CO3	2	3
CO4	3	1
CO5	3	2
Total	11	9
Average	2.2	1.8
Eq. Av Attainment	2	2

SOFTWARE ENGINEERING LABORATORY	**UCS06P11**
L T P 0 -0 -3 : 2 Credits	Prerequisites: *None*

Course Objective:

Software Engineering Laboratory is functional for the purpose of providing Software Engineering tools for developing various software applications in a systematic way. It is useful for the study of various software development steps, different lifecycle models and managing a project in a proper way.

Experiments to be Conducted:

1. Generating SRS document from a given set of requirements for a software to be developed.
2. Make a comparative statement in between a number of Software Development Models with test scenarios.
3. Preparing SPMP document – Activity Network, Critical Path, Gantt chart.
4. Preparing Decision Tree and Decision Table for a given set of requirements for a software to be developed.
5. Function Oriented Design – DFD, Structured chart representation of some sample software to be developed.
6. Object Oriented Design – Studying UML with Rational Rose software and generating different types of UML diagrams and implement them with some programming language.
7. Generating test report.
8. Mini Project (group wise) to represent Software Engineering Methodologies.

Course Outcome:

CO-1	Identify ambiguities, inconsistencies and incompleteness from a requirements specification and state functional and non-functional requirement
CO-2	Identify different actors and use cases from a given problem statement and draw use case diagram to associate use cases with different types of relationship
CO-3	Draw a class diagram after identifying classes and association among them
CO-4	Graphically represent various UML diagrams , and associations among them and identify the logical sequence of activities undergoing in a system, and represent them pictorially
CO-5	Able to use modern engineering tools for specification, design, implementation and testing.

CO-PO Mapping:

Levels: 1: Slight (LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	1	-	-	1	1	1	2
CO2	3	3	-	2	2	-	2	1	2	2	-	1
CO3	2	3	2	2	2	3	1	1	1	1	2	2
CO4	2	2	1	2	3	2	2	-	2	2	1	2
CO5	3	2	3	2	1	2	-	1	2	-	-	3
Total	13	12	8	11	9	8	5	3	8	6	4	10
Average Attainment	2.6	2.4	1.6	2.2	1.8	1.6	1.0	0.6	1.6	1.2	0.8	2.0
Equivalent Average Attainment	3	1	2	2	2	2	1	1	2	1	2	2

To establish the correlation between COs & PSOs

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	PSO-1	PSO-2
CO-1	**2**	**1**
CO-2	**2**	**1**
CO-3	**2**	**2**
CO-4	**2**	**3**
CO-5	**2**	**3**
Total	**10**	**10**
Average Attainment	**2.0**	**2.0**
Equivalent Average Attainment	**2**	**2**

Departmental Elective Subjects in Sixth Semester

COMPUTER AND NETWORK SECURITY	**UCS06E04**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS05B12

Course Objective:

1. To be able to explain security principles and to evaluate risks faced by computer systems,
2. To be able to explain how various attacks work and generalize various software vulnerabilities.
3. To be able to explain how various security mechanisms work, and correlate these security mechanisms with security principles.
4. To be able to apply security principles to solve problems.

Course Content

Unit 1: Introduction to Cryptography

Introduction & threat modelling,Fundamental Security Terminology - CIA Triad, Assets, Threats, Vulnerabilities, Attacks, Risks and Controls Basic security methodology. One-way functions, hash functions, Transport Layer Security, PKI, Messaging & Usability, Cryptocurrency & block chains.

Unit 2: Network security

Networking basics.IP, TCP and DNS. Censorship and mass surveillance. Denial of service. Anonymity & Tor.

Unit 3: Software security

Access control & information flow. Systems security & isolation. Control flow hijacking.

Unit 4: Web security

Password storage. Online authentication. Spam and Abuse. Online crime. Browser security, XSS and XSRF. Web privacy.

Unit 5: Security & Society

This unit will cover Economics, Ethics & Law related with cyber security.

Text Book:

1. William Stalling. "Cryptography and Network Security", PHI.

Reference Books:

1. Pfleeger, C.P and Pfleeger S.L "Security in Computing", Prentice-Hall.
2. Gollmann, "Computer Security", John Wiley & Sons.
3. Christof Paar and Jan Pelzl, "Understanding Cryptography", Springer.

Course Outcomes (CO):

CO1: Discuss the basic methodology in computer security and interpret relating security concepts and terminology.

CO2: Recognise the nature and characteristics of various Network & Software security.

CO3: Illustrate the potential vulnerability of networked applications and select and apply appropriate countermeasures.

CO4: Analyze and evaluate software systems for its security properties.

CO5: Demonstrate and articulate the ethics in cyber world and awareness about law.

Table: CO-PO Matrices :

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION

	CO-PO Mapping of Computer & Network Security											
COs	Program Outcomes(POs)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2	3	3	2	2	0	1	2	2	2	3
CO2	3	3	2	3	2	3	2	0	3	2	3	2
CO3	3	1	1	3	3	2	1	1	3	2	1	3
CO4	3	3	3	1	3	2	0	2	2	2	2	3
CO5	3	3	3	1	3	1	2	2	3	3	3	3
Total	**14**	**12**	**12**	**11**	**13**	**10**	**5**	**6**	**13**	**11**	**11**	**14**

Average	**2.8**	**2.4**	**2.4**	**2.2**	**2.6**	**2**	**1**	**1.2**	**2.6**	**2.2**	**2.2**	**2.8**
Eq. Average Attainment	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**1**	**3**	**2**	**2**	**3**

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	3	2
CO2	2	1
CO3	2	2
CO4	3	1
CO5	3	2
Total	13	8
Average	2.6	1.6
Eq. Av Attainment	3	2

DATA WAREHOUSING & DATA MINING	**UCS06E05**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS05B11

Course Objectives:

1. Interpret the contribution of data warehousing and data mining to the decision-support systems.
2. To understand different data attribute types and apply different data preprocessing techniques.
3. To understand how to identify association among data objects by learning various association mining algorithms.
4. To understand the various classification techniques, their applications in different domains.
5. To understand the various clustering techniques, their applications in different domains.
6. To learn various data visualization techniques for data analysis.

Course content

MODULE I
Introduction: Data Management; Benefits of Data Warehousing; Features of a Data Warehouse; Operational Databases vs Data Warehouses; The Information Flow Mechanism; Role of Metadata; Classification of Metadata; Data Warehouse Architecture; Different Types of Architecture; Data Marts, OLAP, OLTP.

MODULE II
Data Mining, Motivation, Application, Data Mining—On What Kind of Data?, Data Mining Functionalities, Data Mining Task Primitives, Major Issues in Data Mining. Data pre-processing: Attribute types, Similarity

& Dissimilarity measures. Data Preprocessing: Data Cleaning, Data Integration, Data Reduction, Data Transformation & Discretization.

MODULE III
Mining Frequent Patterns: Basic Algorithms, Association Rule Mining, Apriori Algorithm, FP tree growth Algorithm, Advanced Pattern Mining Techniques.

MODULE IV
Classification Techniques: Decision Tree, Bayes Classification, Bayesian Belief Networks, Support Vector Machines, Classification Evaluation Techniques, Classification Accuracy improvement Techniques.

MODULE V
Clustering Techniques: Partitioning algorithms, Hierarchical algorithms, Density-Based algorithms, Grid-Based algorithms, Evaluation of Clustering. Outlier Detection Techniques.

MODULE VI
Applications and Trends in Data Mining: Applications, Advanced Techniques, Web Mining, Web Content Mining, Structure Mining.

Text Books:

1. Paulraj Ponniah; Data Warehousing: Fundamentals for IT Professionals; Wiley India.
2. J. Han and M. Kamber. Data Mining: Concepts and Techniques. 3rd Edition, Morgan Kaufman.
3. Pang Ning Tan, Introduction to Data Mining, 2nd Edition, Pearson.
4. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education.
5. Roiger & Geatz, Data Mining, Pearson Education
6. A.K.Pujari, Data Mining, University Press

References Books:

1. Charu C. Aggarwal, Data Mining: The Textbook, Springer.
2. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann.
3. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice, Hall.

Course Outcomes (CO):

Table1

Course Outcome No.	Course Outcome
CO1	Students will be able to interpret the contribution of data warehousing and data mining in Knowledge discovery process.
CO2	Students will be able to identify different data attribute types and apply different data preprocessing techniques.
CO3	Students will be able to apply the link analysis and frequent item-set algorithms to identify the entities on the real-world data.

CO4	Students will be able to apply the various classification and clustering algorithms for supervised and unsupervised learning problems.
CO5	Students will be able to apply various data visualization techniques for in-depth data analysis.
CO6	Students will be able to apply the advanced data mining techniques and use the popular data warehousing and data mining tools.

CO-PO Mapping:

Table2

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	0	0	0	0	0	0	0
CO2	3	3	3	2	2	2	2	0	0	0	1	0
CO3	3	3	3	2	2	2	2	0	0	0	2	0
CO4	3	3	3	3	2	2	2	0	1	2	1	0
CO5	3	3	3	2	2	1	1	0	2	2	1	0
CO6	3	3	3	1	3	2	1	0	2	2	1	0
Total	18	18	18	12	13	9	8	0	5	6	6	0
Average Attainment	3.0	3.0	3.0	2.0	2.2	1.5	1.3	0.0	0.8	1.0	1.0	0.0
Equivalent Average Attainment	3	3	3	2	2	2	1	0	1	1	1	0

CO-PSO Mapping:

Table3

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PSO1	PSO2
CO1	1	1
CO2	2	2
CO3	2	1
CO4	2	2
CO5	2	2
CO6	2	2
Total	11	10
Average Attainment	2.2	2
Equivalent Average Attainment	2	2

MOBILE COMPUTING	UCS06E06
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objective:

1. The course shall cover the concepts and principles of mobile computing.
2. It distinguishes between types of mobility and provides a computer systems perspective on the converging areas of wireless networking, embedded systems, and software.
3. The goal is to develop skills of finding solutions and building software for mobile computing applications.

Course Content:

UNIT I

Introduction:

Issues and Challenges in mobile computing, Coping with uncertainties, Resource poorness, bandwidth etc., Cellular architecture, Co-channel interference, Frequency reuse, Capacity increase by cell splitting, Evolution of mobile system: CDMA, FDMA, TDMA.

Introduction to Personal Communications Services (PCS):

PCS Architecture, Networks signalling.

UNIT II

Mobility Management:

Cellular architecture, Co-channel interference, Adjacent channel interference, Mobility-handoff, types of handoffs, Location management, HLR-VLR scheme, Hierarchical scheme, Predictive location management schemes, Mobile IP, Cellular IP, DHCP.

Mobile Transport Layer:

Indirect TCP, Snoop TCP, Mobile TCP

Mobile Ad Hoc Network and Routing Protocols:

Hidden and exposed terminal problems, Routing protocols: Destination sequenced distance vector algorithm, Cluster based gateway switch routing, Dynamic source routing, Ad hoc on-demand routing, Location aided routing, Zonal routing algorithm.

UNIT III

Global System for Mobile Communication (GSM) Overview:

GSM Architecture, Mobility management, Network signaling.

General Packet Radio Services (GPRS):

GPRS Architecture, GPRS Network Nodes.

UNIT IV

Mobile Data Communication:

WLANs (Wireless LANs), Bluetooth and IrDA technologies and standards.

Wireless Application Protocol (WAP):

The Mobile Internet standard, WAP Gateway and Protocols.

UNIT V

Third Generation (3G) Mobile Services:
Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.

Wireless Local Loop (WLL):
Introduction to WLL Architecture, Wireless Local Loop Technologies.

UNIT Vi
Different mobile-phone based platform architectures and applications.

Text Book:

1. J. Schiller, "Mobile Communications", Pearson Education.

Reference Book:

1. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley Publishing, 2003.
2. Yi-Bing Lin &ImrichChlamtac, "Wireless and Mobile Networks Architectures", John Wiley & Sons, 2001.
3. Raj Pandya, "Mobile and Personal Communication systems and services", Prentice Hall of India, 2001.
4. "Handbook of Wireless Networks and Mobile Computing "Stojmenovic&Cacute, 1st Ed. Wiley, 2002.

Course Outcomes (COs)

1. Students will be able to understand various concepts of mobile communication.
2. Students will be able to understand and analyze different generations mobile communication systems.
3. Students will be able to understand different layers of mobile communication.
4. Students will be able to analyze various protocols of all layers for mobile and ad hoc wireless communication networks.
5. Students will be able to understand mobile phone platform architectures and applications.

To establish the correlation between COs & POs

Table 1

Course Outcome No.	Course Outcome
CO1	Students will be able to understand various concepts of mobile communication.
CO2	Students will be able to understand and analyze different generations mobile communication systems.
CO3	Students will be able to understand different layers of mobile communication.
CO4	Students will be able to analyze various protocols of all layers for mobile and ad hoc wireless communication networks.
CO5	Students will be able to understand mobile phone platform architectures and applications.

TABLE 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION- "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	-	-	-	-	1	-	-	-
CO2	3	3	2	2	1	1	-	-	1	-	-	-
CO3	3	2	1	1	-	-	-	-	1	-	-	-
CO4	3	3	2	1	2	-	-	-	1	-	-	1
CO5	3	2	2	2	2	1	-	-	2	-	-	-
Total	15	12	8	8	5	2	-		6			1
Average	3	2.4	1.6	1.6	1	0.4			1.4			0.2
Equivalent average attainment	3	2	2	2	1	0	0	0	1	0	0	0

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
CO1	1	1
CO2	2	1
CO3	1	1
CO4	2	2
CO5	1	2
Total	7	7
Average	1.4	1.4
Equivalent Average Attainment	1	1

Seventh Semester

Detailed Syllabus

MACHINE LEARNING	UCS06B17
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS06B13, UCS03C01

Course Objectives:

1. To recognize the characteristics of machine learning that makes it useful to solve real-world problems.
2. To understand the appropriate implementation of supervised, semi supervised and unsupervised learning techniques in real-world applications.
3. To choose a suitable machine learning model, implement, and examine the performance of the chosen model for a given real world problem.
4. To understand cutting edge technologies related to machine learning applications.

Course Content

MODULE I

Introduction: Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. The concept learning task. Concept learning as search through a hypothesis space. General-to-specific ordering of hypotheses. Finding maximally specific hypotheses. Version spaces and the candidate elimination algorithm. Learning conjunctive concepts. The importance of inductive bias.

MODULE II

Supervised Learning: Classification vs. Regression, Linear and Logistic Regression, Gradient Descent, Support Vector Machines, Kernels, Decision Trees, ML and MAP Estimates, K-Nearest Neighbor, Naive Bayes, Introduction to Bayesian Networks, Artificial Neural Networks.

MODULE III

Unsupervised Learning: Partitioning based methods, Hierarchical methods, Density based methods, Gaussian Mixture Models, Learning with Partially Observable Data (EM). Dimensionality Reduction and Principal Component Analysis.

MODULE IV

Optimization Techniques: Bias-Variance tradeoff, Regularization, Evaluation techniques for supervised and unsupervised learning.

MODULE V

Other Learning techniques: A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Recommender Systems.

MODULE VI

Applications of Machine Learning: Texts, Image, Time-series data.

Textbooks:

1. T. Mitchell, Machine Learning, McGrawHill.
2. Ethem Alpaydın, Introduction to Machine Learning 3rd Edition, MIT Press
3. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012

References:

1. Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. Shwartz and David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press.
3. C.M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
4. Andrew Ng, Machine Learning Yearning.
5. Other online material.

Course Outcomes (CO):

Table1

Course Outcome No.	Course Outcome
CO1	Students will be able to understand the mathematics and engineering sciences behind functioning of machine learning.
CO2	Students will be able to analyze the given dataset and data attributes for designing a machine learning-based solution.
CO3	Students will be able to identify different machine learning approaches, optimization techniques, and apply them on different problem domains.
CO4	Students will be able to design and deploy machine learning solutions for real-world applications with popular machine learning tools.

CO-PO Mapping:

Table2

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	2	0	0	1	1	0	0
CO2	3	3	3	3	2	2	2	0	1	1	0	0
CO3	3	3	3	2	2	2	2	1	1	1	2	1
CO4	3	3	3	3	2	2	2	1	2	2	1	1
Total	12	12	12	11	8	8	6	2	5	5	3	2
Average Attainment	3.0	3.0	3.0	2.8	2.0	2.0	1.5	0.5	1.3	1.3	0.8	0.5
Equivalent Average Attainment	3	3	3	3	2	2	2	1	1	1	1	1

CO-PSO Mapping:

Table3

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	2	2
CO4	2	2
Total	8	7
Average Attainment	2.0	1.75
Equivalent Average Attainment	2	2

Departmental Elective Subjects in Seventh Semester

BIG DATA ANALYTICS	UCS07E07
L T P 3 - 0 - 0 : 3 Credits	Prerequisites:UCS05B11

Course Objectives:

1. To recognize the characteristics of Big Data Analytics that makes it useful to solve real-world problems.
2. To understand Hadoop distributed file system (HDFS) and examine MapReduce programming techniques.
3. To appraise the role of business intelligence and its applications across industries.
4. To understand cutting edge technologies related to Big Data Analytics and its applications.

Course Content:

MODULE I
Understanding Big Data, Stages of analytical evolution, State of the Practice in Analytics

MODULE II
Big Data storage concepts, NoSQL Database, Big Data Analytics Lifecycle

MODULE III
Advanced Analytics - Analytics for Unstructured Data - Map Reduce and Hadoop, The Hadoop Ecosystem, In-database Analytics

MODULE IV
Data Visualization Techniques, Stream Computing Challenges, Systems architecture, Main memory data management techniques, energy-efficient data processing, Benchmarking, Security and Privacy, Failover, and reliability.

Textbooks:

1. Nandhini Abirami R, Seifedine Kadry and Amir Gandomi, Big Data: Concepts, Technology and Architecture, Wiley, 2021.
2. Bill Franks, Taming The Big Data Tidal Wave, 1st Edition, Wiley, 2012.
3. Frank J. Ohlhorst, Big Data Analytics,1st Edition, Wiley, 2012.
   Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media,

Course Outcomes (CO):

Table1

Course Outcome No.	Course Outcome
CO1	Students will be able to understand the mathematics and engineering sciences behind functioning of Big Data Analytics.
CO2	Students will be able to master the concepts of HDFS and MapReduce Framework.
CO3	Students will be able to Investigate Hadoop related tools for Big Data Analytics and perform basic Hadoop administration and apply them on different problem domains.
CO4	Students will be able to recognize the role of business intelligence, data warehousing and visualization in decision making.
CO5	Students will be able to infer the importance of core data mining techniques for Big Data Analytics.

CO-PO Mapping:

Table2

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	3	2	2	0	0	1	1	1	2
CO2	2	2	0	2	2	0	0	0	2	2	0	1
CO3	3	3	3	2	2	2	2	1	1	1	2	2
CO4	2	2	0	2	1	2	2	0	2	2	0	2
CO5	3	2	3	2	1	2	0	0	2	0	0	2
Total	10	9	4	9	7	6	4	1	6	6	3	7
Average Attainment	2.5	2.3	1.0	2.3	1.8	1.5	1.0	0.3	1.5	1.5	0.8	1.8
Equivalent Average Attainment	3	2	1	2	2	2	1	0	2	2	1	2

CO-PSO Mapping:

Table3

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PSO1	PSO2
CO1	2	1
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2
Total	10	9
Average Attainment	2	1.8
Equivalent Average Attainment	2	2

CLOUD COMPUTING	UCS07E08
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objective:

1. To study different Cloud Computing architectures and services.
2. To Get familiar with different cloud models
3. To Know the available platforms and services in the industry
4. To Get familiar with cloud applications and programming in cloud platform.

Course Content:

Unit I

Introduction to Cloud Computing -advantages, challenges, and risks.
Enabling Technologies and System Models for Cloud Computing.

Unit II
Distributed System Models
Parallel Computing
Virtualization

Unit III
Cloud Computing Architectures
Service-Oriented Architectures

Unit IV
Cloud OS
Cloud Programming

Unit V
Cloud Platforms in Industry
Unit VI
Cloud Applications

Text Books:

1. Mastering Cloud Computing – RajkumarBuyya, Christian Vecchiola& S. ThamaraiSelvi; McGraw-Hill.
2. Cloud Computing: Concepts Technology and Architecture – Thomas Erl; Pearson Education

Reference Books:

1. Cloud Computing : A Practical Approach - Anthony T. Velte Toby J. Velte, Robert Elsenpeter; The McGraw - Hill.
2. Distributed and Cloud Computing-Kai Hwang, Jack Dongarra& Geoffrey C. Fox; Morgan Kaufmann.

3. Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more - Dr. Kris Jamsa; Jones & Bartlett Learning

(2013)

Course Outcomes (COs)

1. Students will be understand the advantages, challenges and risks associated with cloud computing.
2. Students will be able to understand different computing models and architectures related to cloud computing.
3. Students will be able to understand cloud computing operating systems and do programming in cloud platforms.
4. Students will have the knowledge of different cloud platforms that are available in the industry and will be able to choose the correct one's as required.
5. Students will be able to understand and apply the concepts of cloud applications.

To establish the correlation between COs & POs

Table 1

Course Outcome No.	Course outcome
CO1	Students will be understand the advantages, challenges and risks associated with cloud omputing.
CO2	Students will be able to understand different computing models and architectures related o cloud computing.
CO3	Students will be able to understand cloud computing operating systems and do rogramming in cloud platforms.
CO4	Students will have the knowledge of different cloud platforms that are available in the ndustry and will be able to choose the correct one's as required.
CO5	Students will be able to understand and apply the concepts of of cloud applications.

TABLE 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION- "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**1**	**-**	**-**	**2**
CO2	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**2**
CO3	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**-**	**1**	**1**	**1**	**1**
CO4	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**1**
CO5	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**1**	**3**	**2**	**2**	**1**
Total	**12**	**13**	**10**	**6**	**7**	**4**	**5**	**2**	**7**	**5**	**6**	**7**
Average ttainment	**2.4**	**2.6**	**2**	**1.2**	**1.4**	**0.8**	**1**	**0.4**	**1.4**	**1**	**1.2**	**1.4**
Equivalent verage ttainment	**2**	**3**	**2**	**1**	**1**	**1**	**1**	**0**	**1**	**1**	**1**	**1**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
CO1	**1**	**1**
CO2	**1**	**2**
CO3	**2**	**2**
CO4	**2**	**2**
CO5	**2**	**3**
Total	**8**	**10**
Average	**1.6**	**2**
Equivalent Average Attainment	**2**	**2**

INFORMATION RETRIEVAL	**UCS07E09**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS03B02, UCS04B07

Course Objective:

1. Introduction of the basic concepts and techniques of Information Retrieval and Search engines.
2. Develop skills of information crawling and analyzing.
3. Understanding different indexing approaches.
4. Understanding different retrieval approaches.
5. Understanding and applying ranking algorithms.
6. Ability to evaluate a retrieval system.

Course content:

UNIT I

Introduction: The nature of unstructured and semi-structured text. Inverted index and Boolean queries.

Preprocessing: Tokenization, stemming, stop words, phrase identification, indexing. Index compression: lexicon compression and postings lists compression. Gap encoding, gamma codes, Zipf's Law. Postings size estimation,dynamic indexing, positional indexes, n-gram indexes, real-world issues.

UNIT II

Retrieval Models: Boolean, vector space, probabilistic and language modelling, learning-to-rank,latent semantic indexing. Vector space scoring, cosine measure, Efficiency considerations, Document length normalization, Relevance feedback and query expansion.

Performance Evaluation: Evaluating search engines, precision, recall, F-measure, Mean Average Precision, Mean Reciprocal Rank. Creating test collections: kappa measure, inter-judge agreement.

UNIT III

Classification and Clustering: Introduction to text classification, Naive Bayes models, Spam filtering, Vector space classification using hyper planes, centroids, k-Nearest-Neighbours,Support vector machine classifiers, Kernel functions, Boosting.

Clustering versus classification, Partitioning methods, k-means clustering, Mixture of Gaussians model, Hierarchical agglomerative clustering, Clustering terms using documents,Summarization, Topic detection and tracking, cross language information retrieval

UNIT IV

Web search: Hypertext, web crawling, search engines, ranking, link analysis, PageRank. Recommender Systems - Collaborative Filtering and Content-Based Recommendation ofDocuments and Products Information Extraction and Integration - Extracting Data from Text – XML

- Semantic Web - Collecting and Integrating Specialized Information on the Web.

Text Book:

1. Introduction to Information Retrieval by Christopher D. Manning, PrabhakarRaghavan, and HinrichSchuetze, Cambridge University Press, 2008.

Reference Books:

1. Search Engines: Information Retrieval in Practice by Bruce Croft, Donald Metzler, and Trevor Strohman, Pearson Education, 2009.
2. Modern Information Retrieval by Baeza-Yates Ricardo and BerthierRibeiro-Neto.2nd edition, Addison-Wesley, 2011.
3. Information Retrieval: Implementing and Evaluating Search Engines by Stefan Buttcher, Charlie Clarke, Gordon Cormack, MIT Press, 2010

Course outcomes:

1. Understanding the concept and techniques of Information Retrieval and Search engines.
2. Developing indexed for the crawled documents.
3. Understanding and applying different information retrieval approaches.
4. Understanding and applying different ranking approaches.
5. Ability to evaluate an information retrieval system.

To establish the correlation between COs & Pos

Table 1

COURSE OUTCOME NO	COURSE OUTCOME
UCS07E09 1	Understanding the concept and techniques of Information Retrieval and Search engines.
UCS07E09 2	Developing indexed for the crawled documents.
UCS07E09 3	Understanding and applying different information retrieval approaches.
UCS07E09 4	Understanding and applying different ranking approaches..
UCS07E09 5	Ability to evaluate an information retrieval system..

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION-"-"

CO	PO1	P02	P03	P04	P05	P06	P07	P08	P09	PO10	PO11	PO12
UCS07E09 1	**3**	**2**	**2**	**1**	**1**	**3**	**-**	**1**	**3**	**3**	**1**	**2**
UCS07E09 2	**3**	**2**	**2**	**1**	**2**	**3**	**-**	**1**	**3**	**3**	**2**	**2**
UCS07E09 3	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**2**
UCS07E09 4	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**3**
UCS07E09 5	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**3**
Total	**15**	**10**	**10**	**10**	**12**	**15**	**6**	**5**	**15**	**15**	**12**	**12**
Avg	**3**	**2**	**2**	**2**	**2.4**	**3**	**1**	**1**	**3**	**3**	**2.4**	**2.4**
Eq Av attainment	**3**	**2**	**2**	**2**	**2**	**3**	**1**	**1**	**3**	**3**	**2.4**	**2**

To establish the correlation between COs & PSOs

Table 3

CO	PSO1	PSO2
UCS07E09 1	1	1
UCS07E09 2	1	2
UCS07E09 3	3	3
UCS07E09 4	3	3
UCS07E09 5	3	3
Total	11	12
Average	2	2.4
Eq. Av Attainment	2	2

PATTERN RECOGNITION	**UCS07E10**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objectives:

The objective of this course is to learn machine perception, pattern recognition systems,Applications of pattern recognition, probability of events, random variables, Joint distributionsand densities, moments of random variables,

Baye‟s Theorem, multiple features, conditionallyindependent features, decision boundaries, histograms, Kernel and window estimators, nearestneighbor classification techniques, and unsupervised learning and clustering

Course Content:

INTRODUCTION:

Pattern recognition and learning (supervised, unsupervised), training and test sets, feature selection.

SUPERVISED LEARNING AND CLASSIFICATION:

Discriminant functions and decision boundaries Linear discriminant functions, relaxation procedure, non-separable behaviour Minimum distance classifier. Bayesian decision theory.Maximum likelihood classification. Parameter estimation, sufficient statistics, component analysis and discriminants (PCA, Fisher's) Nonparametric techniques. Density estimation, Parzen window, K-NN estimation, Supervised neural learning: Back-propagation algorithm, Radial basis-function neural net; Support vector machine classifier, Learning vector quantization

UNSUPERVISED LEARNING AND CLUSTERING:

Data description and clustering –similarity measures, criterion for clustering, Methods of clustering - partitional, hierarchical, graph theoretic, density based, k-means, k-mediod, fuzzy c-means clustering, Cluster validity

FEATURE EXTRACTION AND FEATURE SELECTION:

Problems of dimensionality- Feature extraction --PCA-Feature selection –Karhunen Loeve, stochastic approximation, kernel approximation, divergence measures, Independent component analysis.

BOOKS RECOMMENDED:-

1. R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification and Scene Analysis, 2nd ed., Wiley, New York, 2000.
2. J. T. Tou and R. C. Gonzalez, Pattern Recognition Principles, Addison-Wesley, London, 1974.
3. A. Konar, Computational Intelligence: Principles, Techniques, and Applications, Springer 2005.

Course Outcome:

CO1 Summarize the various techniques involved in pattern recognition

CO2 Categorize the various pattern recognition techniques into supervised and unsupervised.

CO3 Illustrate the artificial neural network based pattern recognition

CO4 Discuss the applications of pattern recognition in various applications

CO-PO Mapping:

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	1	2	1	--	--	2
CO2	3	3	2	2	3	2	1	--	--	1	1	2
CO3	3	3	2	2	3	1	1	2	1	2	2	1
CO4	3	3	3	2	3	1	1	2	1	2	2	1

Total	12	12	9	8	10	6	4	6	3	5	5	6
Average	3	3	2.25	2	2.5	1.5	1	1.5	0.75	1.25	1.25	1.5
Eq. Average Attainment	3	3	2	2	2	1	1	1	1	1	1	1

CO-PSO Matrices

CO	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	3
CO4	3	3
Total	12	10
Avg	3	2.5
Eq Avg. Attainment	3	3

SOFT COMPUTING	**UCS07E11**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS06B13

Course Objectives:

1. Understand Soft Computing concepts, technologies, and applications
2. Understand the underlying principle of soft computing with its usage in various application. .
3. Understand different soft computing tools to solve real life problems.

Course content

UNIT-1

Introduction to Fuzzy sets, Fuzzy t- and s- norms, projection, cylindrical extension, Fuzzy relations, Implication relations, Fuzzy relational equations, Possibilistic reasoning, Fuzzy pattern recognition, Introduction to Fuzzy control and Fuzzy databases.

UNIT-2

Biological vs. artificial neurons, McCulloch and Pitts Model, Perceptron as linear classifier, Supervised learning: Perceptron learning algorithm, Steepest descent learning and backpropagation algorithm, Radial basis function neural net. Unsupervised learning: Hopfield neural net, Self-organizing feature map neural net, Competitive neural learning, Reinforcement learning: Q-learning and temporal difference Q-learning, Support vector machine (SVM), Kernelized SVM, Learning vector quantization.

UNIT-3

Genetic Algorithm: Binary and real codes, Genetic programming, Particle swarm optimization, Differential Evolution, Bacterial Foraging

UNIT-4

Hybridization of neuro-fuzzy, neuro-GA, neuro-swarm, neuro-evolution algorithms.Applications in Pattern Recognition, Robotics, and Image Processing.

Text Books:

1. Computational Intelligence: Principles, Techniques, and Applications by A. Konar, Springer.

Reference Books:

2.Computational Intelligence by A. P. Engelbrecht

3.Foundations of Neural Networks, Fuzzy Systems, and Knowldge Engineering, Nikola K. Kasabov, MIT Press.

Course Outcomes(CO):

CO1: Learn about soft computing techniques and their applications

CO2.Analyze various neural network architectures

CO3.Understand perceptrons and counter propagation networks.

CO4.Define the fuzzy systems

CO5.Analyze the genetic algorithms and their applications.

Table: CO-PO Matrices :

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION"--"

	CO-PO Mapping of Design and Analysis of Algorithm											
COs	Program Outcomes(Pos)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	0	1	2	1	1	3
CO2	3	3	3	3	2	3	2	0	3	1	3	3
CO3	3	3	3	3	3	2	1	1	3	2	3	3
CO4	2	3	3	3	3	2	1	2	3	3	3	3
CO5	2	3	3	3	3	1	2	2	2	3	3	3
Total	**13**	**15**	**15**	**15**	**13**	**10**	**5**	**6**	**13**	**10**	**13**	**15**
Average	**2.6**	**3**	**3**	**3**	**2.6**	**2**	**1.2**	**1.2**	**2.6**	**2**	**2.6**	**3**
Eq. Average Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1.2**	**3**	**2**	**3**	**3**

To Establish the correlation between CO and PSO

Table 3

CO	PSO1	PSO2
CO1	2	1
CO2	3	3
CO3	3	2
CO4	3	3
CO5	3	3
TOTAL	14	12
AVG	2.8	2.4
Eq AVG Attainment	3	2

UNIX SYSTEM PROGRAMMING	UCS07E12
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS05B12,

Course objectives:

This course will enable students to

1. Understand the UNIX Architecture, File systems and use of basic Commands.
2. Use of editors and Networking commands.
3. Understand Shell Programming and to write shell scripts.
4. Understand and analyze UNIX System calls, Process Creation, Control & Relationship

Course content:

UNIT – I

Introduction, Brief history. Unix Components/Architecture. Features of Unix.TheUNIXEnvironment and UNIX Structure, Posix and Single Unix specification.The login prompt.

General features of Unix commands/ command structure. Command arguments andoptions.Understanding of some basic commands such as echo, printf, ls, who, date,passwd, cal, Combining commands.Meaning of Internal and external commands. The typecommand: knowing the type of a command and locating it. The man command knowingmore about Unix commands and using Unix online manual pages.The man with keywordoption and whatis. The more command and using it with other commands. Knowing theuser terminal, displaying its characteristics and setting characteristics. Managing the nonuniformbehaviour of terminals and keyboards. The root login. Becoming the super user: sucommand. The /etc/passwd and /etc/shadow files. Commands to add, modify and deleteusers.

UNIT – II

Unix files. Naming files. Basic file types/categories.Organization of files. Hidden files.Standard directories. Parent child relationship.The home directory and the HOMEvariable. Reaching required files- the PATH variable, manipulating the PATH, Relativeand absolute pathnames. Directory commands – pwd, cd, mkdir, rmdir commands. The dot(.) and double dots (..) notations to represent present and parent directories and their usagein relative path names. File related commands – cat, mv, rm, cp, wc and od commands.File attributes and permissions and knowing them. The ls command with options.Changing file permissions: the relative and absolute permissions changing methods.Recursively changing file permissions. Directory permissions.

UNIT – III

The vi editor. Basics. The .exrc file. Different ways of invoking and quitting vi. Differentmodes of vi. Input mode commands. Command mode commands. The ex mode commands.

Illustrative examples Navigation commands. Repeat command. Pattern searching. Thesearch and replace command. The set, map and abbr commands. Simple examples usingthese commands.

The shells interpretive cycle. Wild cards and file name generation. Removing the specialmeanings of wild cards. Three standard files and redirection. Connecting commands: Pipe. Splitting the output: tee. Command substitution. Basic and Extended regular expressions.Thegrep, egrep.Typical examples involving different regular expressions.

UNIT – IV

Shell programming. Ordinary and environment variables.The .profile. Read and readonlycommands.Command line arguments.exit and exit status of a command. Logical operators for conditional execution.The test command and its shortcut.The if, while, for and casecontrol statements. The set and shift commands and handling positional parameters. Thehere(<<) document and trap command. Simple shell program examples. File inodesandtheinode structure. File links – hard and soft links. Filters. Head and tail commands.Cutand paste commands.The sort command and its usage with different options.Theumaskand default file permissions. Two special files /dev/null and /dev/tty.

UNIT – V

Meaning of a process.Mechanism of process creation.Parent and child process. The pscommand with its options. Executing a command at a specified point of time: at command.

Executing a command periodically: cron command and the crontab file.. Signals. The nice and nohup commands. Background processes. The bg and fg command. The kill command.

The find command with illustrative example.

Structure of a perl script. Running a perl script. Variables and operators. String handling functions. Default variables - $_ and $. – representing the current line and current linenumber. The range operator.Chop() and chomp() functions. Lists and arrays. The @-variable. The splice operator, push(), pop(), split() and join(). File handles and handling file– using open(), close() and die () functions.. Associative arrays – keys and value functions.

Overview of decision making loop control structures – the foreach. Regular expressions –simple and multiple search patterns.The match and substitute operators. Defining andusing subroutines.

Text Books:

1. Sumitabha Das., Unix Concepts and Applications., 4th Edition., Tata McGraw Hill

2. Behrouz A. Forouzan, Richard F. Gilberg : UNIX and Shell Programming- Cengage Learning – India Edition. 2009.

Reference Books:

1. M.G. Venkatesh Murthy: UNIX & Shell Programming**,** Pearson Education.

2. Richard Blum , Christine Bresnahan : Linux Command Line and Shell Scripting Bible, 2ndEdition , Wiley,2014.

Course Outcome

CO1	Create Structured Shell Programming
CO2	Use of Shell Functions
CO3	Filename expansion mechanism
CO4	Create Shell Programs with process interrupts
CO5	Shell program efficiency and detect and correct error.

5. Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	1	2	1	2	3	3	2	3
CO2	3	3	4	3	3	2	2	2	2	3	3	3
CO3	2	3	2	3	4	3	2	2	2	2	3	3
CO4	3	4	3	3	2	2	2	-	3	2	2	2
CO5	4	3	3	2	2	3	3	2	2	3	4	3
Total	15	15	14	13	12	12	10	8	12	13	14	14
Average	3	3	2.8	2.6	2.4	2.4	2	1.6	2.4	2.6	2.8	2.8
Eq. Average Attainment	3	3	3	3	2	2	2	2	2	3	3	3

CO PSO Mapping

CO	PSO1	PSO2
CO1	3	2
CO2	3	3
CO3	2	2
CO4	2	3
CO5	2	2
Total	12	12
Average	2.4	2.4
Eq. Av Attainment	2	2

INDUSTRIAL TRAINING (UCS07P01)	**(UCS07P01)**
L T P **1 – 0 – 0 : 1 Credits**	**Prerequisites:None**

Industrial training is a program which is aiming to provide the students with supervised practical exposure in their respective fields within a stipulated time period (as per institute rules). It boosts the students' capability, capacity, performance as well as overall productivity significantly. This training gives an experience to handle the real world problems and helps them in their careers.

INTELLECTUAL PROPERTY RIGHTS (UCS07C01)	**(UCS07C01)**
L T P **1 – 0 – 0 : 0 Credits**	**Prerequisites:None**

Departmental Elective Subjects in Eighth Semester

DEEP LEARNING	UCS08E13
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objectives:

1. To introduce the idea of Artificial Neural Networks and their applications.
2. To study and implement different architectures of Artificial Neural Networks.
3. To study and implement various optimization techniques on Artificial Neural Networks.
4. To enable design and deployment of deep learning models for machine learning problems.

Course Content:

MODULE I
Introduction: Artificial Intelligence and Deep Learning-a historical perspective, Artificial neural networks, Shallow neural networks, Deep neural networks, gradient descent, forward and backpropagation, computational graphs, linear and non-linear activation functions.

MODULE II
Optimization techniques: Regularization, Dropout, Batch Normalization, Vanishing/Exploding gradients, Mini-batch gradient, Gradient descent with momentum, RMSprop, Adam optimization, Learning rate decay, Local optima, Global optima. Hyperparameter tuning,

MODULE III
Convolutional Neural Networks: Basic operations: padding, stride, pooling; Classic convolutional models: LeNet-5, AlexNet, VGG, Modern Deep Convolutional models: ResNet, GoogleNet; Inception Network, 1-D convolutions, Object detection and Face Recognition with CNN.

MODULE IV
Recurrent Neural Networks: Sequence modelling, Types of Recurrent Neural Networks, Backpropagation through time, Language modelling and sequence generation, Word Embeddings, vanishing gradients with RNNs, Long-Short Term Memory (LSTM), Gated Recurrent MODULEs (GRU), Bidirectional LSTMs, Sequence-to-Sequence model, Attention Mechanism, Transformer Network.

MODULE V
Advanced topics: Deep Reinforcement Learning, Generative Adversarial Networks, Auto encoders.

References:

1. Charu C. Aggarwal, Neural Networks and Deep Learning- A textbook, 2018, Springer.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville," Deep Learning (Adaptive Computation and Machine Learning series", MIT Press.
3. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms", O'Reilly Media.
4. Other online resources and research publications.

Course Outcomes (CO):

Table1

Course Outcome No.	Course Outcome
CO1	Students will be able to understand the mathematics and engineering sciences behind functioning of artificial neural networks.
CO2	Students will be able to analyze the given dataset and data attributes for designing a neural network-based solution.
CO3	Students will be able to identify different neural network architectures, neural network optimization techniques, and apply them on different problem domains.
CO4	Students will be able to design and deploy deep learning solutions for real-world applications with popular deep learning tools.

CO-PO Mapping:

Table2

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	0	0	1	1	1	1
CO2	3	3	3	3	2	1	1	0	1	1	1	1
CO3	3	3	3	3	2	1	1	0	1	1	1	1
CO4	3	3	2	2	2	2	1	1	2	2	2	2
Total	12	12	11	11	8	5	3	1	5	5	5	5
Average Attainment	3	3	2.75	2.75	2	1.25	0.75	1	1.25	1.25	1.25	1.25
Equivalent Average Attainment	3	3	3	3	2	1	1	1	1	1	1	1

CO-PSO Mapping:

Table3

Levels: 1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	3	3
CO4	3	2
Total	10	9
Average Attainment	2	1.8
Equivalent Average Attainment	2	2

EMBEDDED AND REAL TIME SYSTEM	UCS08E14
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS04B08

Course Objective

1. To explain the features of a real-time application and explain different task scheduling algorithms in real-time systems.
2. Computing required for the real-time embedded systems.
3. Communication required for the real-time embedded systems.
4. To facilitate the use of various software tools for development of embedded systems.

Course Content:

UNIT I

INTRODUCTION TO EMBEDDED SYSTEMS:

Architecture of Embedded Systems - Hardware Architecture, Software Architecture, Communication Software, Development/Testing Tools. ASIC Design, PLA-PLD-CPLDFPGA evolution,

UNIT II

EMBEDDED SYSTEM MODELING:

State chart, petri net, task graphs, UML, data flow graphs

UNIT III

PROGRAMMING EMBEDDED SYSTEMS:

The Process of Embedded System Development - Design Tradeoffs, Hardware Software codesign, Implementation, Integration and Testing. Hardware Platforms. Communication Interfaces.

UNIT IV

EMBEDDED SYSTEM VALIDATION AND VERIFICATION

EMBEDDED/REAL-TIME OPERATING SYSTEMS:

Representative Embedded Systems, Suitability and Characteristics of operating systems for RT applications.Programming in RT-Linux. RT Rule based Expert System. Embedded Database Application. Mobile Java .

UNIT V

APPLICATIONS:

Embedded Software Development on 8051 Micro-controller Platform DSP-based Embedded Systems - Implementation of Embedded Systems with VHDL, FPGA and CPLD. Embedded Systems Applications using Strong ARM Platform

Text Book:

1. Embedded/Real-time Systems: Concepts, Design and Programmingby Dr. K.V.K.K. Prasad, Dreamtech press.

Reference Book :

1.Programming for Embedded Systems by Dreamtech Software team, Willey – Dreamtech
2.Real time systems by Jane Liu, Prentice Hall
3.Real-Time Systems: Scheduling, Analysis, and Verification by Prof. Albert M. K. Cheng, John Wiley and Sons
4.Embedded Systems: Principles, Techniques, and Applications by A. Konar, Springer 2011

Course Outcome:

Table 1

CO-1	Describe the differences between the general computing system and the embedded system.
CO-2	Recognize the classification of embedded systems.
CO-3	Understand the requirements of a real-time application and analyze the performance of different task scheduling algorithms for real-time systems.
CO-4	Analyze the concept of operating system in Real Time application.
CO-5	Application of various real time algorithms in building embedded systems.

CO-PO Mapping:

Table 2

Levels: 1: Slight(LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	2	1	1	2	3	3	3
CO2	2	1	2	1	1	1	1	3	2	3	3	3
CO3	3	3	2	2	2	2	1	2	2	3	2	3
CO4	2	2	3	3	3	2	1	2	2	3	2	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3
Total	13	12	12	11	9	10	7	11	11	15	13	15
Average Attainment	2.6	2.4	2.4	2.2	1.8	2	1.4	2.2	2.2	3	2.6	3
Equivalent Average Attainment	3	2	2	2	2	2	1	2	2	3	3	3

Table 3: To establish the correlation between COs & PSOs

CO	PSO-1	PSO-2
CO-1	2	2
CO-2	3	2
CO-3	4	3
CO-4	2	2
CO-5	3	2
Total	14	11
Avg	2.8	2.2
Eq. Avg. Attainment	3	2

HUMAN COMPUTER INTERACTION	**UCS08E15**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course Objective:

Human-computer interaction (HCI) has become an area of great interest and concern. HCI is concerned with the joint performance of tasks by humans and machines. It stresses the importance of good interfaces and the relationship of interface design to effective human interaction with computers. It focuses more on application (and less on theory) of user-centered design principles, guidelines, and evaluation. This course provides the concepts of HCI and user interfaces, focusing on user interface design, evaluation, and technologies. This is a non-programming intensive course.

Among the topics studied are the design and evaluation of effective user interaction designs, including principles and guidelines for designing interactive systems. Additionally, much emphasis is given to the development process for user interaction designs as an integral, but different, part of interactive software development. User interaction development activities include requirements and task analysis, usability specifications, design, prototyping, and evaluation. It is a goal of this course to help students realize that user interface development is an ongoing process throughout the full product life cycle.

Course content:

UNIT I

INTRODUCTION

The Human – Input-output channels.Human Memory, thinking, emotions, psychology & design of interactive systems. Computer text entry devices, positioning, pointing &drawing , display devices for Virtual reality, interaction models, Frameworks & HCI, Ergonomics, Interaction styles WIMP Interfaces – context, paradigms for Interaction.

UNIT II

DESIGN PROCESS – SCREEN DESIGN

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. Screen Designing : Design goals– Screen planning and purpose, organizing screen elements, ordering of screen data and content, screen navigation and flow. Visually pleasing composition , amount of information, focus and emphasis, presentation information simply and meaningfully, information retrieval on web, statistical graphics , Technological consideration in interface design .

UNIT III

WINDOWS AND MULTIMEDIA

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls; Components– text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

UNIT IV

SOFTWARE TOOLS AND DEVICES

Software tools – Specification methods, interface –Building Tools , Interaction Devices – Keyboard and function keys pointing devices – speech recognition digitization and generation – image and video displays and drivers.

UNIT V

UBIQUITOUS COMPUTING, HYPERTEXT, WWW

Ubiquitous computing application research – virtual & augmented reality – information & data visualization, understanding hypertext – finding things – Web Technology & issues – Static Web content – Dynamic Web content; Groupware systems – Computer mediated communication – DSS – Frameworks for groupware.

Text Book:

1. Dix A. et al., Human-Computer Interaction. Harlow, England: Prentice Hall, ISBN-10: 0130461091

Reference Books:

1. Wilbert O Galitz, "The essential guide to user interface design", Wiley
2. Ben Shneidermann , Catherine Plaisant, "Designing the user interface, Strategies for effective Human Computer Interaction", Pearson Education.
3.. Alan Dix, Janet Finlay, GreGoryd, Abowd, Russell Beale, "Human – Computer Interaction", Pearson Education.

Course Outcomes

CO1	Student will be able to understand the basics of human and computational abilities and limitations.
CO2	Student will be able to understand basic theories, tools and techniques in HCI.
CO3	Students will be able to understand the fundamental aspects of designing and evaluating interfaces.
CO4	Students will be able to implement and practice a variety of simple methods for evaluating the quality of a user interface.
CO5	Students will be able to practice a variety of simple methods for evaluating the quality of a user nterface.
CO6	Students will be able to apply appropriate HCI techniques to design systems that are usable by people.

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	--	--	--	2	--	2	--	--	--	2
CO2	3	3	2	2	3	--	1	--	--	2	1	2
CO3	3	3	2	2	3	2	1	2	2	3	2	1
CO4	3	3	3	2	3	2	2	2	2	2	2	1
CO5	3	3	3	3	3	2	2	2	1	2	2	1
CO6	3	3	3	3	3	2	2	2	1	2	2	1
Total	18	18	13	12	15	10	8	10	6	11	9	8
Average	3	3	2.16	2	2.5	1.66	1.33	1.66	1	1.83	1.5	1.33
Eq. Average Attainment	3	3	2	2	3	2	1	2	1	2	2	1

Table 2: CO PSO Mapping

CO	PSO1	PSO2
CO1	3	-
CO2	3	-
CO3	3	2
CO4	3	3
CO5	2	3
CO6	2	3
Total	16	11
Average	2.66	1.83
Eq. Av Attainment	3	2

NATURAL LANGUAGE PROCESSING	**UCS08E16**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS06B13, UCS03C01

Course Objective:

This course introduces the fundamental concepts and techniques of Natural Language Processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. This course also provides the leading trends and systems in natural language processing. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches. After successfully completing this course, the undergraduate students will be able to grasp the significance of natural language processing in solving real-world problems.

UNIT-I

Sound : Biology of Speech Processing; Place and Manner of Articulation; Word Boundary Detection; Argmax based computations; HMM and Speech Recognition.

UNIT-II

Words and Word Forms : Morphology fundamentals; Morphological Diversity of Indian Languages; Morphology Paradigms; Finite State Machine Based Morphology; Automatic Morphology Learning; Shallow Parsing; Named Entities; Maximum Entropy Models; Random Fields.

UNIT-III

Structures: Theories of Parsing, Parsing Algorithms; Robust and Scalable Parsing on Noisy Text as in Web documents; Hybrid of Rule Based and Probabilistic Parsing; Scope Ambiguity and Attachment Ambiguity resolution.

UNIT-IV

Meaning: Lexical Knowledge Networks, Wordnet Theory; Indian Language Wordnets and Multilingual Dictionaries; Semantic Roles; Word Sense Disambiguation; WSD and Multilinguality; Metaphors; Coreferences.

UNIT-V

Web 2.0 Applications: Sentiment Analysis; Text Entailment; Robust and Scalable Machine Translation; Question Answering in Multilingual Setting; Cross Lingual Information Retrieval (CLIR).

Text Books:

1. Speech and Language Processing (2nd ed.) Dan Jurafsky and James H. Martin

Reference Books:

1.Foundations of Statistical Natural Language Processingby Manning, Christopher and Heinrich, Schutze , MIT Press.

2. Statistical Language Learning by Charniack, Eugene, MIT Press, 1993.

3. The Handbook of Computational Linguistics and Natural Language Processing, Alexander Clark, Chris Fox, Shalom Lappin.

Table-1

Course Outcome No	Course Outcome
CO1	Understand the fundamental concept of NLP, Regular Expression, Finite State Automata along with the concept and application of word tokenization, normalization, sentence segmentation, word extraction, spell checking in the context of NLP.

CO2	Understand the concept of Morphology such as Inflectional and Derivational Morphology and different morphological parsing techniques
CO3	Understand the concepts related to language modeling with introduction to N-grams, chain rule, smoothing, spelling and word prediction and their evaluation along with the concept of Markov chain, HMM, Forward and Viterbi algorithm, POS tagging.
CO4	Understand the concept of lexical semantics, lexical dictionary such as WordNet, lexical computational semantics, distributional word similarity and concepts related to the field of Information Retrieval in the context of NLP.

Table2

CO-PO Matrices; CO-PSO Mapping of course

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	2	2	0	0	1	1	0	0
CO2	2	3	3	1	2	2	2	0	1	1	0	0
CO3	3	3	3	3	2	2	2	1	1	1	2	1
CO4	3	3	3	3	2	2	2	1	2	2	1	1
Total	11	11	11	10	8	8	6	2	5	5	3	2
Average	2.75	2.75	2.75	2.5	2	2	1.5	0.5	1.3	1.3	0.8	0.5
Eq. Average Attainment	3	3	3	3	2	2	2	1	1	1	1	1

Table3: CO-PSO Matrices

	PSO1	PSO2
CO1	2	2
CO2	3	2
CO3	3	3
CO4	3	3
Total	11	10
Avg	2.75	2.5
Eq Avg. Attainment	3	3

PRINCIPLES OF PROGRAMMING LANGUAGE	UCS08E17
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS03B02, UCS04B07, UCS04B06

Course Objectives

Understand the concepts and terms used to describe languages that support the imperative, functional, object-oriented, and logic programming paradigms.

1. To introduce the major programming paradigms, and the principles and techniques involved in design and implementation of modern programming languages. To introduce frame works for specifying and reasoning about programming languages.
2. Solve problems using the logic programming paradigm.

Course Content

UNIT I

Introduction : The Role of Programming Languages: Why Study Programming Languages, Towards Higher-Level languages, Programming paradigms, Programming environments Language Description: Syntactic structure, language Translation Issues: Programming language Syntax, Stages in translation, Formal translation Models

UNIT II

Properties Data, Data Types, and Basic Statements : Names , variables , binding, type checking, scope, scope rules ,lifetime and garbage collection, primitive data types, strings, array types, associative arrays ,record types, union types, pointers and references , Arithmetic expressions , overloaded operators, type conversions , relational and boolean expressions, assignment statements, mixed mode assignments, control structures, selection ,iterations, branching, guarded statements.

UNIT III

Subprograms and Implementations : Subprograms ,design issues ,local referencing, parameter passing, overloaded methods, generic methods, design issues for functions , semantics of call and return ,implementing simple subprograms , stack and dynamic local variables, nested subprograms, , dynamic scoping.

UNIT IV

Object-Orientation, Concurrency, and Event Handling : Grouping of data and Operations — Constructs for Programming Structures, abstraction Information Hiding, Program Design with Modules, Defined types, Object oriented programming — concept of Object, inheritance, Derived classes and Information hiding – Templates, Semaphores, Monitors, Message passing, Threads, statement level concurrency Exception handling (Using C++ and Java as example language).

UNIT V

Functional and Logic Programming Languages: Introduction to lambda calculus, fundamentals of

functional programming languages, Programming with Programming with ML, Introduction to logic and logic programming – Programming with Prolog.

Text Book:

1. Concepts of Programming Languages Robert .W. Sebesta 8/e, Pearson Education
2. Programming Language Design Concepts, D. A. Watt, Wiley dreamtech

Reference Book:

1. "Programming Languages: Design and Implementations" , Terrance W.Pratt, Marvin V. Zelkowitz, T.V.Gopal,Fourth ed.,Prentice Hall
2. "Programming Language Design Concept", David A. Watt, Willey India
3. "Programming languages: Concepts and Constucts", Ravi Sethi, Second Ed.,Pearson.
4. "Types and programming Languages", Benjamin C. Pierce. The MIT Press Cambridge, Massachusetts London, England
5. Concepts of Programming Languages, Robert W. Sebesta, 10 th Ed.,Pearson

Course Outcomes

CO1	Describe distinguishing characteristics of declarative (functional & logical) and imperative (procedural & object-oriented) programming language paradigms and explain how these characteristics manifest in historic and contemporary programming languages.
CO2	Evaluate syntactic, semantic, and pragmatic tradeoffs among the various programming paradigms and programming languages
CO3	Identification of different phenomenon like: isomorphism, planarity, connectivity, duality and their effect on different types of graphs.
CO4	Develop, analyze, and compare programs written in the various Programming Paradigms
CO5	Demonstrate different forms of declaration, typing, binding, visibility, scoping, and lifetime management for various programming language constructs (e.g. variables, functions, data structures including objects, etc.)
CO6	Choose an appropriate programming language solution for a given programming task

Table: CO-PO Matrices

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	4	3	2	2	1	1	3	1	2	3	2	4
CO2	2	3	4	3	3	2	2	1	2	3	3	3
CO3	2	3	2	3	4	3	2	1	2	2	3	4
CO4	3	4	3	3	2	2	1	-	3	2	3	2
CO5	4	3	3	2	-	3	3	2	2	3	3	3
CO6	3	3	4	3	3	3	2	2	2	4	4	2
Total	18	19	18	16	13	14	13	7	13	17	18	18
Average	3.0	3.16	3.0	2.66	2.16	2.33	2.16	1.16	2.16	2.83	3.0	3.0
Eq. Average Attainment	3	3	3	3	3	2	2	1	2	3	3	3

To establish the correlation between COs & PSOs

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	PSO-1	PSO-2
CO-1	1	1
CO-2	2	1
CO-3	1	3
CO-4	2	1
CO-5	2	3
Total	8	9
Average Attainment	1.6	1.8
Equivalent Average Attainment	2	2

WEB TECHNOLOGY	UCS08E18
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: None

Course objective:

Design and implement dynamic websites with good aesthetic sense of designing and latest technical tools. Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services. Get introduced in the area of Online Game programming.

Course Content:

UNIT I

Internet Principles and Components:

History of the Internet and World Wide Web, HTML, protocols - HTTP, SMTP, POP3, MIME, IMAP.Domain Name Server, Web Browsers and Web Servers, Dynamic HTML.,

UNIT II

Client Side and Server Side Programming: Introduction to JAVA Scripts and VB Scripts, Object Based Scripting for the web Server Pages, Session and Application management, Session tracking and cookies, Access a database from web page, Developing N-tier web application.

UNIT III

XML and ActiveX: Anatomy of xml document - XML markup-working with elements and attributes creating valid documents-xml objects and DOM. ActiveX controls: OLE and ActiveX -ActiveX Documents, Server side Active-X Components, ActiveX DLL and ActiveX Exe.

UNIT IV

Multimedia and Web Application: Multimedia in web design, Audio and video speech synthesis and recognition, Electronic Commerce, E-Business Model – E-Marketing, Online Payments and Security – N-tier Architecture. Search and Design: Working of search engines -optimization-Search interface.

UNIT V

Web Services: Introduction to Web Services, UDDI, SOAP, WSDL, Web Service Architecture, Developing and deploying web services. Ajax – Improving web page performance using Ajax, Programming in Ajax.

Text Books:

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Pearson Education.

References:

1. Web Technologies, by Uttam K. Roy, Oxford Higher Education.

Course Outcome:

CO-1	Apply the knowledge of the internet and related internet concepts that are vital in understanding web application development and analyze the insights of internet programming to implement complete application over the web.
CO-2	Understand, analyze and apply the role of mark up languages like HTML, DHTML, and XML in the workings of the web and web applications.
CO-3	Use web application development software tools i.e. XML, Apache Tomcat etc. and identifies the environments currently available on the market to design web sites.
CO-4	Understand, analyze and build dynamic web pages using client side programming JavaScript and also develop the web application using servlet and JSP.
CO-5	Understand the impact of web services like Ajax and web application by database connectivity with JDBC in the current market place where everyone use to prefer electronic medium for shopping, commerce, fund transfer and even social life also.

CO-PO Mapping:

Levels: 1: Slight (LOW) 2: Moderate(MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	3	1	1	-	-	1	1	1	2
CO2	3	3	-	2	2	-	2	1	2	2	-	1
CO3	2	3	2	2	2	3	1	1	1	1	2	2
CO4	2	2	1	2	3	2	2	-	2	2	1	2

CO5	3	2	3	2	1	2	-	1	2	-	-	3
Total	13	12	8	11	9	8	5	3	8	6	4	10
Average Attainment	2.6	2.4	1.6	2.2	1.8	1.6	1.0	0.6	1.6	1.2	0.8	2.0
Equivalent Average Attainment	3	1	2	2	2	2	1	1	2	1	2	2

To establish the correlation between COs & PSOs

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) and for No Correlation "-"

CO	PSO-1	PSO-2
CO-1	**2**	**1**
CO-2	**1**	**2**
CO-3	**2**	**2**
CO-4	**2**	**2**
CO-5	**2**	**2**
Total	**9**	**9**
Average Attainment	**1.8**	**1.8**
Equivalent Average Attainment	**2**	**2**

WIRELESS SENSOR NETWORK	**UCS08E19**
L T P 3 - 0 - 0 : 3 Credits	Prerequisites: UCS06B15

Course Objective:

1. Understand various components of a sensor node and network architecture and discuss various applications of WSN.
2. Understand MAC protocols developed for WSN.
3. Compare and evaluate routing protocols in wireless sensor networks.
4. Understand various topology control algorithms in WSNs.
5. Compare and contrast various data processing techniques used in wireless sensor networks.

Course Description:

Wireless Sensor Networks is a course that covers the state-of-the art in the technology as well as the industry. It covers the fundamentals of wireless sensor design and radio frequency (RF) technology, the communication protocols used, and the application requirements of this technology.

MODULE -I

Sensor networks overview: Introduction, advantages, unique constraints and challenges, applications, design issues, requirements. Sensor node architecture, factors influencing the sensor network design.

Technologies for WSNs: ZigBee technology, Ultrawide bandwidth technology, Bluetooth technology.

Sensing Models: The Binary Sensing Model, The Probabilistic Sensing Model

MODULE -II

Network architecture: protocols and standards, sensing and communication range, Optimization goals, evaluation metrics, QoS, network design principles. Gateway concepts.

MODULE - III

MAC protocols and energy efficiency: Issues in designing MAC Protocol for WSNs - Classification of MAC Protocols - S-MAC Protocol - B-MAC protocol - IEEE 802.15.4 standard - Zig Bee - Dissemination protocol for large sensor network.

MODULE - IV

Routing protocols: flat routing, flooding and gossiping, resource aware routing, Data centric, hierarchical, location-based, geographic routing, unicast, broadcast, multicast, energy efficient routing. Topology control: Clustering, Time synchronization, Sensor deployment and configuration: Localization and positioning – Scheduling, Coverage and connectivity - Single-hop and multi-hop localization - Self configuring localization systems - Roles of Sensor Nodes and Utilities – Sensor Tasking and Control.

MODULE – V

Querying, data collection and processing, collaborative information processing and group connectivity, Time domain and space domain data analysis. Fault Tolerance in Wireless Sensor Networks, Target tracking. Power management. QoS Management, Security and privacy.

Operating Systems for Wireless Sensor Networks - Introduction to TinyOS and nesC - Berkeley Motes - Programming Challenges. Introduction to Simulation tools- TOSSIM, OPNET, NS2.

Text Books:

1.Protocols and Architectures for Wireless Sensor Networks by Andreas Willig and Holger Karl, Wiley Publications.

Reference Books:

1. Wireless Sensor Networks-An Information Processing Approach by Feng Zhao and Leonidas Guibas, Morgan Kauffman.
2. Wireless Sensor Networks: From Theory to Applications by Ibrahiem M. M. El Emary and S. Ramakrishnan, CRC Press.
3. Wireless sensor networks by Edgar H. Callaway, AUERBACH Publications.
4. Wireless Sensor Networks: Principles and Practice by Fei Hu and Xiaojun Cao, CRC Press.

5. Kazem Sohraby, Daniel Minoli, and Taieb Znati: Wireless Sensor Networks: Technology, Protocols, Applications, Wiley Interscience.
6. A. Hac, *Wireless Sensor Network Designs*, John Wiley &Sons , 2009
7. E. H. Callaway, Jr. E. H. Callaway, *Wireless Sensor Networks Architecture and Protocols:*, CRC Press , 2009
8. Wireless Sensor Actuators and Networks, Roberto Verdone, Davide Dardari, Gianluca Mazzini and Andrea Conti, 2008
9. Wireless Sensor Networks : A systems perspective By Nirupama Bulusu and Sanjay Jha, editors Artech House, August 2005
10. Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2007.
11. Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005.
12. C.S Raghavendra, Krishna M.Sivalingam, Taieb znati , "Wireless Sensor Networks", Springer Science 2004.
13. C. Siva Ram Murthy and B. S. Manoj, "Adhoc Wireless Networks: Architectures and Protocols", Prentice Hall, 2004
14. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education, 2007.

Course Outcome:

CO1: Have an understanding of the principles and characteristics of wireless sensor networks.

CO2: Design a wireless sensor network for given sensor data using microcontroller, transceiver, middleware and operating system.

CO3: Evaluate the performance of schedule based and random Medium Access Control protocols for power consumption, fairness, channel utilization and control packet overhead.

C04: Evaluate the performance of various routing protocols for power consumption, scalability and latency parameters. Analysis of various critical parameters in deploying a WSN.

C05: Understand energy efficient data gathering and querying, reliability, fault tolerance and security.

To establish the correlation between CO and PO

Table 1

Course Outcome No.	Course Outcome
CO1	Have an understanding of the principles and characteristics of wireless sensor networks.
CO2	Design a wireless sensor network for given sensor data using microcontroller, transceiver, middleware and operating system.
CO3	Evaluate the performance of schedule based and random Medium Access Control protocols for power consumption, fairness, channel utilization and control packet overhead.
CO4	Evaluate the performance of various routing protocols for power consumption, scalability and latency parameters. Analysis of various critical parameters in deploying a WSN.
CO5	Understand energy efficient data gathering and querying, reliability, fault tolerance and security.

Table 2

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "-"

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	1	1	1	1	1	1	1
CO2	2	2	3	3	3	3	3	1	3	2	2	2
CO3	2	3	3	3	3	1	1	1	2	2	1	2
CO4	3	3	3	3	3	2	3	1	2	3	2	2
CO5	3	3	3	3	3	1	1	1	3	2	2	2
TOTAL	12	13	14	15	15	8	9	5	11	10	8	9
AVG	2.4	2.6	2.8	3	3	1.6	1.8	1	2.2	2	1.6	1.8
Eq AVG Attainment	2	3	3	3	3	2	2	1	2	2	2	2

To establish the correlation between CO and PSO

Table 3

CO	PSO1	PSO2
CO1	2	1
CO2	3	3
CO3	3	2
CO4	3	3
CO5	3	3
TOTAL	14	12
AVG	2.8	2.4
Eq AVG Attainment	3	2

Open Elective Subject in Eighth Semester

APPLICATION OF MACHINE LEARNING IN TIME SERIES ANALYSIS	UCS08E20
L T P 3 – 0 – 0 : 3 Credits	Prerequisites:None

Course Objectives:

1. To focus on models and algorithms for supervised and unsupervised machine learning with time series.
2. To include discrete and continuous time models from machine learning, statistics and econometrics.
3. To investigate a variety of time series problems including prediction, detection, clustering, and similarity search.

Course Contents:

Section- A : Conventional Time-Series

UNIT - I

1. Stochastic process and its main characteristics

Stochastic process.Time series as a discrete stochastic process.Stationarity.Main characteristics of stochastic processes (means, autocovariation and autocorrelation functions).Stationary stochastic processes.Stationarity as the main characteristic of stochastic component of time series.

2. Autoregressive-moving average models ARMA (p,q)

Moving average models MA(q). Condition of invertability. Autoregressive models AR(p). Yull-Worker equations.Stationarity conditions. Autoregressive-moving average models ARMA (p,q).

UNIT - II

3. Coefficient estimation in ARMA (p,q) processes. Box-Jenkins' approach

Coefficients estimation in autoregressive models.Coefficient estimation in ARMA (p) processes. Quality of adjustment of time series models.AIC information criterion.BIC information criterion."Portmonto"-statistics.Box-Jenkins methodology to identification of stationary time series models.

4. Forecasting in the framework of Box-Jenkins model

Forecasting, trend and seasonality in Box-Jenkins model.

Section- B : Non-stationarity in Time-Series and Dealing with uncertainty in forecasting

UNIT - III

5. Non-stationary in time series. Time series with non-stationary variance. Non-stationary mean.

Hindrances in Economic Time-Series Prediction ,Machine Learning Approach to Time-Series Prediction, Scope of Machine Learning in Time-Series Prediction, Sources of Uncertainty in a Time-Series, Scope of Uncertainty Management by Fuzzy Sets, Fuzzy Time-Series, Partitioning of Fuzzy Time-Series, Fuzzification of a Time-Series, Time-Series Prediction Using Fuzzy Reasoning, Single and Multi-Factored Time-Series Prediction.

UNIT - IV

6. Mini Project for prediction of Economic Time series using machine learning.

Text Books:

1. Time Series Analysis And Forecasting by Example, SorenBisgaard and Murat Kulachi, Wiley Publication.
2. Mathematic for Economic Analysis, Knut Sydsaeter and Peter J. Hammond, Pearson Publication.
3. Computational Intelligence Principal Techniques and Application, AmitKonar, Springer Publication.
4. Time Series Prediction and Applications, AmitKonar and Diptendu Bhattacharya, Springer Publication.

Reference Books:

5. Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, J.-S.R. Jang, C.-T. Sun and E. Mizutani, Pearson Publication.

Course Outcomes (CO):

CO1: Identifying the nature of the phenomenon represented by the sequence of observations, and forecasting (predicting future values of the time series variable).

CO2: To understand a statistical methodology appropriate for longitudinal research designs that involve single subjects or research units that are measured repeatedly at regular intervals over time

CO3: To observe time series can be decomposed into three components: the trend (long term direction), the seasonal (systematic, calendar related movements) and the irregular (unsystematic, short term fluctuations)

CO4. To measure: gathered at regular time intervals (metrics), also Measurements gathered at irregular time intervals (events)

Table 1: CO-PO Mapping

1: Slight (LOW) 2: Moderate (MEDIUM) 3: Substantial (HIGH) and for NO CORELATION "--"

	CO-PO Mapping of Application Of Machine Learning In Time Series Analysis											
COs	Program Outcomes(POs)											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	2	2	0	1	2	1	2	3
CO2	3	3	3	3	2	3	2	0	3	1	3	3
CO3	3	3	3	3	3	2	1	1	3	2	2	3
CO4	3	3	3	3	3	2	0	2	2	2	2	3
Total	**12**	**12**	**12**	**12**	**10**	**9**	**3**	**4**	**10**	**6**	**9**	**12**
Average	**3**	**3**	**3**	**3**	**2.5**	**2.25**	**0.75**	**1**	**2.5**	**1.5**	**2.25**	**3**
Eq. Average Attainment	**3**	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**3**	**2**	**2**	**3**

Table 2: CO PSO Mapping

CO	**PSO1**	**PSO2**
CO1	3	2
CO2	2	_
CO3	2	2
CO4	2	3
Total	9	7
Average	2.25	1.75
Eq. Av Attainment	2	2

PROJECT-II (UCE07P01)	UCE07P01
L T P **2 – 0 – 0 : 2 Credits**	**Prerequisites:None**

The Project-II/ Project (Industry) - thesis work will involve culmination of study / review / evaluation / assessment/ analysis /design / experimental investigation/software development related to Computer Science & Engineering problem of interest. The findings and results are to be presented appropriately in the form of reports/simulation results / experimental studies/ computer printout. A seminar presentation may be given to demonstrate the work done.