Bachelor of Technology

Computer Science and Engineering

B. Tech. CSE

Curriculum

Curriculum implemented from Academic Year 2022-23

Bachelor of Technology

Computer Science and Engineering

B. Tech. CSE

Curriculum

Semester No.	Credits	Teaching Scheme			Examination Scheme			Total
		L	T	P	L	T	P	
1	23	21	1	8	600	25	200	825
2	23	18	2	8	600	50	200	850
3	22	15	4	6	500	100	150	750
4	22	15	3	8	500	75	200	775
5	20	15	1	8	500	25	200	725
6	21	15	2	8	500	50	200	750
7	20	15	0	10	500	0	250	750
8	10	0	0	20	0	0	300	300
Total	**161**							

Teaching Scheme of B. Tech. - I (CSE)

Semester I

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Fundamentals of Engineering Mathematics	MA115	4	3	1	0	100	25	0	125
2	Introduction to Computer Science (Core-1)	CS101	3	3	0	0	100	0	0	100
3	Introduction to Programming (Core-2)	CS103	4	3	0	2	100	0	50	150
4	Digital Electronics & Logic Design (Core-3)	EC103	4	3	0	2	100	0	50	150
5	Basics of Electrical Engineering (Core-4)	EE105	4	3	0	2	100	0	50	150
6	Digital Communication (Core-5)	EC105	4	3	0	2	100	0	50	150
7	Holistic Empowerment & Human Values*	HU107 S1	0	3	0	0	0	0	0	0
	Total		**23**	**21**	**1**	**8**	**600**	**25**	**200**	**825**
	Total Contact Hours per week			**30**						

*Audit Course

Semester-II

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Linear Algebra and Statistics	MA116	4	3	1	0	100	25	0	125
2	Data Structures (Core-6)	CS102	5	3	1	2	100	25	50	175
3	Web Programming and Python (Core-7)	CS104	4	3	0	2	100	0	50	150
4	Physics	PH104	3	3	0	0	100	0	0	100
5	English & Professional Communication	HU110 S2	3	3	0	0	100	0	0	100
6	Energy & Environmental Engineering	CEME106	4	3	0	2	100	0	50	150
7	Community Project*	CS106	0	0	0	2	0	0	50	50
	Total		**23**	**18**	**2**	**8**	**600**	**50**	**200**	**850**
	Total Contact Hours per week			**28**						

*Audit Course

Teaching Scheme of B. Tech. - II (CSE)

Semester III

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Discrete Mathematics (Core-8)	CS201	4	3	1	0	100	25	0	125
2	Computer Organization (Core-9)	CS203	4	3	1	0	100	25	0	125
3	Database Management Systems (Core-10)	CS205	5	3	1	2	100	25	50	175
4	Design and Analysis of Algorithms (Core-11)	CS207	5	3	1	2	100	25	50	175
5	Object Oriented Programming (Core-12)	CS209	4	3	0	2	100	0	50	150
	Total		**22**	**15**	**4**	**6**	**500**	**100**	**150**	**750**
	Total Contact Hours per week			**23**						

Practical Examination Scheme (Continuous Evaluation 50% and End-Semester Evaluation 50%)

Semester IV

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Microprocessor and Interfacing Techniques (Core-13)	CS202	5	3	1	2	100	25	50	175
2	Operating Systems (Core-14)	CS204	5	3	1	2	100	25	50	175
3	Computer Networks (Core-15)	CS206	4	3	0	2	100	0	50	150
4	Automata and Formal Languages (Core-16)	CS208	4	3	1	0	100	25	0	125
5	Artificial Intelligence (Core-17)	CS210	4	3	0	2	100	0	50	150
	Total		**22**	**15**	**3**	**8**	**500**	**75**	**200**	**775**
	Total Contact Hours per week			**26**						

Practical Examination Scheme (Continuous Evaluation 50% and End-Semester Evaluation 50%)

Teaching Scheme of B. Tech. - III (CSE)

Semester V

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	System Software (Core-18)	CS301	5	3	1	2	100	25	50	175
2	Machine Learning (Core-19)	CS303	4	3	0	2	100	0	50	150
3	Professional Ethics, Economics and Business Management	HU301	3	3	0	0	100	0	0	100
4	Core Elective-1	CS3AA	4	3	0	2	100	0	50	150
5	Institute Elective-1	CS3XX	3	3	0	0	100	0	0	100
6	CI/CD Tools	CS305	1	0	0	2	0	0	50	50
	Total		**20**	**15**	**1**	**8**	**500**	**25**	**200**	**725**
	Total Contact Hours per week			**24**						

Practical Examination Scheme (Continuous Evaluation 50% and End-Semester Evaluation 50%)

Core Elective-1 (CS3AA):

1	Advanced Microprocessors (CS321)	4	Information Theory & Coding (CS327)
2	Parallel Processing and Architecture (CS323)	5	Wireless Networks (CS329)
3	Computer Graphics (CS325)		

Institute Elective-1 (CS3XX):

1	Object Oriented Technology (CS361)	4	Computational Geometry (CS367)
2	Software Engineering (CS363)	5	Signals & Systems (CS369)
3	Soft Computing (CS365)		

Teaching Scheme of B. Tech. - III (CSE)

Semester VI

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Information Security and Cryptography (Core-20)	CS302	5	3	1	2	100	25	50	175
2	Cloud Computing (Core-21)	CS304	5	3	1	2	100	25	50	175
3	Core Elective-2	CS3BB	4	3	0	2	100	0	50	150
4	Core Elective-3	CS3CC	4	3	0	2	100	0	50	150
5	Institute Elective-2	CS3YY	3	3	0	0	100	0	0	100
	Total		**21**	**15**	**2**	**8**	**500**	**50**	**200**	**750**
	Total Contact Hours per week			**24**						

Practical Examination Scheme (Continuous Evaluation 50% and End-Semester Evaluation 50%)

Core Elective-2 (CS3BB) / 3 (CS3CC):

1	Data Science (CS322)	6	Cellular Network and Mobile Computing (CS332)
2	Data Visualization (CS324)	7	Service Oriented Architectures (CS334)
3	High Performance Computing (CS326)	8	Optimization Methods (CS336)
4	Social Network Analysis (CS328)	9	Video Codec Standards and Design (CS338)
5	Digital Forensics (CS330)		

Institute Elective-2 (CS3YY):

1	Cyber Physical Systems (CS362)	4	Computer Vision & Image Processing (CS368)
2	Ethical Hacking (CS364)	5	Adaptive Signal Processing (CS370)
3	Smartphone Computing and Applications (CS366)	6	Applied Machine Learning (CS372)

Teaching Scheme of B. Tech. - IV (CSE)

Semester VII/VIII

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
				L	T	P	L	T	P	
1	Distributed Systems (Core-22)	CS401	4	3	0	2	100	0	50	150
2	Core Elective-4	CS4AA	4	3	0	2	100	0	50	150
3	Core Elective-5	CS4BB	4	3	0	2	100	0	50	150
4	Core Elective-6	CS4CC	3	3	0	0	100	0	0	100
5	Innovation, Incubation and Entrepreneurship	HU401	3	3	0	0	100	0	0	100
6	Mini Project	CS403	2	0	0	4	0	0	100	100
	Total		**20**	**15**	**0**	**10**	**500**	**0**	**250**	**750**
	Total Contact Hours per week			**25**						

Core Elective-4 (CS4AA) / 5 (CS4BB):

1	Natural Language Processing (CS421)	6	Animation and Rendering (CS431)
2	Cyber Laws and Forensics Tools (CS423)	7	Deep Learning (CS433)
3	Audio and Speech Signal Processing (CS425)	8	Web Engineering (CS435)
4	Advanced Database Management System (CS427)	9	Machine Learning for Security (CS437)
5	Big Data Analytics (CS429)	10	Blockchain Technology (CS439)

Core Elective - 6 (CS4CC):

1	Research Methodology (CS461)	6	Advanced Computer Architecture (CS471)
2	Network Security (CS463)	7	Security in Resource Constrained Environment (CS473)
3	System Analysis and Simulation (CS465)	8	Secure Software Engineering (CS475)
4	Network Reconnaissance (CS467)	9	Advanced Compiler Design (CS477)
5	Software Security & Defensive Programming (CS469)	10	Formal Specification and Verification of Real Time Systems (CS479)

Teaching Scheme of B. Tech. - IV (CSE)

Semester VII/VIII

Sr. No.	Course	Code	Credits	Teaching Scheme			Examination Scheme			Total
1	Industrial Training	CS402	10	0	0	20	0	0	300	300
	Total		**10**	**0**	**0**	**20**	**0**	**0**	**300**	**300**
	Total Contact Hours per week			**20**						

Practical Examination Scheme (Continuous Evaluation 50% and End-Semester Evaluation

B. Tech. I (CSE) Semester – I
Fundamentals of Engineering Mathematics
MA115

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	Accept the challenge to solve the problem with Mathematics.
CO2	Apply the knowledge of curve tracing to solve problem of engineering.
CO3	Identify, formulate and analyze complex engineering and affiliated field problems, specifically the differential equation concept in different engineering field.
CO4	Apply the knowledge of mathematics for model and analyze computational processes using analytic and combinatorial methods
CO5	Design solutions engineering industrial problems with effective mathematical skill.

2. Syllabus

- **DIFFERENTIAL CALCULUS** **(08 Hours)**

  Differentiation of Hyperbolic and Inverse Hyperbolic functions. Successive Differentiation, standard forms, Leibnitz's theorem and applications, Power series, Expansion of functions, Taylor's and Maclaurin's series. Curvature, Radius of curvature for Cartesian curve with application.

- **PARTIAL DIFFERENTIAL CALCULUS** **(08 Hours)**

  Partial differentiation, Euler's theorem for homogeneous function, Modified Euler's theorem, Taylor's and Maclaurin's series for two variables. Tangent plane and Normal line, Error and Approximation, Jacobians with properties, Extreme values of function of two variables, Lagrange's methods of undetermined multipliers.

- **CURVE TRACING** **(05 Hours)**

  Cartesian, polar and parametric form of standard curves.

- **ORDINARY DIFFERENTIAL EQUATION** **(09 Hours)**

  Reorientation of differential equation first order first degree, exact differential equation and Integrating factors, first order higher degree odes, solvable for p, y and x, Solution of homogenous equations higher order, complementary functions, Particular Integrals, Linear differential equation with variable coefficient, Cauchy's Euler and Legendre's equation with variable coefficient, Method of variation of parameters.

- **APPLICATION OF DIFFERENTIAL EQUATION (Mathematical Modelling)** **(06 Hours)**

Modelling of Real world problems particularly Engineering System, Electrical network models (LCR), spread of epidemic (SI, SIS, SIR), Newton's Law of cooling, Compartment modelling, Bending of beam models.

- **SERIES SOLUTION AND SPECIAL FUNCTIONS** **(06 Hours)**

Regular point, Singular point, series solution of ODE of 2nd order with variable coefficient with special emphasis to differential equation of Legendre's and Bessel's for different cases of roots of indicial equations.

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. Books Recommended:

1. James Stewart, "Calculus", Thomson Asia, Singapore, 2003.
2. Kreyszing E., "Advanced Engineering Mathematics", John Wiley & Sons, Singapore, Int. Student Ed. 2015.
3. Wiley C. R., "Advanced Engineering Mathematics", McGraw Hill Inc., New York Ed. 1993.
4. F. B. Hilderband, "Methods of Applied mathematics", PHI, New Delhi, 1968
5. Ramana D. V., "Higher Engg. Mathematics", The McGraw-Hill Inc., New Delhi, 2007.

ADDITIONAL REFERENCE BOOKS

1. Srimanta Pal, Subodh C. Bhunia, "Engineering Mathematics", Oxford University Press, New Delhi, 2015.
2. Bali and Iyengar, "Engineering Mathematics", Laxmi Publications, New Delhi, 2004.
3. Mary L. Boas, "Mathematical Methods in the Physical Sciences", John Wiley & Sons, Ed.2005

B. Tech. I (CSE) Semester – I
INTRODUCTION TO COMPUTER SCIENCE (CORE-1)
CS101

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	Acquire knowledge about computers and computational problem solving.
CO2	Design the solutions of computational problems using iterative and recursive methods using flowcharts and pseudo-codes.
CO3	Solve computational problems in different number systems.
CO4	Analyse the importance of different types of memory and evaluate the impact of different algorithms on memory.
CO5	Experiment with different operating systems such as Windows and Linux and write scripts to automate repetitive tasks.

2. Syllabus

- **INTRODUCTION TO COMPUTER AND ITS ARCHITECTURE (04 Hours)**

  Introduction and Characteristics, Computer Architecture, Generations, Classifications, Applications, Central Processing Unit and Memory, Communication between various Units, Processor Speed, Multiprocessor System, Peripheral Buses, Motherboard Demonstration.

- **NUMBER SYSTEMS (06 Hours)**

  Introduction and type of Number System, Conversion between Number System, Arithmetic Operations in different Number System, Signed and Unsigned Number System.

- **COMPUTATIONAL PROBLEM SOLVING (08 Hours)**

  Program Development Cycle, Pseudocode, Flowchart, Representing Information as Bits, Binary System, Storing Integers, Storing Fractions, Examples of Computational Problems, Iterative and Recursive Approaches to Solve Computational Problems, Easy and Hard Computational Problems

- **MEMORY AND VARIOUS INPUT AND OUTPUT DEVICES (03 Hours)**

  Introduction to Memory, Input and Output Devices, Memory Hierarchy, Primary Memory and its Types, Secondary Memory, Classification of Secondary Memory, Various Secondary Storage Devices and their Functioning.

- **INTRODUCTION TO SYSTEM SOFTWARES AND PROGRAMMING LANGUAGES** **(03 Hours)**

  Classification of Computer Languages, Introduction of Operating System, Evolution, Type and Function of OS, Unix Commands, Evolution and Classification of programming Language, Feature and Selection of good Programming Language, Development of Program, Algorithm and Flowchart, Program Testing and Debugging, Program Documentation and Paradigms, Characteristics of good Program.

- **WINDOWS OPERATING SYSTEM AND ITS ENVIRONMENT** **(02 Hours)**

  Introduction to GUI based OS, Configuration, Setup, Services, Network Configuration.

- **LINUX OPERATING SYSTEM AND ITS ENVIRONMENT** **(06 Hours)**

  Introduction to Linux OS, Configuration, Setup, Commands – Navigating File System, File Permissions (R/W/X), Access control and super user (sudo) privileges, Scripting basics, Bash Shell : Input, Output, Comparison Operators, File Handling Operators, Functions, Variables, Control Flow, Loops, Arrays, and Functions, Network Configuration.

- **DEBUGGING TOOLS AND COMPILER OPTION** **(02 Hours)**

  Different Debugging tools, Commands, Memory dump, Register and Variable Tracking, Instruction and Function level debugging, Compiler Options, Profile Generation.

- **DATA COMMUNICATION, COMPUTER NETWORK AND INTERNET BASICS** **(04 Hours)**

  Data Communication and Transmission media, Multiplexing and Switching, Computer Network and Network Topology, Communication Protocols and Network Devices, Evolution and Basic Internet Term, Getting Connected to Internet and Internet Application, Email and its working, Searching the Web, Languages of Internet, Internet and Viruses.

- **SYSTEM AND NETWORK SECURITY BASICS** **(04 Hours)**

  Security Services, Security Attacks, and Security Mechanisms, Authentication, Password Strengths and Entropy, Access Control Mechanisms, Read/Write/Execute Permissions and Super User/Administrator Privileges, Introduction of HTTPS and Digital Certificates

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Introduction to Computer Science", Fourth Impression, Pearson Education, ITL Education Solutions Limited, 2009.
2. Nell Dale and John Lewis,"Computer Science Illuminated", Jones and Bartlett Publishers.
3. Robert Sedgewick and Kevin Wayne, "ComputerScience", Addison-Wesley.

B. Tech. I (CSE) Semester – I
INTRODUCTION TO PROGRAMMING (CORE-2)
CS103 S1

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	Acquire knowledge about fundamentals of C programming language.
CO2	Apply the knowledge of C Programming to solve computational problems.
CO3	Debug, test, and analyse C Programs to find and correct errors and improve the solutions.
CO4	Learn various programming techniques such as iteration and recursion, and apply them to solve computational problems.
CO5	Learn and apply the advanced programming concepts such as modularization, memory management, and file handling to improve the efficiency of computational problems.

2. Syllabus

- **OVERVIEW OF C PROGRAMMING LANGUAGE (02 Hours)**

  History of C, Importance of C, Basic Structure of a C Program, How to Compile a C Program, How to Run a C Program, Sample Programs.

- **CONSTANTS, VARIABLES, AND DATA TYPES (03 Hours)**

  Character Set in C, Keywords, Identifiers, Constants, Strings, Operators, Special Symbols, Variables, Data Types: Primary Data Types and User Defined Data Types, Declaration of Variables, Assigning Values to Variables, Initialization of Variables, Defining Symbolic Constants, Declaring Variables as Constants.

- **OPERATORS AND EXPRESSIONS (03 Hours)**

  Operators: Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise, Comma Operator, sizeof Operator, Operators used in Pointers and Structures, Arithmetic Expressions, How C programming Evaluates Arithmetic Expressions, Precedence of Arithmetic Operators and Associativity Rule, Type Conversion: Implicit and Explicit.

- **LIBRARY FUNCTIONS: INPUT, OUTPUT, MATHEMATICS, DATE AND TIME (02 Hours)**

  Reading Character from Keyboard, Printing Character on Screen, Reading String from Keyboard, Printing String on Screen, Formatting input and Output, difftime, clock, time, Math Functions: abs, fmod, reminder, log, log2, pow, sqrt, ceil, floor.

- **DECISION MAKING AND BRANCHING (04 Hours)**

  Decision Making in C Programming, If Statement, Nested If Statement, Else .. If Ladder, Switch Statement, Conditional Operator Statement, Goto Statement, Decision Making with Logical Operators, Sample Programs.

- **DECISION MAKING AND LOOPING (04 Hours)**

  Introduction to Loops, While Loop, Do While Loop, For Loop, Break Statement, Goto Statement, Continue Statement, Sample Programs.

- **ARRAYS AND CHARACTER ARRAYS (04 Hours)**

  Introduction to Arrays, One Dimensional Array, Declaration and Initialization of One Dimensional Array, Two Dimensional Array, Declaration and Initialization of Two Dimensional Array, Multi-Dimensional Array, Sample Programs, Declaration and Initialization of Strings, Arithmetic Operations on Characters, String Functions: Strlen(), Strcat(), Strcpy(), Strstr(), Strcmp(), etc.

- **FUNCTIONS (05 Hours)**

  Function Declaration, Function Definition, Function Calls, Functions with No Arguments and No Return Values, Functions with Arguments and No Return Values, Functions with No Arguments and Return Values, Functions with Arguments and Return Values, Recursive Functions, Passing Arrays to Functions, Call by Value, Call by Reference, Scope and Lifetime of Functions: Local, Global, Static, and Register Declaration.

- **STRUCTURES AND UNIONS (04 Hours)**

  Structure Template, Structure Variable Declaration and Initialization, Structure Variable Assignment, Accessing Structure Variables, Arrays as Structure, Arrays with Structures, Passing Structure Members to Functions, Unions, Difference Between Structures and Unions, Bit Fields.

- **POINTERS AND MEMORY MANAGEMENT (05 Hours)**

  Declaration and Initialization of Pointers, Accessing Memory through Pointers, Dynamic Memory Allocation, Memory Management Functions: Malloc, Calloc, and Free, Using Pointers to Access Dynamically Allocated Memory Locations, Pointers with Arrays, Use of Pointers to Return Multiple Values From Functions, Sample Program: Linked List.

- **FILE MANAGEMENT (04 Hours)**

  Opening and Closing a File, Modes in File Opening: Read, Write and Append, Input and Output Operations on Files, File Handling Functions such as fseek(), ftell(), rewind().

- **PREPROCESSOR DIRECTIVES (02 Hours)**

  Macro Substitution, Importing a File, Compiler Control Directives.

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. Practicals:

1 C Programming – How to write a program, compile a program, and execute a program

2 Read the input from a keyboard and write the output to computer screen

3 Variable declaration, initialization, and assignment, Constant declaration, Experiments with different data types

4 Experiments with different C Operators, Analysing the impact of precedence and associativity rules while evaluating expressions in C

5 Experiments with standard library functions related to math library, time library, standard input and output library etc.

6 Experiments with If, Else If, Switch, Goto statements

7 Experiments with While, Do .. While, For Loops, and analysing the impact of Break, Goto and Continue statements on C Loops

8 Experiments with Arrays and Character Arrays

9 Experiments with Different Functions having Arguments/No Arguments and Return Values/No Return Values, Scope and Lifetime of Functions, and Understanding Local, Global, Static, and Register Declaration

10 Experiments with Structures and Unions, Analysing the difference between the structure and union with respect to memory

11 Experiments with Pointers with respect to Accessing Memory from the Stack and Heap Section of the RAM (i.e., Experiments with Static and Dynamic Memory Management)

12 Opening, Closing the Files using a C program, and accessing the files to get the input from the file and store the output to the file.

13 Experiments with pre-processor directives.

4. Books Recommended:

1. E. Balagurusamy, “Programming in ANSI C”, Mc-Graw Hill.
2. Brian W. Kernighan / Dennis Ritchie,“The C Programming Language”, Pearson.
3. YashavantKanetkar, “Let us C”, BPB Publications.
4. Harbison and Steele, “C: A Reference Manual”

B. Tech. I (CSE) Semester – I
DIGITAL ELECTRONICS & LOGIC DESIGN (CORE-3)
EC103

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes(COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about different types of diodes and circuits.
CO2	apply the knowledge of gates, Boolean algebra and operational amplifier in designing logical and integrated circuits.
CO3	analyse the logical, integrated, and operational amplifier based circuits.
CO4	evaluate the different circuits and compare their performance.
CO5	design ALU and control unit.

2. Syllabus

- **PN DIODE AND TRANSITOR (04 Hours)**

  PN Diode Theory, PN Characteristic and Breakdown Region, PN Diode Application as Rectifier, Zener Diode Theory, Zener Voltage Regulator, Diode as Clamper and Clipper, Photodiode Theory, LED Theory, 7 Segment LED Circuit Diagram and Multi Colour LED, LASER Diode Theory and Applications, Bipolar Junction Transistor Theory, Transistor Symbols And Terminals, Common Collector, Emitter and Base Configurations, Different Biasing Techniques, Concept of Transistor Amplifier, Introduction to FET Transistor And Its Feature.

- **WAVESHAPING CIRCUITS AND OPERATIONAL AMPLIFIER (06 Hours)**

  Linear Wave Shaping Circuits, RC High Pass and Low Pass Circuits, RC Integrator and Differentiator Circuits, Nonlinear Wave Shaping Circuits, Two Level Diode Clipper Circuits, Clamping Circuits, Operational Amplifier OP-AMP with Block Diagram, Schematic Symbol of OP-AMP, The 741 Package Style and Pinouts, Specifications of Op-Amp, Inverting and Non-Inverting Amplifier, Voltage Follower Circuit, Multistage OP-AMP Circuit, OP-AMP Averaging Amplifier, OP-AMP Subtractor.

- **BOOLEAN ALGEBRA AND SWITCHING FUNCTIONS (04 Hours)**

  Basic Logic Operation and Logic Gates, Truth Table, Basic Postulates and Fundamental Theorems of Boolean Algebra, Standard Representations of Logic Functions- SOP and POS Forms, Simplification of Switching Functions-K-Map and Quine-Mccluskey Tabular Methods, Synthesis of Combinational Logic Circuits.

- **COMBINATIONAL LOGIC CIRCUIT USING MSI INTEGRATED CIRCUITS (07 Hours)**

  Binary Parallel Adder; BCD Adder; Encoder, Priority Encoder, Decoder; Multiplexer and Demultiplexer Circuits; Implementation of Boolean Functions Using Decoder and Multiplexer;

Arithmetic and Logic Unit; BCD to 7-Segment Decoder; Common Anode and Common Cathode 7-Segment Displays; Random Access Memory, Read Only Memory And Erasable Programmable ROMS; Programmable Logic Array (PLA) and Programmable Array Logic (PAL).

- **INTRODUCTION TO SEQUENTIAL LOGIC CIRCUITS (04 Hours)**

  Basic Concepts of Sequential Circuits; Cross Coupled SR Flip-Flop Using NAND or NOR Gates; JK Flip-Flop Rise Condition; Clocked Flip-Flop; D-Type and Toggle Flip-Flops; Truth Tables and Excitation Tables for Flip-Flops; Master Slave Configuration; Edge Triggered and Level Triggered Flip-Flops; Elimination of Switch Bounce using Flip-Flops; Flip-Flops with Preset and Clear.

- **SEQUENTIAL LOGIC CIRCUIT DESIGN (06 Hours)**

  Basic Concepts of Counters and Registers; Binary Counters; BCD Counters; Up Down Counter; Johnson Counter, Module-N Counter; Design of Counter Using State Diagrams and Table; Sequence Generators; Shift Left and Right Register; Registers With Parallel Load; Serial-In-Parallel-Out (SIPO) And Parallel-In-Serial-Out(PISO); Register using Different Type of Flip-Flop.

- **REGISTER TRANSFER LOGIC (04 Hours)**

  Arithmetic, Logic and Shift Micro-Operation; Conditional Control Statements; Fixed-Point and Floating-Point Data; Arithmetic Shifts; Instruction Code and Design Of Simple Computer.

- **PROCESSOR LOGIC DESIGN (03 Hours)**

  Processor Organization; Design of Arithmetic Logic Unit; Design of Accumulator.

- **CONTROL LOGIC DESIGN (04 Hours)**

  Control Organization; Hard-Wired Control; Micro Program Control; Control Of Processor Unit; PLA Control.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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4. <u>Practicals:</u>

1. Study of BJT Characteristics
2. Study of CE Amplifier
3. Study of RC Coupled / Tuned Amplifier
4. Study of FET Characteristics
5. Study of Diode Clipper Circuits
6. Study of Diode Clamper Circuits
7. Study and Implement RC Low Pass and High Pass Filter Circuits

8. Study and Implement RC Integrator Circuits
9. Study and Implement RC Differentiator Circuits
10. Full and Half-Adder/ Half-subtarctor Circuits using a serial Input
11. 4-Bit Gray to Binary/ Binary to Gray Code convertor using Select input
12. Logic expression with the Help of MUX IC 74153
13. Flip-flops using NAND/ NOR Gate
14. Modulo-7 Ripple Counter
15. 4-Bit Shift Left/Right Register
16. Sequence Generator

5. Books Recommended:

1. Schilling Donald L. and Belove E., "Electronics Circuits- Discrete and Integrated", 3rd Ed., McGraw-Hill, 1989, Reprint 2008.
2. Millman Jacob, Halkias Christos C. and Parikh C., "Integrated Electronics", 2nd Ed., McGraw-Hill, 2009.
3. Taub H. and Mothibi Suryaprakash, Millman J., "Pulse, Digital and Switching Waveforms", 2nd Ed., McGraw-Hill, 2007.
4. Mano Morris, “Digital Logic and Computer Design”, 5th Ed., Pearson Education, 2005.
5. Lee Samual, “Digital Circuits and Logic Design”, 1st Ed., PHI, 1998.

ADDITIONAL REFERENCE BOOKS

1. Malvin Albert & David J. Bates, "Electronic Principles", 7th edition, Tata McGraw Hill, 2007.
2. De Debashis, "Basic of Electronics", 1st Ed., Pearson Education, 2008.
3. Floyd and Jain, “Digital Fundamentals”, Pearson Education, 2006.

B. Tech. I (CSE) Semester – I
BASICS OF ELECTRICAL ENGINEERING (CORE-4)
EE105

	L	T	P	Credit
SCHEME	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about AC circuits, electrical network basics, transforms, wave form representation.
CO2	apply the fundamentals of electrical network basics to analyse different networks.
CO3	analyse electrical network using different theorems and different wave forms.
CO4	evaluate network performance using different parameters.
CO5	design and analyse different types of systems using network principles and network theorems.

2. Syllabus

- **AC FUNDAMENTALS AND CIRCUITS (07 Hours)**

  Alternating Voltages and Currents through Purely Resistive Inductive and Capacitive Circuits, R-L, R-C, R-L-C Series Circuits, Impedance and Admittance, Circuits in Parallel, Series and Parallel Resonance, Complex Algebra and its Application to Circuit Analysis, Circuit Transient, Initial and Final Value Theorem, DC and Induction Machines, Electrical Measurements, Power System.

- **POLYPHASE CIRCUITS AND TRANSFORMES (04 Hours)**

  Balanced Three Phase Systems, Star and Mesh Connections, Relation between Line and Phase Quantities, Measurement of Power, Principle of Transformer, Construction, Transformer on no-load and with load, Phasor Diagram for Transformer under No-Load and Loaded Condition (with unity, lagging power factor load) Equivalent Circuit, Open Circuit and Short Circuit Test, Efficiency, Voltage Regulation.

- **NETWORK CONCEPTS (04 Hours)**

  Network Element Symbols and Conventions, Active Element Conventions, Current and Voltage Conventions, Loops and Meshes, Nodes, Coupled circuits and Dot Conventions.

- **MESH CURRENT AND NODE VOLTAGE NETWORK ANALYSIS (07 Hours)**

  Kirchhoff's Voltage Law, Kirchhoff's Current Law, Definitions of Mesh Current and Nodal Voltage, Choice of Mesh Currents or Nodal Voltages for Network Analysis, Self and Mutual Inductances, Mesh Equation in the Impedance Matrix Form by Inspection, Solution of Linear Mesh Equations,

Nodal Voltage Analysis Nodal Equations in the Form of Admittance Matrices by Inspection, Solution of Linear Nodal Equations.

- **NETWORK THEOREMS AND GRAPH (07 Hours)**

  Linearity and Superposition, Independent and Dependent Source and their Transformations, Thevenin, Norton, Reciprocity and Maximum Power Transfer Theorems, Use of these Theorems in Circuit Analysis, Duality and Dual of a Planner Network, Fundamental Concepts, Definition of Graph and Various Related Terms, Paths and Circuits Connections, Tree of a Graph, Cut Sets and Tie Sets, Non-separable Planner and Dual Graphs, Matrices of Oriented Graphs, Properties and Inter-Relationship of Incidence, Tie Set and Cut Set Matrices, Complete Analysis Using Tie Set and Cut Set Matrices.

- **WAVE FORM ANALYSIS BY FOURIER SERIES (06 Hours)**

  Trigonometric and Complex Exponential Forms, Frequency Spectra of Periodic Wave Forms, Fourier Integral and Continuous Frequency Spectra, Fourier Transform and their Relationship with Laplace Transform.

- **NETWORK FUNCTIONS AND TWO PORT PARAMETERS (07 Hours)**

  Poles and Zeros of a Function, Physical and Analytical Concepts, Terminal and Terminal Pairs, Driving Point Immitances, Transfer Functions, Definitions, Calculations and Interrelationship of Impedance, and Admittance, Hybrid and Transmission Line Parameters for four Terminal Networks. Image Impedance and its Calculations for Symmetrical and Unsymmetrical π, T and Ladder Networks.

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. <u>Practicals:</u>

1. To study Ammeter and Voltmeter for current and voltage measurement in circuit.
2. To study Energy meter.
3. To study Power measurement method for three phase circuits using watt meter method.
4. Verification of superposition theorem for electric circuit.
5. Verification of Thevenin's theorem of electric circuit.
6. Calculation and verification Norton's theorem.
7. Open circuit and short circuit test for the transformers for efficiency calculation.
8. Verification of Kirchhoff's current law and Kirchhoff's voltage law for electric circuit.
9. Capacitance measurement of parallel plates.

10. Calculation of efficiency of auto transformer.

4. Books Recommended:

1. W.H.Hyat, J.E.Kemmerly, S.M.Durbin, "Engineering Circuit Analysis", 6th Edition, TMH, 2006.
2. Van Valkenburg M E, "Network Analysis", 3rd Edition, PHI, 2002.
3. Samarjit Ghosh, "Network Theory, Analysis & Synthesis",3rd Edition, PHI, 2005.
4. C.L.Wadhwa, "Network Analysis & Synthesis", Revised 3rd Edition, New Age International Publishers, 2007.
5. Kothari and Nagrath, "Basic Electrical Engineering", 2nd edition, Tata McGraw-Hill Education, 2007.

ADDITIONAL REFERENCE BOOKS

1. V. N. Mittle & Arvind Mittal, "Basic Electrical Engineering", 2nd edition, Tata McGraw-Hill Education, 2005.

B. Tech. I (CSE) Semester – I
DIGITAL COMMUNICATION (CORE-5)
EC105

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the basics of communication theory.
CO2	apply different modulations schemes for designing the communication network.
CO3	analyze different modulations schemes to design better schemes for different types of channels.
CO4	evaluate and compare different communication topology, modulations schemes and their performance over various types of channels.
CO5	design robust communication network based of advanced modulations scheme.

2. Syllabus

- **INTRODUCTION** **(05 Hours)**

  History, Concept of Transmitter, Receiver, Channel, Noise, Modulation, Types of Modulation, Different communication systems based on Input and Output. Classification Of Signals, Unit Impulse Signals, Correlation Of Signals, Orthogonal Signal Set, Exponential Fourier Series, Types of Noises, Internal: Shot, Thermal, Agitation, Transit Time Noise and External: Atmospheric, Extra-Terrestrial, Industrial Noise, White Noise and Filtered Noise, AWGN Properties, Signal To Noise Ratio.

- **AMPLITUDE MODULATION (AM)** **(06 Hours)**

  AM, AM Index, Frequency spectrum, Average Power for Sinusoidal AM, Effective Voltage and Current, Non sinusoidal Modulation, DSBFC & DSBSC Modulation, Amplitude modulator and Demodulator Circuits, AM Transmitters.

- **SINGLE-SIDEBAND (SSB) MODULATION** **(06 Hours)**

  SSB Principles, Balanced Modulators, SSB Generation and Reception.

- **ANGLE MODULATION** **(06 Hours)**

  Frequency Modulation (FM), Frequency spectra, Average power, Deviation Ratio, Measurement of Modulation Index, Phase Modulations (PM), Sinusoidal PM, Digital PM, Angle Modulator Circuits, FM Transmitters, Angle Modulations Detectors.

- **PULSE MODULATION** **(07 Hours)**

  Pulse Amplitude Modulation, Pulse Code Modulation, Delta Modulation, Pulse Frequency Modulation, Pulse Time Modulation, Pulse Position modulation and Pulse Width Modulation.

- **DIGITAL CARRIER SYSTEM** **(06 Hours)**

  Introduction and representation of Digital Modulated Signal, ASK, PSK, FSK, QAM with Mathematics and Constellation Diagram, Spectral Characteristics of Digitally Modulated Signals. M-Ary Digital Carrier Modulation.

- **FIBER-OPTIC COMMUNICATIONS** **(06 Hours)**

  Principles of Light Transmission in Fiber Losses in Fibers, Dispersion, Light Sources and Detectors for Fiber Optics.

  Practicals will be based on the coverage of the above topics separately. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Practicals:

1. Study of The Spectrum Analyzer.
2. Study of Various Signals and its Spectrum Using MATLAB.
3. DSB-SC and DSB-C AM Transmitter and Receiver with Tone and Voice Input.
4. FM Transmission and Reception Techniques.
5. Frequency Division Multiplexing Techniques.
6. AM and FM Simulation on MATLAB with AWGN Channel and Concept of SNR.
7. Study of Sampling Theorem Pulse Code Modulation and Demodulation.
8. Study of PAM/PWM/PPM Modulation.
9. Study of Delta Modulation and Demodulation.
10. ASK, FSK, PSK, QAM With Performance Analysis Under Channel Effects And BER

4. Books Recommended:

1. Dennis Roddy & John Coolen, “Electronic Communications”, PHI, 4/E, 1995.
2. George Kennedy, “Electronic Communication Systems”, 3/E, McGraw Hill Book Co., 1993.

3. Simon Haykin, “Communication Systems”, 2/E, Wiley Eastern Ltd, 1994.
4. Taub and Schilling, “Principles of communication Systems”,3/E, Mc Graw Hill Publication, 1992.
5. B. P. Lathi, ”Modern digital and analog communication systems”,4th Ed., Holt, Sounders Pub. 1998.

ADDITIONAL REFERENCE BOOKS

1. Lathi B. P. and Ding Zhi, "Modern Digital and Analog Communication Systems", Oxford University Press, 4th Ed., 2010.
2. Proakis J. and Salehi M., "Fundamental Of Communication Systems", PHI/Pearson Education-LPE, 2nd Ed., 2006.

B. Tech. I (CSE) Semester – I
HOLISTIC EMPOWERMENT AND HUMAN VALUES
HU107 S1
HU107 S2

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**02**

1. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Motivation behind the course, Holistic Empowerment, Mental, Spiritual and Social Health.

- **HUMAN VALUES AND ETHICS** **(12 Hours)**

  Positive Attitude and Professional Ethics, Values through Literature, Sustainable Leadership for Professional and Personal Effectiveness, Social Media Pros and Cons.

- **HEALTH AND MEDICATION** **(12 Hours)**

  Awareness about life style diseases, Emotional Intelligence, Substance Abuse, Life Management Skills.

- **PHYSICAL FITNESS AND MENTAL HEALTH** **(12 Hours)**

  Importance of games and exercises on Physical Fitness, Importance of Yoga and Meditation on Physical and Mental Health.

(Total Contact Time: 42 Hours)

3. Books Recommended:

1. Chakraborty, S. K. and Chakraborty, Debanshu, Human Values and Ethics: Achieving Holistic Excellence, The ICFAI University Press, Hyderabad, (2006).

2. Gaur, R.R., Sangal, R. and Bagaria, G.P., A Foundation Course in Human Values and Professional Ethics.

3. R. Subramanian, Professional Ethics, Oxford University Press, 2013.

4. Kalam, A P J Abdul, Ignited Minds: Unleashing the Power Within India, Penguin, 2014.

5. Kalam, A P J Abdul, Wings of Fire: An Autobiography, Universities Press; 1st Edition, 1999.

6. Priestley, J. B., An Inspector Calls, Three Acts Play.

7. http://livingvalues.net/ Living Values Education Activities for Young Adults, Book 1, 2019.

8. Living Values Education Activities for Young Adults, Book 2, 2019.

B. Tech. I (CSE) Semester – II
Linear Algebra and Statistics
MA116

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	accept the challenge to solve the problem with statistics
CO2	apply the knowledge of Linear Algebra to solve problem of engineering.
CO3	identify, formulate and analyze complex engineering and affiliated field problems, specifically the Partial differential equation concept in different engineering field
CO4	apply the knowledge of vector calculus and analyze computational processes
CO5	design solutions to work on engineering industrial problems with effective mathematical skill.

2. Syllabus

- **PROBABILITY THEORY AND RANDM PROCESS** **(08 Hours)**

Fundamentals of Probability Theory: - views of probability, Random variables and Joint distributions, Marginal distribution, Conditional probability, Conditional independence, Expectation and variance, Probability distributions Central limit theorem, Functions of random variable, Sum of independent random variable, Correlation and regression, Random process, Stationary random process, Autocorrelation and cross correlation, Ergodic process, Markov process, Birth and death process, Poisson process, Markov chain, Chapman Kolmogorov theory, Spectral analysis of random processes, power spectral density.

- **ESTIMATION AND STATISTICS** **(07 Hours)**

Sampling theory, Population and sample, Statistical interference, Sampling distribution, Sample mean, Bias estimation, Unbiased estimator, Confidence interval, Point estimation and interval estimates, Statistical decision, Hypothesis testing, Statistical hypotheses, Null hypotheses, Significance test, Type I and types II errors, Level of significance, One tail and two tailed test, Chi square test, Maximum likelihood estimate, Least square estimate, MAP estimate, Minimum mean square estimate.

- **INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATION** **(09 Hours)**

Introduction to Partial differential equation, Formation of partial differential Equation, Partial differential Equation of first order, Linear partial differential equation of first order ($Pp + Qq = R$) and method of obtaining its general solution, Non-linear partial differential equation of first order $f(p, q)=0$, $f(z, p, q)=0$, $f(x, p)= g(y, q)$, $z= px + qy + f(p,q)$.

- **BASIC CONCEPTS OF VECTOR CALCULUS** **(07 Hours)**

  Scalar and vector point function, differential operator, gradient, directional derivative, divergence, curl and Laplacian operator with their properties.

- **LINEAR ALGEBRA** **(11 Hours)**

  Linear systems, Elementary row and column transformation, rank of matrix, consistency of linear system of equations, Linear Independence and Dependence of vectors, Gauss Elimination method, Gauss-Jorden Method, Gauss-Jacobi Iteration Method; Vector spaces, Subspace, Field, Ring, Norm and distance, Linear Mapping, Orthogonality, Eigenvectors and Eigenvalues, Least square, Least square data fitting, Constrained least square applications.

  Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

3. Books Recommended:

1. Kreyszing E., “Advanced Engineering Mathematics”, John Wiley & Sons, Singapore, Int. Student Ed. 2015.
2. Wiley C. R., “Advanced Engineering Mathematics”, McGraw Hill Inc., New York Ed. 1993.
3. Gilbert Strang, “Introduction to Linear Algebra”, Wellesley Cambridge Press, 4th Ed., 2009.
4. David C. Lay, “Linear Algebra and its applications”, 3rd Ed., Pearson, 2006.
5. A. Papoulis and S. U. Pillai, “Probability, Random Variables and Stochastic Processes”, 4th Ed., Mc-Graw Hill, 2002.

ADDITIONAL REFERENCE BOOKS

1. Ramana D. V., “Higher Engg. Mathematics”, McGraw-Hill Inc., New Delhi, 2007.
2. Srimanta Pal, Subodh C. Bhunia, “Engineering Mathematics”, Oxford University Press, New Delhi, 2015.
3. Mary L. Boas, “Mathematical Methods in the Physical Sciences”, John Wiley & Sons, Ed.2005.

B. Tech. II (CSE) Semester – II
DATA STRUCTURES (CORE-6)
CS102

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

2. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	recognize the need of different data structures and understand its characteristics.
CO2	apply different data structures for given problems.
CO3	design and analyse different data structures, sorting and searching techniques.
CO4	evaluate data structure operations theoretically and experimentally.
CO5	give solution for complex engineering problems.

3. Syllabus

- **INTRODUCTION TO DATA STRUCTURES (02 Hours)**

  Review of Concepts: Information and Meaning, Abstract Data Types, Internal Representation of Primitive Data Structures, Arrays, Strings, Structures, Pointers.

- **LINEAR LISTS (06 Hours)**

  Sequential and Linked Representations of Linear Lists, Comparison of Insertion, Deletion and Search Operations for Sequential and Linked Lists, Doubly Linked Lists, Circular Lists, Lists in Standard Template Library(STL), Applications Of Lists.

- **STACKS (06Hours)**

  Sequential and Linked Implementations, Representative Applications such as Recursion, Expression Evaluation Viz., Infix, Prefix and Postfix, Parenthesis Matching, Towers of Hanoi, Wire Routing in a Circuit, Finding Path in a Maze.

- **QUEUES (06 Hours)**

  Operations of Queues, Circular Queue, Priority Queue, Dequeue, Applications of Queues, Simulation of Time Sharing Operating Systems, Continuous Network Monitoring System Etc.

- **SORTING AND SEARCHING (04 Hours)**

Sorting Methods, BubbleSort, SelectionSort, QuickSort, RadixSort, BucketSort, Dictionaries, Hashing, Analysis of Collision Resolution Techniques, SearchingMethods, Linear Search, Binary Search, Character Strings and Different String Operations.

- **TREES** **(08 Hours)**

  Binary Trees and Their Properties, Terminology, Sequential and Linked Implementations, Tree Traversal Methods and Algorithms, Complete Binary Trees, General Trees, AVL Trees, Threaded Trees, Arithmetic Expression Evaluation, Infix-Prefix-Postfix Notation Conversion, Heaps as Priority Queues, Heap Implementation, Insertion and Deletion Operations, Heapsort, Heaps in Huffman Coding, Tournament Trees, Bin Packing.

- **MULTIWAY TREES** **(04 Hours)**

  Issues in Large Dictionaries, M-Way Search Trees, BTrees, Search, Insert and Delete Operations, Height of B-Tree, 2-3 Trees, Sets and Multisets in STL.

- **GRAPHS** **(06 Hours)**

  Definition, Terminology, Directed and Undirected Graphs, Properties, Connectivity in Graphs, Applications, Adjacency Matrix and Linked Adjacency Chains, Graph Traversal, Breadth First and Depth First Traversal, Spanning Trees, Shortest Path and Transitive Closure, Activity Networks, Topological Sort and Critical Paths.

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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4. Tutorials:

1 Problems on Array

2 Problems on Stack and Queue

3 Problems on Linked List

4 Problems on Trees

5 Problems on Graph

5. Practicals:

1 Implementation of Array and its applications

2 Implementation of Stack and its applications

3 Implementation of Queue and its applications

4 Implementation of Link List and its applications

5 Implementation of Trees and its applications

6 Implementation of Graph and its applications

7 Implementation of Hashing functions and collision resolution techniques

8 Mini Project (Implementation using above Data Structure)

6. Books Recommended:

1. Trembley & Sorenson: "An Introduction to Data Structures with Applications", 2/E, TMH, 1991.
2. Tanenbaum & Augenstein: "Data Structures using C and C++", 2/E, Pearson, 2007.
3. Horowitz and Sahani: "Fundamentals of Data Structures in C", 2/E, Silicon Press, 2007.
4. T. H. Cormen, C. E. Leiserson, R. L. Rivest: "Introduction to Algorithms",3/E, MIT Press, 2009.
5. Robert L. Kruse, C. L. Tondo and Brence Leung: "Data Structures and Program Design in C", 2/E, Pearson Education, 2001.

B. Tech. I (CSE) Semester – II
WEB PROGRAMMING AND PYTHON (CORE-7)
CS104

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the basics of web pages, need of web server, configuration, client and server side scripting, style of web pages and script programming.
CO2	install and configure the web server and apply the knowledge of programming to develop web application pages using html, style sheets, client and server side scripts using script programming.
CO3	analyse given problem for the requirement of html, style sheets, client side or server side script with different programming constructs.
CO4	evaluate web application programming solutions with different aspects like the presentation and working of the web application and usage of different scripting constructs.
CO5	utilize the standard tools for design and development of web project solution for given problems by integrating html, client and server pages with style and scripting.

2. Syllabus

- **INTRODUCTION (02 Hours)**

  Basics of Internet, World Wide Web, HTTP Protocol, Universal Resource Locator, Web Server, Different Types of Web Servers, Domain Name Server, Web Server Configuration, Internet Browser, Web Document and Mark-Up Language, Hypertext Mark-Up Language, Hypermedia, Web Site Organization, Content Organization, Web Server on Different Operating System Platforms, Web Applications, Web Interface, Web Standards & Accessible Design.

- **STATIC AND DYNAMIC WEB PAGES,STYLE SHEETS AND WEB PUBLISHING (16 Hours)**

  Web Page, Static Web Page, Hypertext Mark-Up Tags, Handling Font Style, Types, Size, Colour Etc., Handling Table, List, Images, Graphics, Menu Etc; Forms, Input Text Box, Drop Down Menu, Name Variable, Cookie Management, Session Management, Animation, Structure Web Pages, Image Mapping, Link Setup In Image, Frames, Structuring Web Pages Using Frames, Multimedia Handling, Linking To Pages; Dynamic Web Pages and Scripting - Scripting Language, Dynamic Pages and Forms Validation, Validation of Input Text Box, Dynamic Drop Down Menu, Validation and Accessing Name Variable-Value Pair, Cookie Management Through Scripting, Session Management through Scripting, Animation through Scripting, Dynamic Image Mapping Through Scripting, Link Handling through Scripting, Multimedia Handling through Scripting; Web Page

Designing using Style Sheet, Different Types of Style Sheet, Defining Different Styles, Export and Importing Style Sheet, Cascade Style Sheet. Web Hosting and Publishing - Different Steps of Web Hosting and Publishing, Documents Interchange Standards, Website Evaluation, Components of Web Publishing, Document Management, Search Engines, and Registration of a Web Site on Search Engines, Publishing Tools.

- **PYTHON PROGRAMMING (24 Hours)**

Basics of Python Programming: Variables, Keywords, Expressions, Data Types, Operators and Operands, Assignments, Order of Operations, Controlling Statements, Branching and Loops, Functions, Definitions, Arguments, Returning Values, Scopes, Recursive Functions, Modules and Import, Strings, Tuples, and Lists; Handling Exceptions – Try/Except, Standard Exceptions, Exceptions as Control Flow Mechanisms; Object Oriented Programming – Classes, Abstract Data Types, Inheritance, Encapsulation; Debugging – Syntax errors, Runtime Errors, Semantic Errors, Test Cases; Files – Reading, Iterating over Lines, Finding a File in File system, Writing Data to Files, CSV Format, Read and Write To/From CSV File; Dictionaries – Introduction, Dictionary Operations, Aliasing, Copying, Dictionary Accumulation, Introduction to Module Packages.

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. Practicals:

1 To prepare the web page using hypertext markup language

2 To study and setup the web server for implementation

3 To learn client side scripting

4 To learn server side scripting

5 To apply style to the web pages

6 To implement functions for files

7 To implement dictionary

4. Books Recommended:

1. Martin C. Brown, “Python: The Complete Reference, Osborne, McGraw-Hill, 2018.
2. Thomas Powell and fritz Schneider, “JavaScript: The Complete Reference, McGraw-Hill, 2017.
3. J. Sklar, “Principles of Web Design”, 7/E, Cengage Learning, 2017.
4. H. Deitel, A. Deitel, “Internet and World Wide Web How to Program”, 5/E, Pearson, 2012.
5. John V. Guttag, “Introduction to Computation and Programming Using Python”, MIT Press, 2013 Edition.

ADDITIONAL REFERENCE BOOKS

1. M. L. Young," The Complete reference of Internet", Tata Mc Graw Hill, 2002.
2. W. G. Lehnert, "Internet 101, 1/E, Person Education, 2001.
3. B. Underdahle and K. Underdahle, "Internet and Web Page/ Website design", 2/E, IDG Books India (P) Ltd., 2001.
4. D. Comer, "The Internet Books," Prentice Hall of India, 2/E, 2001.

B. Tech. I (CSE) Semester – II
Physics
PH104

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

2. Syllabus

- **ELECTROSTATICS** **(04 Hours)**

  Gauss's law and its applications, Divergence and Curl of Electrostatic fields, Electrostatic Potential, Boundary conditions, Dielectrics, Polarization, Bound Charges, Electric displacement.

- **MAGNETOSTATICS** **(04 Hours)**

  Lorentz force, Biot-Savart and Ampere's laws and their applications, Divergence and Curl of Magnetostatic fields, Magnetic vector Potential, Magnetic materials, Magnetization, Bound currents.

- **ELECTRODYNAMICS** **(04 Hours)**

  Ohm's law, Motional EMF, Faraday's law, Lenz's law, Maxwell's equations, Continuity Equation, Wave solution of Maxwell Equations.

- **ELECTROMAGNETIC WAVES** **(04 Hours)**

  Polarization, reflection & transmission at oblique incidences.

- **QUANTUM MECHANICS** **(06 Hours)**

  Two-slit experiment, de Broglie's hypothesis, Uncertainty Principle, Wave equation: Wave function and Probability, Time-dependent and time-independent Schrödinger equations, Particle in an infinite potential box.

- **PHOTONICS** **(10 Hours)**

  Einstein's theory of matter radiation interaction and A & B coefficients, Properties of laser, Spontaneous and stimulated emission, Amplification of light by population inversion, Types of lasers: solid-state laser (Neodymium), gas lasers (CO_2), Optical fibre- principle [TIR] - types- material, mode, refractive index-Fibre loss-Expression for acceptance angle and numerical aperture, Application-Communication.

- **NEW ENGINEERING MATERIALS** **(10 Hours)**

  Dielectric materials: Definition – Dielectric breakdown, Dielectric loss, Internal field, Clausius-Mossotti relation, Superconducting materials: Introduction, Properties, Meissner effect, Type I & Type II superconductors, BCS theory and applications; Nanomaterials: Introduction, Synthesis of

nano materials, Top down and Bottom up approach, Ball milling, PVD method, Applications; Smart materials: Shape memory alloys, Biomaterials (properties and applications).

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Narciso Garcia, Arthur Damask, “Physics for Computer Science Students”, Springer- Verlag, 1991.

2. M. N. O. Sadiku, “Elements of Electromagnetics”, Oxford, 2006.

3. R. P. Feynman, R. B. Leighton and M. Sands, ”The Feynman Lectures on Physics, Vol. II”, Narosa Publishing House, 1998.

4. I. S. Grant and W. R. Phillips, “Electromagnetism”, John Wiley, 1990.

5. R. Eisberg and R. Resnick, “Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles”, John-Wiley, 2nd Edition, 2006.

B. Tech. I (CSE) Semester – II
ENGLISH AND PROFESSIONAL COMMUNICATION
HU110 S1
HU110 S2

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Syllabus

- **COMMUNICATION** **(05 Hours)**

  Introduction to Communication, Different forms of Communication, Barriers to Communication and some remedies, Non Verbal Communication – Types, Non-Verbal Communication in Intercultural Context.

- **COMMON ERRORS** **(02 Hours)**

  Common Errors, Indianisms through Goodbye Party for Miss Pushpa T.S. (Poem by Nissim Ezekiel).

- **LISTENING SKILLS** **(05 Hours)**

  Effective Listening – Process, Types- Appreciative, comprehensive, empathetic, analytical, Modes of Listening-Active and Passive, Listening and note taking practice, Listening for various purposes-Practice and activities .

- **SPEAKING SKILLS** **(12 Hours)**

  Effective Speaking- Informal Speech, JAM, Presentation Skills- types, preparation and practice Interviews- types, preparation and mock interview; Group Discussion- types, preparation and practice.

- **READING SKILLS** **(05 Hours)**

  Reading Skills- Comprehension (unseen passage- literary /scientific / technical) Reading with fluency and speed, Skimming and scanning, identifying relevant information, isolating fact from opinion Understanding concepts and arguments, Identifying distinctive features of language.

- **WRITING SKILLS** **(13 Hours)**

  Technical Writing- types and practice, Memo, Letter Writing- types and practice, Email etiquette and Netiquette, Résumé writing- types and practice, Report Writing -types and practice, Editingpractice.

(Total Contact Time: 42 Hours)

2. Books Recommended:

1. Kumar, Sanjay and Pushp, Lata. Communication Skills, 2nd Edition, OUP, New Delhi, 2015.

2. Raman, Meenakshi & Sharma Sangeeta. Technical Communication Principles and Practice, 3rd Edition, OUP, New Delhi, 2015.

3. Sharma R.C. & Mohan Krishna. Business Correspondence and Report Writing, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.

4. Raymond V. Lesikar and Marie E Flatley. Basic Business Communication skills for Empowering the Internet generation. Tata McGraw Hill publishing company limited. New Delhi 2005.

5. Ezekiel, Nissim. Goodbye Party for Miss Pushpa T.S., http://www.english-forstudents.com/Goodbye-Party.html

ADDITIONAL REFERENCE BOOKS

1. Bovee, Courtland L., Thill, John V., and Chaturvedi, Mukesh. Business Communication Today, 9th Edition. Pearson, 2009.

2. Farahthullah, T.M. Communication Skills for Technical Students, 5th Edition, Orient Blackswan, Kolkatta, 2009.

3. Leech, Geoffery& Svartvil. A Communicative Grammar of English, Longman Group UK Ltd., 2006.

4. Pfeiffer, William Sanborn and Padmaja, T.V.S., Technical Communication: A Practical Approach, 6th edition, Pearson books, 2007.

B. Tech. I (CSE) Semester – II
ENERGY AND ENVIRONMENTAL ENGINEERING
CEME106 S1
CEME106 S2

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Syllabus

- **ENVIRONMENT AND ECOSYSTEMS** **(12 Hours)**

  Introduction: Concept of an ecosystem- structure and functions of ecosystem. Components of ecosystem - producers, consumers, decomposers, Food chains, food webs, ecological pyramids, Energy flow in ecosystem. Bio-geo- chemical cycles, Hydrologic cycle Components of Environment and their relationship, Impact of technology on environment, Environmental degradation. Environmental planning of urban network services such as water supply, sewerage, solid waste management.

- **ENVIRONMENTAL POLLUTION** **(10 Hours)**

  Water, air, soil, noise, thermal and radioactive, marine pollution: sources, effects and engineering control strategies; Drinking water quality and standards, Ambient air and noise quality standards.

- **GLOBAL ENVIRONMENTAL ISSUES AND ITS MANAGEMENT** **(08 Hours)**

  Engineering aspects of climate change. Acid rain, depletion of ozone layer; Concept of carbon

  Credit; Concepts of Environmental impact assessment and Environmental audit. Environmental

  life cycle assessment.

- **ENERGY FUNDAMENTALS** **(08 Hours)**

  Energy systems; Importance of energy; Quantifying energy, types of energy sources and end uses; Energy conversion processes; Conventional energy sources; Non-conventional energy sources.

- **ENERGY AND THE ENVIRONMENT** **(07 Hours)**

  Global and Indian energy demand and growth; Environmental impacts of energy production – air and water; Climate change and energy; Energy and environment policy; Transportation and energy; Built environment and energy.

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

(Total Contact Time: 42 Hours)

Practicals:

1. Study of different ecosystem and different Biochemical cycles.
2. Study of Water Treatment Plant.
3. Study of Water Distribution Network.
4. Study of Effluent Treatment Plant
5. Study of Solid Waste Management system for urban area.
6. Demonstration of air pollution and noise monitoring equipments
7. Exercise on life cycle Assessment
8. Exercise on EIA
9. Exercise on Quantifying energy and energy growth demand
10. Analysis of Carbon Credit
11. Tutorial on Energy in Built environment

2. Books Recommended:

1. Daniel B. Botkin & Edward AKeller, Environmental Sciences, John Wiley & Sons.
2. R. Rajagopalan, Environmental Studies, Oxford University Press.
3. Benny Joseph, Environmental Studies, TMH Publishers.
4. Dr. Suresh K. Dhameja, Environmental Studies, S. K. Kataria & Sons, 2007.
5. U. K. Khare, Basics of Environmental Studies, Tata McGraw Hill, 2011.

B. Tech. II (CSE) Semester – III
DISCRETE MATHEMATICS (CORE-8)
CS201

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs):

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

CO1	acquire knowledge of sets, group and functions, graphs.
CO2	apply group theory, relations and lattice.
CO3	analyse functions, counting and based on mathematical logic.
CO4	evaluate formal verification of computer programmes.
CO5	design solutions for various types of problems in different disciplines like information security, optimization, mathematical analysis.

2. Syllabus

- **Introduction** **(04 Hours)**

  Introduction to set theory, Basics of functions, Application of Functions in Computer Science Areas.

- **GROUP THEORY** **(08 Hours)**

  Basic Properties of Group, Groupoid, Semigroup & Monoid, Abelian Group, Subgroup, Cosets, Normal Subgroup, Lagrange's Theorem, Cyclic Group, Permutation Group, Homomorphism & Isomorphism of Groups, Basic Properties, Error Correction & Detection Code.

- **RELATION & LATTICES** **(05 Hours)**

  Definition & Basic Properties, Graphs Of Relation, Matrices Of Relation, Equivalence Relation, Equivalence Classes, Partition, Partial Ordered Relation, Posets, Hasse Diagram, Upper Bounds, Lower Bound, GLB & LUB Of Sets, Definition & Properties Of Lattice, Sub Lattice, Distributive & Modular Lattices, Complemented & Bounded Lattices, Complete Lattices & Boolean Algebra.

- **MATHEMATICAL LOGIC AND PROGRAM VERIFICATION** **(05 Hours)**

  Induction, Propositions, Combination Of Propositions, Logical Operators & Propositional Algebra, Equivalence, Predicates & Quantifiers, Interaction of Quantifiers with Logical Operators, Logical Interference & Proof Techniques, Formal Verification of Computer Programs (Elements of Hoare Logic).

- **COUNTING AND RECURRENCE RELATION** **(05 Hours)**

First Counting Principle, Second Counting Principle, Permutation, Circular Permutations, Combination, Pigeonhole Principle, Recurrence Relations, Linear Recurrence Relations, Inclusion And Exclusion, Generating Functions.

- **BASICS OF GRAPHS** **(05 Hours)**

Graph Definition, Graph Representation, Basic Concepts Of Finite & Infinite Graph, Incidence & Degree, Isomorphism, Subgraph, Walk, Path & Circuits, Cliques, Cycles and Loops, Operations On Graphs, Connected Graph, Disconnected Graph & Components, Complete Graph, Regular Graph, Bipartite Graph, Planar Graphs, Weighted Graphs, Directed & Undirected Graphs, Connectivity Of Graphs.

- **GRAPHS ALGORITHMS** **(10 Hours)**

Flows, Combinatorics, Euler's Graph, Hamiltonian Paths & Circuits, Activity Planning and Critical Path, Planar Graphs: Properties, Graph Coloring, Vertex Coloring, Chromatic Polynomials, Edge Coloring, Planar Graph Coloring, Matching and Factorizations: Maximum Matching In Bipartite Graphs, Maximum Matching In General Graphs, Hall's Marriage Theorem, Factorization; Networks: Max-Flow Min-Cut Theorem, Menger's Theorem, Graph and Matrices; Probabilistic Graphical Models:Graphical models, Directed models: Bayesian network, Undirected model: Markov Random Fields, Dynamic model: Hidden Markov Model, Learning in Graphical models: Parameter estimation, Expectation Maximization.

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. <u>Books Recommended:</u>

1. Rosen K.H., "Discrete Mathematics and Its Applications", 6/E, MGH, 2006.
2. Liu C.L., "Elements of Discrete Mathematics", MGH, 2000.
3. Deo Narsingh., "Graph theory with applications to Engineering & Computer Science", PHI, 2000.
4. J. A.Bondy and U. S. R.Murty, "Graph Theory", Springer, 2008.
5. V. K. Balakrishnan, "Theory and Problems of Graph Theory", Tata McGraw-Hill, 2007.

ADDITIONAL REFERENCE BOOKS

1. Kolman B., Busby R.C. & Ross S., "Discrete Mathematical Structure", 5/E, PHI, 2003.
2. Tremblay J. P. & Manohar R., "Discrete Mathematical structure with applications to computer science", MGH, 1999.
3. D. B. West, "Introduction to Graph Theory", 2nd Edition, PHI 2002.
4. G. Chatrand and O.R. Ollermann, "Applied and Algorithmic Graph Theory", McGraw Hill, 1993.

B. Tech. II (CSE) Semester – III
COMPUTER ORGANIZATION (CORE-9)
CS203

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of basics of computer architecture, its components with peripheral devices, instruction set architecture, instruction execution using data path and control unit interface.
CO2	apply knowledge of combinational and sequential logic circuits to mimic simple computer architecture to solve the given problem.
CO3	analyze performance of various instruction set architecture, control unit, memories, various processor architectures.
CO4	evaluate programming solutions to implement fast methods of ALU, FP unit implementations, processor architectures and instruction set architectures.
CO5	implement fast methods of ALU, FP unit implementations and to design and develop hardware solution for given instruction coding scheme of an Instruction Set Architecture or vice versa using available technology tools.

2. Syllabus

- **PROCESSOR BASICS** **(05 Hours)**

  Basics CPU Organization - Functional Units, Data Paths, Registers, Stored Program Concept, Data Representation - Basic Formats, Fixed and Floating Point Representation, Instruction Sets, Instruction Types, Instruction Formats, Addressing Modes, Designing of an Instruction Set, Data path Design, Concepts of Machine Level Programming, Assembly Level Programming and High Level Programming.

- **ARITHMETIC AND LOGIC UNIT** **(08 Hours)**

  Arithmetic and Logical Operation and Hardware Implementation, Implementation of some Complex Operation: Fixed-Point Arithmetic Multiplication Algorithms-Hardware Algorithm, Booth Multiplication Algorithm, Division Algorithm, Divide Overflow Algorithm, Combinational ALU and Sequential ALU, Floating Point Arithmetic Operations.

- **CONTROL UNIT** **(07 Hours)**

  Basic Concepts, Instruction Interpretation and Execution, Hardwired Control, Microprogrammed Control, CPU Control Unit Design, Performance.

- **SUBROUTINE MANAGEMENT** **(03 Hours)**

  Concepts of Subroutine, Subroutine Call and Return.

- **MEMORY ORGANIZATION** **(06 Hours)**

  Concepts of Semiconductor Memory, Cpu-Memory Interaction, Organization of Memory Modules, Cache Memory and Related Mapping and Replacement Policies, Virtual Memory.

- **SYSTEM ORGANIZATION** **(05 Hours)**

  Introduction to InputAnd Output Processing, Working with Video Display Unit and Keyboard and Routine to Control them, Programmed Controlled I/O Transfer, Interrupt Controlled I/O Transfer, DMA Controller, Secondary Storage and Type Of Storage Devices, Introduction to Buses and Connecting I/O Devices to CPU and Memory.

- **PIPELINE CONTROL AND PARALLEL PROCESSING** **(08 Hours)**

  Instruction Pipelines, Pipeline Hazards, Pipeline Performance, Superscalar Processing, Introduction to Parallel Processing, Processor-Level Parallelism, Multiprocessor.

  Tutorials will be based on the coverage of the above topics separately. **(14 Hours)**

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

3. Tutorials:

1 Problems on data conversion in various formats and floating-point representation

2 Solving computations involving complex arithmetic operations and hardware implementation of the same

3 Interpretation of basic instruction execution and various addressing modes possible

4 Learning instruction set architecture level instructions for the high level language programming

5 Problems on memory management, mapping and replacement policies

4. Books Recommended:

1. John L. Hannessy, David A. Patterson, "Computer organization and Design", 3/E, Morgan Kaufmaan, reprint -2003.
2. Andrew S. Tanenbaum, "Structured Computer Organization", 6/E, PHI EEE, reprint 1995.
3. William Stallings, "Computer Organization & Architecture: Designing For Performance", 6/E, PHI, 2002.
4. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5/E, McGraw-Hill, 2002.
5. Morris Mano, "Computer Systems Architecture", 3/E, PHI, reprint 1997.

B. Tech. II (CSE) Semester – III
DATABASE MANAGEMENT SYSTEMS (CORE-10)
CS205

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand different database models and query languages to manage the data for given real life application scenario.
CO2	apply the concept of database model, relational tables, normalization to solve different problems.
CO3	analyze the problems for designing the effective solution using procedural and nonprocedural languages and/or index.
CO4	evaluate the solution using transaction management, concurrency management, query performance and optimization, or recovery.
CO5	implement an efficient solution using industry standards for real life problems.

2. Syllabus

- **INTRODUCTORY CONCEPTS OF DBMS** **(02 Hours)**

  Introduction, Applications of DBMS, Purpose of Database, Data Independence, Database System Architecture, Data Abstraction, Database users and DBA.

- **ENTITY RELATIONSHIP MODEL** **(06 Hours)**

  Basic Concepts, Design Process, Constraints, Keys, Design Issues, E-R Diagrams, Attribute Types, Mapping Cardinality, Types of Relationship, Weak/Strong Entity Sets, Extended E-R Features – Generalization, Specialization, Aggregation.

- **RELATIONAL MODELS** **(04 Hours)**

  Structure of Relational Databases, Domains, Relations, Mapping of ER Model to Relational Model, Relational Algebra – Fundamentals, Operators and Syntax, Relational Algebra Queries, Tuple Relational Calculus.

- **RELATIONAL DATABASE DESIGN** **(08 Hours)**

  Functional Dependency – Definition, Trivial and Non-trivial FD, Closure of FD Set, Closure of Attributes, Irreducible Set of FD, Normalization – 1Nf, 2NF, 3NF, Decomposition using FD-Dependency Preservation, BCNF, Multi- Valued Dependency, 4NF, Join Dependency and 5NF.

- **QUERY PROCESSING AND OPTIMIZATION** **(04 Hours)**

Overview of Query Processing, Measures of Query Cost, Select Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions, Overview of Query Optimization, Transformation of Relational, Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans, Materialized Views, Advanced Topics in Query Optimization.

- **TRANSACTION MANAGEMENT** **(06 Hours)**

  Transaction Concepts, Properties of Transactions, Serializability of Transactions, Testing for Serializability, Concurrent Executions of Transactions and Related Problems, Locking Mechanism, Solution to Concurrency Related Problems, Two-phase Locking Protocol, Deadlock, Isolation, Intent Locking, System Recovery, Recovery and Atomicity, Log-based Recovery.

- **SQL CONCEPT** **(04 Hours)**

  Basics of SQL, DDL,DML,DCL, Structure – Creation/Alteration, Defining Constraints – Primary Key, Foreign Key, Unique, Not Null, Check, IN Operator.

- **PL-SQL CONCEPT** **(04 Hours)**

  Cursors, Stored Procedures, Stored Function, Database Triggers.

- **ADVANCED TOPICS** **(04 Hours)**

  Data Security: Introduction, Discretionary Access Control, Mandatory Access Control, Data Encryption, Semi Structured Data and XML, Object Oriented and Object Relational DBMS, Distributed DBMS, NOSQL DBMS.

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Tutorials:

1 Introduction and application of DBMS

2 Designing Relational Models, ER Models and Relational databases

3 Query solving using SQL and PL/SQL

4 Optimum query designing

5 Managing Locks for the management of Transactions and concurrent access of the database

4. Practicals:

1 Implementation for Physical data storage (Sequential, Index Sequential..)

2 Practicing DDL and DML Queries for database creation and managing the data

3 Develop a Database system for the real life application scenario by managing the storage constrains

4 Practicing PL/SQL with the designed databases

5 Design considering Transaction management and concurrency control

6 Design of ER model based example

7 Design of Relational model based example

8 Design of Normalized form of database

5. Books Recommended:

1. A Silberschatz, H. F. Korth, and S Sudarshan, "Database System Concepts", 6/E, TMH, 2010.
2. McFadden, F.Hoffer, Prescott : M. B "Modern database management", 8/E, Benjamin/Cummings Inc,2006.
3. C.J Date, "An Introduction to Database Systems", Publisher: Addison, Wesley, 8/E, 2003.
4. Raghu Ramakrishnan and Gehrke: "Database Management System", 3/E, WCB/McGraw-Hill, 2003.
5. Margaret H. Dunham, "Data Mining: Introductory and advanced topics", Pearson Education, 2003.

B. Tech. II (CSE) Semester – III
DESIGN AND ANALYSIS OF ALGORITHMS (CORE-11)
CS207

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of course, students will be able to**	
CO1	acquire knowledge about the application of mathematical formula and technique to solve the problem and computational complexity analysis.
CO2	apply the different algorithm design techniques for designing a solution of different applications.
CO3	analyse the performance of algorithms using different algorithmic design techniques based on asymptotic or amortized or probabilistic methods.
CO4	evaluate the correctness and implementation of algorithms using different methods of performance evaluation.
CO5	design and innovate efficient algorithms in the field of computer science & engineering and industry related applications using the different algorithm design techniques.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Algorithms, Analysis and Design Techniques, Analysis Techniques: Mathematical, Empirical and Asymptotic Analysis. Recurrence Relations and Solving Recurrences, Mathematical Proof Techniques, Amortized Analysis, Probabilistic Analysis.

- **DIVIDE AND CONQUER APPROACH** **(06 Hours)**

  Sorting & Order Statistics, Divide and Conquer Technique, Various Comparison based Sorts, Analysis of the Worst-Case and the Best-Cases, Randomized Sorting Algorithms, Lower Bound on Sorting, Non-comparison based Sorts, Medians and Order Statistics, Min-Max Problem, Polynomial Multiplication, Fast Fourier Transform.

- **GREEDY DESIGN TECHNIQUES** **(08 Hours)**

  Basic Greedy Control Abstraction, Motivation, Thirsty Baby Problem, Formalization, Activity Selection and its Variants, Huffman Coding, Horn Formulas, Tape Storage Problem, Container Loading Problem, Knapsack Problem, Graph Algorithms, Graph algorithms: All-pairs Shortest Paths, Topological Ordering of DAG, DFS in Directed Graphs, Strongly Connected Components, Minimum Spanning Trees, Single Source Shortest Paths, Maximum Bipartite Cover Problem, Network Flows: Ford Fulkerson Algorithm, Max-flow Min-cut Theorem, Polynomial Time Algorithms for Max-flow.

- **DYNAMIC PROGRAMMING** **(08 Hours)**

Motivation, Matrix Multiplication Problem, Assembly Line Problem, Coin Changing Problem, Longest Common Subsequence, 0/1 Knapsack problem, All-pairs Shortest Path Problems, Dynamic Programming Control Abstraction, Optimal Binary Search Tree.

- **SEARCHING ALGORITHMS** **(04 Hours)**

Backtracking, N-Queens Problem, Sum of Subset Problem, Complexity Analysis, Branch & Bound, Least Cost Branch & Bound (LCBB), LCBB Complexity Analysis, 15-Puzzle Problem, Traveling Sales Person Problem.

- **NUMBER THEORETIC ALGORITHMS** **(06 Hours)**

Number Theoretic Notions, GCD, Modular Arithmetic, Chinese Remainder Theorem, Generators, Cyclic Groups, Galois Fields, Applications in Cryptography, Primality Testing.

- **NP-COMPLETE PROBLEMS** **(06 Hours)**

Polynomial Time, Verification, NP-completeness, Search Problems, Reductions, Dealing with NP-Completeness, Approximation Algorithms, Local Search Heuristics.

Tutorials will be based on the coverage of the above topics. **(14 Hours)**

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. Practicals:

1. Practical based on time analysis of sorting algorithms.
2. Practical based on divide and conquer technique.
3. Practical based on greedy design technique.
4. Practical based on dynamic programming.
5. Practical based on searching algorithms.
6. Practical based on back tracking technique.
7. Practical based on Graph based algorithms.
8. Practical based on branch and bound technique.

4. Books Recommended:

1. Cormen, Leiserson, Rivest, Stein," Introduction to Algorithms", 3/E, MIT Press, 2009.
2. J. Kleinberg, E. Tardos, "Algorithm Design", 1/E, Pearson Education, Reprint 2006.
3. SartajSahni, "Data Structures, Algorithms and Applications in C++", 2/E, Universities Press/Orient Longman, 2005

4. Sara Baase, Allen van Gelder," Computer Algorithms: Introduction to Design & Analysis, 3/E, Pearson Education, 2000.
5. Knuth, Donald E., "The Art of Computer Programming, Vol I &III", 3/E, Pearson Education, 1997.

B. Tech. II (CSE) Semester – III
OBJECT ORIENTED PROGRAMMING (CORE-12)
CS209

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes(COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of object oriented programming.
CO2	apply the knowledge of object oriented concepts to solve the real world problems.
CO3	analyse object oriented concepts to solve the problem efficiently.
CO4	evaluate the object oriented features' suitability for the implementation of the problem.
CO5	design and implement the efficient object oriented program using various object oriented concepts.

2. Syllabus

- Introduction **(06 Hours)**

  Review of High Level Language, Difference between Procedure Oriented and Object Oriented Approach; Characteristics of Object-Oriented Languages Object Oriented Concepts: Objects, Classes, Principals like Abstraction, Encapsulation, Inheritance and Polymorphism; Dynamic Binding, Message Passing; , Types of Operators, Operator precedence and associativity, Data type conversions; Selection and Loops

- Classes and Objects **(08 Hours)**

  Abstract data types, Object and classes, attributes, methods, Class declaration, Local Class and Global Class, State identity and behaviour of an object, Local Object and Global Object, Scope resolution operator, Friend Functions, Inline functions, Constructors and destructors, instantiation of objects, Types of Constructors, Static Class Data, Array of Objects, Constant member functions and Objects, Memory management Operators.

- Inheritance **(06 Hours)**

  Inheritance, Types of Inheritance, access modes – public, private & protected, Abstract Classes, Ambiguity resolution using scope resolution operator and Virtual base class, Aggregation, composition vs. classification hierarchies, Overriding inheritance methods, Constructors in derived classes, Nesting of Classes.

- Polymorphism **(06 Hours)**

  Polymorphism, Type of Polymorphism – Compile time and runtime, Function Overloading, Operator Overloading (Unary and Binary) Polymorphism by parameter, Pointer to objects, this pointer, Virtual Functions, pure virtual functions, Late Binding, Abstract Classes.

- Strings, Files and Exception Handling **(04 Hours)**

  Manipulating strings, Streams and files handling, formatted and Unformatted Input output. Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration, unexpected exceptions, exception when handling exceptions, resource capture and release.

- Dynamic memory management **(04 Hours)**

  Dynamic memory management, new and delete operators, object copying, copy constructor, assignment operator, virtual destructor.

- Standard Template Library **(08 Hours)**

  Standard Template Library, Overview of Standard Template Library, Containers, Algorithms, Iterators, Other STL Elements, The Container Classes, General Theory of Operation, Vectors, Usage of Template Library for the Implementation of Data Structure.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Practicals using C++/JAVA:</u>

1. Creation of objects in programs.
2. Experiments with private, public member variables and functions and friend functions.
3. Experiments for the usage of constructors and destructors.
4. Experiments for the working of operator overloading.
5. Experiments with abstract classes, interfaces and inheritance to access objects.
6. Experiments with polymorphism and virtual functions.
7. Experiments for strings manipulation.
8. Experiments on file handling.
9. Implementing common data structures, such as trees, lists and hash tables.
10. To deal with runtime errors using exception handling mechanism.
11. Implementation of mini project using object oriented concepts.

4. <u>Books Recommended:</u>

1. E. Balagurusamy, “Object Oriented Programming with C++”, McGraw Hill Education (India).
2. E. Balagurusamy, “Programming with JAVA“, McGraw Hill.

3. Yashwant Kanetkar, “Object Oriented Programming using C++”, BPB, 2004.
4. R. Lafore, “Object Oriented Programming using C++”, BPB Publications, 2004.
5. Naughton P. and Schildt H., “Java2 Complete Reference”, Eighth Edition, Tata McGraw Hill, 2011.

ADDITIONAL REFERENCE BOOKS

1. Parasons, “Object Oriented Programming with C++”, BPB Publication, 1999.
2. Steven C. Lawlor, “The Art of Programming Computer Science with C++”, Vikas Publication, 2002.
3. Jaime Nino, Fredrick A. Hosch, “An Introduction to Programming and Object Oriented Design using Java”, Wiley India Private Limited, 2010.

B. Tech. II (CSE) Semester – IV
MICROPROCESSOR AND INTERFACING TECHNIQUES (CORE-13)
CS202

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of different architectures, addressing modes and instructions of 8085/86.
CO2	interface memory, I/O devices and interrupt controller with 8085/86 microprocessors.
CO3	analyse and compare the features of microprocessors and microcontrollers.
CO4	describe the internal architecture and different modes of operations of a typical peripheral device.
CO5	design and develop assembly language programs using 8085/86 instructions, software interrupts, subroutines, macros.

2. Syllabus

- **INTRODUCTION TO MICROPROCESSORS EVOLUTION (02 Hours)**

  Introduction to Microprocessor and Development and its Operation.

- **ARCHITECTURE FEATURES OF 8085 (03 Hours)**

  8085 Architecture and Pin out diagram, 8085 Operations.

- **INSTRUCTION SET AND PROGRAMMING OF 8085 (06Hours)**

  Data Transfer instructions, Arithmetic instructions and its examples, Logical Instructions and its examples, Branch, Stack, and I/O related instructions, How to write, assemble and execute assembly language programmes, Assembly language programming Practice Based on above instructions for 8085, Design Counters in 8085, Design Time delays in 8085, Stack & Subroutines: Restart, Conditional and Unconditional Call and Return Instructions, Advanced Subroutine Concepts, Code Conversion, 16-bit Data Operation.

- **PERIPHERAL & MEMORY INTERFACING WITH 8085 (08 Hours)**

  Basic I/O Interfacing Concepts: Interfacing Display devices, Interfacing Input devices, Memory Interfacing: Absolute decoding, Partial Decoding, Shadow Memory, Interfacing Peripherals: 8255A Programmable Peripheral Interface, Examples of Interfacing Keyboard and seven-segment Display, Examples of Bidirectional Data transfer Between Two Microcomputer, The 8254 (8253) Programmable Interval Timer, The 8259A Programmable Interrupt Controller, Direct Memory

Access and 8237 DMA Controller, The 8279 Programmable Keyboard/Display Interface, Interfacing Scanned Multiplexed Displays and Liquid Crystal Displays, Interfacing a Matrix Keyboard, Serial I/O and Data Communication: Basic concepts in Serial I/O, Software-Controlled Asynchronous Serial I/O, The 8085-Serial I/O lines: SOD and SID, Hardware Controlled Serial I/O Using Programmable Chips.

- **8085 INTERRUPT MANAGEMENT** **(04 Hours)**

  Interrupts and its Types in 8085, Interrupt Vector Table, Priority of Interrupts, Programming using Interrupts.

- **8086 ARCHITECTURE** **(03 Hours)**

  8086 Architecture, Pin Out Diagram and its Features, Registers of 8086.

- **INSTRUCTION SET OF 8086** **(06 Hours)**

  Data Transfer Instructions and Examples based on it, Arithmetic Instructions and Examples based on it, Logical Instructions, Comparison Instructions, Jump Instructions, Examples based on Logical, Comparison, Jump Instructions, Various 8086 Assembler Directives, Examples based on Various Assembler Directives, What are Procedures in 8086?, Procedure based Examples in 8086, What are Macros in 8086?, Macros based Examples in 8086.

- **PERIPHERAL & MEMORY INTERFACING WITH 8086** **(04 Hours)**

  Interfacing Peripherals:- 8255A: Examples of Interfacing Keyboard and Seven-segment Display, Interfacing with Alphanumeric Displays, Examples of Bidirectional Data Transfer Between Two Microcomputer, 8254, 8259A, and 8279 Interfacing with 8086.

- **8086 INTERRUPTS MANAGEMENT AND APPLICATIONS** **(03 Hours)**

  8086 Interrupts and Interrupts Responses, Interrupt Pointer Table, Hardware Interrupt, Software Interrupts, Interrupt Applications.

- **RECENT TRENDS IN MICROPROCESSORS** **(03 Hours)**

Tutorials will be based on the coverage of the above topics separately **(14 Hours)**

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Practicals:

1 Introduction of 8085 kit and Installation 0f 8085 simulator

2 Assembly Language Programming based on Data transfer and Arithmetic and Logic instructions

3 Assembly Language Programming based on Branch operations

4 Assembly Language Programming based on stack and subroutines

5 Assembly Language Programming based on Code conversions

6. Assembly Language Programming based on counter and time delays

7. Introduction of 8086 Microprocessor and Installation of TASM,TLINK, TD, and DEBUG

8. Assembly Language Programming based on 8086 instruction and assembler directives

9. Practical based on 8085 interfacing

4. Books Recommended:

1. Sentilkumar N, Saravanan M and Jeevananthan S, “Microprocessors and Microcontrollers” 2/E, Oxford University Press, 2018.
2. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", 6/E, Penram International Publishing (India) Pvt. Ltd., 2013.
3. Douglas V Hall, "Microprocessors and Interfacing: Programming & Hardware", 3/E, TMH, 2013.
4. Brey, “The Intel Microprocessors", 8/E, Pearson Education, 2009.
5. A K Ray and K M Bhurchandi, "Advanced Microprocessors & Peripherals: Architecture Programming & Interfacing", 2/E, TMH, 2006.

ADDITIONAL REFERENCE BOOKS

1. Abel Peter and Nizamuddin, "IBM PC Assembly Language and Programming", 5/E, Pearson Education, 2001.

B. Tech. II (CSE) Semester – IV
OPERATING SYSTEMS (CORE-14)
CS204

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of course, students will be able to**	
CO1	understand the significance of operating system in computing devices, exemplify the communication between application programs and hardware devices through system calls.
CO2	compare and illustrate various process scheduling algorithms.
CO3	apply appropriate memory and file management schemes.
CO4	illustrate various disk scheduling algorithms.
CO5	design access control and protection based modules for an operating system.

2. Syllabus

- **OPERATING SYSTEM OVERVIEW** **(03 Hours)**

  Operating System (OS) Objectives, Evolution, Types, Major Achievements, Modern Operating Systems, Virtual Machines, OS Design Considerations for Multiprocessor and Multicore.

- **PROCESSES AND THREADS** **(05 Hours)**

  Process Concept, Process States, Process Description, Process Control Block, PCB as a Data Structure in Contemporary Operating Systems, Process Hierarchy, Processes vs Threads, Types of Threads, Multicore and Multithreading, Case Study: Linux & Windows Process and Thread Management and its Related System Calls.

- **CONCURRENCY: MUTUAL EXCLUSION AND SYNCHRONIZATION** **(04 Hours)**

  Principles of Concurrency, Mutual Exclusion, Semaphores, Monitors, Message Passing, Readers/Writers Problem.

- **CONCURRENCY: DEADLOCK AND STARVATION** **(04 Hours)**

  Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Dining Philosopher's Problem, Case Study: Linux & Windows Concurrency Mechanism.

- **SCHEDULING** **(08 Hours)**

  Uniprocessor Scheduling: Long Term Scheduling, Medium Term Scheduling, Short Term Scheduling, Scheduling Algorithms: Short Term Scheduling Criteria, Use of Priorities, Alternative Scheduling Policies, Performance Comparison, Fair-Share Scheduling. Multiprocessor Scheduling:

Granularity, Design Issue, Process Scheduling, Thread Scheduling, Real-Time Scheduling: Characteristics of RTOS, Real-Time Scheduling, Deadline Scheduling, Rate Monotonic Scheduling, Priority Inversion. Case Study: Linux & Windows Scheduling.

- **MEMORY MANAGEMENT (05 Hours)**

  Memory Hierarchy, Static and Dynamic Memory Allocation, Overview of Swapping, Multiple Partitions, Contiguous and Non-Contiguous Memory Allocation, Concepts of Simple Paging, Simple Segmentation.

- **VIRTUAL MEMORY (05 Hours)**

  Virtual Memory Concepts, Paging and Segmentation using Virtual Memory, Protection and Sharing, Fetch Policy, Placement Policy, Replacement Policy, Resident Set Management, Cleaning Policy, Load Control, Case Study: Linux & Windows Memory Management.

- **I/O MANAGEMENT AND DISK SCHEDULING (04 Hours)**

  I/O Device, Organisation of the I/O Function, Operating System Design Issue, I/O Buffering, Disk Scheduling, RAID, Disk Cache, Case Study: Linux & Windows I/O.

- **FILE MANAGEMENT (04 Hours)**

  Overview of : Files & File Systems, File Structure, File Management Systems, File Organisation and Access, B-tree, File Directories, File Sharing, Record Blocking, Secondary Storage Management, File System Security, Case Study: Linux & Windows File System.

Tutorials will be based on the coverage of the above topics separately. (14 Hours)

Practicals will be based on the coverage of the above topics separately (28 Hours)

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours= 84 Hours)

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3. Tutorials:

1 Assignment based on Process scheduling algorithm.

2 Questions based on Page replacement algorithm.

3 Assignment based on Banker's algorithm.

4 Assignment based on Semaphores and monitors.

4. Practicals:

1 Introduction to Basic and Advance commands of Linux.

2 Introduction to Shell Script and programs based on it.

3 Practical based on different Memory management scheme.

4 Practical based on different Process scheduling algorithm.

5 Practical based on different Disk scheduling algorithm.

6 Process synchronization and deadlock.

7 Practical based on file management system.

8 Practical based on input output device management.

5. Books Recommended:

1. Silberschatz, Galvin and Gagne, "Operating System Concepts", 10/E, John Wiley & Sons, 2018.
2. W. Stallings, "Operating Systems: Internals and Design Principles", 9/E, Pearson Pub., 2017.
3. W Richard Stevens, Stephen A Rago, "Advanced Programming in the UNIX Environment"; 3/E, Addison Wesley Professional, 2013.
4. Kernighan & Pike, "UNIX programming Environment", 2/E, PHI-EEE, 2001.
5. A Tanenbaum, A Woodhull, "Operating Systems - Design and Implementation", 3/E, PHI EEE, 2006.

ADDITIONAL REFERENCE BOOKS

1. Crawley, "Operating Systems - A Design Oriented Approach", 1/E, McGraw Hill, 1998.

B. Tech. II (CSE) Semester – IV
COMPUTER NETWORKS (CORE - 15)
CS206

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand computer network models and services offered at different layers of network protocol stack.
CO2	apply knowledge of data communication, data transmission techniques using various transmission media to deliver error free data and communicate with multiple nodes.
CO3	analyse various routing methods to identify effective routing protocols.
CO4	evaluate network performance by means of transport and flow control protocols, Congestion Control protocols and Quality of services.
CO5	create a computer network application using modern network tools and simulation softwares.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Overview of Computer Networks and Data Communication, Computer Networking Protocols and Standards, Types of Computer Networks, Network Topology, Protocol Hierarchies and Design Issues, Interfaces and Services, Networking Devices, OSI and TCP/IP Reference Models.

- **PHYSICAL LAYER** **(06 Hours)**

  Physical Layer Design Issues, Data Transmission Techniques, Multiplexing, Transmission Media, Asynchronous Communication, Wireless Transmission, ISDN, ATM, Cellular Radio, Switching Techniques and Issues.

- **LOGICAL LINK CONTROL LAYER** **(06 Hours)**

  LLC Design Issues, Framing, Error and Flow Control, Framing Techniques, Error Control Methods, Flow Control Methods, PPP and HDLC.

- **MEDIUM ACCESS CONTROL LAYER** **(06 Hours)**

  MAC Layer Design Issues, Channel Allocation Methods, Multiple Access Protocols - ALOHA, CSMA, CSMA/CD Protocols, Collision Free Protocols, Limited Contention Protocols, LAN Architectures, IEEE

-802 Standards, Ethernet(CSMA/CD), Token Bus, Token Ring, DQDB, FDDI, Bridges and Recent Developments.

- **NETWORK LAYER** **(06 Hours)**

Network Layer Design Issues, Routing Algorithms and Protocols, Congestion Control Algorithms and QoS, Internetworking, Addressing, N/W Layer Protocols and Recent Developments.

- **TRANSPORT LAYER** **(06 Hours)**

Transport Layer Design Issues, Transport Services, Sockets, Addressing, Connection Establishment, Connection Release, Flow Control and Buffering, Multiplexing, Transport Layer Protocols, Real Time Transport Protocol (RTP), Stream Control Transmission Protocol (SCTP), Congestion Control, QoS and Recent Developments, Virtualization, Network Functions Virtualization(NFV), Software Defined Networks.

- **APPLICATION LAYER** **(06 Hours)**

Client Server Model, Domain Name System (DNS), Hyper Text Transfer Protocol (HTTP), Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, Dynamic Host Control Protocol (DHCP), Simple Network Management Protocol (SNMP) and Recent Developments.

Practicals will be based on the coverage of the above topics separately **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours= 84 Hours)

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3. Practicals:

1 Study network configuration commands and computer network setup.
2 Implementation of different Data Link and MAC Layer protocols.
3 Implementationof different Network Layer protocols.
4 Implementation of different Transport and Application Layer protocols.
5 Design and configure a network systems using modern network simulator softwares.
6 Implementation of Secured Socket Layer protocol.
7 Implementation of ICMP based message transmission over network.
8 Implementation of SMTP protocol for mail transfer.

4. Books Recommended:

1. William Stalling, "Data and Computer Communication", 10/E, Pearson India, 2017.
2. B. Forouzan, "Data Communication and Networking", 5/E, McGraw Hill, 2017.

3. Douglas E. Comer, "Internetworking with TCP/IP Volume – I", 6/E Pearson India, 2015.
4. Andrew S. Tanenbaum, "Computer Network", 5/E, Pearson India, 2013.
5. W. Richard Stevens, "TCP/IP Illustrated Volume - I", 2/E, Addison Wesley, 2011.

B. Tech. II (CSE) Semester – IV
AUTOMATA AND FORMAL LANGUAGES (CORE-16)
CS208

	L	T	P	Credit
Scheme	**3**	**1**	**0**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of the basis of theory of computation, different computational problems and the importance of automata as a modelling tool of computational problems.
CO2	to apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO3	analyse the solutions for different problems and argue formally about correctness on different restricted machine models of computation.
CO4	evaluate and Identify limitations of computational models and possible methods of proving them.
CO5	design the solution in the forms of different types of machine with correctness proof and able to develop different system software.

2. Syllabus

- **INTRODUCTION (05 Hours)**

  Basic Mathematical Objects: Sets, Logic, Functions, Relations, Strings, Alphabets, Languages; Mathematical Induction: Inductive Proofs, Principles, Recursive Definitions, Set Notation.

- **FINITE AUTOMATA AND REGULAR EXPRESSIONS (12 Hours)**

  Finite State Systems, Deterministic Finite Automata; Nondeterministic Finite Automata, Nondeterministic Finite Automata with Epsilon, Applications, Kleene' Theorem; Two-way Finite Automata, Finite Automata with Output, Regular Languages & Regular Expressions, Properties of Regular Sets: The Pumping Lemma for Regular Sets, Closure Properties, Decision Properties of Regular Languages, Equivalence and Minimization of Automata, Moore and Mealy Machines.

- **CONTEXT FREE GRAMMARS (14 Hours)**

  Definition, Derivation Trees & Ambiguity, Inherent Ambiguity, Parse Tree, Application of CFG, Simplification of CFG, Normal Form of CFG, Chomsky Normal Form and Chomsky Hierarchy, Unrestricted Grammars, Context-Sensitive Languages, Relations between Classes of Languages, Properties of Context Free Languages: The Pumping Lemma, Closure Properties, Decision Properties of CFL.

- **PUSHDOWN AUTOMATA (05 Hours)**

  Definitions, Languages of PDA, Equivalence of PDA and CFG , Deterministic PDA.

- **TURING MACHINES** **(06 Hours)**

  Turing Machine Model, Language of a Turing Machine (TM), Programming Techniques of the TM, Variations of TM, Multiple TM, One-Tape and Multi-Tape TM, Deterministic and Non deterministic TM, Universal TM, Churche Thesis, Recursively Enumerable Languages, Decidability, Reducibility, Intractable Problem Classes of Problems NP Hard, NP Complete.

  Tutorials will be based on the coverage of the above topics. **(14 Hours)**

  (Total Contact Time: 42 Hours + 14 Hours = 56 Hours)

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3. Tutorials:

1 Problem statements based on Regular Language and Finite Automata.

2 Questions based on Context Free Grammar.

3 Problems regarding Push Down Automata.

4 Solving Problems for Turing Machine.

5 Decidable and Undecidable Problems.

4. Books Recommended:

1. Michael Sipser, “Introduction to the Theory of Computation”,Cengage Learning, 3/E, 2013.
2. John C Martin, “Introduction to Languages & the Theory of Computation”, 3/E, Tata McGraw-Hill, 2011.
3. John E. Hopcroft, Rajeev Motwani, Jeffrey Ullman, “Introduction to Automata theory, languages computation, 3/E, Pearson India, 2008.
4. Daniel I A Cohen, “Introduction to Computer Theory”, John Wiley & Sons, 2/E, Reprint 2008.
5. Andrew Ilachinski, “Cellular Automata”, 1st Ed., World Scientific, 2001.

ADDITIONAL REFERENCE BOOKS

1. Sushil Kumar Azad, “Theory of Computation, An introduction to /automata, Formal Languages And Computability”, Dhanpat Ray & Co., New Delhi, 2005.
2. A.M. Natarajan, A.Tamilarasi, “Theory of computation”, New Age Publication, 1/E, 2003.

B. Tech. II (CSE) Semester – IV
ARTIFICIAL INTELLIGENCE (CORE-17)
CS210

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At end of the program, students will be able to**	
CO1	understand the role of agents and how it is related to environment and the way of evaluating it and how agents can act by establishing goals.
CO2	apply various knowledge representation technique, searching techniques, constraint satisfaction problem and example problems- game playing techniques.
CO3	analyse the current scope, potential, limitations, and implications of intelligent systems.
CO4	evaluate the AI techniques suitable for recent areas of applications like expert systems, neural networks, fuzzy logic, robotics, natural language processing, and computer vision.
CO5	design a real world problem for implementation and understand the dynamic behaviour of a system.

2. Syllabus

- **INTRODUCTION TO AI** **(03 Hours)**

  Intelligent Agents, AI Techniques, AI-Problem formulation, AI Applications, Production Systems, Control Strategies.

- **KNOWLEDGE REPRESENTATION** **(06 Hours)**

  Knowledge Representation Using Predicate Logic, Introduction to Predicate Calculus, Resolution, Use of Predicate Calculus, Knowledge Representation Using other Logic-Structured Representation of Knowledge.

- **PRODUCTION SYSTEM** **(06 Hours)**

  Defining the Problems as a State Space Search, Production Systems, Production Characteristics, Production System Characteristics, Forward and Backward, State-Space Search, Problem Solving Methods – Problem Graphs, Matching, Indexing.

- **PROBLEM-SOLVING THROUGH SEARCH** **(06 Hours)**

Generate and Test, BFS, DFS, Blind, Heuristic, Problem-Reduction, A, A*, AO*, Minimax, Constraint Propagation, Neural, Stochastic, and Evolutionary Search Algorithms, Sample Applications, Measure of Performance and Analysis of Search Algorithms, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis, Issues in the Design of Search Programs.

- **KNOWLEDGE INFERENCE (06 Hours)**

Knowledge Representation -Production Based System, Frame Based System; Inference – Backward Chaining, Forward Chaining, Rule Value Approach; Fuzzy Reasoning – Certainty Factors, Bayesian Theory-Bayesian Network-Dempster – Shafer Theory; Symbolic Logic Under Uncertainty: Non-Monotonic Reasoning, Logics for Non-Monotonic Reasoning; Statistical Reasoning : Probability and Bayes Theorem, Certainty Factors, Probabilistic Graphical Models, Bayesian Networks, Markov Networks, Fuzzy Logic.

- **GAME PLAYING AND PLANNING (06 HOURS)**

Overview and Example Domain: Overview, Minimax, Alpha-Beta Cut-Off, Refinements, Iterative Deepening, The Blocks World, Components of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems, Other Planning Techniques.

- **NATURAL LANGUAGE PROCESSING (04 Hours)**

Introduction, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Spell Checking.

- **EXPERT SYSTEMS (05 Hours)**

Expert Systems, Architecture of Expert Systems, Roles of Expert Systems, Knowledge Acquisition, Meta Knowledge, Heuristics, Typical Expert Systems – MYCIN, DART, XOON, Expert Systems Shells.

Practicals will be based on the coverage of the above topics using prolog. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Practicals:</u>

1 Practical assignment to understanding basic concepts of prolog.

2 Practical assignment to implement various search strategies.

3 Practical assignment to implement various algorithm based on game theory.

4 Implementation of heuristic based search techniques.

5 Implementation of neural network based application.

6 Implementation of fuzzy logic based application.

7 Implementation of fuzzy inference engine for an application.

8 Implementation of neuro-fuzzy based system.

4. Books Recommended:

1. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.
2. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, 3rd Edition, Prentice Hall, 2009.
3. Nils Nilsson, Artificial Intelligence: A New Synthesis, Morgan Kaufmann, 1998,
4. W. Patterson, ‘Introduction to Artificial Intelligence and Expert Systems’, Prentice Hall of India, 2010.
5. I. Bratko, "Prolog Programming for Artificial Intelligence", 3/E, Addison-Wesley, 2001, 0-201-40375-7.

B. Tech. III (CSE) Semester – V
SYSTEM SOFTWARE (CORE-18)
CS301

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand systems software components, finite automata, regular expression and context free grammar.
CO2	apply the knowledge of assembler and macro processors to convert assembly language into machine code.
CO3	analyze working phases of Compiler, various parsing techniques, semantic analysis, Error handling, code generation and code optimization techniques to undertake meaningful language translation.
CO4	evaluate Linkers, Loaders, interpreters and debugging methods to manages system memory and provide a portable runtime environment.
CO5	create a language translator application and mimic a simple compiler.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to System Software, Utility Software, Systems Programming, Recent Trends in Software Development, Programming Languages and Language Processors, Data Structures for Language Processing.

- **ASSEMBLERS** **(06 Hours)**

  Overview of the Assembly Process, Cross Assembler, Micro Assembler, Meta Assembler, Single Pass Assembler, Two Pass Assembler, Design of Operation Code Table, Symbol Table, Literal Table, Advanced Assembly Process .

- **MACRO PROCESSORS** **(06 Hours)**

  Introduction of Macros, Macro Processor Design, Forward Reference, Backward Reference, Positional Parameters, Keyword Parameters, Conditional Assembly, Macro Calls within Macros, Implementation of Macros Within Assembler. Designing Macro Name Table, Macro Definition Table, Kew Word Parameter Table, Actual Parameter Table, Expansion Time Variable Storage.

- **COMPILERS** **(14 Hours)**

  Phases of Compiler, Analysis-Synthesis Model of Compilation, Interface with Input, Parser and Symbol Table, Token, Lexeme, Patterns and Error Reporting in Lexical Analysis, Programming

Language Grammars, Classification of Grammar, Ambiguity in Grammatical Specification, Top Down Parsing, Recursive Descent Parsing, Transformation on The Grammars, Predictive Parsing, Bottom Up Parsing, Operator Precedence Parsing, LR Parsers, Language Processor Development Tools – LEX & YACC, Semantic Gap, Binding and Binding Times, Memory Allocation, Compilation of Expression, Intermediate Representations, Basic Code Optimization.

- **LINKERS AND LOADERS** **(06 Hours)**

Design of a Linker, Program Relocation, Linking of Overlay Structured Programs, Dynamic Linking, General Loader Schemes, Absolute Loader, Relocating Loader, Dynamic Loader, Bootstrap Loader, Linking Loader, other Loading Schemes, Linkers v/s Loaders.

- **INTERPRETERS & DEBUGGERS** **(06 Hours)**

Overview of Interpretation and Debugging Process, Types of Errors, Classification of Debuggers, Dynamic/Interactive Debugger, The Java Language Environment, Java Virtual Machine and Recent Developments.

Tutorials will be based on the coverage of the above topics separately. **(14 Hours)**

Practicals will be based on the coverage of the above topics separately. **(28 Hours)**

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Tutorials

1 Problem solving on the basics of assembler.

2 Problem solving on the basics of macro processor.

3 Problem solving on the basics of lexical analysis.

4 Problem solving on the basics of parsing.

5 Problem solving on the basics of linkers and loaders.

6 Problem solving on the basics of interpreters & debuggers.

4. Practicals:

1 Study, install and setup various system software tools.

2 Implementation ofsingle pass and two pass assembler.

3 Design and implement scanner using lexical analyzer (LEX) tool.

4 Design and implement parser using YACC tools.

5 Design and configure a compiler application using modern tools and softwares.

6 Implementation of different stages of compiler.

7 Implementation of interpreter and debugger.

8 Implementation of optimization based compiler design.

BOOKS RECOMMENDED

1. D. M. Dhamdhere, "Systems Programming", 1/E, McGraw Hill, 2011.
2. Leland L. Beck, "System Software - An Introduction to System Programming", 3/E, Pearson Education, 2002.
3. John Donovan, “Systems programming”, 1/E, McGraw Hill, 2017.
4. Santanu Chattopadhyay, “System Software” 1/E, Prentice-Hall India, 2007.
5. A.V.Aho, R.Sethi & J D.Ullman, "Compilers-Principles, Techniques and Tools", 2/E, Pearson India, 2013.

ADDITIONAL REFERENCE BOOKS

1. Allen. Holub, "Compiler Design in C", 1/E, Pearson India, 2015.
2. Ronald Mak, “Writing Compilers and Interpreters: A Software Engineering Approach”, 3/E, Wiley, 2009.

B. Tech. III (CSE) Semester – V
MACHINE LEARNING (CORE - 19)
CS303

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of pattern recognition, regression, classification, clustering algorithms and statistics.
CO2	apply different classification, regression, machine learning algorithms and modelling.
CO3	analyze the data patterns and modelling for applying the learning algorithms.
CO4	evaluate the performance of an algorithm and comparison of different learning techniques.
CO5	design solution for real life problems like biometric recognition, natural language processing and its related applications using various tools and techniques of machine learning.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Pattern Representation, Concept of Pattern Recognition and Classification, Feature Extraction, Feature Selection, Basics of Probability, Bayes Decision Theory, Maximum-Likelihood and Bayesian Parameter Estimation, Error Probabilities, Learning of Patterns, Modelling, Regression, Discriminant Functions, Linear Discriminant Functions, Decision Surface, Learning Theory, Fisher Discriminant Analysis.

- **SUPERVISED LEARNING ALGORITHMS** **(09 Hours)**

  Linear Regression, Gradient Descent, Support Vector Machines, Artificial Neural, Networks, Decision Trees, ML and MAP Estimates, K-Nearest Neighbor, Naive Bayes, Bayesian Networks, Classification, Overfitting, Regularization, Multilayer Networks, Back-propagation, Bayes Classification, Nearest Neighbor Classification, Cross Validation and Attribute Selection, K Means Clustering, Agglomerative Hierarchical Clustering.

- **UNSUPERVISED LEARNING ALGORITHMS** **(09 Hours)**

  K-Means Clustering, Gaussian Mixture Models, Learning with Partially Observable Data, Expectation Maximization Approach. Dimensionality Reduction, Principal Component Analysis, Model Selection and Feature Selection.

- **TRANSFORM DOMAIN PATTERN ANALYSIS (06 Hours)**

  Signal Transformation, Frequency Domain Representation of Signal, Feature Extraction and Analysis, Multiresolution Representation, Wavelet Transform, Discrete Cosine Transform.

- **APPLICATIONS (09 Hours)**

  Signal Processing Application, Image Processing, Biometric Recognition, Face and Speech Recognition, Information Retrieval, Natural Language Processing.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. Practical:

1. Implement classification and regression techniques.
2. Implement clustering and statistical modeling methods.
3. Implement various dimensionality reduction techniques.
4. Implement neural networks and non-parametric techniques.
5. Implement mini-project based on machine learning approaches.

4. Books Recommended:

1. Geoff Dougherty, “Pattern Recognition and Classification: An Introduction”, 1st Edition, Springer, 2013.
2. Theodoridis and K.Koutroumbas, “Pattern Recognition”, 4th Ed., Academic Press, 2009.
3. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, 1st Edition, Springer, 2006.
4. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Classification”, 2nd Edition, Wiley, 2001.
5. K. Fukunaga, “Introduction to Statistical Pattern Recognition”, 2nd Edition, Academic Press, 2000.

ADDITIONAL REFERENCE BOOKS

1. Ranjjan Shinghal, “Pattern Recognition Techniques and Application”, 1st Edition, Oxford university press, 2006.

B. Tech. III (CSE) Semester – V
PROFESSIONAL ETHICS, ECONOMICS AND BUSINESS MANAGEMENT
HU301

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):

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

CO1	develop knowledge regarding Professional ethics
CO2	develop knowledge of Economics in engineering
CO3	develop managerial skills to become future engineering managers
CO4	develop skills related to various functional areas of management (Marketing Management, Financial Management, Operations Management, Personnel Management etc.)
CO5	build knowledge about modern management concepts
CO6	develop experiential learning through Assignments, Management games, Case study discussion, Group discussion, Group presentations etc.

2. Syllabus

- **PROFESSIONAL ETHICS** **(06 Hours)**

  Introduction, Meaning of Ethics, Approaches to Ethics, Major attributes of Ethics, Business Ethics, Factors influencing Ethics, Importance of Ethics, Ethics in Management, Organizational Ethics, Ethical aspects in Marketing, Mass communication and Ethics - Television, Whistle blowing, Education – Ethics and New Professional, Intellectual Properties and Ethics, Introduction to Professional Ethics, Engineering Ethics.

- **ECONOMICS** **(08 Hours)**

  Introduction To Economics, Applications & Scopes Of Economics, Micro & Macro Economics, Demand Analysis, Demand Forecasting, Factors Of Production, Types Of Cost, Market Structures, Break Even Analysis.

- **MANAGEMENT** **(14 Hours)**

  Introduction to Management, Features Of Management, Nature Of Management, Development of Management Thoughts – Scientific Management By Taylor & Contribution of Henry Fayol, Coordination & Functions Of Management, Centralization & Decentralization, Decision Making; Fundamentals of Planning; Objectives & MBO; Types of Business Organizations: Private Sector, Public Sector & Joint Sector; Organizational Behavior: Theories of Motivation, Theories of Leadership.

- **FUNCTIONAL MANAGEMENT** **(12 Hours)**

  Marketing Management: Core Concepts Of Marketing, Marketing Mix (4p), Segmentation – Targeting – Positioning, Marketing Research, Marketing Information System, Concept of International Marketing, Difference Between Domestic Marketing & International Marketing; Operations Management: Introduction to Operations Management, Types of Operation Systems, Types of Layouts, Material Handling, Purchasing & Store System, Inventory Management; Personnel Management: Roles & Functions of Personnel Manager, Recruitment, Selection, Training; Financial Management: Goal of Financial Management, Key Activities In Financial Management, Organization of Financial Management, Financial Institutions, Financial Instruments, Sources of Finance.

- **MODERN MANAGEMENT ASPECTS** **(02 Hours)**

  Introduction To ERP, e – CRM, SCM, RE – Engineering, WTO, IPR Etc.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Balachandran V. and Chandrasekaran, "Corporate Governance, Ethics and Social Responsibility", PHI, 2nd Edition, 2011.
2. Prasad L.M., "Principles & Practice of Management, Sultan Chand & Sons", 8th Edition, 2015.
3. Banga T. R. & Shrama S.C., "Industrial Organisation & Engineering Economics", Khanna Publishers, 25th Edition, 2015.
4. Everett E. Adam, Ronald J. Ebert, "Production and Operations Management", Prentice Hall of India, 5th edition, 2012.
5. Kotler P., Keller K. L, Koshi A. & Jha M., "Marketing Management – A South Asian Perspective", Pearson, 14th Edition, 2014.
6. Tripathi P.C., Personnel Management & Industrial Relations, Sultan Chand & sons, 21st Edition, 2013
7. Chandra P., Financial Management, Tata McGraw Hill, 9th Edition, 2015.

ADDITIONAL REFERENCE BOOKS

1. Crane A. & Matten D., "Business Ethics: Managing Corporate Citizenship and Sustainability in the Age of Globalisation", Oxford University, 2010.
2. Fritzsche D. J., "Business Ethics: A Global and Managerial Perspectives", McGraw Hill Irwin, Singapore, 2004.
3. Mandal S. K., "Ethics in Business and Corporate Governance", Tata McGraw Hill, 2011.

B. Tech. III (CSE) Semester – V
ADVANCED MICROPROCESSORS (CORE ELECTIVE-1)
CS321

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	describe different modes of operations of a typical microprocessor.
CO2	design and develop 80x86 assembly language programs using software interrupts and various assembler directives.
CO3	develop Interface microprocessors with various external devices.
CO4	analyze and compare the features of 80x86 microprocessors, Multicore architecture, ARM processors and microcontrollers.
CO5	design and develop assembly language programs using 8051 microcontroller.

2. Syllabus

- **ARCHITECTURAL FEATURES OF 16/32/64 MICROPROCESSORS (06 Hours)**

  Internal Architecture, Register Organization (General-Purpose Register, Segment Register, Status and Control Register, Instruction Pointer, Segment Descriptor Cache Register, System Address Registers LDTR, GDTR, Debug Register, Test Registers, Control Registers. Addressing Modes , Real, PVAM, Paging, Address Translation in Real, PVAM, Paging, Enabling and Disabling Paging (Machine Status Word), Salient Features of 32/64 System Architecture, Superscalar Execution, Separate Code & Data Cache, Floating Point Exceptions, Branch Prediction, Intel MMX Architecture.

- **MICROCONTROLLER (06 Hours)**

  Overview of Micro Controllers-8051 Family Microcontrollers, Instruction Set, Pin Out, Memory Interfacing.

- **ARM PROCESSOR FUNDAMENTALS (07 Hours)**

  Registers, Current Program Status Registers, Pipeline Exceptions, Interrupts and Vector Table, Architecture Revisions, ARM Processor Families, ARM Instruction Set, Thumb Instruction Set-Exceptions Handing, Interrupts, Interrupt Handling Schemes, Firmware, Embedded Operating Systems, Caches-Cache Architecture, Cache Policy, DSP on the ARM7TDMI, ARM9TDMI.

- **ADVANCED INTEL PROCESSORS (06 Hours)**

Architecture and Programming Including Xeon and Others, Dual Processors, DSP Processors, Various Peripherals and Interfacing Including Memory and I/O.

- **INTRODUCTION TO MULTICORE PROCESSORS** **(05 Hours)**

  Hyper Threading Technology, Define Core, Limitations of Single Core Processor, Concept of Multi Core Processing and Its Advantages, Homogeneous and Heterogeneous Multicore Processors, Single Core and Multicore Processors Comparison, Major Issues in Multicore Processing, Internal Architecture of Intel Core2 Duo, Important Technological Features of IA Processors, Comparison of Core I3, I5 and I7 Processors.

- **INTERFACE C/C++ WITH ASSEMBLY LANGUAGE** **(06 Hours)**

  C and Assembly, Inline Assembly, Linked Assembly, Calling Conventions.

- **I/O BUSES, PARALLEL & SERIAL PORTS, USB** **(03 Hours)**

  Bus Characteristics, Bus Design Considerations, Bus Communications, Bus Standards, Bus Details.

- **CHIPSET, MOTHERBOARD AND CURRENT TRENDS OF PC** **(03 Hours)**

  Chipset Architecture, North/South Bridge Architecture, Hub Architecture, Case Study of Intel Chipsets.

Practicals will be based on the coverage of the above topics separately. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. <u>Books Recommended:</u>

1. Douglas V Hall, "Microprocessors and Interfacing: Programming & Hardware", 3/E, TMH, 2013.
2. Barry B. Brey, "The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions, 8/e, 2008.
3. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2nd Edition, Pearson Education, 2011.
4. James L. Antonakos, "An introduction to the Intel Family of Microprocessors", 3/E, Pearson Education, Reprint 2001.
5. Shameem Akhter and Jason Roberts, “Multi-Core Programming: Increasing Performance through Software Multi-Threading”, Intel Press, 2006.

ADDITIONAL REFERENCE BOOKS

1. Maurice Herlihy and NirShavit, “The Art of Multiprocessor Programming“, Revised First Edition, Elsevier Publication, 2012.

B. Tech. III (CSE) Semester – V
PARALLEL PROCESSING AND ARCHITECTURE
(CORE ELECTIVE-1)
CS323

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs):

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

CO1	understand implicit and explicit parallel platforms and its physical organization.
CO2	decompose given problem into many sub problems using different decomposition techniques.
CO3	use different performance metrics for analyzing parallel algorithms.
CO4	evaluate performance of various existing parallel algorithms.
CO5	develop parallel algorithms for tightly coupled and loosely coupled parallel systems for various applications.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Implicit Parallelism: Microprocessor Architectures, Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Parallel Platforms and Its Physical Organization, Routing Mechanisms for Networks, Communication Costs in Parallel Machines, Impact of Process-Processor Mapping and Mapping Techniques.

- **PARALLEL ALGORITHM DESIGN ALGORITHMS (06 Hours)**

  Preliminaries, Decomposition Techniques, Load Balancing in Parallel System, Mapping Techniques for Load Balancing, Tasks and Interactions, Interaction Overheads, Parallel Algorithm and its Models.

- **COMMUNICATION OPERATIONS (06 Hours)**

  One-To-All Broadcast and All-To-One Reduction, All-To-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-To-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

- **ANALYTICAL MODELING (06 Hours)**

  Sources of Overhead in Parallel Programs, Performance Metrics, Effect of Granularity and Data Mapping on Performance, Scalability, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs.

- **MESSAGE PASSING PARADIGM (06 Hours)**

Principles of Message-Passing Programming, The Building Blocks for Send and Receive Operations, MPI for The Message Passing Interface, Topologies, Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators.

- **SHARED ADDRESS SPACE PLATFORMS THREAD BASICS (04 Hours)**

  Thread Application Programmer Interface, Synchronization Primitives, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs.

- **ALGORITHMIC APPROACHES (05 Hours)**

  Matrix-Vector Multiplication, Matrix-Matrix Multiplication, Issues in Sorting on Parallel Computers, Sorting Networks, Bubble Sort and its Variants, Quick Sort: Definitions and Representation, Minimum Spanning Tree: Prim's Algorithm, Single-Source Shortest Paths: Dijkstra's Algorithm, All-Pairs Shortest Paths.

- **ADVANCE TOPICS AND TOOLS (05 Hours)**

  Counting Problems, Interactive Proofs, Probabilistically Checkable Proofs, OpenMP Tools, OpenMP Compilers, High Performance Parallel Programming, CUDA.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. Books Recommended:

1. Kai Hwang, F. Briggs, "Computer Architecture and Parallel Processing", McGraw Hill International Edition, Reprint 2006.
2. M. Flynn, "Computer Architecture: Pipelined and Parallel Processor Design", 1/E, Jones and Bartlett, 1995.
3. Harry F. Jordan, "Fundamentals of Parallel Processing", 1/E, Prentice Hall, 2002.
4. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability, Programmability", 1/E, Tata McGraw Hill, Reprint 2008.
5. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, “Introduction to Parallel Computing”, 2/E, Pearson Publication, 2003.

B. Tech. IV (CSE) Semester – V
COMPUTER GRAPHICS (CORE ELECTIVE-1)
CS325

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand Computer Graphics Systems, scan conversion process, object representation, object filling and related algorithms.
CO2	use geometric transformations on graphics objects and apply them in composite form.
CO3	analyze various techniques of clipping, transformations and projection to extract scene and transform it to display device.
CO4	evaluate various techniques for effective scene generation with special effects and animation.
CO5	create an application using computer graphics tools and software's in the development of computer games, information visualization and business applications.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Overview, Classification, Characteristics and Advantages of Computer Graphics, Coordinate Representation, Raster Scan & Random Scan methods, Video Basics, Display devices, Interactive Devices and Hardcopy Devices. Digital Images, Image Formation, Image Representation and Modelling, Overview of Image and Graphics Applications, Graphics Libraries & Graphic Software's.

- **GRAPHICS PRIMITIVES** **(08 Hours)**

  Line, Circle, Ellipse Generating Algorithms, Character Generation, Polygon Drawing and Representation, Polygon Filling Algorithms – Scanline Algorithms, Edge List Algorithm, Edge Fill Algorithm, Fence Fill Algorithm, Edge Flag Algorithm, Seed Fill Algorithms, Simple Seed Fill, Scan Line Seed Fill Algorithms.

- **2D AND 3D TRANSFORMATIONS** **(08 Hours)**

  Representation of Objects in Matrix Form, 2-D Transformations, Homogeneous Coordinates, Combined Transformations, Transformation between Coordinate Systems, Affine Transformation, 3-D Transformation, Multiple Transformation, Coordinate Transformation.

- **3D PROJECTION** **(04 Hours)**

Introduction to Projection, Categories of Projection, Parallel Projection, Perspective Projection, 3-D Viewing and Viewing Parameters.

- **CLIPPING** **(08 Hours)**

Viewing Transformation, Window to Viewport Coordinate Transformation, Point Clipping, Line Clipping, Cohen-Sutherland Line Clipping algorithm, Mid-Point Line Clipping Algorithm, Polygon Clipping, Sutherland-Hodgeman Algorithm, Weiler Atherton Algorithm; Curve Clipping, Text Clipping, Interior Exterior Clipping, 3- D Clipping, 3-D Mid-Point Subdivision Algorithm.

- **ADVANCE TOPICS** **(08 Hours)**

Overview of Hidden Lines and Visible Surface Methods, Fundamentals of Curve Generation, Illumination, Shading Lighting, Color and Animation, Special-Purpose Graphics Hardware, Recent Developments.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. <u>Books Recommended:</u>

1. Peter Shirley, Steve Marschner and others, “Fundamentals of Computer Graphics”, 4/E, A K Peters/CRC Press, 2015.
2. James D. Foley, Andries van Dam, Steven K. Feiner, F. Hughes John, “Computer Graphics: Principles and Practice in C”, Addison Wesley, 2/E, 2012.
3. D. Hearn and M. Baker, “Computer Graphics with OpenGL“, 3/E, Pearson India, 2013.
4. Edward Angel, “Interactive Computer Graphics - A Top-Down Approach Using OpenGL”, 5/E, Pearson Education, 2012.
5. F. S. Hill Jr. and S. M. Kelley, “Computer Graphics using OpenGL”, 3/E, Pearson India, 2015.

B. Tech. III (CSE) Semester – V
INFORMATION THEORY & CODING (CORE ELECTIVE-1)
CS327

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the basics of information measure, Entropy, bit error, various error control encoding and decoding techniques, communication channel capacity and rate.
CO2	apply principles of information theory and linear algebra in source coding, channel coding and efficient error correcting codes.
CO3	analyze the performance of error control codes and communication channel.
CO4	evaluate different types of the channel modelling and codes.
CO5	design and innovate efficient codes, communication channel in terms of higher rate and less distortion.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Information Source, Symbols and Entropy, Mutual Information, Information Measures for Continuous Random Variable, Joint and Conditional Entropy, Relative Entropy, Applications Based on Information Theoretic Approach.

- **SOURCE CODING** **(08 Hours)**

  Source Coding Theorem, Kraft Inequality, Shannon-Fano Codes, Huffman Codes, Run Length Code, Arithmetic Codes, Lempel-Ziv-Welch Algorithm, Universal Source Codes, Prefix Codes, Variable Length Codes, Uniquely Decodable Codes, Instantaneous Codes, Shannon's Theorem, Shannon Fano Encoding Algorithm, Shannon's Noiseless Coding Theorem, Shannon's Noisy Coding Theorem.

- **COMMUNICATION CHANNEL** **(08 Hours)**

  Channel and its Capacity, Continuous and Gaussian Channels, Discrete Memory-Less Channels, Symmetric Channel, Binary Erasure Channel, Estimation of Channel Capacity, Noiseless Channel, Channel Efficiency, Shannon's Theorem on Channel Capacity, MIMO Channels, Channel Capacity with Feedback.

- **VIDEO AND SPEECH CODING** **(08 Hours)**

Video Coding Basics, Quantization, Symbol Encoding, Intraframe Coding, Predictive Coding, Transform Coding, Subband Coding, Vector Quantization, Interframe Coding, Motion Compensated Coding, Image Compression, JPEG, LZ78 Compression, Dictionary Based Compression, Statistical Modelling, Variable Length Coding, Bit Allocation.

- **ERROR CONTROL CODING** **(10 Hours)**

Overview of Field, Group, Galois Field, Types of Codes, Hamming Weight, Minimum Distance Based Codes, Error Detection and Error Correction Theorems, Maximum Likelihood Decoder, MAP Decoder, Linear Block Codes and Their Properties, Equivalent Codes, Generator Matrix and Parity Check Matrix, Systematic Codes, Cyclic Codes, Convolution Codes and Viterbi Decoding Algorithm, Turbo Codes and Low Density-Parity-Check Codes, Asymptotic Equipartition Property.

- **RATE DISTORTION THEORY** **(04 Hours)**

Rate Distortion Function, Random Source Codes, Joint Source-Channel Coding and the Separation Theorem.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. Books Recommended:

1. R. Bose, “Information Theory, Coding and Cryptography”, 3rd Edition, McGraw-Hill, 3rd Ed., 2016.
2. R. Johannesson and K.S. Zigangirov, “Fundamentals of Convolutional Coding”, 2nd Edition, Wiley-IEEE Press, 2015.
3. T. M. Cover and J. A. Thomas,” Elements of Information Theory”, 2nd Edition John Wiley & Sons, New York, 2012.
4. A. B. Robert, “Information Theory”, 2nd Edition, Dover Special Priced Titles, 2007.
5. R. M. Roth, “Introduction to Coding Theory”, Cambridge University Press, 2006.

ADDITIONAL REFENCE BOOKS

1. R.H. Morelos-Zaragoza, “The Art of Error Correcting Coding”, Wiley and sons, 2006.
2. T. K. Moon, “Error Correction Coding: Mathematical Methods and Algorithms”, Wiley, 2005.
3. S. Lin and D. J. Costello, “Error Control Coding”, 2nd Edition, Prentice-Hall, 2004.
4. Mark Nelson, Jean-Loup Gailly, “Data Compression” ,2nd Ed., BPB Publication,1996.
5. R. Hill,”A First Course in Coding Theory”, Oxford University Press, 1986.

B. Tech. III (CSE) Semester – VI
WIRELESS NETWORKS (CORE ELECTIVE-1)
CS329

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs):

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

CO1	understand wireless communication technologies, communication standards and multiple acces scheme.
CO2	apply mobile adhoc networks routing methods and forwarding strategies.
CO3	analyze routing protocols for Delay Tolerant Networks, Vehicular Ad-hoc Networks, Wireless Acce Protocol and GPS.
CO4	evaluate IoT Design & Deployment, IoT System Management and Platforms Design Methodology.
CO5	create a wireless network using modern tools and simulation software's.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Overview of Wireless Technologies and Communication Standards, Medium Access Control in Wireless LANs, Bluetooth Technology, Personal Area Networks, Delay Tolerant Networks and Cellular Networks.

- **MULTIPLE ACCESS SCHEMES** **(06 Hours)**

  Time Division Multiple Access (TDMA), Frequency Division Multiple Access (FDMA), Spread Spectrum Technique, Code Division Multiple Access (CDMA).

- **MOBILE AD HOC NETWORKS** **(08 Hours)**

  Topology-Based Versus Position Based Approaches, Proactive Routing Protocols, Reactive Routing Protocols, Hybrid Routing Protocols, Position Based Routing Issues and Forwarding Strategies.

- **WIRELESS SENSOR NETWORKS** **(08 Hours)**

  Routing Protocols, Localization Methods, Sensor Deployment Strategies, Traffic Flow Pattern in WSN, One to Many, Many to One and Many to Many, Routing Protocols for Delay Tolerant Networks, Routing protocols for Vehicular Ad-hoc Networks, Wireless Access Protocol, GPS (Global Positioning System) and Applications, RFID and its Applications.

- **INTERNET OF THINGS & ITS APPLICATIONS** **(06 Hours)**

Physical Design, Logical Design, IoT Enabling Technologies, IoT Levels & Deployment Templates, Domain Specific IoTs, IoT and M2M, IoT System Management, IoT Platforms Design Methodology.

- **ADVANCED TOPICS:** 5G and Related Technology and Standards, Recent Trends in Wireless Networks. **(08 Hours)**

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours= 70 Hours)

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3. Books Recommended:

1. M. S. Gast, "802.11 wireless networks: The Definitive Guide", 3/E, O'Reilly, 2017.
2. J. Schiller, "Mobile Communications", 2/E, Pearson India, 2008.
3. Charles Perkins, "Adhoc Networking", Addison Wesley, 1/E, 2000.
4. WCY Lee, " Mobile Cellular Telecommunications: Analog and Digital Systems ", 2/E,TMH, 2017.
5. J. W. Mark and W. Zhuang, "Wireless Communications and Networking", 1/E, Pearson, 2002.

ADDITIONAL REFERENCE BOOKS

1. Robert Faludi, “Building Wireless Sensor Networks”, 1/E, O'REILLY, 2011.
Maciej Kranz, “Building the Internet of Things”, 1/E, Wiley, 2016.

B. Tech. III (CSE) Semester – V
OBJECT ORIENTED TECHNOLOGY (INSTITUTE ELECTIVE-1)
CS361

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the Project development life cycle, software requirements, model concepts.
CO2	apply models' concepts for different perspective to solve the given problem statement.
CO3	analyze the problem requirement, refinement of requirement, model and resolve errors.
CO4	evaluate object oriented models using various testing concepts and matrices.
CO5	utilize the standard tools for the design and development of solution for given problems.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Information Systems, Problems in Information Systems Development, Project Life Cycles, Structured System Analysis and Design, Managing Information System Development, User Involvement and Methodological Approaches, Basic Concepts and Origins of Object Orientation Modelling Concepts, Iterative Development and Unified Process.

- **MODELLING REQUIREMENT (02 Hours)**

  Requirement Capture, Requirement Analysis, Refining the Requirement Models, Object Interaction.

- **STRUCTURAL MODELLING (06 Hours)**

  Object Oriented Fundamentals, Basic Structural Modelling, UML Model, Class Diagrams, Object Diagrams, Packages and Interfaces, Case Studies**.**

- **BEHAVIOURAL AND ARCHITECTURAL MODELLING (10 Hours)**

  Use Case Diagrams, Interaction Diagrams, State Chart Diagrams, Collaborations, Design Patterns, Component Diagrams, Deployment Diagrams, Case Studies.

- **OBJECT ORIENTED TESTING METHODOLOGIES (10 Hours)**

  Implications of Inheritance on Testing, State Based Testing, Adequacy and Coverage, Scenario Based Testing, Testing Workflow, Case Studies, Object Oriented Metrics.

- **COMPONENTS** **(10 Hours)**

  Abuses of Inheritance, Danger of Polymorphism, Mix-In Classes, Rings of Operations, Class Cohesion and Support of States and Behaviour, Components and Objects, Design of a Component, Lightweight and Heavyweight Components, Advantages and Disadvantages of Using Components.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Bahrami A., "Object Oriented System Development", McGraw Hill, 1/E, 2017, ISBN: 9780070265127.
2. Page Jones M., "Fundamentals of Object Oriented Design in UML", Pearson Education, 2/E, 2005, ISBN: 9780321267979.
3. Baugh J., Jacobson I. & Booch G., "The unified Modelling Language Reference Manual", Addison Wesley, 2/E, 2004, ISBN-13: 978-0321718952.
4. Booch G., Rumbaugh J. & Jacobsons I., "The Unified Modelling Language User Guide", Addison Wesley 3/E, 2004, ISBN: 9789332553941.
5. Simon Benett, Steve Mc Robb & Ray Farmer, "Object Oriented System Analysis and Design using UML", McGraw Hill, 2/E, 2004, ISBN: 9780070597914.

ADDITIONAL REFERENCE BOOKS

1. Lar Man C., Applying UML & Patterns: "An Introduction to Object-Oriented Analysis& Design", Addison Wesley, 2002, ISBN: 9780201699463.

B. Tech. III (CSE) Semester – V
SOFTWARE ENGINEERING (INSTITUE ELECTIVE-1)
CS363

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand various phases of software development lifecycle.
CO2	apply appropriate software modelling and testing techniques for the given application scenario.
CO3	analyze various tools and techniques used in software development lifecycle.
CO4	evaluate the software for quality and risk factors.
CO5	design and develop software systems using appropriate software processes.

2. Syllabus

- **INTRODUCTION** **(02 Hours)**

  Software Process - Software Development Life Cycle – Software Qualities - Problems with Software Production – Brooke's No Silver Bullet.

- **SOFTWARE LIFE-CYCLE MODELS** **(04 Hours)**

  Build-and-Fix, Waterfall, Rapid Prototyping, Incremental, Spiral, Agile, Comparison, ISO 9000 – CMM levels , Comparing ISO 9000 and CMM.

- **SOFTWARE REQUIREMENTS AND ANALYSIS** **(06 Hours)**

  Techniques, Feasibility Analysis, Requirements Elicitation, Validation, Rapid Prototyping, OO Paradigms vs. Structured Paradigm, OO Analysis (Modules, Object, Cohesion, Coupling, Objects and Reuse), CASE tools.

- **SOFTWARE SPECIFICATIONS** **(12 Hours)**

  Specification Document, Specification Qualities, Uses, Classification, Operational Behavioural, DFD, Overview of UML Diagrams, Finite State Machines, Petri nets, Descriptive Specifications, ER Diagrams, Logic, Algebraic Specs, Comparison of Various Techniques and CASE Tools.

- **FORMAL METHODS IN SOFTWARE ENGINEERING** **(06 Hours)**

  Formal Specifications, Software Verification & Validation, Clean Room Engineering, Formal Approaches, Model Checking, SPIN Tool for Distributed Software.

- **CASE TOOLS, ISO AND CAPABILITY MATURITY MODEL (04 Hours)**

  CASE Tools, Stepwise Refinement, Cost-Benefit Analysis, Scope of CASE, Versions Control, Current State of the Art in Software Engineering.

- **SOFTWARE TESTING PRINCIPLES (06 Hours)**

  Non-execution & Execution based Testing, Automated Static Analysis, Test-Case Selection, Black-Box and Glass-Box Testing, Testing Objects, Testing vs. Correctness Proof.

- **ADVANCED TOPICS (02 Hours)**

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Rajib Mall: "Fundamentals of Software Engineering", 4/E, PHI Learning, 2015.
2. Sommerville: "Software Engineering", 9/E, Pearson Education, 2010.
3. Stephen R. Schach: "Object Oriented and Classical Software Engineering", McGraw-Hill 8/E, 2010.
4. Roger S. Pressman: "Software Engineering – A Practitioner's Approach", McGraw-Hill 7/E, 2010.
5. Pankaj Jalote: "An Integrated approach to Software Engineering", Narosa, 3/E, 2005.

ADDITIONAL REFERENCE BOOKS

1. Ghezzi, Jazayeri, Mandrioli: "Fundamentals of Software Engineering", 2/E, Pearson Education, 2002.
2. Stephen R. Schach: "Software Engineering with JAVA", TMH, 1999.

B. Tech. III (CSE) Semester – V
SOFT COMPUTING (INSTITUE ELECTIVE-1)
CS365

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the human intelligence, artificial Intelligence and the knowledge about the soft computing approaches.
CO2	apply different soft computing techniques like fuzzy logic, genetic algorithm, neural network and bio-inspired techniques, Evolutionary approaches for problem solving.
CO3	analyse the learning methods for optimizing the solution.
CO4	evaluate performance of different soft computing techniques.
CO5	design and innovate solution for real life example using bio-inspired techniques which mimic human brain abilities.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Concepts of Artificial Intelligence, Need of Machine Learning, Learning Methods, Soft Computing Approach, Fuzzy Computing, Neural Computing, Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Applications.

- **NEURAL NETWORK** **(12 Hours)**

  Model of Artificial Neuron, Neural Network Architectures, Weights, Activation Functions, Learning Models, Learning Rate, Bias, McCulloch Pitts Neuron, Single Layer Neural Network, Multi Layers Neural Networks, Training Algorithms, Back Propagation Method, Supervised Learning, Unsupervised Learning, Radial Basis Functions, Auto-associative Memory, Bi-directional Hetero-associative Memory, Hopfiled Network, Kohonen Self-organizing Network, Learning Vector Quantization, Simulated Annealing Network, Boltzmann Machine, Applications.

- **FUZZY SET THEORY** **(08 Hours)**

  Fuzzy Sets, Membership, Fuzzy Operations, Properties, Fuzzy Relation, Fuzzy Systems, Fuzzy Logic, Fuzzification, Fuzzy Inference, Decision Making, Fuzzy Rule based System, De-fuzzification, Applications.

- **GENETIC ALGORITHMS** **(08 Hours)**

Fundamentals of Genetic Algorithms, Chromosomes, Encoding, Selection Operator, Mutation Probability, Mutation Operator, Crossover Probability, Crossover Operator, Fitness Function, Different Variants of Genetic Algorithms, Applications.

- **NATURE INSPIRED TECHNIQUES AND HYBRID SYSTEM (08 Hours)**

Ant Colony, Particle Swarm Optimization, Integrating Neural Networks, Fuzzy Logic, and Genetic Algorithms, GA based Back Propagation Networks, Fuzzy Back Propagation Networks, Applications.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Timothy J. rd Ross, “Fuzzy Logic with Engineering Applications”, 3rd Ed., Willey, 2010.
2. B. Yagnanarayana, "Artificial Neural Networks", 1st Ed., PHI, 2009.
3. Simon O. Haykin, "Neural Networks and Learning Machines", 3/E, Prentice Hall, 2009.
4. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", PHI, 2007.
5. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", 1st Ed., Addison-Wesley Professional, 2006.

ADDITIONAL REFERENCE BOOKS

1. S. N. Sivanandam, S. N. Deepa, “Principles of Soft Computing”, Wiley India Edition, 2010.
2. Hoffmann F., Koeppen M., Klawonn F., Roy R, “Soft Computing: Methodologies and Applications”, Springer, 2005.
3. Rafik Aziz Aliev, Rashad Rafig Aliyev, “Soft Computing and Its Applications”, World Scientific, 2001.
4. F. Martin, Mc Neill, and Ellen Thro, “Fuzzy Logic: A Practical approach”, AP Professional, 2000.

B. Tech. IV (CSE) Semester – V
COMPUTATIONAL GEOMETRY (INSTITUE ELECTIVE-1)
CS367

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand fundamental problems within computational geometry and general techniques for solving problems.
CO2	apply geometric techniques to real-world problems in various application domains viz., graphics rendering, geographical information systems and robotics.
CO3	analyze geometrical algorithmic techniques for large domains.
CO4	evaluate geometric algorithms and determine its significance and merits with respect to given criteria.
CO5	design and develop algorithms and data structures to solve geometric problems.

2. Syllabus

- **INTRODUCTION** **(02 Hours)**

  Convex Hulls, Degeneracies and Robustness, Application domains.

- **LINE SEGMENT INTERSECTION** **(04 Hours)**

  Line Segment Intersection, Doubly-Connected Edge List, Computing the Overlay of Two Subdivisions, Boolean Operations.

- **POLYGON TRIANGULATION AND PARTITIONING** **(04 Hours)**

  Art Gallery Theorems, Triangulation, Area of Polygon, Monotone Partitioning, Trapezoidalization, Partition into Monotone Mountains, Linear Time Triangulation, Convex Partitioning.

- **CONVEX HULLS** **(04 Hours)**

  The Complexity of Convex Hulls in 2D and 3D Space, Computing Convex Hulls, The Analysis, Convex Hulls and Half-Space Intersection.

- **LINEAR PROGRAMMING** **(04 Hours)**

  The Geometry of Casting, Half-Plane Intersection, Incremental Linear Programming, Randomized Linear Programming, Unbounded Linear Programs, Linear Programming in Higher Dimensions, Smallest Enclosing Discs.

- **ORTHOGONAL RANGE SEARCHING** **(04 Hours)**

  1-Dimensional Range Searching, Kd-Trees, Range Trees, Higher-Dimensional Range Trees, General Sets of Points.

- **VORONOI DIAGRAMS** **(04 Hours)**

  Definition and Basic Properties, Computing the Voronoi Diagram, Voronoi Diagrams of Line Segments, Farthest-Point Voronoi Diagrams, Connection to Convex hulls.

- **POINT LOCATION** **(04 Hours)**

  Point Location and Trapezoidal Maps, Randomized Incremental Algorithm, Dealing with Degenerate Cases, Tail Estimate.

- **MOTION PLANNING** **(04 Hours)**

  Shortest Path, Moving a Disk, Translating a Convex Polygon, Moving a Ladder, Robot Arm Motion, Separability.

- **ARRANGEMENT AND DUALITY** **(04 Hours)**

  Computing the Discrepancy, Duality, Arrangements of Lines, Levels and Discrepancy.

- **ADVANCED TOPICS** **(04 Hours)**

  Interval Trees, Priority Search Trees, Segment Trees, Binary Space Partitions, Robot Motion Planning, Quadtrees, Visibility Graphs.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Joseph O'Rourke, Computational geometry in C, Cambridge University Press, 1998.
2. Mark de Berg, Otfried Cheong, Marc van Kreveld, Mark Overmars, Computational Geometry - Algorithms and Applications, 3/E, Springer, 2008.
3. Franco P. Preparata and Michael Ian Shamos, Computational geometry, Springer, 1985.
4. Csaba D. Toth, Joseph O'Rourke, Jacob E. Goodman, “Handbook of Discrete and Computational Geometry (Discrete Mathematics and Its Applications)”, 3rd Edition, Chapman and Hall/CRC, 2017.
5. Mark de Berg, Marc van Kreveld, Mark Overmars, “Computational Geometry: Algorithms and Applications”, 1st Edition, Springer, 2013.

B. Tech. III (CSE) Semester – V
SIGNALS & SYSTEMS (INSTITUE ELECTIVE-1)
CS369

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about basics signals and their classification, different types of systems, the process of sampling.
CO2	apply the Laplace transform and Z – transform for analysis of continuous-time and discrete-time signals and systems and designing the filters.
CO3	analyze system properties based on impulse response and Fourier analysis for different applications.
CO4	evaluate the laplace transform, fourier transform and Z-transform, system performance, filter performance etc.
CO5	design and innovate a solution using the knowledge about various filter design and signal processing concepts.

2. Syllabus

- **INTRODUCTION TO SIGNALS** **(06 Hours)**

  Signal Classification: Analog vs. Digital Signal, Energy, Power, Even-odd, Periodic-aperiodic, Deterministic-random Signals, Standard Signals: Unit Step, Unit Impulse, Ramp, Exponential, Sinusoids, Continuous-time Signals and Discrete Signals and their Properties, Discrete Exponential Functions and their Properties, Discrete Unit Step and Impulse Signals and their Properties.

- **INTRODUCTION TO SYSTEMS** **(08 Hours)**

  System Classifications, Analog-digital Systems, Continuous-discrete Time Systems, Linearity, Time Invariance, Memory, Linear-time-invariant Systems, Causality, System Stability, System Response: Impulse Response, Unit Step Response, Convolution.

- **SIGNAL TRANSFORMS AND SAMPLING** **(08 Hours)**

  Laplace Transform, Fourier Series and Fourier Transform, Digital Sequences, Linear Difference Equations with Constant Coefficients, Realizations, Frequency-domain Representation of Discrete-time Signals and Systems, Sampling of Continuous-time Signals: Periodic Sampling, Frequency-Domain Representation of Sampling, Reconstruction of a Band-limited Signal, Changing the Sampling Rate Using Discrete-time Processing, Quantization, Aliasing, Interpolation, Decimation.

- **Z-TRANSFORM** **(04 Hours)**

Properties of the Z-transform, Transfer Function Representation, Inverse Z-transform, Z-transform Applied to Difference Equations, The Complex Convolution Theorem, Stability of Discrete-time Systems, Frequency Response of Discrete-time Systems.

- **DISCRETE FOURIER TRANSFORM (04 Hours)**

Discrete-Time Fourier Transform (DTFT), The Discrete Fourier Series, The Fourier Transform of Periodic Signals, Discrete Fourier Transform (DFT), Properties of the DFT, System Analysis via the DTFT and DFT, Circular Convolution, Linear Convolution Using the DFT, Implementation of the DFT Using Convolution

- **FAST FOURIER TRANSFORM (FFT) ALGORITHMS (04 Hours)**

Decimation in Time FFT, Introduction to Radix-2 FFTs, Some Properties of Radix-2 Decimation in Time FFT, Decimation in Frequency Algorithm, Computing the Inverse DFT by Doing a Direct DFT.

- **FILTERS AND ADVANCED SIGNAL PROCESSING (08 Hours)**

Multirate Signal Processing, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) Filter Design, Power Spectral Density, Applications of Digital Signal Processing.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Alan V. Oppenheim and Alan S. Willsky, “Signals and Systems”, 2nd Edition, Pearson Education, 2014.
2. Vinay K. Ingle and John G. Proakis, “Digital Signal Processing using MATLAB”, 2nd Edition, Companion Series 2000.
3. Johnny Johnson,” Introduction to Digital Signal Processing”, PHI, New Delhi, 1997.
4. John G. Proakis & Dimitris G. Manolakis, “Digital Signal Processing: Principles, Algorithms, and Applications”, 3/E, PHI,1996
5. Alan W. Oppenheim & Ronald W. Schafer, “Discrete-time Signal Processing”, 2nd Edition, PHI, New Delhi, 1992.

B. Tech. II (CSE) Semester – V
CI/CD Tools
CS305

	L	T	P	Credit
Scheme	**0**	**0**	**2**	**01**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	Understand the concepts of Continuous Inspection, Continuous Integration, and Continuous Deployment, and the difference between them.
CO2	learn how to use an open source automation server to build, test, and deploy the software using Jenkins Pipeline and Jenkins File.
CO3	understand the pain points in the traditional Software Development Life Cycle which paved the way for CI / CD/ DevOps.
CO4	learn how to create a multi-stage Jenkins job and visualize the complicated Jenkins build pipeline with Jenkins build pipeline plugin.
CO5	be able to program with Docker containers in a Jenkins context

2. Syllabus

Issues in the Old School Software Development Life Cycle, Bringing in Continuous Integration, The Open Source Automation Server; Continuous Integration and Continuous Delivery for solving the pain points in software development; Maturing to Continuous Deployment. DevOps, Jenkins; Programming with the CI/CD tools; Programming with Docker containers in a Jenkins context.

Practicals will be based on the coverage of the above topics separately. (28 Hours)

(Total Contact Time: 28 Hours)

B. Tech. III (CSE) Semester – VI
INFORMATION SECURITY AND CRYPTOGRAPHY (CORE-20)
CS302

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of the course, the students will be able to**	
CO1	Understand the concepts related to Information Security and Cryptography.
CO2	Apply the concept of security services and mechanisms from the application developers and network administrator's perspective.
CO3	Analyse the security schemes for their use in different application scenarios.
CO4	Evaluate and asses the computer and network systems for associated risks.
CO5	Design the security schemes depending on the organisation's requirements.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Security Attacks, Services and Mechanisms, CIA Traid, Security Design Principles, Attack Surface and Attack Trees, Model for Network Security, Introduction to Number Theory, Shannon's Theory

- **SYMMETRIC KEY CIPHERS** **(10 Hours)**

  Substitution Techniques, Transposition Techniques, Digital Watermarking and Steganography, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Block Cipher Modes of Operation, Random Bit Generation and Stream Ciphers

- **ASYMMETRIC KEY CIPHERS** **(08 Hours)**

  Principles of Public-Key Cryptosystems, RSA, Diffie-Hellman Key Exchange, Elgamal Cryptosystem, Elliptic Curve Cryptography.

- **CRYPTOGRAPHIC HASH FUNCTIONS** **(04 Hours)**

  Hash Functions and Data Integrity, Security of Hash Functions-The Random Oracle Model, Iterated Hash Functions- Merkel Damgard Construction, Secure Hash Algorithm (SHA).

- **MESSAGE AUTHENTICATION** **(06 Hours)**

  Message authentication requirements, message authentication codes (MAC) based on hash functions-HMAC and block ciphers-DAA and CMAC, Authenticated Encryption-CCM and GCM

- **DIGITAL SIGNATURES (06 Hours)**

  Security requirements, RSA Digital Signatures, NIST Digital Signature Algorithm (DSA), Elliptic Curve Digital Signature Algorithm (ECDSA), RSA-PSS Digital Signature Algorithm

- **IDENTIFICATION SCHEMES AND ENTITY AUTHENTICATION (02 Hours)**

  Challenge Response Protocols, Password Based Authentication, Zero Knowledge Schemes.

- **ADVANCED TOPICS (02 Hours)**

  Practicals will be based on the coverage of the above topics. (28 Hours)

  Tutorials will be based on the coverage of the above topics. (14 Hours)

  (Total Contact Time: 42 Hours + 28 Hours + 14 Hours =84 Hours)

3. Books Recommended:

1. William Stallings, Cryptography and Network Security – Principles and Practice, 7th Edition, Pearson Education, 2013.
2. Forouzan and Mukhopadhyay, Cryptography and Network Security, 3rd Edition, McGraw Hill, 2015.
3. Menezes Bernard, Network Security and Cryptography, 1st Edition, Cengage Learning India, 2010.
4. Douglas Stinson, Cryptography: Theory and Practice, 3rd Edition, CRC Press, 2006.
5. William Stallings, Network Security Essentials: Applications and Standards, 3rd Edition, Pearson Education, 2009.

ADDITIONAL REFERENCE BOOKS

1. Menezes, Oorschot and Vanstone, Handbook of Applied Cryptography, CRC Press, 1996.
2. Dhiren Patel,Information Security: Theory and Practice, PHI, 2008.

B. Tech. III (CSE) Semester – VI
CLOUD COMPUTING (CORE-21)
CS304

	L	T	P	Credit
Scheme	**3**	**1**	**2**	**05**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of important concepts, key technologies, strengths, and limitations of cloud computing along with its state of the art applications.
CO2	give cloud enabled solutions.
CO3	analyze effectiveness of cloud based solutions.
CO4	identify and evaluate services being offered by different cloud providers.
CO5	design, develop and deploy cloud based applications.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Nutshell of Cloud Computing, Feature Characteristics and Components of Cloud Computing, Challenges, Risks and Approaches of Migration into Cloud, Evaluating the Cloud's Business Impact and Economics, Future of the Cloud.

- **CLOUD COMPUTING ARCHITECTURE** **(14 Hours)**

  Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor, VMware, KVM, Xen. Virtualization of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of Datacentre, Cloud Reference Model, Layer and Types of Clouds, Services Models, Datacentre Design and Interconnection Network, Architectural Design of Computer and Storage Clouds, Micro Service Architecture.

- **CLOUD SERVICE MODELS** **(04 Hours)**

  Introduction, PAAS – Working Principle, Example, SAAS – Working Principle, Example, IAAS – Working Principle, Examples, Service Level Agreements (SLAs), Billing & Accounting, Comparing Scaling Hardware, Economics of Scaling, Managing Data.

- **CLOUD SECURITY** **(06 Hours)**

Infrastructure Security, Data Security and Storage, Identity and Access Management, Access Control, Trust and Reputation, Authentication in Cloud Computing.

- **CASE STUDY ON OPEN SOURCE AND COMMERCIAL CLOUDS (12 Hours)**

  Eucalyptus, VMware Cloud, GCP, AWS, MS AZURE, IBM CLOUD, Elastic Search.

Tutorial will be based on the coverage of the above topics. (14 Hours)

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 14 Hours + 28 Hours = 84 Hours)

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3. Books Recommended:

1. Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", 2nd Edition, Springer, 2012.
2. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms",1st Edition, Wiley, 2011.
3. Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", 1st Edition, Wiley-India, 2010.
4. Barrie Sosinsky: "Cloud Computing Bible", 1st Edition, Wiley-India, 2010.
5. Tim Mather, Subra Kumara swamy, Shahed Latif, “Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance”, 1st Edition, O'Reilly Media, 2009.

B. Tech. III (CSE) Semester – VI
DATA SCIENCE (CORE ELECTIVE-2/3)
CS322

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At end of the Course student will be able to**	
CO1	understand types of data and various data science approaches.
CO2	apply various data pre-processing and manipulation techniques including various distributed analysis paradigm using hadoop and other tools and perform advance statistical analysis to solve complex and large dataset problems.
CO3	analyze different large data like text data, stream data, graph data.
CO4	interpret and evaluate various large datasets by applying Data Mining techniques like clustering, filtering, factorization.
CO5	design the solution for the real life applications.

2. Syllabus

- **INTRODUCTION** **(02 Hours)**

  Examples, Applications and Results Obtained Using Data Science Techniques, Overview of the Data Science Process.

- **MANAGING LARGESCALE DATA** **(02 Hours)**

  Types of Data and Data Representations, Acquire Data (E.G., Crawling), Process and Parse Data, Data Manipulation, Data Wrangling and Data Cleaning.

- **PARADIGMS FOR DATA MANIPULATION, LARGE SCALE DATA SET** **(08 Hours)**

  Mapreduce (Hadoop), Query Large Data Sets in Near Real Time with Pig and Hive, Moving from Traditional Warehouses to Map Reduce, Distributed Databases, Distributed Hash Tables.

- **TEXT ANALYSIS** **(10 Hours)**

  Data Flattening, Filtering and Chunking, Feature Scaling, Dimensionality Reduction, Nonlinear Factorization, Shingling of Documents, Locality Sensitive Hashing for Documents, Distance Measures, LSH Families for Other Distance Measures, Collaborative Filtering.

- **MINING DATA STREAM** **(08 Hours)**

Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Moments, Windows, Clustering for Streams.

- **ADVANCED DATA ANALYSIS** **(12 Hours)**

  Graph Visualization, Data Summaries, Hypothesis Testing, ML Model-Checking and Comparison, Link Analysis, Mining of Graph, Frequent Item Sets Analysis, High Dimensional Clustering, Hierarchical Clustering, Recommendation Systems.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Books Recommended:

1. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'reilly Media, 2015, ISBN: 9781491901687.
2. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014, ISBN: 9781107077232.
3. Peter Bruce, Andrew Bruce, "Practical Statistics for Data Scientists: 50" by , 1st Edition, O'reilly publishing house, 2017, ISBN: 9781491952962.
4. Joel Grus, J. "Data science from scratch", 1st Edition, O'Reilly Media, 2015, ISBN: 9781491901410.
5. Montgomery, Douglas C., and George C. Runger. "Applied statistics and probability for engineers", John Wiley & Sons, 7th Edition, 2018, ISBN: 9781119400363.

B. Tech. III (CSE) Semester – VI
DATA VISUALIZATION (CORE ELECTIVE-2/3)
CS324

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the design principles of data visualization, categories of data visualization, and data visualization tools.
CO2	apply visualization approaches for animation, representing geospatial, network and other high dimensional data.
CO3	analyze the data visualization categories applicability according to the given data.
CO4	evaluate data visualization both in qualitative and quantitative manner by using various mapping.
CO5	represent real-time data using various visualizations tools and techniques.

2. Syllabus

- **INTRODUCTION (06 Hours)**

  Data Visualization, Design, Data and Tasks, Data Types, Dataset Types, Basic Charts and Plots, Use of Statistical Indicators, Multivariate Data Visualization, Principles of Perception, Color, Design, and Evaluation, Graphical Integrity, Data-Ink Ratio, Aspect Ratios & Scales.

- **VISUALISATION FORMATS AND STRATEGIES (06 Hours)**

  Formats-Static Graphs, Interactive Graphs, Infographics, Websites, Animated Videos, GIFs. Strategies-Qualitative and Text-Based Data, Color-Coding, Timelines, Calendars, and Diagrams, Filtering, Parallel Coordinates, Aggregation.

- **DATA VISUALIZATION CATEGORY (10 Hours)**

  Text Data Visualization, Document Visualization, Images and Video, Interactivity and Animation, Temporal Data Visualization, Part-to-Whole Relationships Visualization, Geospatial Data Visualization, Hierarchical Data Visualization, Network Data Visualization, High-Dimensional Data Visualization, Maps.

- **DATA VISUALISATION SYSTEM (10 Hours)**

Visual Story Telling, Messaging, Effective Presentations, Design for Information, Visualization and Arts, Visualization Systems, Database Visualization, Redesign Principles and Design Dimensionality, Rapidly Prototype Visualizations, Quantitatively and Qualitatively Evaluation of Visualizations.

- **DATA-DRIVEN DOCUMENTS (D3) (06 Hours)**

  Introduction, Relative vs. Absolute Judgments, Luminance Perception, D3 Key Features and Concepts, Visualization Process, Design Iterations, Sketching, Data Types, Statistical Graphs, Interaction Design, Brushing and Linking, Animation, Trees and Networks, Radial Layouts, Linear Layouts, Maps, Tree maps, Choropleth Maps, Cartograms, Symbol Maps, Flow Maps, Real-Time Maps.

- **OTHER DATA VISUALISATION TOOLS (04 Hours)**

  Excel, R, Tableau, Python

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Books Recommended:

1. Scott Murray "Interactive Data Visualization for the Web" O'Reilly Media, 2/E, 2017.
2. Alberto Cairo, “The Truthful Art: Data, Charts, and Maps for Communication” 1/E, Berkeley, California: New Riders, 2016, ISBN: 9780321934079.
3. Colin Ware, “Visual Thinking for Design”, Morgan Kaufman Series, 1/E, 2008, ISBN: 9780123708960.
4. Ben Fry "Visualizing Data: Exploring and Explaining Data with the Processing Environment" O'Reilly Media, 1/E, 2008, ISBN: 9780596514556.
5. Few, S, “Information dashboard design: The effective visual communication of data Sebastopol” O’Reilly, 1/E, 2006, ISBN: 9780596100162.

ADDITIONAL REFERENCE BOOKS

1. Edward Tufte "The Visual Display of Quantitative Information" Graphics Press, 2/E, 2001, ISBN: 9781930824133.

B. Tech. III (CSE) Semester – VI
HIGH PERFORMANCE COMPUTING (CORE ELECTIVE – 2/3)
CS326

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	learn concepts, issues and limitations related to parallel computing architecture and software development.
CO2	apply different parallel models of computation, parallel architectures, interconnections and various memory organization in modern high performance architectures.
CO3	analyze the algorithms to map them onto parallel architectures for parallelism.
CO4	evaluate the performance of different architectures and parallel algorithms with different aspects of real time problems.
CO5	design parallel programs for shared-memory architectures and distributed-memory architectures using modern tools like OpenMP and MPI, respectively for given problems.

2. Syllabus

- **PARALLEL PROCESSING CONCEPTS (08 Hours)**

  Levels of Parallelism (Instruction, Transaction, Task, Thread, Memory, Function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation etc.), Architectures: N-wide Superscalar Architectures, Multi-core, Multi-threaded.

- **FUNDAMENTAL DESIGN ISSUES IN PARALLEL COMPUTING (06 Hours)**

  Synchronization, Scheduling, Job Allocation, Job Partitioning, Dependency Analysis, Mapping Parallel Algorithms onto Parallel Architectures, Performance Analysis of Parallel Algorithms.

- **FUNDAMENTAL LIMITATIONS FACING PARALLEL COMPUTING (06 Hours)**

  Bandwidth Limitations, Latency Limitations, Latency Hiding/Tolerating Techniques and their Limitations, Power-Aware Computing and Communication, Power-Aware Processing Techniques, Power-Aware Memory Design, Power-Aware Interconnect Design, Software Power Management

- **PARALLEL PROGRAMMING (10 Hours)**

  Programming Languages and Programming-Language Extensions for HPC, Inter-Process Communication, Synchronization, Mutual Exclusion, Basics of Parallel Architecture, Parallel

Programming Parallel Programming with OpenMP and (Posix) Threads, Message Passing with MPI.

- **PARALLEL PROGRAMMING WITH CUDA** **(08 Hours)**

  Processor Architecture, Interconnect, Communication, Memory Organization, and Programming Models in High Performance Computing Architectures: (Examples: IBM CELL BE, Nvidia Tesla GPU, Intel Larrabee Micro architecture and Intel Nehalem Micro architecture), Memory Hierarchy and Transaction Specific Memory Design, Thread Organization.

- **ADVANCE TOPICS** **(04 Hours)**

  Petascale Computing, Optics in Parallel Computing, Quantum Computers.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. John L. Hennessy and David A. Patterson, “Computer Architecture -- A Quantitative Approach”, 4th Edition, Morgan Kaufmann Publishers, 2017, ISBN 13: 978-0-12-370490-0.
2. Barbara Chapman, Gabriele Jost and Ruud van der Pas, “Using OpenMP: portable shared memory parallel programming”, The MIT Press, 2008, ISBN-13: 978-0-262-53302-7.
3. Marc Snir, Jack Dongarra, Janusz S. Kowalik, Steven Huss-Lederman, Steve W. Otto, David W. Walker, “MPI: The Complete Reference, Volume2”, The MIT Press, 1998, ISBN: 9780262571234.
4. Pacheco S. Peter, “Parallel Programming with MPI”, Morgan Kaufman Publishers, 1992, Paperback ISBN: 9781558603394.
5. https://docs.nvidia.com/cuda/cuda-c-programming-guide/index.html.

B. Tech. III (CSE) Semester – VI
SOCIAL NETWORK ANALYSIS (CORE ELECTIVE-2/3)
CS328

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the social network data, relations among data, identification of network structure and relevant programming.
CO2	apply the model for the solution of social network problem statement to generate data sets, relations, graph.
CO3	analyze the problem solution for social network analysis considering social influence.
CO4	evaluate programming solutions with different aspects of social network analysis.
CO5	design an innovative optimised solution for the social network application problem using network dynamics.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  Introduction of Social Networks, Social Networks Data, Development of Social Network Analysis, Analyzing Social Network Data, Formal Methods, Paths and Connectivity, Graphs to Represent Social Relations, Working with Network Data, Network Datasets, Strong and Weak Ties, Closure, Structural Holes, and Social Capital, Measures for Social Network Analysis.

- **SOCIAL INFLUENCE** **(09 Hours)**

  Homophily, Mechanisms Underlying Homophily, Social Influence, Affiliation, Identification of Roles, Tracking Link Formation in OnLine Data, Spatial Model of Segregation - Positive and Negative Relationships , Structural Balance, Applications of Structural Balance, Weaker Form of Structural Balance.

- **WEB INFORMATION NETWORKS** **(09 Hours)**

  The Structure of the Web, World Wide Web, Information Networks, Hypertext, and Associative Memory, Web as a Directed Graph, Bow-Tie Structure of the Web, Link Analysis and Web Search, Searching the Web: Ranking, Link Analysis using Hubs and Authorities, Page Rank, Link Analysis in Modern Web Search, Applications, Spectral Analysis, Random Walks, and Web Search, Social Network Visualization.

- **SOCIAL NETWORK MINING** **(08 Hours)**

Social Networks, Geography, Neighbourhood Effects, Clustering of Social Network Graphs: Betweenness, Girvan Newman Algorithm, Discovery of Communities, Cliques and Bipartite Graphs, Graph Partitioning Methods, Matrices, Eigen Values, Simrank.

- **NETWORK DYNAMICS** **(08 Hours)**

Network Effects of Local Social Networks and Global Social Networks, Spread of Behaviour, Cascading Behaviour in Networks: Diffusion in Networks, Modelling Diffusion, Cascades and Cluster, Thresholds, Extensions of the Basic Cascade Model, Six Degrees of Separation, Structure and Randomness, Decentralized Search, Empirical Analysis and Generalized Models, Analysis of Decentralized Search, Problem Solving.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Books Recommended:

1. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2/E, 2014, ISBN: 9781316638491.
2. Borgatti, S. P., Everett, M. G. & Johnson, J. C., “Analyzing social networks”, SAGE Publications Ltd; 1/E, 2013, ISBN: 9781446247419.
3. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning about a highly connected world”, Cambridge Univ. Press, 2010, ISBN: 9780521195331.
4. Robert A., Hanneman and Mark Riddle, “Introduction to social network methods”, University of California, 2005.
5. John Scott, “Social Network Analysis: A Handbook”, SAGE Publications Ltd; 2/E, 2000, ISBN: 9780761963394.

ADDITIONAL REFERENCE BOOKS

1. Wasserman S. & Faust K., “Social Network Analysis: Methods and Applications”, Cambridge University Press, 1/E, 1994, ISBN: 9780521387071.

B. Tech. III (CSE) Semester – VI
DIGITAL FORENSICS (CORE ELECTIVE-2/3)
CS330

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	get exposure of digital forensic, cryptography and investigation techniques on different computing platforms as well as mobile devices.
CO2	analyze cyber-attacks to assist conventional forensic to investigate digital platforms.
CO3	create disk images, recover deleted files and extract hidden information.
CO4	describe the representation and organization of data and metadata within modern computer systems with the use of various forensic tools.
CO5	to define research problems and develop effective solutions for digital forensic and can compose a draft which can be used for legal procedure.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Computer Forensics: Computer Crimes, Evidence, Extraction, Preservation, Analogies to Traditional Forensics and Differences from Traditional Forensics, Hardware and Operating Systems: Structure of Storage Media/Devices; Windows / Macintosh / Linux -- Registry, Boot Process, File Systems, File Metadata.

- **DATA RECOVERY** **(02 Hours)**

  Identifying Hidden Data, Encryption/Decryption, Steganography, Recovering Deleted Files.

- **DIGITAL EVIDENCE ON WINDOWS SYSTEM** **(06 Hours)**

  Deleted Data, File Carving, Hibernation, Sleep, Hybrid Sleep, Registry Structure, Attribution, External Devices, Print Spooling, Recycle Bin, Date and Time Stamp, Thumbnail Cache, Restore Points, Shadow Copy, Link Files.

- **DIGITAL EVIDENCE ON UNIX SYSTEM** **(04 Hours)**

  UNIX Boot Disk, File System, Data Recovery, Log Files, File System Traces, Internet Traces.

- **NETWORK FORENCIS** **(04 Hours)**

Collecting and Analysing Network-Based Evidence, Reconstructing Web Browsing, Email Activity, and Windows Registry Changes, Intrusion Detection, Tracking Offenders, etc.

- **INTERNET AND EMAIL FORENSICS** **(06 Hours)**

  Internet Overview, Role of Internet in Criminal Investigation, Online Anonymity and Self-Protection, Web Technology, Web Browsers, Cookies, Cache, History, Browser Artifacts in Registry, Chat Clients, Email Protocols, Email Evidence, Tracing Email, Email Forgery, Social Networking Sites.

- **MOBILE DEVICE FORENSICS** **(04 Hours)**

  Cellular Network-Basics-Components-Types, Mobile Operating Systems, Cellphone Evidences-Call-detail Records-Collection-Handling-Subscriber Identity Modules-Cellphone Acquisition, Cellphone Forensics Tools, GPS.

- **SOFTWARE REVERSE ENGINEERING** **(04 Hours)**

  Software Reverse Engineering Defend Against Software Targets for Viruses, Worms and Other Malware, Improving Third-Party Software Library, Identifying Hostile Codes-Buffer Overflow, Provision of Unexpected Inputs, etc.

- **ADVANCE TOPICS AND LEGAL ISSUES** **(08 Hours)**

  Forensic Tools, Forensic report writing, Criminal Law, Expectation of Privacy, Private Searches, Privacy Law, Search Warrant.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Eoghan Casey, "Digital evidence and computer crime: Forensic science, computers, and the internet", 3rd Edition, Academic press, 2011.
2. Dejey and Murugan, "Cyber Forensics", 1st Edition, Oxford University Press, 2018.
3. Sammons, John, "The basics of digital forensics: the primer for getting started in digital forensics", 2nd Edition, Elsevier, 2012.
4. Sherri Davidoff, Jonathan Ham, "Network Forensics: Tracking Hackers Through Cyberspace", Prentice Hall, 2012.
5. Computer Forensics: Hard Disk and Operating Systems, 2nd Edition, EC Council, September 17, 2009.

ADDITIONAL REFERENCE BOOKS

1. Computer Forensics Investigation Procedures and response, EC-Council Press, 2010.
2. Brian Carrier, "File System Forensic Analysis", Addison-Wesley Professional, March 27, 2005.

3. Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, 'The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory", ISBN: 978-1-118-82509-9, July 2014.

B. Tech. III (CSE) Semester – VI
CELLULAR NETWORK AND MOBILE COMPUTING
(CORE ELECTIVE - 2/3)
CS332

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the signalling system and different spread spectrum techniques.
CO2	apply the signal estimation and equalization techniques.
CO3	analyze the cellular system and mobile applications for different types of networks like GSM, GPRS, CDMA and Adhoc.
CO4	evaluate the performance of the protocols, mobile applications and network solutions for wireless communication.
CO5	design and develop the techniques to solve the issues of communication in different types of networks.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Wired Network vs. Wireless Network, Overview of Wireless Applications, Wireless Transmission: Path Loss, Multi-path Propagation, Doppler Shift, Fading, Time Division Multiplexing, Frequency Division Multiplexing, Spread Spectrum Technique, Direct Sequence Spread Spectrum, Frequency Hopping Spread Spectrum, CDMA - Code Division Multiple Access, OFDM - Orthogonal Frequency Division Multiple Access, Satellite Communication.

- **WIRELESS CHANNEL** **(08 Hours)**

  Statistical Modeling of Multipath Fading Channel, Frequency Selective and Non-selective Fading Channels, Flat Fading Channels, Path-loss, Propagation Model, Shadowing, Rayleigh Fading, Equalization, Channel Modeling and Estimation, Blind Channel Estimation, AWGN Channel.

- **CELLULAR SYSTEM** **(10 Hours)**

  Cellular Network Organization, Cellular System Evolution, Cellular Fundamentals: Capacity, Topology, Operation of Cellular Systems, Cellular Geometry, Frequency Reuse, Cell Spitting, Sectoring, Handoff, Power Control, Case study: Global System for Mobile communication

(GSM) Network, General Packet Radio Service (GPRS), Code Division Multiple Access (CDMA 2000), Cordless System, Wireless Local Loop, Mobility Management-Location Management, HLR-VLR Scheme, Hierarchical Scheme, Predictive Location Management Schemes, Types of Interference, Estimation of Adjacent Channel Interference and Co-channel Interference, Trunk Efficiency, Grade of Service, Blocking Probabilities, Propagation Models, Frequency Management and Channel Assignment.

- **AD HOCWIRELESS NETWORK** **(08 Hours)**

Cellular vs. Ad Hoc, Applications, Issues, MAC protocols, Routing Protocols, Transport Layer Protocol, Multicasting protocols, Wireless Access Protocol, Standards: IEEE 802.11, Wi-Fi, Wireless Broadband-Wi-MAX, Bluetooth, IEEE 802.15, Security in Wireless Network, Hyper LAN.

- **MOBILE COMPUTING** **(10 Hours)**

Mobile Computing, Issues: Resource Management, Interference, Bandwidth, Frequency Reuse, Mobile Data Transaction Models, File Systems, Mobility Management, Security, Mobile Computing Architecture, Mobile IP Protocol, Mobile TCP Protocol, Wireless Application Protocol, Security Issues in Mobile Computing, Server-Client programming.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Books Recommended:

1. William Stallings, "Wireless Communications & Networks", 2/E, Pearson Education India, Reprint 2007.
2. Jochen Schiller, "Mobile Communications", 2/E, Pearson Education India, reprint 2007.
3. T S Rappaport, "Wireless Communications: Principles & Practice", 2/E, Pearson Education, 2002.
4. C E Perkins, "Ad Hoc Networking", 1st Edition, Addison Wesley, 2000.
5. Asoke K Talukder, Roopa R Yavagal, “Mobile Computing: Technology, Applications and Service Creation”, Tata McGraw-Hill , Third reprint 2006.

ADDITIONAL REFERENCE BOOKS

1. Sandeep Singhal, "The Wireless Application Protocol", Addison Wesley, India, reprint 2001.
2. C. Siva Ram Murthy and B. S. Manoj,“Ad Hoc Wireless Networks: Architectures and Protocols”, Pearson education 2007.
3. Gottapu Sasibhushana Rao, “Mobile Cellular Communication”, Pearson, 2013.

B. Tech. IV (CSE) Semester – VI
SERVICE ORIENTED ARCHITECTURES (CORE ELECTIVE-2/3)
CS334

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of course, students will be able to**	
CO1	acquire knowledge of SOA ecosystem from a business/technical perspective.
CO2	apply SOA and web services concepts for application design and development.
CO3	analyze different web services in terms of business/technical perspective.
CO4	evaluate SOA based system in terms of business/technical perspective.
CO5	design and develop SOA based system.

2. Syllabus

- **INTRODUCTION** **(10 Hours)**

  XML Document Structure, Well Formed and Valid Documents, Namespaces, DTD, XML Schema, X-Files, Parsing XML using DOM –SAX, XML Transformation and XSL, XSL Formatting, Modelling Databases in XML.

- **SERVICE ORIENTED ARCHITECTURE** **(10 Hours)**

  Characteristics of Service Oriented Architecture, Comparing SOA with Client-Server and Distributed Architectures, Characteristics of SOA, Benefits of SOA, Principles of Service Orientation, Service Layers, Business Process Management.

- **WEB SERVICES** **(14 Hours)**

  SOA and Web Services, Web Services Protocol Stack, Service Descriptions, WSDL, Messaging with SOAP, Service Discovery, UDDI, Service Level Interaction Patterns, XML and Web Services, Enterprise Service Bus, Message Exchange Patterns, WS Transactions, Web Services Technologies, JAX-RPC, JAX-WS, Web Service Standards, WS-RM, WS-Addressing, WS-Policy, Service Orchestration and Choreography, Composition Standards , BPEL, Service Oriented Analysis and Design, Search Engine Optimization.

- **BUILDING SOA-BASED APPLICATIONS** **(08 Hours)**

  Service Oriented Analysis and Design, Service Modelling, Design Standards and Guidelines, Composition, WS-BPEL, WS-Coordination, WS-Policy, WS-Security, SOA Support in Java, B2B and

B2C E-commerce Development, REST Architecture, REST Full APIs, Micro Service Architecture for Highly Scalable Applications.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Books Recommended:

1. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", 1st Edition, Pearson Education, 2005.
2. Eric Newcomer, Greg Lomow, "Understanding SOA with Web Services", 1st Edition, Pearson Education, 2005.
3. Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004.
4. James McGovern, Sameer Tyagi, Michael E. Stevens, Sunil Mathew, "Java Web Services Architecture", 1st Edition, Morgan Kaufmann Publishers, 2003.
5. Ron Schmelzer et al. "XML and Web Services", 1st Edition, Pearson Education, 2002.

ADDITIONAL REFERENCE BOOKS

1. Frank P. Coyle, "XML, Web Services and the Data Revolution", Pearson Education, 2005.

B. Tech. III (CSE) Semester – VI
OPTIMIZATION METHODS (CORE ELECTIVE-2/3)
CS336

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about optimization methods to model real-life problems.
CO2	apply the knowledge of optimization techniques to solve engineering optimization problems.
CO3	analyze the complexity and efficiency of optimization techniques.
CO4	evaluate various optimization methods for a given problem.
CO5	design and develop a solution to complex engineering problem with the help of suitable optimization technique.

2. Syllabus

- **INTRODUCTION AND MATHEMATICAL REVIEW** **(04 Hours)**

  Methods of Proof, Vector Spaces and Matrices, Real Vector Space, Rank of a Matrix, Linear Equations, Inner Product and Norms, Linear Transformations, Eigen Values and Eigen Vectors, Orthogonal Projections, Quadratic Forms, Matrix Norms, Line Segments, Hyperplanes and Linear Varieties, Convex Sets, Neighbourhood, Polytopes and Polyhedral, Sequences and Limits, Differentiability, The Derivative Matrix, Differentiation Rules, Level Sets and Gradients, Taylor Series.

- **UNCONSTRAINED OPTIMIZATION** **(12 Hours)**

  Basics of Set-Constrained and Unconstrained Optimization, Conditions for Local Minimizers, Golden Section Search, Fibonacci Search, Newton's Method, Secant Method, Gradient Methods, The Method of Steepest Descent, Analysis of Gradient Methods, Convergence, Convergence Rate, Levenberg-Marquardt Modification, Newton's Method for Nonlinear Least-Squares, Conjugate Direction Methods, Quasi-Newton Methods, Approximating the Inverse Hessian, The Rank One Correction Formula, The DFP Algorithm, The BFGS Algorithm, Solving Ax = b, Least-Squares Analysis , Recursive Least-Squares Algorithm, Kaczmarz's Algorithm, Unconstrained Optimization and Neural Networks, Single-Neuron Training, Backpropagation Algorithm, Genetic Algorithms, Chromosomes and Representation Schemes, Selection and Evolution, Real-Number Genetic Algorithms.

- **LINEAR PROGRAMMING** **(10 Hours)**

Introduction, Examples, Two-Dimensional Linear Programs, Convex Polyhedra and Linear Programming, Standard Form Linear Programs, Basic Solutions, A Geometric View of Linear Programs, Simplex Methods, Solving Linear Equations Using Row Operations, The Canonical Augmented Matrix, Updating the Augmented Matrix, The Simplex Algorithm, Matrix Form of the Simplex Method, The Two-Phase Simplex Method, The Revised Simplex Method, Duality, Dual Linear Programs, Properties of Dual Problems, Non-Simplex Methods, Khachiyan's Method, Affine Scaling Method, Karmarkar's Method.

- **NONLINEAR CONSTRAINED OPTIMIZATION** **(10 Hours)**

Problems with Equality Constraints, Tangent and Normal Spaces, Lagrange Condition, Second-Order Conditions, Minimizing Quadratics Subject to Linear Constraints, Problems with Inequality Constraints, Karush-Kuhn-Tucker Condition, Second-Order Conditions, Convex Optimization Problems, Convex Functions, Algorithms for Constrained Optimization, Projections, Projected Gradient Methods, Penalty Methods.

- **SPECIAL TOPICS FOR APPLIED AREAS** **(6 Hours)**

Accelerated First Order Methods, Bayesian Methods, Coordinate Methods, Cutting Plane Methods, Interior Point Methods, Optimization Methods for Deep Learning, Parallel and Distributed Methods, Robust Optimization Problems and Methods, Stochastic Mini-batch Methods, Submodular Optimization Problems and Methods, Variance Reduced Stochastic Methods, Zeroth Order Methods.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Books Recommended:

1. E. K. P. Chong and S. Zak, “An introduction to optimization”, 2nd Edition, John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
2. T. Hastie, R. Tibshirani and M. J. Wainwright, “Statistical Learning with Sparsity: The Lasso and Generalizations”, 1st Edition, Chapman and Hall/CRC Press, 2015.
3. S. Sra, S. Nowozin, and S. Wright (eds), “Optimization for Machine Learning”, 1st Edition, The MIT Press, 2011.
4. Y. Nesterov, “Introductory lectures on convex optimization”, 2nd Edition, Kluwer-Academic, 2003.
5. S. Boyd and L. Vandenberghe, “Convex Optimization”, 1st Edition, Cambridge University Press, 2003.

ADDITIONAL REFERENCE BOOKS

1. D. Bertsekas, Nonlinear Programming, 3rd Edition, Athena Scientific, 1999.
2. R. Fletcher, Practical methods of optimization, 2nd Edition, Wiley, 2000, New York.

B. Tech. IV (CSE) Semester – VI
VIDEO CODEC STANDARDS AND DESIGN
(CORE ELECTIVE – 2/3)
CS338

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand image and video compression standards and related algorithms.
CO2	apply motion Estimation and Compensation techniques to enhance Motion Model.
CO3	analyse working of various coding methods and Video Coding Standards to undertake meaningful CODEC design.
CO4	evaluate Control Parameters and Status Parameters for design of a CODEC to improve Performance.
CO5	carry out design and testing of a video CODEC for the given application.

2. Syllabus

- **IMAGE AND VIDEO COMPRESSION FUNDAMENTALS (06 Hours)**

  Image Compression Fundamentals, Classification of Image Compression Algorithms, Lossless and Lossy Compression Algorithms, Various Image and Video Standards.

- **MOTION ESTIMATION AND COMPENSATION (06 Hours)**

  Introduction, Motion Estimation and Compensation, Full Search Motion Estimation, Comparison of Motion Estimation Algorithms, Sub-Pixel Motion Estimation, Choice of Reference Frames, Enhancements to the Motion Model, Implementation.

- **CODING (06 Hours)**

  Discrete Wavelet Transform, Fast Algorithms for the DCT, Separable Transforms, Flow Graph Algorithms, Distributed Algorithms, Other DCT Algorithms, Implementing the DCT, Software DCT, Hardware DCT, Quantization, Types of Quantizing methodologies: Related Design, Implementation, Vector Quantization.

- **VIDEO CODING STANDARDS : H.261, H.263 AND H.26L (06 Hours)**

  H.261, H.263 and H.26L, Motion Estimation and Compensation, Transform Coding, Entropy Coding, Pre and Post Processing, Rate, Distortion and Complexity, Transmission of Coded Video, Platforms, And Video CODEC Design.

- **VIDEO CODING STANDARDS : JPEG AND MPEG** **(06 Hours)**

  Introduction, The International Standard Bodies, The Expert Groups, The Standardization Process, Understanding and Using the Standards, JPEG, Motion JPEG, MPEG , JPEG-2000, lMPEG- 1, MPEG-2, MPEG-4.

- **VIDEO CODEC DESIGN** **(06 Hours)**

  Introduction, Video CODEC Interface, Coded Data In/Out, Control Parameters , Status Parameters, Design of a Software CODEC, Design Goals, Specification and Partitioning, Designing the Functional Blocks, Improving Performance, Testing, Design of a Hardware CODEC: Design Goals.

- **ADVANCED TOPICS** **(06 Hours)**

  Current Standard Evolution, Video Coding Research, Platform Trends, Application Trends, Video CODEC Design, Contemporary Research Topics.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Iain E. Richardson, “Video Codec Design: Developing Image and Video Compression Systems” 1/E, Wiley, 2002.
2. Iain E. Richardson, “H.264 and MPEG-4 Video Compression: Video Coding for Next Generation Multimedia “, 1/E, Wiley, 2008.
3. M. Ghanbari, “Standard Codecs: Image Compression to Advanced Video Coding (Telecommunications)”, 3/E, Institution of Engineering and Technology, 2010.
4. Khalid Sayood, “Lossless Compression Handbook (Communications, Networking and Multimedia)”, 1/E, Academic Press, 2002.
5. Aaron Owen and Andy Beach, “Video Compression Handbook, 2E, Peachpit Press, ISBN: 9780134846736, July 2018.

B. Tech. III (CSE) Semester – VI
CYBER PHYSICAL SYSTEMS (INSTITUTE ELECTIVE-2)
CS362

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand basic concept of embedded systems.
CO2	apply and analyse the applications in various processors and domains of embedded system.
CO3	analyse and develop embedded hardware and software development cycles and tools.
CO4	evaluate different Embedded Computing and IoT systems.
CO5	design the embedded systems using different concepts of a RTOS, sensors, memory interface, and communication interface.

2. Syllabus

- **INTRODUCTION: HARDWARE** **(04 Hours)**

  Introduction to Embedded System Hardware Needs, Typical and Advanced, Timing Diagrams, Memories (RAM, ROM, EPROM), Tristate Devices, Buses, DMA, UART and PLD's Built-ins on the Microprocessor.

- **INTERRUPTS** **(04 Hours)**

  Interrupts Basics ISR, Context Saving, Shared Data Problem, Atomic and Critical Section, Interrupt Latency.

- **SOFTWARE AND OS** **(04 Hours)**

  Survey of Software Architectures, Round Robin, Function Queue Scheduling Architecture, Use of Real Time Operating System, RTOS, Tasks, Scheduler, Shared Data Re-entrancy, Priority Inversion, Mutex Binary Semaphore and Counting Semaphore.

- **INTER-PROCESS COMMUNICATION** **(05 Hours)**

  Inter Task Communication, Message Queue, Mailboxes and Pipes, Timer Functions, Events Interrupt Routines in an RTOS Environment.

- **EMBEDDED COMPUTING** **(07 Hours)**

  Embedded Design Process, System Description Formalisms, Instruction Sets- CISC and RISC, Embedded Computing Platform- CPU bus, Memory Devices, I/O Devices, Interfacing, Designing with Microprocessors, Debugging Techniques, Hardware Accelerators- CPUs and Accelerators, Accelerator

System Design, Embedded System Software Design using an RTOS Hard Real-Time and Soft Real-Time System Principles, Task Division, Need of Interrupt Routines, Shared Data.

- **INTERNET OF THINGS** **(04 Hours)**

  Introduction, IoT Work Flow, IoT Protocols: HTTP, CoAP, MQTT, 6LoWPAN, Building IoT Applications.

- **TOOLS** **(06 Hours)**

  Embedded Software Development Tools, Host and Target Systems, Cross Compilers, Linkers, Locators for Embedded Systems, Getting Embedded Software into the Target System, Debugging Techniques like JTAGS, Testing on Host Machine, Instruction Set Emulators, Logic Analysers In-Circuit Emulators and Monitors.

- **NETWORK** **(04 Hours)**

  Distributed Embedded Architectures, Networks for Embedded Systems, Network-Based Design, and Internet Enabled Systems.

- **SYSTEM DESIGN TECHNIQUES** **(04 Hours)**

  Design Methodologies, Requirements Analysis, System Analysis and Architecture Design, Quality Assurance.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", 2nd Edition, Pearson Education, 2011.
2. Raj Kamal, "Embedded Systems-Architecture, Programming and Design", 2/E, TMH, 2007.
3. Jonathan W. Valvano, "Embedded Microcomputer Systems-Real Time Interfacing", 2nd Edition, Thomson Learning, 2006.
4. David A. Simon, "An Embedded Software Primer", 1/E, Pearson Education,2001.
5. Louis L. Odette, "Intelligent Embedded Systems", Addison-Wesley, 1991.

ADDITIONAL REFERENCE BOOKS

1. Wolf, W. "Computers as components- Principles of embedded computing system design", Academic Press (Indian edition available from Harcourt India Pvt. Ltd., 27M Block market, Greater Kailash II, New Delhi-110 048).
2. Denial D. Gajski , Frank Vahid, "Specification and design Embedded systems", Prentice Hall; Facsimile edition, 1994.

B. Tech. III (CSE) Semester – VI
ETHICAL HACKING (INSTITUTE ELECTIVE-2)
CS364

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of core concepts related to information security and ethical hacking.
CO2	install, configure, and use different state of the art hacking software on a closed network environment.
CO3	analyze the vulnerabilities related to computer system and networks using state of the art tools and technologies.
CO4	evaluate best practices in information security to maintain confidentiality, integrity and availability.
CO5	implement effective solutions for ethical hacking in different environments.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Ethical Hacking: Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans & Backdoors, Virus & Worms.

- **INFORMATION AND NETWORK SECURITY** **(09 Hours)**

  Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering System and Network Vulnerability and Threats to Security , Various Types of Attack and the Various Types of Attackers in the Context of the Vulnerabilities Associated With Computer and Information Systems and Networks Physical Security, Steganography.

- **ETHICAL HACKING – 1** **(12 Hours)**

  Cryptography, Wireless Hacking, Firewall & Honeypots, IDS & IPS, Vulnerability, Penetration Testing, Session Hijacking, Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow.

- **ETHICAL HACKING – 2** **(12 Hours)**

  Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobile Phone Hacking Basic Ethical Hacking Tools and Usage of These Tools in a Professional Environment. Legal, Professional and Ethical Issues Likely to Face the Domain of Ethical Hacking. Ethical

Responsibilities, Professional Integrity and Making Appropriate Use of the Tools and Techniques Associated With Ethical Hacking.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Dominic Chell, Tyrone Erasmus, Shaun Colley, Oflie Whitehouse," The Mobile Application Hacker's Handbook", 2nd Edition, Wiley, 2015.
2. Michael Gregg, "Certified Ethical Hacker (CEH) Cert Guide", 2nd Edition, Pearson India, 2014.
3. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", 2nd Edition, CRC Press, 2017.
4. Allen Harper, Shome Harris, Jonathan Ness,Chris Eagle, Gideon Lenkey, TerronVilliams "Gray Hat Hacking The Ethical Hakers Handbook", 3rd Edition, TMH, 2011.
5. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", 2nd Edition, Elsevier, 2013.

ADDITIONAL REFERENCE BOOKS

1. Jon Erickson "HACKING: The art of Exploitation", 2nd Edition, William Pollock No Starch Press, 2008.

B. Tech. III (CSE) Semester – VI
SMARTPHONE COMPUTING AND APPLICATIONS
(INSTITUTE ELECTIVE-2)
CS366

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about different types of mobile operating systems and architecture.
CO2	setup, configure, deploy and run applications on smart phone using state of the art IDE and/or tools.
CO3	debug and troubleshoot the issues related to operating system, database, security, etc.
CO4	evaluate effectiveness of different mobile operating systems.
CO5	design and develop different smart phone applications.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Introduction to Mobile Computing, Introduction to Android Development Environment, Mobile Devices vs. Desktop Devices, ARM and Intel Architectures, Power Management, Screen Resolution, Touch Interfaces, Application Deployment, App Store, Google Play, Windows Store, Development Environments: XCode, Eclipse, VS2012, PhoneGAP, etc., Native vs. Web Applications, Factors in Developing Mobile Applications: Mobile Software Engineering, Frameworks and Tools, Generic UI Development, Android User, Graphics and Multimedia: Performance and Multithreading, Graphics and UI Performance, Android Graphics, Mobile Agents and Peer-to-Peer Architecture, Android Multimedia.

- **MOBILE OS ARCHITECTURE** **(09 Hours)**

  Comparing and Contrasting Architectures of All Three – Android, iOS and Windows, Underlying OS, Kernel Structure and Native Level Programming. Approaches to Power Management, Security. Android/iOS/Win 8 Survival and Basic Apps: Building a Simple "Hello World" App in All Three Applications, App-structure, Built-in Controls, File Access, Basic Graphics. Platforms and Additional Issues: Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles, Testing.

- **ANDROID/IOS/WIN APPLICATIONS** **(12 Hours)**

  DB Access, Network Access, Contacts/Photos/etc. Underneath the Frameworks: Native Level Programming on Android, Low-Level Programming on (jailbroken) iOS, Windows Low Level APIs.

Intents and Services: Android Intents and Services, Characteristics of Mobile Applications, Successful Mobile Development; Storing and Retrieving Data: Synchronization and Replication of Mobile Data, Getting the Model Right, Android Storing and Retrieving Data, Working with a Content Provider; Putting It All Together: Packaging and Deploying, Performance Best Practices, Android Field Service App.

- **ADVANCE TOPICS** **(06 Hours)**

Power Management: Wake Locks and Assertions, Low-Level OS Support, Writing Power-Smart Applications. Augmented Reality via GPS and Other Sensors: GPS, Accelerometer, Camera. Mobile Device Security in Depth: Mobile Malware, Device Protections, iOS "Jailbreaking", Android "rooting" and Windows "defenestration"; Security and Hacking: Active Transactions, More on Security, Hacking Android.

- **MOBILE PRIVACY AND SECURITY** **(06 Hours)**

Side Channel Attacks, Inference Algorithms, Hardware Loopholes, Sensor Data Leaks, Case Studies.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Tomasz Nurkiewicz and Ben Christensen, "Reactive Programming with RxJava", O'Reilly Media, 2016.
2. Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, "Android Programming: The Big Nerd Ranch Guide", Big Nerd Ranch LLC, 2nd edition, 2015.
3. Cristian Crumlish and Erin Malone, "Designing Social Interfaces", 2nd edition, O'Reilly Media, Inc., 2014.
4. Maximiliano Firtman, "Programming the Mobile Web", O'Reilly Media Inc., 2nd edition, 2013.
5. Suzanne Ginsburg, "Designing the iPhone User Experience: A User-Centered Approach to Sketching and Prototyping iPhone Apps", Addison-Wesley Professional, 2010.

ADDITIONAL REFERENCE BOOKS

1. Brian Fling, "Mobile Design and Development", O'Reilly Media Inc., 2009.
2. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design and Development", Prentice Hall, 2004.

B. Tech. III (CSE) Semester – VI
COMPUTER VISION &IMAGE PROCESSING (INSTITUTE ELECTIVE-2)
CS368

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand building approaches of digital image processing systems, image models and mathematical tools for image processing.
CO2	apply spatial filtering, frequency domain filtering, image restoration and color image processing techniques for overall image improvement.
CO3	analyse various image compression methods for effective storage management without degrading the image quality.
CO4	evaluate various morphology, segmentation and object recognition methods to gain high level of understanding of content of an image.
CO5	create an image processing application in the development of computer vision, machine learning, deep learning domains.

2. Syllabus

- **INTRODUCTION (02 Hours)**

  Image Model, Image Sensing and Acquisition, Sampling and Quantization, Mathematical Tool for Digital Image Processing, Types of Digital Images, Image File Formats, Colour Fundamentals and Models.

- **INTENSITY TRANSFORMATION AND SPATIAL FILTERING (06 Hours)**

  Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing and Sharpening Spatial Filters.

- **FILTERING IN FREQUENCY DOMAIN (06 Hours)**

  Sampling and Fourier Transform, Discrete Fourier Transform (DFT), 2-D DFT, Filtering in the Frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Selective Filtering.

- **IMAGE RESTORATION (06 Hours)**

  Image Degradation/ Restoration Process, Noise Models, Spatial Filtering and Frequency Domain Filtering for Noise Reduction, Linear Position-Invariant Degradations, Estimating the Degradation Function, Filtering, Image Reconstruction from Projection.

- **COLOR IMAGE PROCESSING (06 Hours)**

Color Models, Pseudocolor Image Processing, Full Color Image Processing, Color Transformation, Smoothing and Sharpening, Color Based Image Segmentation.

- **IMAGE COMPRESSION** **(06 Hours)**

  Image Compression Fundamentals, Classification of Image Compression Algorithms, Types of Redundancy, Lossless Compression Algorithms, Lossy Compression Algorithms, Image and Video Compression Standards and its Variations.

- **MORPHOLOGY AND SEGMENTATION** **(06 Hours)**

  Erosion and Dilation, Opening and Closing, Morphological Algorithms, Grey Scale Morphology, Point, Line and Edge Detection, Thresholding, Region based Segmentation, Segmentation using Morphological Watersheds, Use of Motion in Segmentation.

- **ADVANCED TOPICS** **(04 Hours)**

  Image Representation and Description, Object Recognition and Recent Developments.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Rafael C. Gonzales andRichard E. Woods,"Digital Image Processing", 4/E, Pearson Education, 2018.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", 1/E, Pearson India, 2015.
3. S. Jayaraman, T. Veerakumar and S. Esakkirajan, "Digital Image Processing", 1/E, TMG, 2017
4. S. Sridhar, "Digital Image Processing", 2/E, Oxford University Press, 2016.
5. S. Annadurai, R. Shanmugalakshmi, "Fundamentals of Digital Image Processing", 1/E, Pearson Education, 2006.

B. Tech. III (CSE) Semester – VI
ADAPTIVE SIGNAL PROCESSING (INSTITUTE ELECTIVE-2)
CS370

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the adaptive signal processing, approaches of least mean square and adaptive filters.
CO2	apply recursive least square algorithm for estimation of least mean square and adaptive filtering of stationary process.
CO3	utilize theory and software implementation to solve adaptive signal problem and analyse the results obtained.
CO4	evaluate the accuracy and performance of the Kalman filtering utilized in adaptive signal processing.
CO5	design an efficient and innovative solution for the real time problems using different adaptive signal processing techniques.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  Adaptive Processing of Signals, Adaptive Filters, Stochastic Processes, Correlation, System Modeling, Minimum Mean Squared Error (MMSE) Estimation, Linear MMSE Estimation, Sequential Linear MMSE Estimation, Introduction to Applications – Noise Cancellation, Inverse Modeling, Discrete Time Wiener Filter, Hilbert Space Formulation, Levinson Filtering, Orthogonalization and Orthogonal project, Orthogonal Decomposition of Signal Subspace.

- **LEAST MEAN SQUARE ALGORITHM** **(08 Hours)**

  FIR Adaptive Filters, Newton's Method, Steepest Descent Method, Convergence Analysis, Performance Surface, LMS Adaption Algorithms, Convergence, Excess Mean Square Error, Leaky LMS, Normalized LMS, Block LMS.

- **LINEAR LEAST SQUARE ESTIMATION** **(08 Hours)**

  Least Square Estimation Problem, Geometric Approach, Projection Theorem, Stochastic Linear Least Square Estimation, Recursive Least Square (RLS) Algorithm for Adaptive Filtering of Stationary Process, RLS Adaptive Lattice, RLS Lattice Recursions, Matrix Inversion, Comparison with LMS, RLS for Quasi-Stationary Signals, Exponentially Weighted RLS, Sliding Window RLS, RLS

Algorithm for Array Processing, Adaptive Beam Forming, Other Applications of Adaptive Filters, Echo Cancellation, Channel Equalization.

- **KALMAN FILTERING (09 Hours)**

  State Space Model, Dynamic State Estimation, Statistical Filtering for Non-Stationary Signals, Kalman filtering Principles, Initialization and Tracking, Scalar and Vector Kalman filter, Derivation of Kalman Filter using Innovations Approach, Continuous time Kalman Filter, Discrete Kalman Filter, Convergence, Applications in Signal Processing, Time Varying Channel Estimation, Radar Target Tracking.

- **SYSTEM IDENTIFICATION AND APPLICATIONS (09 Hours)**

  Process of System Identification, Least Square System Identification Method, RLS based System Identification, Levinson Type Identification, Adaptive Blind Equalization, MIMO, Multi User Detection Application, Channel Estimation, Interference Cancelling, Beam-Forming, Speech Processing.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Simon O. Haykin, “Adaptive Filter Theory”, 5th Edition, Pearson Education Limited, 2014.
2. Monson H. Hayes, “Statistical Digital Signal Processing and Modeling,” 1st Edition, Wiley India Pvt. Ltd, 2008.
3. Alexander D. Poularikas, Zayed M. Ramadan, “Adaptive filtering primer with MATLAB”, 1st Edition, CRC Press, 2006.
4. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, “Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering, and Array Processing”, 1st Edition, McGraw-Hill, 2005.
5. Bernard Widrow, Samuel D Stearns, “Adaptive Signal Processing”, 1st Edition, Pearson Education, 2002.

ADDITIONAL REFERENCE BOOKS

1. Ali H. Sayed, “Fundamentals of Adaptive Filtering”, 1st Edition, Wiley-IEEE Press, 2003.
2. Michael G. Larimore, C. Richard Johnson, “Theory and Design of Adaptive Filters”, 1st Edition, Pearson, 2001.

B. Tech. III (CSE) Semester – VI
APPLIED MACHINE LEARNING (INSTITUTE ELECTIVE-2)
CS372

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
Co1	To understand various machine learning techniques and formulation of problem in diverse field.
Co2	To perform data analysis, data clustering and data transformation techniques for better usage and enhancement of available data.
Co3	To evaluate and compare the appropriateness and complexity of various machine learning techniques for real life problems.
Co4	To apply these techniques of the algorithms to the hard machine learning problems.
Co5	To design the solution for the real life problems using machine learning approaches.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

Towards Intelligent Machines, Machine Learning Problems , Applications of machine learning in Diverse Fields, Data Representation, Domain knowledge, Forms of Learning, Fundamentals of Artificial Intelligence, Machine Learning, Deep Learning, Data Analytics, Big Data, IoT and Cloud Technologies.

- **MACHINE LEARNING TECHNIQUES** **(08 Hours)**

Supervised Learning, Unsupervised Learning, Statistical Learning, Support Vector Machine, Neural Networks, Decision Tree Learning, Tree Based Ensembles.

- **DATA CLUSTERING AND TRANSFORMATION TECHNIQUES** **(04 Hours)**

Data Analysis, Cluster Analysis, standard Clustering Techniques, Classification, Data Enhancement, standard transformation Techniques, Feature Selection, Feature Extraction.

- **MACHINE LEARNING APPLICATIONS** **(20 Hours)**

Overview, Design cycle, Machine Learning Applications like Mobility: Robotics, Action Learning, Automatic Driving; Imaging: Object / Face Detection, Recognition, Tracking; Interfaces: Brainwaves (for the disable), Handwriting &Speech Recognition; Security: Spam / Virus Filtering, Virus Troubleshooting; Banking: Identify Good Customers, Minimize Credit Risk, Market Analysis; Gaming: Intelligent Player/Agent, Object Tracking, 3D Modelling; Medicine: Screening, Diagnosis of Drug Discovery; Security: Face, Signature, Iris Recognition; Bioinformatics: Disease Classification, Gene Detection, Protein Folding Prediction.

- **RESEARCH TOPICS** **(06 Hours)**

Genetic Algorithm, Reinforce Learning, Advance Research Topics

(Total Contact Time: 42 Hours)

3. **BOOKS RECOMMENDED**

1. Applied Machine Learning, M. Gopal, 1/E, ISBN-13: 978-3319640204.
2. Machine Learning, T. Michel, TMG
3. Artificial Intelligence, S. Russell and P. Nerving, Pearson

B. Tech. IV (CSE) Semester – VII
DISTRIBUTED SYSTEMS (CORE-22)
CS401

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the concepts of distributed System and design and implementation issues.
CO2	define key mechanism for designing distributed algorithms for different primitives like mutual exclusion, deadlock detection, agreement etc.
CO3	analyze different types of faults and fault handling techniques in order to implement fault tolerant systems.
CO4	correlate different election algorithm, file system, time synchronization and naming services.
CO5	design and develop distributed programs subject for specific design and performance constraints.

2. Syllabus

- **INTRODUCTION TO DISTRIBUTED SYSTEMS** **(04 Hours)**

  Review of Networking Protocols, Point to Point Communication, Operating Systems, Concurrent Programming, Characteristics and Properties of Distributed Systems, Goals of Distributed Systems, Multiprocessor and Multicomputer Systems, Distributed Operating Systems, Network Operating Systems, Middleware Concept, The Client-Server Model, Design Approaches-Kernel Based-Virtual Machine Based, Application Layering.

- **COMMUNICATIONIN DISTRIBUTED SYSTEMS** **(04 Hours)**

  Layered Protocols, Message Passing-Remote Procedure Calls-Remote Object Invocation, Message Oriented Communication, Stream Oriented Communication, Case Studies.

- **PROCESS MANAGEMENT** **(04 Hours)**

  Concept of Threads, Process, Processor Allocation, Process Migration and Related Issues, Software Agents, Scheduling in Distributed System, Load Balancing and Sharing Approaches, Fault Tolerance, Real Time Distributed System.

- **SYNCHRONIZATION** **(06 Hours)**

Clock Synchronization, Logical Clocks, Global State, Election Algorithms-The Bully algorithm-A Ring algorithm, Mutual Exclusion-A Centralized Algorithm-A Distributed Algorithm-A token ring Algorithm, Distributed Transactions.

- **CONSISTENCY AND REPLICATION** **(06 Hours)**

Introduction to Replication, Object Replication, Replication as Scaling Technique, Data Centric Consistency Models-Strict-Linearizability and Sequential-Causal-FIFO-Weak-release-Entry, Client Centric Consistency Models-Eventual Consistency-Monotonic Reads and Writes-Read your Writes-Writes Follow Reads, Implementation Issues, Distribution Protocols-Replica Placement-Update Propogation-Epidemic Protocols, Consistency Protocols.

- **FAULT TOLERANCE** **(04 Hours)**

Introduction, Failure Models, Failure Masking, Process Resilience, Agreem in Faulty Systems, Reliable Client Server communication, Group communication, Distributed Commit, Recovery.

- **DISTRIBUTED OBJECT BASED SYSTEMS** **(06 Hours)**

Introduction to Distributed Objects, Compile Time Vs Run Time Objects, Persistent and Transient Objects, Enterprise JAVA Beans, Stateful and Stateless Sessions, Global Distributed Shared Objects, Object Servers, Object Adaptors, Implementation of Object References, Static And Dynamic Remote Method Invocations, Replica Framework.

- **DISTRIBUTED FILE SYSTEMS** **(04 Hours)**

Introduction, Architecture, Mechanisms for Building Distributed File Systems-Mounting-Caching-Hints-Bulk Data Transfer-Encryption, Design Issues-Naming and Name Resolution-Caches on Disk or Main Memory-Writing Policy-Cache consistency-Availability-Scalability-Semantics, Case Studies, Log Structured File Systems.

- **DISTRIBUTED WEB BASED SYSTEMS** **(04 Hours)**

Architecture, Processes, Communication, Naming, Synchronization, Web Proxy Caching, Replication of Web Hosting Systems, Replication of Web Applications.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time 42 Hours + 28 Hours = 70 Hours)

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3. <u>Practicals:</u>

1 Implementation of concepts of communication protocols using UDP and TCP IP.

2 Implement the remote procedure call with an application.

3 Implementation of object based system using RMI or CORBA.

4 Implementation of distributed system for file sharing and message passing.

5 Implementation of Socket programming.

6 Implementation of distributed client-server application.

7 Implementation of client-server application with scheduling in distributed environment.

8 Implementation of distributed load balancing and resource sharing.

4. Books Recommended:

1. Andrew S Tanenbaum, “Distributed systems: Principles and Paradigms”, Second Edition, Pearson Education. Inc 2007.
2. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems”, TMH, McGraw-Hill, Inc. New York, USA 1994.
3. Pradeep K. Sinha, “Distributed Operating System: Concept and design”, PHI, New Delhi 2019.
4. W Richard Stevens, “Unix Network Programming: Vol 1, Networking APIS: Sockets & XTI”, Second Edition E, Pearson Education, 1998.
5. Colouris, Dollimore, Kindberg, "Distributed Systems Concepts & Design", Fourth Edition, Pearson Ed. 2005.

B. Tech. IV (CSE) Semester – VII
NATURAL LANGUAGE PROCESSING (CORE ELECTIVE-4/5)
CS421

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	Understand basics principles of natural language processing.
CO2	apply machine learning techniques for NLP based different tasks.
CO3	perform statically analysis and classification, recognition using NLP knowledge acquired.
CO4	evaluate the performance of machine translation solutions through statistical parameters.
CO5	design efficient solution for parser, translator and different applications based on NLP for day to day usage.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Human Languages, Language Models, Computational Linguistics , Ambiguity and Uncertainty in Language, Processing Paradigms, Phases in Natural Language Processing, Basic Terminology, Overview of Different Applications, Regular Expressions and Automata, Finite State Transducers and Morphology, Automata, Word Recognition, Lexicon, Morphology, Acquisition Models, Linguistics Resources, Introduction to Corpus, Elements in Balanced Corpus.

- **SYNTAX AND SEMANTICS (08 Hours)**

  Natural Language Grammars, Lexeme, Phonemes, Phrases and Idioms, Word Order, Tense, Probabilistic Models of Spelling, N-grams, Word Classes and Part of Speech Tagging using Maximum Entropy Models, Transformation Based Tagging (TBL), Context Free Grammars for English, Features and Unification, Lexicalized and Parsing, Treebanks, Language and Complexity, Representing Meaning, Semantic Analysis, Lexical Semantics, Word Sense Disambiguation.

- **PROBBILISTIC LANUAGE MODELING (08 Hours)**

  Statistical Inference, Hidden Markov Models, Probabilistic (weighted) Finite State Automata, Estimating the Probability of a Word, and Smoothing, Probabilistic Parsing, Generative Models of Language, Probabilistic Context Free Grammars, Probabilistic Parsing, Statistical Alignment and Machine Translation, Clustering, Text Categorization, Viterbi Algorithm for Finding Most Likely HMM Path.

- **PRAGMATICS** **(06 Hours)**

  Discourse, Dialogue and Conversational Agents, Natural Language Generation, Machine Translation, Dictionary Based Approaches, Reference Resolution, Algorithm for Pronoun Resolution, Text Coherence, Discourse Structure, Applications of NLP- Spell-Checking.

- **MACHINE TRANSLATION** **(08 Hours)**

  Probabilistic Models for Translating One to Another Language, Alignment, Translation, Language Generation, Expectation Maximization, Automatically Discovering Verb Subcategorization, Language Modelling Integrated into Social Network Analysis, Automatic Summarization, Question-Answering, Interactive Dialogue Systems.

- **ADVANCED TOPICS** **(08 Hours)**

  Summarization, Information Retrieval, Vector Space Model, Term Weighting, Homonymy, Polysemy, Synonymy, Improving User Queries, Document Classification, Sentence Segmentation, and Other Language Tasks, Automatically-Trained Email Spam Filter, Automatically Determining the Language, Speech Recognition.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Daniel Jurafsky, James H. Martin: "Speech and Language Processing", 2/E, Pearson Education, 2009.
2. James Allen, "Natural Language Understanding", 2/E, Addison-Wesley, 1994.
3. Christopher D. Manning, Hinrich Schutze: "Foundations of Statistical Natural Language Processing", 1/E, MIT Press, 1999.
4. Steven Bird, “Natural Language Processing with Python”, 1st Edition, O'Reilly, 2009.
5. Jacob Perkins, “Python Text Processing with NLTK 2.0 Cookbook”, 2nd Edition, Packt Publishing, 2010.
6. Bharati A., Sangal R., Chaitanya V., “Natural language processing: A Paninian perspective”, PHI, 2000.
7. Siddiqui T., Tiwary U. S., “Natural language processing and Information retrieval”, 1st Edition, OUP,2008.

B. Tech.VI (CSE) Semester – VII
CYBER LAWS AND FORENSICS TOOLS (CORE ELECTIVE-4/5)
CS423

Scheme

L	T	P	Credit
3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the basics of cyber law and cyber forensics with respect to Indian IT Act.
CO2	apply knowledge of cyber law to provide solutions to cyber security.
CO3	analyze various computer forensics technologies and systems.
CO4	evaluate and assess the methods for data recovery and digital evidence collection.
CO5	give solutions to real life problems using state of the art cyber forensics tools and techniques.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  Cyber Security and its Problem-Intervention Strategies: Redundancy, Diversity and Autarchy, Cyber-Crime and The Legal Landscape Around the World, Why Do We Need Cyber Laws, Cyber Forensics Fundamentals, Benefits of Forensics, Cyber Forensics Evidence and Courts, Legal Concerns and Private Issues.

- **CYBER LAWS -1** **(08 Hours)**

  The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India, Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber Law, Technology and Students: Indian Scenario.

- **CYBER LAWS -2** **(08 Hours)**

  Private Ordering Solutions, Regulation and Jurisdiction For Global Cyber Security, Copyright Source of Risks, Pirates, Internet Infringement, Fair Use, Postings, Criminal Liability, First Amendments, Data Losing, Cyber Ethics - Legal Developments, Cyber Security in Society, Security in Cyber Laws Case Studies, General Law and Cyber Law-A Swift Analysis.

- **CYBER FORENSICS -1** **(09 Hours)**

  Cyber Investigation - Procedure for Corporate High-Tech Investigations, Understanding Data Recovery Workstation and Software, Conducting and Investigations, Data Acquisition - Understanding Storage Formats and Digital Evidence, Determining the Best Acquisition Method, Acquisition Tools, Validating Data Acquisitions, Performing RAID Data Acquisitions, Remote Network Acquisition Tools, Other Forensics Acquisitions Tools.

- **CYBER FORENSICS -2** **(09 Hours)**

  Current Cyber Forensics Tools- Software and Hardware Tools, Validating and Testing Forensic Software, Addressing Data-Hiding Techniques, Performing Remote Acquisitions, E-Mail Investigations- Investigating Email Crime and Violations, Understanding E-Mail Servers, Specialized E-Mail Forensics Tool.

  Practicals will be based on the coverage of the above topics. **(28 Hours)**

  (Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. Practicals:

1 Introduction to various software tools related to cyber law and cyber forensics.

2 Practical based on disk forensics.

3 Practical based on network forensics.

4 Practical based on device forensics.

5 Practical based on email security.

6 Practical using forensic tools for image and video fraud.

7 Practical using on e-commerce related cyber-attacks.

8 Practical based on social network and online transactions related cyber threats.

4. Books Recommended:

1. Sunit Belapure and Nina Godbole, Cyber "Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, 1st Edition, Wiley India Pvt. Ltd, 2011.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", 1st Edition, Cambridge University Press, 2006.
3. Jonathan Rosenoer, "Cyber Law: The law of the Internet", 1st Edition, Springer-Verlag, 1997.
4. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", 1st Edition, Addison Wesley, 2002.
5. B. Nelson, A. Phillips, F. Enfinger, C. Stuart, "Guide to Computer Forensics and Investigations, 2nd Edition, Thomson Course Technology, 2006, ISBN: 0-619-21706-5.

ADDITIONAL REFERENCE BOOKS

1. J. Vacca, "Computer Forensics: Computer Crime Scene Investigation", 2nd Edition, Charles River Media, 2005, ISBN: 1-58450-389.

B. Tech. IV (CSE) Semester – VII
AUDIO AND SPEECH SIGNAL PROCESSING
(CORE ELECTIVE-4/5)
CS425

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge of audio and speech production mechanism with signal processing fundamentals.
CO2	apply the knowledge of time and frequency domain analysis methods for audio and speech signal processing.
CO3	analyse the signals for feature extraction as per the requirement of different applications.
CO4	evaluate signals using different modelling, classification and regression techniques.
CO5	build the efficient applications for recognition, classification, synthesis and translation for usage in different fields.

2. Syllabus

- **INTRODUCTION** **(06 Hours)**

  Basic of Signal, Fundamentals of Sound, Speech Production, Frequency Spectrum, Transforms, Human Auditory System, Physics of Audio Signal Generation, Acoustics and Hearing, Discrete Signal Representation and Formats, Convolution, Linearity, Time Variant and Invariant System, Different Types of Digital Filters.

- **SIGNAL PROCESSING** **(06 Hours)**

  Properties of Audio and Speech Signal, Audio Signal Features, Short Time Fourier Transform, Audio Effects, Harmonics, Spectrogram, Audio and Speech Signal Compression, Speech Production, Equalization, Perceptual Audio Coding, Sound Synthesis, Pattern Recognition, Acoustics and Auditory Perception, Auto Correlation Function, Power Spectral Density Function, Wiener Filter.

- **AUDIO PROCSSING** **(10 Hours)**

  Psychoacoustic Representation, Compression Schemes, MP3 and Other Formats, Sound Mixture Organization, Code Book, Audio Coding, Linear Prediction Coding, Noise Reduction, Music Signal Processing, Modulation, Filters for Audio Signal Processing, Echo Cancellation, Music Analysis and Retrieval, Acoustic Source Localization and Tracking.

- **SPEECH SIGNAL** **(10 Hours)**

  Articulatory Phonetics, Models of Speech Production, Waveform Coding, Time Domain Analysis, Frequency Domain Analysis, Speech Features: Energy, Magnitude, Zero-crossing, Autocorrelation, Silence, Linear Prediction, Acoustic Feature Extraction, Ceptral Processing, Pitch, Mel Frequency Cepstral Coefficients, Speech Recognition, Speaker Recognition, Linear Discriminant Analysis, Principle Component Analysis, Hidden Markov Models, Acoustic Classification Methods: Bayes Methods, Gaussians Mixture Models.

- **ADVANCE TOPICS** **(10 Hours)**

  Independent Component Based Analysis, Neural Network Based Processing, Blind Source Separation, Recognition, Transcription, Enhancement, Coding, Synthesis as well as Applications to Advanced Fixed and Wireless Communication Systems, Speech Conversion, Deep Learning and Audio Activity Detection.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Zölzer, Udo, “Digital Audio Signal Processing”, John Wiley & Sons Ltd., 2nd edition, 2008.
2. Quatieri, T.F., “Discrete-time speech signal processing: principles and practice”, 1st Edition, Upper Saddle River, NJ: Prentice Hall, 2002.
3. Gold, B.; Morgan, N.; Ellis, D., “Speech and audio signal processing: processing and perception of speech and music”, 2nd rev. ed. Wiley-Blackwell, 2011.
4. Dutoit, T.; Marqués, F.; Rabiner, L.R., “Applied signal processing: a MATLAB-based proof of concept”, 1st Edition, New York; London:Springer, 2009.
5. Rabiner, L.R.; Schafer, R.W., “Theory and applications of digital speech processing”, 1st Edition, Prentice Hall, 2010.

ADDITIONAL REFERENCE BOOKS

1. Huang, Y.A.; Benesty, J. (eds.), “Audio signal processing for next-generation multimedia communication systems”, New York: Kluwer Academic Publishing, 2004.

B. Tech. IV (CSE) Semester – VII
ADVANCED DATABASE MANAGEMENT SYSTEMS
(CORE ELECTIVE-4/5)
CS427

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will**	
CO1	understand advanced database techniques for storing a variety of data with various database models.
CO2	apply various database techniques/functions with Object Oriented approach to design database for real life scenarios.
CO3	analyse the problem to design database with appropriate database model.
CO4	evaluate methods of storing, managing and interrogating complex data.
CO5	develop web application API's, distributed databases with the integration of various programming languages.

2. Syllabus

- **DISTRIBUTED DATABASE CONCEPTS** **(06 Hours)**

  Overview of Client - Server Architecture and its Relationship to Distributed Databases, Concurrency Control Heterogeneity Issues, Persistent Programming Languages, Object Identity and its Implementation, Clustering, Indexing, Client Server Object Bases, Cache Coherence.

- **PARALLEL DATABASES** **(06 Hours)**

  Parallel Architectures, Performance Measures, Shared Nothing/Shared Disk/Shared Memory Based Architectures, Data Partitioning, Intra-operator Parallelism, Pipelining, Scheduling, Load Balancing.

- **QUERY PROCESSING** **(06 Hours)**

  Index Based, Cost Estimation, Query Optimization: Algorithms, Online Query Processing and Optimization, XML, DTD, XPath, XML Indexing, Adaptive Query Processing.

- **ADVANCED TRANSACTION MODELS** **(06 Hours)**

  Save Points, Sagas, Nested Transactions, Multilevel Transactions, Recovery: Multilevel Recovery, Shared Disk Systems, Distributed Systems 2PC, 3PC, Replication and Hot Spares, Data Storage, Security and Privacy Multidimensional K- Anonymity, Data Stream Management.

- **MODELS OF SPATIAL DATA** **(05 Hours)**

Conceptual Data Models for Spatial Databases (e.g. Pictogram Enhanced ERDs), Logical Data Models for Spatial Databases: Raster Model (Map Algebra), Vector Model, Spatial Query Languages, Need for Spatial Operators and Relations, SQL3 and ADT, Spatial Operators, OGIS Queries.

- **WEB ENABLED APPLICATIONS** **(05 Hours)**

  Review of 3-Tier Architecture - Typical Middle-ware Products and Their Usage. Architectural Support for 3 -Tier Applications: Technologies Like RPC, CORBA, COM, Web Application Server - WAS Architecture Concept of Data Cartridges - JAVA/HTML Components, WAS.

- **OBJECT ORIENTED DATABASES** **(04 Hours)**

  Notion of Abstract Data Type, Object Oriented Systems, Object Oriented DB Design. Expert Databases: Use of Rules of Deduction in Databases, Recursive Rules.

- **ADVANCED TOPICS** **(04 Hours)**

  No SQL Databases, Unstructured Databases, Couchbase, MongoDB, Cassandra, Redis, Memcached.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. R. Elmasri and S. Navathe, “Fundamentals of Database Systems”, 5th Edition, Benjamin- Cummings Pearson Education India, 2007.
2. Avi Silberschatz, Hank Korth, and S. Sudarshan, “Database System Concepts”, 5th Edition, McGraw Hill, 2005.
3. S. Shekhar and S. Chawla, “Title Spatial Databases: A Tour”, 1st Edition, Prentice Hall, 2003.
4. Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, “Database Systems”, 2nd Edition, Pearson, 2008.
5. Carlos Coronel, Steven Morris, “Database Systems: Design, Implementation, & Management”, 11th Edition, Cengage Learning, 2014.

B. Tech. IV (CSE) Semester – VII
BIG DATA ANALYTICS (CORE ELECTIVE - 5)
CS429

Scheme

L	T	P	Credit
3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the key requirements and issues in big data management and its associated applications in intelligent business and scientific computing.
CO2	use state of the art big data analytics techniques and algorithms.
CO3	analyze large sets of data to discover patterns and other useful information.
CO4	compare and evaluate the impact of big data analytics tools and techniques.
CO5	develop big data solutions using state of the art analytics tools/techniques.

2. Syllabus

- **INTRODUCTION – DATA WAREHOUSING, DATA MINING (09 Hours)**

  Define Data Warehousing and Data Mining - The Building Blocks, Defining Features – Data Warehouses and Data Marts, Overview of the Components, Metadata in the Data Warehouse, Need for Data Warehousing, Basic Elements of Data Warehousing, Trends in Data Warehousing.

- **CONCEPTS AND TECHNIQUES IN DATA WAREHOUSING (08 Hours)**

  OLAP (Online analytical processing) Definitions, Difference Between OLAP and OLTP, Dimensional Analysis, Define Cubes, Drill-down and Roll-up - Slice and Dice or Rotation, OLAP Models, ROLAP versus MOLAP, Defining Schemas: Stars, Snowflakes and Fact Constellations.

- **CONCEPT DESCRIPTION AND ASSOCIATION RULE MINING (08 Hours)**

  Introduction to Concept Description, Data Generalization and Summarization-based Characterization, Analytical Characterization, Class Comparisons, Descriptive Statistical Measures, Market Basket Analysis- Basic Concepts, Association Rule Mining, The Apriori Algorithm, Mining Multilevel Association Rule Mining, Mining Multidimensional Association Rule Mining.

- **INTRODUCTION TO CLASSIFICATION AND PREDICTION (09 Hours)**

  Introduction to Classification and Prediction, Issues Regarding Classification, Classification using Decision Trees, Bayesian Classification, Classification by Back Propagation, Prediction Classification Accuracy.

- **ADVANCED TOPICS** **(08 Hours)**

  Clustering, Spatial Mining, Web Mining, Text Mining, Map-Reduce and Hadoop Ecosystem.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. J. Han, M. Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, Jun 22, 2011.
2. Paulraj Ponnian, "Data Warehousing Fundamentals", 1st Edition, John Willey, May 24, 2010.
3. Robert D. Schneider, Hadoop for Dummies, 1st Edition, Wiley India, Apr 14, 2014.
4. M. Kantardzic, "Data mining: Concepts, models, methods and algorithms", 3rd Edition, John Wiley &Sons Inc., Nov 12, 2019.
5. M. Dunham, "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson, Sep 1, 2002.

B. Tech. IV (CSE) Semester – VII
ANIMATION & RENDERING (CORE ELECTIVE – 4/5)
CS431

Scheme

L	T	P	Credit
3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the fundamentals of animation, drawings, images and lighting.
CO2	apply the knowledge of mathematics, graphics, rendering in making of animation and rendering.
CO3	analyse the different light and sound sources, its effects and characterizing the animated character with different visual effects.
CO4	evaluate the different scenario generated using sound and light for animation and rendering.
CO5	create 2D-3D animated movies, advertisement, children educational tool kits, and developing tools for awareness among the society.

2. Syllabus

- **INTRODUCTION** **(08 Hours)**

  History, Fundamentals of Images, Video, Sound and Audio, Traditional Art, 2D Animation, Lighting, Texture, Rendering, Colour, Key Frames, Video Composition, Graphics Principles, Affine Transformation, Projection, Rotation, Illumination, Reflection, Refraction, Shadow, Focusing, 3D Model, Media Technology, Basic Mathematics: Polynomials, Graphs, Trigonometry, Vector, Differentiation.

- **VISUAL EFFECTS AND RENDERING** **(06 Hours)**

  Concepts of Light, Material Property, Spotlight, Free Lights, Directional Light, Ray Tracing, Radiosity Computation, Surface Property, Surfacing, Volume Rendering, Light Fields, Procedural and Image-based Texturing and Shading, Non-photorealistic Rendering, Creation and Management of Layers, Parallel Rendering, Rigging and Animation, 3D Lighting, Editing, Colour Grading, Special Effects.

- **ANIMATION DESIGN** **(06 Hours)**

  Observational Drawing, Characters, Shapes, Verbal Articulation, Storytelling, Translating Sequential Images Into Action, Frame Creation, Scripting, Gestures, Expression, Nonverbal Communication, Motion, Attitude and Body Language of Characters, 2D and 3D Composition, Lip Syncing, Morphology, 3D Animation, Shadow Effects, Mesh Representation, Recoil Effects, Stretching, Squash, Overlapping Action, Object Behaviour and Time Synchronization, Humour, Deformers, Blend Shaping, Action and Reaction, Scene Timing and Invisible Activity, Polygon Modelling, Nurbs Modelling.

- **VIDEO PROCESSING** **(06 Hours)**

  Fundamentals of Video Production, Still Images, Blurring and Focusing, Camera Functioning, Framing, Photography, Cinematography, Morphology, Visual Design, Filming, Sound and Audio Processing, Filters, Tracking, Image Sequences and Object Layers, Video Codecs, Video Streaming, Video Editing.

- **AUDIO PROCESSING** **(04 Hours)**

  Basic of Signals, Fundamentals of Sound, Audio Features, Transforms, Recording, Analysis and Synthesis, Dynamics of Sound, Sound Tracks, Digital Filters, Spectrum, Formats, Recording and Effects, Equalizer, Mixer, Post Processing of Recorded Sound, Musical Instruments and Spectrum Analysis.

- **ADVANCED TOPICS** **(12 Hours)**

  Creating a Walkthrough, Dynamic FX, Dynamic Simulations of Collision, Rigid Bodies, Fire and Fluid Simulation, VFX Technology, MAYA Basic Workflow and Interface, Objects Hierarchy and Animation Design, Crowd Control, Advanced Modelling Methods, Highlights of Constitutional Rule and Laws, Copyright Act, IT Act, etc.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Watt A. and M. Watt, “Advanced Animation and Rendering Techniques: Theory and Practice”, 2nd Edition, Addison-Wesley, 1992.
2. Mascelli Joseph V, “The Five C’s of Cinematography: Motion Pictures Filming Techniques”, 1st Edition, Silman-James Press, 1998.
3. Preston Blair, “Cartoon Animation”, 1st Edition, Walter Foster Publishing Inc., CA, 1995.
4. Richard Taylor , “Encyclopedia of Animation Techniques”,2nd Edition, Book Sales, 2004.
5. David Lewis Yewdall, “Practical Art of Motion Picture Sound”, 2nd Edition, Focal Press, 2003.

ADDITIONAL REFERENCE BOOKS

1. Foley, J.D., A. Van Dam, S. Feiner, and J. Hughes, “Computer Graphics: Principles and Practice”, 2nd Edition in C, Addison-Wesley, 1996.
2. Zölzer, Udo, “Digital Audio Signal Processing”, 2nd Edition, John Wiley & Sons Ltd, 2008.
3. B. Gold, N. Morgan, D. Ellis, “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, 2nd Edition, John Wiley & Sons Ltd, 2011.

4. Ed Hooks, “Acting for Animators”, 2nd Edition, Routledge, 2013.
5. Harold Whitaker and John Halas, “Timing for Animation”, 2nd Edition, Focal Press, Oxford, 2002.
6. John Culhane, “Disney’s Aladdin – The Making of an Animated Film Hyperion”, NY, 1992.
7. Dave Smith, “The Official Encyclopedia – Disney A to Z”, Hyperion, 1996.
8. Leonard Maltin, “Mice and Magic – A History of American Animated Cartoons Plume”, Penguin Books. USA, 1990.
9. Bob Thompson, “Disney’s Art of Animation – From Mickey Mouse to Hercules Hyperion”, NY, 1997.
10. Donald Craften, “Before Mickey – The Animated Film [1898 – 1928]”, the University of Chicago Press, 1993.
11. Peter Hames (edited by), “Dark Alchemy: The Films of Jan Svankmajer”, 2nd Edition, Wallflower Press, 2008.
12. Robert Russett, “Experimental Animation: Origins of a New Art Cecile Starr”, 1st Edition, Da Capo, 1988.
13. Daniel Arijon, “Film Technique”, 1st Edition, Silman-James Press, 1991.
14. David Sonnensch, “Sound Design: The Expressive Power of Music, Voice and Sound Effects in Cinema”, 2nd Edition, Michael Wiese Productions, 2013.
15. Tomlinson Holman, “Sound for Film and Television”, 2nd Edition, Focal Press, 2001.

B. Tech. IV (CSE) Semester – VII
DEEP LEARNING (CORE ELECTIVE – 4/5)
CS433

Scheme	L	T	P	Credit
	3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand fundamental principles, theory and approaches for learning with deep neural networks.
CO2	learn different types of Neural Network and Deep Neural Networks.
CO3	apply NN and DNN for various learning tasks in different domains.
CO4	evaluate various NN and DNN by performing complex statistical analysis for DL techniques.
CO5	design DL algorithms for real-world problems.

2. Syllabus

- **INTRODUCTION TO DEEP LEARNING (02 Hours)**

  Basics of Human learning, Attributes of learning algorithms, Applications, Learning techniques, Types of Learning algorithms, Basics of Deep learning.

- **NEURAL NETWORKS BASICS (08 Hours)**

  Biological Neuron, Idea of Computational Units, Output vs Hidden Layers; Linear vs Nonlinear Networks, McCulloch–Pitts Model, Thresholding Logic, Linear Perceptron, Perception Learning Algorithm, Linear Separability. Convergence Theorem for Perception Learning Algorithm, Learning via Gradient Descent, Logistic Regression, Back Propagation Models, Feed Forward Model Empirical Risk Minimization, Regularization, Auto Encoders, Continuous and Discrete Distributions; Maximum Likelihood, Cost Functions, Hypotheses and Tasks; Training Data; Cross Entropy, Bias-variance Trade Off, Regularization, Activation Function : Sigmoid, Tanh, RELU, Softmax; Types of Neural Network : Feed Forward Neural Network , Radial Basis Function Neural Network, Convolution Neural Network, Recurrent Neural Network(RNN) Long Short Term Memory, Modular Neural Network; Simple Word Vector Representations: Word2vec, GloVe.

- **DEEP NEURAL NETWORKS (12 Hours)**

  Deep Learning Models : Restricted Boltzmann Machines, Deep Belief Nets, Convolutional Model; Deep Neural Networks: Difficulty of Training Deep Neural Networks, Greedy Layerwise Training; Better Training of Neural Networks: Newer Optimization Methods for Neural Networks (Adagrad, Adadelta, Rmsprop, Adam, NAG), Second Order Methods for Training, Saddle Point Problem in Neural Networks, Regularization Methods (Dropout, Drop Connect, Batch

Normalization);Recurrent Neural Networks: Back Propagation Through Time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs ;Convolution Neural Networks: LeNet, AlexNet; Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, Gradient Computations in RBMs, Deep Boltzmann Machines.

- **RECENT TRENDS** **(12 Hours)**

  Auto Encoders (Standard, Denoising, Contractive, etc), Variational Auto Encoders, Adversarial Generative Networks, Maximum Entropy Distributions, Guest Lecture, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning.

- **APPLICATIONS** **(08 Hours)**

  Vision, NLP, Speech; Deep Learning Platforms and Software Libraries:-H2O.ai, DatoGraphLab, Theano, Caffe, TensorFlow etc.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning (Adaptive Computation and Machine Learning series)", MIT Press, 2016.
2. Russell, S. and Norvig, N. "Artificial Intelligence: A Modern Approach", 3rd Edition, Prentice Hall Series in Artificial Intelligence Pearson, 2015.
3. Christopher M. Bishop, "Pattern Recognition and Machine Learning (Information Science and Statistics)", 3rd Edition, Springer, 2016.
4. Raúl Rojas, "Neural Networks - A Systematic Introduction", 2nd Edition, Springer-Verlag, Berlin, New-York, 2013.
5. Nikhil Buduma, Nicholas Locascio, "Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms", 1st Edition, O'reily, 2017.

B. Tech. IV (CSE) Semester – VII
WEB ENGINEERING (CORE ELECTIVE – 4/5)
CS435

Scheme

L	T	P	Credit
3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the web application development methodologies, web application architecture, modelling and testing techniques.
CO2	apply the knowledge of web application development steps to configure the web application project to solve the given problem.
CO3	analyze the given problem statement for which web application is required and debug, troubleshoot the basics issues with web application.
CO4	test the web application, manage web resources and also evaluate quality of web project.
CO5	develop the web project, maintain and manage changes in the web project for given problems.

2. Syllabus

- **INTRODUCTION (05 Hours)**

  Web Application, Categories of Web Applications, Characteristics of Web Applications, Product-Related Characteristics, Usage Related Characteristics, Development-Related Characteristic, Concepts And Reference Model Web Engineering: Introduction And Perspectives, Evolution of Web Engineering, Web Engineering Resources Portal (WEP): A Reference Model And Guide.

- **REQUIREMENTS ENGINEERING ACTIVITIES (04 Hours)**

  Introduction, Principles for Requirement Engineering of Web Applications, Adapting Requirement Engineering Methods to Web Application Development, Requirement Types, Notations, Tools.

- **WEB APPLICATION DEVELOPMENT (04 Hours)**

  Web Application Development Methodologies, Relationship Analysis- A Technique to Enhance Systems Analysis For Web Development, Engineering Location-Based Services in the Web, Tools.

- **WEB APPLICATION ARCHITECTURES & MODELLING (06 Hours)**

  Categorizing Architectures, Specifics of Web Application Architectures, Components of a Generic Web Application Architecture, Layered Architectures, 2-Layer Architectures, N-Layer Architectures, Data-Aspect Architectures, Database-Centric Architectures, Architectures for Web Document Management, Architectures for Multimedia Data, Modelling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modelling Requirements, Hypertext Modelling, Hypertext

Structure Modelling Concepts, Access Modelling Concepts, Relation to Content Modelling, Presentation Modelling, Relation to Hypertext Modelling, Customization Modelling, Relation to Content.

- **TESTING WEB APPLICATIONS (07 Hours)**

  Introduction, Fundamentals, Terminology, Quality Characteristics, Test Objectives, Test Levels, Role of the Tester, Test Specifics in Web Engineering, Test Approaches, Conventional Approaches, Agile Approaches, Test Scheme, Three Test Dimensions, Applying the Scheme to Web Applications, Test Methods and Techniques, Link Testing, Browser Testing, Usability Testing, Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, Test Automation, Benefits and Drawbacks of Automated Test, Test Tools.

- **WEB METRICS AND QUALITY (03 Hours)**

  Models and Methods, Architectural Metrics for Web Application: A Balance Between Rigor and Relevance, The Equal Approach to the Assessment of Web Application Quality, Web Cost Estimation.

- **WEB RESOURCE MANAGEMENT (03 Hours)**

  Models and Techniques, Ontology-Supported Web Content Management, Design Principles And Applications of XML.

- **WEB MAINTENANCE AND EVOLUTION (04 Hours)**

  Techniques and Methodologies, Program Transformations for Web Application Restructuring, The Requirements of Methodologies for Developing Web Applications, A Customer Analysis-Based Methodology for Improving Web Business Systems.

- **WEB PROJECT MANAGEMENT (06 Hours)**

  Understanding Scope, Refining Framework Activities, Building a Web Team, Managing Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project.

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Achyut Godbole, Atul Kahate “Web Technologies”, 3rd Edition, Tata McGraw Hill, India, 2017, ISBN: 978-1259062681.
2. Peter Smith, “Professional Website Performance”, 1st Edition, Wiley India Pvt. Ltd, 2012, ISBN: 9781118487525.

3. Roger Pressman and David Lowe, “Web Engineering: A Practitioner's Approach”, 1st Edition, McGraw-Hill, 2009, ISBN:0073523291, 9780073523293.
4. J. Governor, D. Hinchcliffe and D. Nickull, “Web 2.0 Architectures: What Entrepreneurs and Information Architects Need to Know”, 1st Edition, O'Reilly, 2009, ISBN: 9780596514433.
5. Andrew King, “Website Optimization”, 1st Edition, Shroff Publishers, India, 2009, ISBN: 9788184045628.

ADDITIONAL REFERENCE BOOKS

1. Guy W. Lecky-Thompson, “Just Enough Web Programming with XHTML, PHP, and Mysql”, 1st Edition, Cengage Learning, 2008, ISBN 9781598634815.

B. Tech. IV (CSE) Semester – VII
MACHINE LEARNING FOR SECURITY (CORE ELECTIVE – 4/5)
CS437

Scheme

L	T	P	Credit
3	0	2	04

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	have a knowledge of the limitations of the conventional security software in the wake of machine learning based attacks on the security software
CO2	be able to apply the concepts machine learning based intrusion detection to analyze the IDSs.
CO3	be able to analyze the malware analysis and mitigation based solutions for the probable threats therein.
CO4	be able to design the threat models based on machine learning approaches for network analysis.
CO5	be able to use the concepts of machine learning to prevent security design faults.

2. Syllabus

- **INTRODUCTION& REVIEW OF THE MACHINE LEARNING BASICS (02 Hours)**

  Review of the basic concepts in Linear Algebra, Probability and Statistics. Introduction to the ML techniques. Machine Learning problems viz. Classification, Regression, Clustering, Association rule learning, Structured output, Ranking. The Supervised and Unsupervised learning algorithms. Linear Regression, Gradient descent for convex functions, Logistics Regression and Bayesian Classification Support Vector Machines, Decision Tree and Random Forest, Neural Networks, DNNs , Ensemble learning. Principal Components Analysis. Un-supervised learning algorithms: K-means for clustering problems, K-NN (k nearest neighbors). Apriori algorithm for association rule learning problems. Generative vs Discriminative learning. Empirical Risk Minimization, loss functions, VC dimension. Data partitioning (Train/test/Validation), cross-validation, Biases and Variances, Regularization.

- **MACHINE LEARNING FOR SECURITY (04 Hours)**

  Introduction to Information Assurance. Review of Cybersecurity Solutions: Proactive Security Solutions, Reactive Security Solutions: Misuse/Signature Detection, Anomaly Detection, Hybrid Detection, Scan Detection. Profiling Modules. Understanding the Fundamental Problems of Machine-Learning Methods in Cybersecurity. Incremental Learning in Cyber infrastructures. Feature Selection/Extraction for Data with Evolving Characteristics. Privacy-Preserving Data Mining. Motivation for ML in security with real-world case studies. Topics of interest in applications of machine learning for security.

- **MACHINE LEARNING TECHNQIUES FOR INTRUSION DETECTION (08 Hours)**

Emerging Challenges in Cyber Security for Intrusion Detection: Unifying the Current Anomaly Detection Systems, Network Traffic Anomaly Detection. Imbalanced Learning Problem and Advanced Evaluation Metrics for IDS. Reliable Evaluation Data Sets or Data Generation Tools. Privacy Issues in Network Anomaly Detection. Machine Learning Techniques: for Anomaly Detection, for Misuse/Signature detection, for Hybrid detection, for Scan detection. Cost-Sensitive Modeling for Intrusion Detection. Data Cleaning and Enriched Representations for Anomaly Detection in System Calls.

- **MACHINE LEARNING TECHNQIUES FOR MALWARE ANALYSIS (08 Hours)**

Emerging Cyber Threats in malwares: Threats from Malware, Botnets, Cyber Warfare, Mobile Communication. Cyber Crimes. Malware Analysis: Feature generation, Features to Classification. Taxonomy of malware analysis approaches based on machine learning. Malware Detection, Similarity Analysis, Category Detection. Feature Extraction. PE Features. Supervised, Unsupervised and Semi-supervised learning algorithms for Malware Detection. Using Deep Learning Approaches: Generative Adversarial Networks.

- **NETWORK TRAFFIC ANALYSIS&WEB ABUSE DETECTION (08 Hours)**

Machine Learning for Profiling Network Traffic: Theory of Network defense (access control, authentication, detecting in-network attackers, data-centric security, honeypots), Predictive model for classifying network attacks.

- **MACHINE LEARNING IN PRIVACY PRESERVATION (06 Hours)**

k-anonymity; l-diversity; deferentially private data storage/release; verifiable differential privacy; privacy-preserving inference of social networking data; privacy-preserving recommender system; privacy versus utility. Machine learning techniques for Privacy Preserving Data Mining.

- **ADVERSARIAL MACHINE LEARNING (06 Hours)**

Adversarial Machine Learning: Motivation and Background. Practical Scenarios and Examples. Modelling the Adversary: Attack Surface Adversary Goals Adversary capabilities. Taxonomy of Adversarial Attacks on Machine Learning: Influence Specificity Security Violation. Data poisoning; Perturbation; Defense mechanism; Generative Adversarial Networks. A peep into Industry Perspectives: Theme of inference Secure Software Development Life Cycle or Secure Development Cycle. Key Inferences in terms of Security gaps, Suggested panacea.

Practicals will be based on the coverage of the above topics. (28 Hours)

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Clarence Chio, David Freeman. Machine Learning and Security. Protecting Systems with Data and Algorithms, O'Reilly Media Publications. 2018

2. Marcus A. Maloof (Ed.) , Machine Learning and Data Mining for Computer Security: Methods and Applications, Springer-Verlag London Limited, 2006
3. Sumeet Dua and Xian Du. Data Mining and Machine Learning in Cybersecurity. CRC Press, Taylor and Francis Group, LLC. 2011
4. Research Papers Prescribed in the class.

B. Tech. IV (CSE) Semester – VII
BLOCKCHAIN TECHNOLOGY (CORE ELECTIVE – 4/5)
CS439

	L	T	P	Credit
Scheme	**3**	**0**	**2**	**04**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the need, functions and challenges of blockchain technology.
CO2	deploy smart contracts for given use cases.
CO3	analyse blockchain based system structure and security offered therein.
CO4	asses functions, benefits and limitations of various blockchain platforms.
CO5	design and develop solution using blockchain technology in various application domains.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Blockchain Technology, Concept of Blocks, Transactions, Distributed Consensus, the Chain and the Longest Chain, Cryptocurrency, Blockchain 2.0, Permissioned Model of Blockchain, Permission less Blockchain.

- **DECENTRALIZATION USING BLOCKCHAIN** **(06 Hours)**

  Methods of Decentralization, Disintermediation, Contest-Driven Decentralization, Routes to Decentralization, the Decentralization Framework Example, Blockchain and Full Ecosystem Decentralization, Storage, Communication, Computing Power and Decentralization, Smart Contracts, Decentralized Autonomous Organizations, Decentralized Applications (DApps), Requirements and Operations of DApps, DApps Examples, Platforms for Decentralizations.

- **CRYPTO PRIMITIVES FOR BLOCKCHAIN** **(04 Hours)**

  Symmetric and Public Key Cryptography, Cryptographic Hard Problems, Key Generation, Secure Hash Algorithms, Hash Pointers, Digital Signatures, Merkle Trees, Patricia trees, Distributed Hash Tables.

- **BITCOINS AND CRYPTOCURRENCY** **(06 Hours)**

  Introduction, Digital Keys and Addresses, Private and Public Keys in Bitcoins, Base58Check Encoding, Vanity Addresses, Multi Signature Addresses, Transaction Lifecycle, Data Structure for Transaction, Types of Transactions, Transaction Verification, The Structure of Block in Blockchain, Mining, Proof of Work, Bitcoin Network and Payments, Bitcoin Clients and APIs,

Wallets, Alternative Coins, Proof of Stake, Proof of Storage, Various Stake Types, Difficulty Adjustment and Retargeting Algorithms, Bitcoin Limitations.

- **SMART CONTRACTS** **(02 Hours)**

  Smart Contract Templates, Oracle, Smart Oracle, Deploying Smart Contract on Blockchain.

- **PERMISSIONED BLOCKCHAIN** **(05 Hours)**

  Models and Use-cases, Design Issues, Consensus, Paxos, RAFT Consensus, Byzantine General Problem, Practical Byzantine Fault Tolerance.

- **DEVELOPMENT TOOLS AND FRAMEWORKS** **(05 Hours)**

  Solidity Compilers, IDEs, Ganache, Metamask, Truffle, Contract Development and Deployment, Solidity Language, Types, Value Types, Literals, Enums, Function Types, Reference Types, Global Variables, Control Structures, Layout of Solidity Source Code File.

- **HYPERLEDGER** **(05 Hours)**

  The Reference Architecture, Requirements and Design Goals of Hyperledger Fabric, The Modular Approach, Privacy and Confidentiality, Scalability, Deterministic Transactions, Identity, Auditability, Interoperability, Portability, Membership Services in Fabric, Blockchain Services, Consensus Services, Distributed Ledger, Sawtooth Lake, Corda.

- **BLCOKCHAIN USE-CASES AND CHALLENGES** **(05 Hours)**

  Finances, Government, Supply Chain, Security, Internet of Things, Scalability and Challenges, Network Plane, Consensus Plane, Storage Plane, View Plane, Block Size Increase, Block Interval Reduction, Invertible Bloom Lookup Tables, Private Chains, Sidechains, Privacy Issues, Indistinguishability Obfuscation, Homomorphic Encryption, Zero Knowledge Proofs, State Channels, Secure Multiparty Computation, Confidential Transactions.

Practicals will be based on the coverage of the above topics. **(28 Hours)**

(Total Contact Time: 42 Hours + 28 Hours = 70 Hours)

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3. <u>Books Recommended:</u>

1. Imran Bashir, “Mastering Blockchain”, 2/E, Packt publishing, Mumbai, 2018.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, 2/E, O’Reilly, 2014.
3. Melanie Swan, “Blockchain Blueprint for a New Economy”, 1/E, O'Reilly Media, 2015.
4. Don and Alex Tapscott, “Blockchain Revolution”, 1/E, Penguin Books Ltd, 2018.
5. Alan T. Norman, “Blockchain Technology Explained”,1/E, CreateSpace Independent Publishing Platform, 2017.

B. Tech. IV (CSE) Semester – VII
RESEARCH METHODOLOGY (CORE ELECTIVE - 6)
CS461

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand different research techniques to perform the research in academic as well as real life.
CO2	apply sampling techniques and develop hypothesis on the real world problems.
CO3	perform, evaluate, analyse and interpret the research design through project development and case study analysis using appropriate tools.
CO4	evaluate the outcomes in terms of hypothesis testing and accepting or rejection the decision based on the problem statement.
CO5	design, develop and innovate a research strategy for complex engineering problems.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Research: Definition, Characteristics, Motivation and Objectives, Research Methods vs Methodology, Types of Research – Descriptive vs Analytical, Applied vs Fundamental, Quantitative vs Qualitative, Conceptual vs Empirical.

- **RESEARCH METHODOLOGY** **(04 Hours)**

  Research Process, Formulating the Research Problem, Defining the Research Problem, Research Questions, Research Methods vs. Research Methodology.

- **RESEARCH DESIGN** **(04 Hours)**

  Concept and Importance in Research, Features of a Good Research Design, Exploratory Research Design, Concept, Types and Uses, Descriptive Research Designs, Concept, Types and Uses, Experimental Design: Concept of Independent & Dependent variables.

- **LITERATURE REVIEW** **(04 Hours)**

  Review Concepts and Theories, Formulation of Hypothesis, Sources of Hypothesis, Characteristics of Hypothesis, Role of Hypothesis, Tests of Hypothesis.

- **DATA MODELING AND SIMULATIONS** **(08 Hours)**

Mathematical Modeling, Experimental Skills, Simulation Skills , Data Analysis and Interpretation.

- **TECHNICAL WRITING AND TECHNICAL PRESENTATIONS (04 Hours)**
- **TOOLS AND TECHNIQUES FOR RESEARCH (06 Hours)**

  Methods to Search Required Information Effectively, Reference Management Software, Software for Paper Formatting, Software for Detection of Plagiarism.

- **CREATIVITY AND ETHICS IN RESEARCH, INTELLECTUAL PROPERY RIGHTS (04 Hours)**
- **DISCUSSION AND DEMONSTRATION OF BEST PRACTICES (04 Hours)**

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. John W. Creswell, “Research Design: Qualitative, Quantitative, and Mixed Methods Approaches”, 2nd Edition, SAGE Publications, 2002.
2. C.R. Kothari, “Research Methodology: Methods and Techniques”, 4th Edition, New Age International, 2012.
3. David Silverman, “Qualitative Research”, 4th Edition, SAGE Publications Ltd, 2016.
4. Norman K. Denzin, Yvonna Sessions Lincoln, “Handbook of Qualitative Research”, 2nd Edition, SAGE Publications Ltd, 2011.
5. Michael Quinn Patton, “Qualitative research and evaluation methods”, 3rd Edition, SAGE Publications Ltd, 2002.

B. Tech. IV (CSE) Semester – VII
NETWORK SECURITY (CORE ELECTIVE - 6)
CS463

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	gain knowledge of network and system security attacks and its prevention mechanisms.
CO2	apply different security mechanisms for given application scenario.
CO3	perform security analysis of network and system security protocols.
CO4	evaluate security protocols for different metrics like functionality, cost and efficiency.
CO5	design and integrate security protocols depending on organization's requirement.

2. Syllabus

- **INTRODUCTION** **(04 Hours)**

  Introduction to Network and System Security, Security Attacks, Security Requirements, Confidentiality, Integrity, and Availability, Security Mechanisms, NIST Security Standards, Assets and Threat Models.

- **REVIEW OF CRYPTOGRAPHIC TOOLS** **(04 Hours)**

  Number Theory, Prime Numbers, Modular Arithmetic, Confidentiality with Symmetric Encryption, Message Authentication and Hash Functions, Public-Key Encryption, Digital Signatures and Key Management, Random and Pseudorandom Numbers.

- **SYSTEM SECURITY** **(10 Hours)**

  User Authentication - Means of Authentication, Password-Based Authentication, Token-Based Authentication, Biometric Authentication, Remote User Authentication, Access Control-Access Control Principles, Subjects, Objects, and Access Rights, Discretionary Access Control, Example: UNIX File Access Control, Role-Based Access Control, Database Security-The Need for Database Security, Database Access Control, Inference, Statistical Databases, Database Encryption, Cloud Security, Malicious Software, Intruders, Denial of Service and Distributed Denial of Service attacks, Intrusion Detection and Prevention.

- **SOFTWARE SECURITY AND TRUSTED SYSTEMS** **(12 Hours)**

  Buffer Overflow-Stack Overflows, Defending Against Buffer Overflows, Other Forms of Overflow Attacks, Software Security-Software Security Issues, Handling Program Input, Writing Safe Program Code, Interacting with the Operating System and Other Programs, Handling

Program Output, Operating System Security-System Security Planning, Operating Systems Hardening, Application Security, Security Maintenance, Linux/Unix Security, Windows Security, Virtualization Security, Trusted Computing and Multilevel Security-The Bell-LaPadula Model for Computer Security, Other Formal Models for Computer Security, The Concept of Trusted Systems, Application of Multilevel Security, Trusted Computing and the Trusted Platform Module, Common Criteria for Information Technology Security Evaluation, Assurance and Evaluation.

- **NETWORK SECURITY** **(10 Hours)**

  Internet Security Protocols and Standards-Secure E-mail and S/MIME, Pretty Good Privacy (PGP), Domain Keys Identified Mail, Secure Sockets Layer (SSL) and Transport Layer Security (TLS), HTTPS, IPv4 and IPv6 Security, IPSec Protocol, Internet Authentication Applications-Kerberos, X.509, Public-Key Infrastructure, Federated Identity Management, Wireless Network Security-Wireless Security Overview, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security, Network Management Security-SNMP Protocol.

- **ADVANCED TOPICS** **(02 Hours)**

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. William Stallings, Computer Security: Principles and Practice, 2/E, Pearson, 2012.
2. John Vacca, Network and System Security, 2/E, Elsevier, 2013.
3. William Stallings, Network Security Essentials: Applications and Standards, Prentice Hall, 4th edition, 2010.
4. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone, Handbook of Applied Cryptography, CRC Press, 2001.
5. William Stallings, Cryptography and Network Security, 7/E, Pearson, 2018.

B. Tech. IV (CSE) Semester – VII
SYSTEM ANALYSIS AND SIMULATION (CORE ELECTIVE - 6)
CS465

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	acquire knowledge about the important elements of discrete event simulation and modelling paradigm.
CO2	interpret the model and apply the results to resolve critical issues in a real world environment.
CO3	identify and analyse the system requirements using various system analysis techniques.
CO4	use computer simulation software to solve and interpret the results.
CO5	develop skills to apply simulation software to construct and execute goal-driven system models.

2. Syllabus

- **INTRODUCTION** **(09 Hours)**

  Introduction, Organizational and Business Context of System Development.

- **APPROACHES TO SYSTEMS DEVELOPMENT AND PROJECT MANAGEMENT** **(08 Hours)**

  System Development Methodologies, Models, Tools and Techniques for Developing Quality Software.

- **SYSTEM ANALYSIS ACTIVITIES** **(08 Hours)**

  Define, Prioritise, and Evaluate Requirements of an Information System as well as Build General and Detailed Models that Specify the System Requirements.

- **ESSENTIALS OF SYSTEM DESIGN** **(09 Hours)**

  Describe, Organize and Structure the Components of a System, Including Decisions About the System's Hardware, Software, and Network Environment, Designing Effective User and System Interfaces Considering Human-Computer Interaction Principles.

- **ADVANCE SYSTEM DESIGN CONCEPTS** **(08 Hours)**

  Apply Object-Oriented Design in Order to Build Detailed Models that Assist Programmers in Implementing the System, Store and Exchange Data in the System by Considering Database

Management and Security Issues, and Creating Database Models and Controls, Making the System Operational.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. J. W. Satzinger, R. B. Jackson and S. D. Burd, "Systems Analysis and Design in a Changing World", 6th ed. Boston, USA: Thomson Course Technology, 2012.
2. Averill M. Law, "Simulation modelling and analysis (SIE)", 4th Edition, Tata McGraw Hill India, 2007.
3. David Cloud, Larry Rainey, "Applied Modelling and Simulation", Tata McGraw Hill, India.
4. Gabriel A. Wainer, "Discrete-event modelling and simulation: a practitioner's approach", 1st Edition, CRC Press, 2009.
5. Bernard P. Zeigler, Herbert Praehofer, Tag Gon Kim, "Theory of modelling and simulation: integrating discrete event and continuous complex dynamic systems", 2nd Edition, Academic Press, 2000.

ADDITIONAL REFERENCE BOOKS

1. Walter J. Karplus, George A. Bekey, Boris Yakob Kogan, "Modelling and simulation: theory and practice", 1st Edition, Springer, 2003.

B. Tech. IV (CSE) Semester – VII
NETWORK RECONNAISSANCE (CORE ELECTIVE - 6)
CS467

Scheme	L	T	P	Credit
	3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will**	
CO1	have a knowledge of the basic concepts of network, host, services and vulnerability gathering techniques employed by an attacker.
CO2	be able to use the tools for doing network footprinting including stealth scanning.
CO3	be able to analyze the installations for the vulnerabilities that could be exploited by an adversary.
CO4	be able to design the secure system installations that can withstand the adversarial attacks.
CO5	be able to extend the existing tools for network and systems protection.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Review of the Network Fundamentals, Network Topologies, Network Components, TCP/IP Networking Basics, TCP/IP Protocol Stack: DNS, SNMP, TCP, UDP, IP, ARP, RARP, ICMP protocols. Ethernet, Subnet Masking, Subnetting, Supernetting. Review of the Security Basics: Attributes, Mechanisms and Attacks Taxonomy. The CIA Traid. Threats, Vulnerabilities, Attacks

- **NETWORK SECURITY CONCERNS (04 Hours)**

  Network Security Concerns. Fundamental Network Security Threats. Types of Network Security Threats. Network Security Vulnerabilities, their types: Technological Vulnerabilities, Configuration Vulnerabilities, Security policy Vulnerabilities. Types of Network Security Attacks

- **INTELLIGENCE (INT) GATHERING (08 Hours)**

  Learning about the target, its business, its organizational structure, and its business partners. To output the list of company names, partner organization names, and DNS names, and the servers. The concepts of Search engines, Financial databases, Business reports. The use of WHOIS, RWHOIS, Domain name registries and registrars, Web archives and the corresponding open source tools for mining these data. Cloud reconnaissance.

- **NETWORK FOOTPRINTING (08 Hours)**

  Active & Passive Footprinting. Network and system footprinting. Tools for network footprinting. Using Search engines to find the tools. Mining the DNS host names, corresponding IP addresses, IP address ranges, Firewalls, Network maps. Use of search engines, social media, social engineering, the websites of the target organization. Using archive.org. Using Neo trace, DNS Footprinting and whois databases. Use of the contemporary tools (e.g. png, port scanners) for finding this information. Email footprinting. Email Tracking. Footprinting through Google tools. Using traceroute. Verification to confirm the validity of information collected in the prior phases. The countermeasures to prevent successful network footprinting.

- **SCANNING & ENUMERATION (08 Hours)**

  Scanning: goals and type, overall scanning tips, sniffing with tcpdump, network tracing, port scanning. OS fingerprinting, version scanning. Identify open ports. Web Service Review Tools: Identify web-based vulnerabilities. Network Vulnerability Scanning Tools: Identify infrastructure-related security issues. The illustrative tools are Nmap, ping, AngryIP, Nikto, OpenVAS, udp-proto-scanner, Netsparker, Nessus, Masscan, SQLMap, Nexpose, Burpsuite, Qualys, HCL AppScan, Amass, wpscan, Eyewitness, WebInspect, ZAP. Stealth Scannning: Scanning Beyond an IDS. Network diagram generation using typical tools viz. Network Topology Mapper, OpManager, LANState, Friendly Pinger. Proxy Servers, The Onion Routing. http tunneling. ssh tunneling. Anonymizers.

- **EXPLOITATION (10 Hours)**

  Network based exploitation: using tools a such as Metasploit to compromise vulnerable systems, basics of pivoting, and pilfering. Detection of IP Spoofing. Common web vulnerabilities: Cross-site scripting, OS and Command injections, Buffer overflows, SQL injection, race conditions, and such other vulnerabilities scanning and exploitation techniques, including those in OWASP Top 25. Extracting information about the user namesusing email IDs, the list of default passwords used by the products used at the target, user names using the SNMP protocol, user groups from Windows and the DNS zone transfer information. SuperScan. Route Analysis Tools. SNMP Enumeration. Reconnaissance Attacks and how to mitigate reconnaissance attacks.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. John Slavio. Hacking: A Beginners' Guide to Computer Hacking, Basic Security, And Penetration Testing.
2. Yuri Diogenes, Dr. Erdal Ozkaya. Cybersecurity – Attack and Defense Strategies: Counter modern threats and employ state-of-the-art tools and techniques to protect your organization against cybercriminals, 2nd Edition Kindle Edition, Packt Publishing; 2nd edition, 2019.
3. Hidaia Mahmood Alassouli. Footprinting, Reconnaissance, Scanning and Enumeration Techniques of Computer Networks, Blurb Publishers.

4. Robert Shimonski. Cyber Reconnaissance, Surveillance and Defense 1st Edition, Kindle Edition, Syngress; 2014.
5. by Format: Kindle Edition Michael Sikorski, Andrew Honig. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software
6. Dafydd Stuttard and Marcus Pinto. The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws

B. Tech. IV (CSE) Semester – VII
SOFTWARE SECURITY & DEFENSIVE PROGRAMMING
(CORE ELECTIVE - 6)
CS469

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):	
At the end of the course, students will be able to	
CO1	have a knowledge of the basic concepts and problems of memory unsafe and memory safe languages
CO2	be able to use the concepts to detect security vulnerabilities and prevent them.
CO3	be able to analyze/interpret program code for doing Static and Dynamic Security Testing.
CO4	be able to design the new software with the security features builtin rather than reliance on the security software.
CO5	be able to use the concepts of information security to prevent security design faults.

2. Syllabus

- **INTRODUCTION (02 Hours)**

  Introduction to the course; Review of Information Security concepts; The CIA Triad; Systems Security, Information Security, Application Security, Network Security – commonalities and differences. Essential Terminologies; Secure Software & its properties. Security Software: Critical shortcomings. Studies of various catastrophes due to Insecure software; What is Software Security? Software Assurance? Motivation for the Software Security; Software Security vs Security Software; The trinity of troubles viz. Connectivity, Extensibility and Complexity; Model Based Security Engineering; Security in Software Development Lifecycle (SDLC); Software Security Best Practices applied to various software artifacts in the SDLC; Addressing security throughout the SDLC; Three Pillars of Software Security; Software Security Touchpoints.

- **SECURITY ATTACKS AND TAXONOMY OF SECURITY ATTACKS (02 Hours)**

  Review of security attacks – Taxonomy of Security Attacks, Methods. Attacks in each phase of software life cycle. Attacks on the TCP/IP protocol suite layers; Motivation for attackers, Methods for attacks: Malicious code, Hidden software mechanisms, Social Engineering attacks, Physical attacks. Non-malicious dangers to software; The Denial of Service Attacks in each phase of software life cycle; Security Vulnerabilities and Attack Taxonomy in Internet of Things and Cyber Physical Systems; Review of Malwares: Viruses, Trojans, and Worms. Malware Terminology: Rootkits, Trapdoors, Botnets, Key loggers, Honeypots. IP Spoofing, Tear drop, DoS, DDoS attacks.

- **THE SOFTWARE VULNERABILITIES (08 Hours)**

  The Software Vulnerabilities: Vulnerabilities in the Memory-safe and memory-unsafe languages; Introduction to the Program Stack Analysis; Hands-on on Stack Analysis using gcc compiler and gdb debugger tool; Methods of security attack exploiting the vulnerabilities in the code; Taxonomy of security vulnerabilities; Remote Code Execution; State-of-the-art in research in Security Vulnerabilities; Overview of C, C++, Java Security Vulnerabilities.

- **THE WEB VULNERABILITIES & COUNTERMEASURES (08 Hours)**

  The common Web vulnerabilities: the Buffer Overflow - Stack overflows, Heap Overflows, the Code and Command Injections and the types: SQL injection, Cross-site scripting, Interpreter injection; the Format String vulnerabilities, writing shell code; The Seven Pernicious Kingdoms; The Hidden form fields, Weak session cookies; Fault injection & Fault monitoring, Fail open authentication; The OWASP Top 25 vulnerabilities in the current year.

- **THE WEB VULNERABILITIES IN MEMORY SAFE LANGAUGES & COUNTERMEASURES (08 Hours)**

  Introduction to Session Management in Web Applications; Session Management best practices; The XSRF (Cross-site Request Forgery) Attack; Security vulnerabilities in Java: Connection String Injection, LDAP Injection, Reflected XSS, Resource Injection, Persistent XSS attacks in Java, The XPath Injection; Insecure deserialization, Remote code execution (RCE); Log injection; Mail injection; Vulnerabilities in Java libraries; Vulnerabilities in the Java sandboxing mechanism; Insufficient Transport Layer Protection (ITLP); Application misconfiguration and Software Composition Analysis (SCA).

- **CODE REVIEWS AND STATIC ANALYSIS OF THE SOURCE CODE (04 Hours)**

  Introduction to Code reviews and Static Informal reviews, Formal inspections; Illustrations, Introduction to Code reviews and Static Analysis, Code Reviews, Static Code Analysis; Static and Dynamic Application Security Testing (SAST and DAST) tools; Using basic linting to detect security vulnerabilities in the code with the linux find(), grep(), awk(), splint() and the FlawFinder; A glance at Code Analyzer Tools : Top-10: Raxis, SonarQube for Code Quality and Code Security, PVS-Studio, reshift, Embold, SmartBear Collaborator, CodeScene Behavioral Code Analysis, RIPS Technologies.Others: Cscope, Ctags, Editors, Cbrowser. Comparison with the Dynamic Application Security Testing.

- **THREAT MODELLING (06 Hours)**

  Finding Threats: Using STRIDE, Attack Patterns, Attack Trees, Misuse Patterns; Threat modelling with Attack Trees and Graphs; Anti-models, State transition diagrams, Access control models; Specifying Secrecy, Authentication and Assertions; Graph based specifications, UML-based specifications; Formal Security specifications; Web Threats, Cloud Threats, Mobile Threats, Threats to Cyrptosystems; Attack Libraries: Properties, OWASP Top Ten, CAPEC. Threat Modelng tools: Secure Design – Principles: Secure Software Design Principles and Practices. Security Architectures. Design oriented, Goal oriented and Problem oriented approaches; Security Patterns: Modelling and

Classification of Security Patterns. Patterns characterization; Security Design Approaches viz. UML, Secure UML, UMLSec and Misuse cases; Illustrating the design of a security protocol.

- **SECURITY IN DESIGN** **(04 Hours)**

  Secure Design – Principles: Secure Software Design Principles and Practices; Security Architectures; Design oriented, Goal oriented and Problem oriented approaches; Security Patterns: Modelling and Classification of Security Patterns; Patterns characterization; Security Design Approaches viz. UML, Secure UML, UMLSec and Misuse cases; Illustrating the design of a security protocol.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Andrew Magnusson. Practical Vulnerability Management: A Strategic Approach to Managing Cyber Risks.
2. H Mouratidis. Software Engineering for Secure Systems – Industrial and Research Perspectives. Information Science Reference, IGI global, 2011.
3. Gary McGraw. Software Security : Building Security In. Addison Wesley Software Security Series. 2006 edition.
4. Theodor Richardson, Charles Thies. Secure Software Design. Jones and Bartlet Learning, 2013
5. Malcolm McDonald. Web Security for Developers: Real Threats, Practical Defense, No Starch Press.

ADDITIONAL REFERENCE BOOKS

1. Steven Palmer. Web Application Vulnerabilities: Detect, Exploit, Prevent by
2. Izar Tarandach . Threat Modeling: A Practical Guide for Development Teams
3. Tanya Janca. Alice and Bob Learn Application Security.

B. Tech. IV (CSE) Semester – VII
ADVANCED COMPUTER ARCHITECTURE
(CORE ELECTIVE - 6)
CS471

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	describe the various architectural concepts to optimize and enhance the classical Von Neumann architecture into high performance computing hardware systems.
CO2	interpret performance of different pipelined processors and multiprocessor architecture.
CO3	identify, compare and assess issues related to memory, control and I/O functions.
CO4	evaluate the programming solution based on parallelism.
CO5	design solutions in the area of advanced computer architecture.

2. Syllabus

- **OVERVIEW OF VON NEUMANN ARCHITECTURE** **(04 Hours)**

  Instruction Set Architecture, The Arithmetic and Logic Unit, The Control Unit, Memory and I/O Devices and Their Interfacing to the CPU; Measuring and Reporting Performance; CISC and RISC Processors.

- **PIPELINING** **(04 Hours)**

  Basic Concepts of Pipelining, Data Hazards, Control Hazards, and Structural Hazards; Techniques for Overcoming or Reducing the Effects of Various Hazards.

- **INSTRUCTION LEVEL PARALLELISM** **(06Hours)**

  ILP Concepts, Pipelining Overview, Compiler Techniques for Exposing ILP, Dynamic Branch Prediction, Dynamic Scheduling, Multiple instruction Issue, Hardware Based Speculation, Static Scheduling, Multi-threading, Limitations of ILP, Case Studies.

- **DATA-LEVEL PARALLELISM** **(06 Hours)**

  Vector Architecture, SIMD Extensions, Graphics Processing Units, Loop Level Parallelism.

- **THREAD LEVEL PARALLELISM** **(06 Hours)**

Symmetric and Distributed Shared Memory Architectures, Performance Issues, Synchronization, Models of Memory Consistency, Case studies: Intel i7 Processor, SMT & CMP Processors.

- **MEMORY AND I/O** **(06 Hours)**

  Cache Performance, Reducing Cache Miss Penalty and Miss Rate, Reducing Hit Time, Main Memory and Performance, Memory Technology, Types of Storage Devices, Buses, RAID, Reliability, Availability and Dependability, I/O Performance Measures.

- **MULTIPROCESSOR ARCHITECTURE** **(06 Hours)**

  Taxonomy of Parallel Architectures; Centralized Shared-Memory Architecture, Synchronization, Memory Consistency, Interconnection Networks; Distributed Shared-Memory Architecture, Cluster Computers.

- **NON VON NEUMANN ARCHITECTURES:** **(04 Hours)**

  Data Flow Computers, Reduction Computer Architectures, Systolic Architectures.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. J. L. Hennessy, and D.A. Patterson, "Computer Architecture: A quantitative approach", Fifth Edition, Morgan Kaufman Publication, 2012.
2. M. J. Flynn, "Computer Architecture: Pipelined and Parallel Processor Design", 1st Edition, Narosa Publishing House, 2011.
3. J.P. Shen and M.H. Lipasti, "Modern Processor Design", 1st Edition, MC Graw Hill, Crowfordsville, 2005.
4. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", 1st Edition, MC Graw-Hill International Edition, 2000.

Sima D, Fountain T and Kacsuk P," Advanced Computer Architectures: A Design Space Approach", 1st Edition, Addison Wesley, 2000.

B. Tech. IV (CSE) Semester – VII
SECURITY IN RESOURCE CONSTRAINED ENVIRONMENT
(CORE ELECTIVE - 6)
CS473

Scheme

L	T	P	Credit
3	0	0	03

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the significance of security in embedded devices, design issues in the security protocols, characteristics of Wireless Sensor Network along with types of probable attacks.
CO2	apply the security mechanisms in embedded systems and Wireless Sensor Networks using various tools.
CO3	debug, trouble shoot basic issues in RTOSs, resource constrained devices and provide security to devices.
CO4	create and evaluate the solution thoroughly using simulators like TOSSIM, Contiki, Cooja.
CO5	design security protocols for a typical Wireless Sensor Network/IoT Systems.

2. Syllabus

- **INTRODUCTION TO EMBEDDED SECURITY** **(04 Hours)**

  Introduction, Review of Security Basics, Services & Mechanisms, Security Requirements in Embedded Systems. Design Challenges in Security for Embedded Systems, Security Gap, Typical Generic Security Threats in Embedded Systems.

- **WIRELESS SENSOR NETWORKS AS EMBEDDED SYSTEMS** **(06 Hours)**

  Evolution of Human Computer Interfaces, Ubiquitous Computing, Pervasive Computing, The Illustrative Sensor Motes, Typical Configurations, Deployment Models and Issues, Typical Applications, Security Issues, Security in Wireless Sensor Networks, Typical Attacks and Countermeasures. The Denial of Service Attacks on Wireless Sensor Networks.

- **TINYOS OPERATING ENVIRONMENT** **(03 Hours)**

  Hands-on on the TinyOS Operating Environment, the NesC Programming Language. The TOSSIM Simulator. The Avrora Emulator. The TinySec Environment and its Files. Hands-on on ContikiCooja Simulator.

- **SECURE DATA AGGREGATION IN WIRELESS SENSOR NETWORKS** **(08 Hours)**

  Motivation for Secure Data Aggregation in Wireless Sensor Networks. End-to-End and Hop-by-Hop Secure Data Aggregation and Issues, Design of a Hop-by-Hop Link Layer Security Protocol in

Wireless Sensor Networks. Design Issues Viz. Security Issues, Performance Issues, Ciphers, Initialization Vector, Message Authentication Code, Authenticated Encryption Modes. Investigating Replay attacks in Link Layer Security Architectures and Typical Mitigation Approaches. The Replay Protection Algorithms Continued. Flexibly Configurable Link Layer Security Architecture for Wireless Sensor Networks.

- **END-TO-END SECURE DATA AGGREGATION IN WIRELESS SENSOR NETWORKS (05 Hours)**

The End-to-End Secure Data Aggregation in Wireless Sensor Networks. The Concept of Fully Homomorphic Encryption, Using the Classical Homomorphic Encryption Algorithms for Privacy in WSNs. Different Approaches to Offer Data Integrity viz. using Conventional MAC - Aggregate MAC, Homomorphic MAC Hybrid Secure Data Aggregation, Malleability Resilient Concealed Data Aggregation.

- **CIPHERS IN THE RESOURCE CONSTRAINED DEVICES (07 Hours)**

Lightweight Ciphers for RFID Devices. The AES Cipher Working and Demo in WSNs. Assignment on AES Encryption Decryption Routines. The TEA Cipher Operation, Demo of Executing RC5 and XXTEA Ciphers in TinySec Environment. Case Study of the Ciphers – Representative Ciphers from the List viz. TEA, XXTEA, RC5, miniAES, PRESENT, Simon, Speck – their Encryption, Decryption and Key Management Routines. Doing Hand Computation of the Intermediate Ciphertext at each Stage in all these Ciphers.

Public Key Infrastructure in Wireless Sensor Networks, The TinyPK Protocol as a Case Study. Attribute Based Encryption and its Motivation for Embedded Systems.

- **SECURITY AND PRIVACY ISSUES IN IOT SYSTEMS (05 Hours)**

The Internet of Things, Architecture, Constituent Elements, The Security and Privacy Issues in IoT Systems, Overview of the IoT Protocols Viz. Continua for Home Health Devices, DDS, DPWS: WS-Discovery-SOAP-WS Addressing-WDSL-XML Schema, HTTP/REST, MQTT, UPnP, XMPP, ZeroMQ. The IoT Security Protocols viz. ZigBee, Bluetooth, 6LowPAN, RPL. The CoAP.

- **SIDE CHANNEL ATTACKS IN EMBEDDED SYSTEMS (02 Hours)**

Introduction, Side Channel Attacks, Passive Versus Active Attacks, Timing, Analysis, Power Analysis, Electromagnetic Analysis, Analysis Tools and Equipment.

- **MISCELLANEOUS TOPICS (02 Hours)**

Overview of Security Support in Data Protection Protocols for the Embedded Systems. SSL, IPSec, IKE, and TLS in Resource Constrained Devices.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Fei Hu., "Security and Privacy in Internet of Things (IOT's): Models, Algorithms and Implementations Handcover", 1st Edition, CRC Press, 2016.
2. R.Giladi, N. Dimitrios, "Security and Embedded Systems", VOL 2, IOS Press, 2006.
3. A.G. Voyiatzis, A.G. Fragopoulos, and D.N. Serpanos "Security in Embedded Systems Design Issues in Secure Embedded Systems", 1st Edition, CRC press,2005.
4. R. Zurawski, "Embedded Systems Handbook", 1st Edition, CRC Press,2006.
5. T. Stapko, "Practical Embedded Security: Building Secure Resource-Constrained Systems", 2nd Editions, Newnes, 2007.

B. Tech. IV (CSE) Semester – VII
SECURE SOFTWARE ENGINEERING (CORE ELECTIVE - 6)
CS475

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand the security field and its key concept.
CO2	catch attack patterns.
CO3	analyse the risk behind any system/code.
CO4	evaluate the attack as well as cybercrimes.
CO5	design a system with minimal risk and attack possibilities.

2. Syllabus

- **INTRODUCTION (04 Hours)**

  Software Security, Security in SDLC, Review of Software Engineering Concepts, SDLC, Software Qualities, Interdependence of Software Qualities, Security as a Software Quality, Review of Information Security Concepts, Software Security vs. Information Security vs. Application Security, Terminologies, The Trinity of Trouble viz. Connectivity, Extensibility and Complexity, Studies of Various Catastrophes Due to Insecure software, Model Based Security Engineering, Three Pillars of Software Security, Security in Software Lifecycle.

- **ATTACKS AND TYPES OF ATTACKERS (06 Hours)**

  Attacks-Types, Methods, Attacks in Each Phase of Software Life Cycle, Motivation for Attackers, Methods for Attacks: Malicious Code, Hidden Software Mechanisms, Social Engineering Attacks, Physical Attacks, Non-malicious Dangers to Software, Attacks in Each Phase of Software Life Cycle, Security Vulnerabilities and Attack Taxonomy in Internet of Things and Cyber Physical Systems, Attack Trees, Attack Trees for BGP, PGP, PGP Probable Vulnerabilities.

- **SECURITY VULNERABILITIES-I (06 Hours)**

  Introduction to Stack Analysis, Hands on Stack Analysis using gcc Compiler and sdb Debugger Tool, Methods of Attack, Taxonomy of Security Vulnerabilities, Introduction to Code Reviews and Static Informal Reviews, Formal Inspections. Code Coverage and Code Coverage Criteria viz. Statement Coverage, Branch Coverage, Condition Coverage, Path Coverage, Illustrations.

- **SECURITY VULNERABILITIES-II (04 Hours)**

  Format String Vulnerabilities, Race Conditions Vulnerability, Examples of TOCTOU Race Conditions in Linux Environment, Code Injection and its Types, SQL Injection, Interpreter Injection; Weak Session Cookies, Buffer Over flows, Hidden Form Fields, Fail Open Authentication, Cross-site Scripting.

- **INTRODUCTION TO PETRINETS** **(04 Hours)**

  Petrinet as a Modelling Tool, Graphical Notations, Modelling Deadlocks and Starvation, Coloured Petrinets, Simulations of Real time Applications using Petrinets

- **INTEGRATING SECURITY INTO SDLC.** **(02 Hours)**

  Risk Management and Threat Modelling Methodologies, Software Risk Assessment and Threat Modelling Methodologies, Secure Development Cycle Activities and Practices.

- **USECASE MODELLING** **(04 Hours)**

  Usecases, Sequence Diagram, Collaboration Diagram, Illustrations of Kerberos and SET Through Sequence Diagram.

- **ATTACK PATTERNS** **(04 Hours)**

  The Attack Patterns, Illustrations, Review of Design Patterns in SE and Multi-tier architecture, Attack Proles, Attack Proles from Attack Patterns, Usage of Attack Proles, Using Attack Patterns in Attack Proles, Generating Attack Patterns, Case Studies, Abuse Cases, Misuse Cases, Using Attack Patterns to Generate an Abuse Case Model and Anti-Requirements, Finite State Machines for Security Requirements, Case Studies, Security Patterns.

- **ARCHITECTURAL RISK ANALYSIS** **(04 Hours)**

  Introduction to UMLSEC AND SECUREUML, Risk Analysis using Z for Secure Specifications, Introduction To Penetration Testing.

- **SECURE PROGRAMMING** **(04 Hours)**

  Common Software Security Bugs and Coding Errors.

(Total Contact Time: 42 Hours)

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3. <u>Books Recommended:</u>

1. Gary McGraw, “Software Security: Building Security”, 2nd Edition, Addison Wesley Software Security Series, 2006.
2. Theodor Richardson, Charles Thies, “Secure Software Design”, 2nd Edition, Jones and Bartlet Learning, 2013.
3. Ghezzi, Jazayeri, Mandrioli, “Fundamentals of Software Engineering”, 2nd Edition, Pearson EDU, 2003.
4. Mark Merkow, “Secure, Resilient, and Agile Software Development”, 1st Edition, Auerbach Publications, 2019.
5. Jason Grembi, “Secure Software Development: A Security Programmer's Guide”, 1st Edition, Cengage Learning, 2008.

B. Tech. IV (CSE) Semester – VII
ADVANCED COMPILER DESIGN
(CORE ELECTIVE - 6)
CS477

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs):	
At the end of the course, students will be able to	
CO1	understand compiler structure and overall compilation process.
CO2	apply code generation and optimization techniques for machine-independent optimization.
CO3	analyse processor architecture, scheduling and pipeling to achieve Instruction Level parallelism and optimize for parallelism and locality.
CO4	evaluate various inter procedural analysis methods to analyze a program with multiple procedures.
CO5	design and develop the mechanism required for compiling advanced language translators.

2. Syllabus

- **INTRODUCTION (08 Hours)**

  Overview of the Translation Process, Compiler Structure, and Compilation Process, Difference between Interpreter, Assembler and Compiler, Phases of Compiler, Programming Language Grammars, Lexical Analysis, Syntax Analysis, Intermediate Code Generation and Run Time Environment.

- **CODE GENERATION (06 Hours)**

  Issues in the Design of Code Generation, Addresses in Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Simple Code Generator, Peephole Optimization, Optimal code Generation for Expression, Dynamic Programming Code Generation.

- **MACHINE-INDEPENDENT OPTIMIZATION (06 Hours)**

  Scope for Optimization, Data and Control Flow Analysis, Constant Propagation, Partial Redundancy Elimination, Loops in Flow Graph, Region Based Analysis, Symbolic Analysis.

- **INSTRUCTION LEVEL PARALLELISM (06 Hours)**

  Processor Architecture, Code Scheduling Constraints, Basic Block Scheduling, Global Code Scheduling, Software Pipelining.

- **OPTIMIZING FOR PARALLELISM AND LOCALITY (06 Hours)**

Parallelization and Multiprocessors, Iteration Spaces, Affine Array Indexes, Data Reuse, Array Data Dependant Analysis, Synchronization Free Parallelism, Synchronization Between Parallel Loops, Pipelining, Locality Optimization, Uses of Affine Transforms.

- **INTERPROCEDURAL ANALYSIS** **(06 Hours)**

  Need for Inter Procedural Analysis, Logical Representation of Data Flow, Pointer Analysis, Context Insensitive Inter Procedural Analysis, Context Sensitive Pointer Analysis, Datalog Implementation.

- **ADVANCED TOPICS** **(04 Hours)**

  Code Profiling, Parallelization and Vectorization, Garbage Collector, Just in Time Compilation and Recent Developments.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Aho, Sethi, Ullman, Compilers, “Principles, Techniques, and Tools”, 2nd Edition, Addison Wesley, 2011.
2. Nandini Prasad, “Principles of Compiler”, 3rd Edition, Cengage Publication, 2017.
3. Steven Muchnick, “Advanced Compiler Design and Implementation”, 1st Edition M. Kaufmann, 1997.
4. R. Wilhelm and D. Maurer, “Compiler Design (International Computer Science Series)”, 1st Edition, Addison Wesley, 1995.
5. V. Raghavan, “Principles of Compiler Design”, 1st Edition, TMG publication, 2017.

B. Tech. IV (CSE) Semester – VII
FORMAL SPECIFICATION AND VERIFICATION OF REAL TIME SYSTEMS (CORE ELECTIVE - 6)
CS479

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	understand automatic verification of programs using different techniques like, propositional logic and predicate logic.
CO2	apply methods of program verification for the given problem and represent system using Binary Decision Diagrams.
CO3	analyse the programs for correctness and complexity.
CO4	evaluate different programs using model checking methods.
CO5	design and develop a framework for software verification.

2. Syllabus

- **PROPOSITIONAL LOGIC (02 Hours)**

  Declarative Sentences, Natural Deduction, Rules for Natural Deduction, Derived Rules, Natural Deduction in Summary, Provable Equivalence, An Aside: Proof by Contradiction, Propositional Logic as a Formal Language, Semantics of Propositional Logic, The Meaning of Logical Connectives, Mathematical Induction, Soundness of Propositional Logic, Completeness of Propositional Logic, Normal Forms, Semantic Equivalence, Satisfiability and Validity, Conjunctive Normal Forms and Validity, Horn Clauses and Satisfiability, SAT Solvers, A Linear Solver, A Cubic Solver.

- **PREDICATE LOGIC (02 Hours)**

  The Need for a Richer Language, Predicate Logic as a Formal Language, Free and Bound Variables, Substitution, Proof Theory of Predicate Logic, Natural Deduction Rules, Quantifier Equivalences, Semantics of Predicate Logic, Models, Semantic Entailment, The Semantics of Equality, Undecidability of Predicate Logic, Expressiveness of Predicate Logic, Existential Second-Order Logic, Universal Second-Order Logic, Micromodels of Software, State Machines, Software Micromodel.

- **VERIFICATION BY MODEL CHECKING (06 Hours)**

  Motivation for Verification, Linear-Time Temporal Logic, Syntax of LTL, Semantics of LTL, Practical Patterns of Specifications, Important Equivalences Between LTL Formulas, Adequate Sets of Connectives for LTL, Model Checking: Systems, Tools, Properties, Example: Mutual Exclusion, The NuSMV Model Checker, Running NuSMV, Mutual Exclusion Revisited, The Ferryman, The Alternating Bit Protocol, Branching-Time Logic, Syntax of CTL, Semantics of CTL, Practical Patterns

of Specifications, Important Equivalences Between CTL Formulas, Adequate Sets of CTL Connectives. CTL* and The Expressive Powers of LTL and CTL, Boolean Combinations of Temporal Formulas in CTL, Past Operators in LTL, Model-Checking Algorithms, The CTL Model-Checking Algorithm, CTL Model Checking With Fairness, The LTL Model-Checking Algorithm, The Fixed-Point Characterisation of CTL, Monotone Functions.

- **PROGRAM VERIFICATION** **(04 Hours)**

  Need for Specification and Verification of Code, A Framework for Software Verification, Hoare Triples, Partial and Total Correctness, Program Variables and Logical Variables, Proof Calculus for Partial Correctness, Proof Rules, Proof Tableaux, Proof Calculus for Total Correctness, Programming by Contract.

- **BINARY DECISION DIAGRAMS** **(06 Hours)**

  Representing Boolean Functions, Propositional Formulas and Truth Tables, Binary Decision Diagrams, Ordered BDDs, Algorithms for Reduced OBDDs, The Algorithm Reduce, The Algorithm Apply, The Algorithm Restrict, The Algorithm Exists, Assessment of OBDDs, Symbolic Model Checking, Representing Subsets of the Set of States, Representing the Transition Relation, Implementing the Functions pre∃ and pre∀, Synthesising OBDDs, A Relational Mu-Calculus, Syntax and Semantics, Coding CTL Models and Specifications, BDD-Based Symbolic Model Checking.

- **SAT SOLVING** **(04 Hours)**

  CDCL SAT Solvers: Organization, CDCL SAT Solvers, SAT-Based Problem Solving, Armin Biere and Daniel Kröning, Bounded Model Checking on Kripke Structures, Bounded Model Checking for Hardware Designs, Bounded Model Checking for Software, Encodings into Propositional SAT.

- **SATISFIABILITY MODULO THEORIES** **(04 Hours)**

  SMT in Model Checking, The Lazy Approach to SMT, Theory Solvers for Specific Theories, Combining Theory Solvers, SMT Solving Extensions and Enhancements, Eager Encodings to SAT, Additional Functionalities of SMT Solvers.

- **COMPOSITIONAL REASONING** **(02 Hours)**

  Reasoning with Assertions, Automata-Based Assume-Guarantee Reasoning.

- **ABSTRACTION AND ABSTRACTION REFINEMENT** **(06 Hours)**

  Simulation and Bisimulation Relations, Abstraction Based on Simulation, Counter Example-Guided Abstraction Refinement (CEGAR), Abstraction Based on Modal Simulation, Completeness, Predicate Abstraction for Program Verification, Characterizing Correctness via Reachability, Characterizing Correctness via Inductiveness , Solving Refinement Constraints for Predicate Abstraction.

- **MODEL CHECKING CASE STUDIES** **(06 Hours)**

Equational Logic Frameworks, Real-time Frameworks, Reactive Frameworks, Pi-calculus, Tree Automata and Weak Second-Order Logic with k Successors (WSkS), Automatic Verification of Finite State Systems: Case Study of Languages and Systems like Z, B, Spin, PVS, Step.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Bloem Roderick, Clarke Edmund, M. Henzinger, Thomas A. Veith, Helmut, "Handbook of Model Checking", Springer International Publishing, 2018, ISBN: 978-3-319-10575-8,3319105752, 978-3-319-10574-1.
2. Michael Huth Mark Ryan, "Logic in Computer Science: Modelling and Reasoning about Systems", 2nd Edition, Cambridge University Press New York, NY, USA, 2004, ISBN:052154310X.
3. P. Cousot, Jan Van Leeuwen (edited by), "Methods and Logics for Proving Programs in Handbook of Theoretical Computer Science", The MIT Press, 1994.
4. Robinson, Alan JA, and Andrei Voronkov, "Handbook of Automated Reasoning", 2nd Edition, Gulf Professional Publishing, 2001.
5. Antoni Ligeza, "Logical Foundations for Rule-Based Systems (Studies in Computational Intelligence)", 2nd Edition, Springer, 2006.

ADDITIONAL REFERENCE BOOKS

1. Uwe Schöning, "Logic for Computer Scientists (Modern Birkhauser Classics)", 1st Edition, Birkhauser, 2008.

B. Tech. IV (CSE) Semester – VII
INNOVATION, INCUBATION AND ENTREPRENEURSHIP
HU401

	L	T	P	Credit
Scheme	**3**	**0**	**0**	**03**

1. Course Outcomes (COs): **At the end of the course, students will be able to**	
CO1	explain the concepts of entrepreneurship.
CO2	develop skills related to various functional areas of management (Marketing Management, Financial Management, Operations Management, Personnel Management etc.)
CO3	develop skills related to Project Planning and Business Plan development.
CO4	demonstrate the concept of Innovation, Intellectual Property Rights (IPR) and Technology Business incubation.
CO5	build knowledge about Sources of Information and Support for Entrepreneurship.

2. Syllabus

- **CONCEPTS OF ENTREPRENEURSHIP (08 Hours)**

  Scope of Entrepreneurship, Definitions of Entrepreneurship and Entrepreneur, Entrepreneural Traits, Characteristics and Skills, Entrepreneurial Development models and Theories, Entrepreneurs Vs Managers, Classification of Entrepreneurs; Major types of Entrepreneurship – Techno Entrepreneurship, Women Entrepreneurship, Social Entrepreneurship, Intrapreneurship (Corporate entrepreneurship), Rural Entrepreneurship, Family Business etc.; Problems for Small Scale Enterprises and Industrial Sickness; Entrepreneurial Environment – Political, Legal, Technological, Natural, Economic, Socio – Cultural etc.

- **FUNCTIONAL MANAGEMENT AREA IN ENTREPRENEURSHIP (14 Hours)**

  Marketing Management: Basic concepts of Marketing, Development of Marketing Strategy and Marketing plan.

  Operations Management: Basic concepts of Operations management, Location problem, Development of Operations strategy and plan.

  Personnel Management: Main operative functions of a Personnel Manager, Development of H R strategy and plan.

  Financial Management: Basics of Financial Management, Ratio Analysis, Investment Decisions, Capital Budgeting and Risk Analysis, Cash Flow Statement, Break Even Analysis.

- **PROJECT PLANNING (08 Hours)**

  Search for Business Idea, Product Innovations, New Product Development – Stages in Product Development; Sequential stages of Project Formulation; Feasibility analysis – Technical, Market,

Economic, Financial etc.; Project report; Project appraisal; Setting up an Industrial unit – procedure and formalities in setting up an Industrial unit; Business Plan Development.

- **PROTECTION OF INNOVATION THROUGH IPR (02 Hours)**

  Introduction to Intellectual Property Rights – IPR, Patents, Trademarks, Copy Rights.

- **INNOVATION AND INCUBATION (06 Hours)**

  Innovation and Entrepreneurship, Creativity, Green Technology Innovations, Grassroots Innovations, Issues and Challenges in Commercialization of Technology Innovations, Introduction to Technology Business Incubations, Process of Technology Business Incubation.

- **SOURCES OF INFORMATION AND SUPPORT FOR ENTREPRENEURSHIP (04 Hours)**

  State level Institutions, Central Level institutions and other agencies.

(Total Contact Time: 42 Hours)

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3. Books Recommended:

1. Desai Vasant, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, India, 6th Revised Edition, 2020.
2. Charantimath P. M., "Entrepreneurial Development and Small Business Enterprises", Pearson Education, 3rd Edition, 2018.
3. Holt David H., "Entrepreneurship: New Venture Creation", Pearson Education, 2016.
4. Chandra P., "Projects: Planning, Analysis, Selection, Financing, Implementation and Review", Tata McGraw Hill, 9th Edition, 2019.
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