INFORMATION TECHNOLOGY

3rd Semester

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/week
			L	T	P		
1.	Mathematics – III	MA301	3	1	0	4	4
3.	Programming & Data Structure	IT 301	4	0	0	4	4
4.	Digital Logic & Circuit Design	IT 302	4	0	0	4	4
2.	Discrete Mathematics & Graph theory	IT 303	3	1	0	4	4
5.	Signals, System & Circuits	IT304	3	1	0	4	4
	Theory Sub-total		17	3	NIL	20	20
6.	Programming & Data structure lab	IT 351	0	0	3	2	3
7.	Digital Logic & Circuit Design Lab	IT 352	0	0	3	2	3
	Sessional Sub-total		NIL	NIL	6	4	6
	3rd Semester Total					**24**	**26**

4th Semester

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/ Week
			L	T	P		
1.	Intro. to Mgmt. & Industrial Sociology	HU3401	3	1	0	4	4
2.	Computer Graphics	IT403	3	0	0	3	3
3.	Formal Language and Automata	IT404	3	0	0	3	3
4.	Computer Organisation & Architecture	IT401	3	1	0	3	3
5.	Communication Systems	IT402	3	1	0	3	3
	Theory Sub-total		15	4	NIL	16	16
6.	Computer Graphics Lab.	IT453	0	0	3	2	3
7.	Computer Org. & Architecture Lab.	IT451	0	0	3	2	3
8.	Communication system lab	IT 452	0	0	3	2	3
9.	Modelling and Simulation Lab.	IT455	0	0	3	2	3
	Sessional Sub-total		NIL	NIL	9	8	12
	4th Semester Total					**24**	**28**

5th Semester IT

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/week
			L	T	P		
1.	Microprocessor	IT501	3	0	0	3	3
3.	Operating System	IT 502	3	1	0	4	4
4.	Database Management Systems	IT 503	3	1	0	4	4
2.	Elective - I	IT 521/X	3	0	0	3	3
5.	Open Elective	IT531/X	3	0	0	3	3
	Theory Sub-total		15	3	NIL	17	17
6.	Microprocessor lab	IT 551	0	0	3	2	3
7.	Operating System Lab	IT 552	0	0	3	2	3
8.	Database Management System lab	IT553	0	0	3	2	3
9.	Mini Project I	IT 571	0	0	2	2	2
	Sessional Sub-total		NIL	NIL	11	8	11
	5th Semester Total					**25**	**28**

Open Elective:
Multimedia Systems
Elective I:

1. Object oriented programming
2. Telecommunication & Traffic Engg.

6th Semester IT

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/ Week
			L	T	P		
1.	Intro. to Mgmt. & Industrial Sociology	HU3401	4	0	0	4	4
2.	Design & Analysis of Algorithm	IT601	3	1	0	4	4
3.	Compiler Design	IT602	3	1	0	4	4
4.	Computer Networks	IT603	3	0	0	3	3
5.	Elective -II	IT 621/X	3	1	0	4	4
	Theory Sub-total		15	3	NIL	19	19
6.	Design & Analysis of Algorithm Lab.	IT651	0	0	3	2	3
7.	Compiler Design Lab.	IT652	0	0	3	2	3
8.	Computer Networks Lab.	IT653	0	0	3	2	3
9.	Grand viva	IT 691				2	
	Sessional Sub-total		NIL	NIL	9	8	9
	6th Semester Total					**27**	**28**

Elective II:
1. System Programming
2. Advance computer architecture
3. Mobile Communication
4. Distributed database

7th Semester

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/week
			L	T	P		
1.	Software Engineering	IT701	3	0	0	3	3
2.	Internet & Web Technology	IT 702	4	0	0	4	4
3.	Open Elective II	IT 731/X	3	0	0	3	3
4.	Elective III	IT 721/X	3	0	0	3	3
5.	ADB I	IT731/X	3	0	0	3	3
	Theory Sub-total		16	0	NIL	16	16
6.	S/W Engineering LAB	IT 751	0	0	3	2	3
7.	Internet & WEB Technology Lab.	IT 752	0	0	3	2	3
8.	ADB I Lab	IT 763/X			3	2	3
	Sessional Sub-total		NIL	NIL	9	6	9
	7th Semester Total					**22**	**24**

Open Elective II:
1. DSP
2. Computational Geometry

Elective III:
a) Graph algorithms
b) Information and Coding Theory
c) Distributed and Parallel Systems
d) Data mining and data warehousing

8th Semester

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/ Week
			L	T	P		
1.	Accountancy & F.Mgmt.	HU7801	3	0	0	3	3
2.	Information & Systems Security	IT801	3	1	0	4	4
3.	ADB II	IT832/X	3	0	0	3	3
4.	ADB III	IT833/X	3	0	0	3	3
5.	ADS I	IT841	3	0	0	3	3
	Theory Sub-total		15	1	NIL	16	16
6.	Information & Systems Security LAB	IT851	0	0	3	2	3
7.	ADB II Lab	IT862/X	0	0	3	2	3
8.	Project Thesis Part I	IT871	0	0	4	2	4
8.	Project Thesis Part I viva voce	IT872	0	0	0	2	
9.	Comprehensive Viva voce	IT891				4	
	Sessional Sub-total		NIL	NIL	9	12	10
	8th Semester Total					**28**	26

9th Semester

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/week
			L	T	P		
1.	ADS II	IT942/X	3	0	0	3	3
3.	ADS III	IT 943/X	3	0	0	3	3
4.	ADS IV	IT 944/X	3	0	0	3	3
2.	ADS V	IT 945/X	3	0	0	3	3
	Theory Sub-total		12	0	NIL	12	12
6.	Project Thesis Part II	IT 972	0	0	9	6	9
7.	Project Thesis Viva Voce II					3	
7.	ADS II lab	IT 981/X	0	0	3	2	3
	Sessional Sub-total		NIL	NIL	12	11	12
	9th Semester Total					**23**	**24**

10th Semester

Sl. No	Course Name	Course code	Class Load/Week			Credit	Class load/ Week
			L	T	P		
	Theory Sub-total						
1.	Project Thesis III	IT X73	0	0	20	12	20
2.	Project Thesis Viva-voce					4	
	Sessional Sub-total		NIL	NIL	20	16	20
	10th Semester Total					**16**	20

Name of Specialization: Computer Science and Information Technology (CSIT)	
ADB I (IT 715/X)	Algebra and Computation
ADB II (IT 812/X)	Artificial Intelligence
ADB III (IT 813/X)	Image Processing and Pattern recognition
Advanced Specialized subjects	**Electives**
ADS I (IT 824/X)	Algorithm II, Distributed Algorithms, Big data analytics, and Introduction to Embedded and Real Time Systems
ADS II (IT 921/X)	Complex Systems and Cellular Automata, Wireless Sensor Network, Cognitive Radio Networks, Embedded Processors and Microcontrollers
ADS III (IT 922/X)	Computational Topology, Computer Vision, Medical Image Processing, Multi-core Architectures Systems
ADS IV (IT 923/X)	Human computer Interaction, Multimedia coding and compression, Embedded System Security
ADS V (IT 924/X)	Soft computing techniques, Cloud computing, Mobile Computing, Embedded Programming

Detailed Syllabus
3rd Semester

MATHEMATICS-III (MA 301)

Weekly contact: 4– 0 – 0 (L-T-S) **Full Marks: 100(Credit-4)**

Sl. No.	Module Name and Topics	No. of Classes
1.	**Probability :** Intuitive Notion, Classical definition of probability, Combinatorial applications, Axiomatic approach to probability theory, Univariate probability distributions – discrete and continuous. Standard distributions: Binomial, Poisson, Geometric, Hypergeometric, Exponential, Normal, Uniform and Gamma. Bivariate distributions : concepts of joint and conditional distributions, Mathematical expectation, variance and covariance, Correlation coefficient, Tchebycheff's inequality. Concept of convergence in probability. Laws of Large Numbers (Statement only). Sample Distributions : χ^2, t and F	14
2.	**Statistics :** Concept of Statistics, Elements of the theory of Point Estimation: Unbiasedness and Mean Squared Error-Bias-variance decomposition. Minimum Variance Unbiased Estimators. Maximum Likelihood Estimation. Consistent Estimators. Interval Estimation: Confidence interval for mean of a normal population. Correlation and Regression. Simple linear regression model.	9
3.	**Laplace Transform:** Definition**,** Laplace transform of elementary functions, basic operational properties, Inverse Laplace transform, Convolution Theorem, Applications to initial value problems involving Ordinary Differential Equations.	6
4.	**Linear Programming Problem :** Basic solution, reduction of basic solution to basic feasible solution, convex combination, convex set, extreme points, hyperplanes, slack and surplus variables, Simplex Method, Charnes' Big-M method , Two Phase method.	10
	Total	39

PROGRAMMING & DATA STRUCTURES (IT 301)

Weekly contact: 3 – 1 – 0 (L – T – S) **Full Marks: 100**

Prerequisite: Concepts of C Language

Sl. No.	Module Name and Topics	No. of Classes
1.	**Introduction**:Functions; arrays; introduction to pointers; structures; dynamic allocation; linked structures; time and space requirements.	6
2.	**Stack**: Introduction, Array Implementation Multiple Stacks, Applications and use of Stacks: Conversion from Infix to Postfix, Evaluation of Postfix Expressions, Prefix Notation, etc.	6
3.	**Queue:** Introduction, Linear Queue, Circular Queue, De-queue, Priority Queue, ArrayImplementations of Queues, Applications of Queues, GeneralsLists.	4
4.	**Linked Lists:**Introduction, pointer and Implementation, Linear Linked Lists, Circular Linked Lists, Doubly Linked Lists, Doubly circular, Implementation of Linked Lists, Linked Stacks and Queues, Application of Linked List: Polynomials, High precision Arithmetic, Josephus Proble, etc.	8
5.	**Recursion:** Recursion Algorithm, Type of Different Recursion Algorithms, Removal of Recursion.	2
6.	**Binary Trees:** Tree Terminology, Binary Tree, Binary Tree Representation, Binary Tree Traversals, Threaded Binary Tree,Binary Search Tree Concepts and Implementation.AVL Tree.	10
7	**Search Methods:**Linear search, Binary search, Complexities of the searching algorithms.	4
8	**Sorting:** Introduction to sorting and Comparison of Sorting Techniques.	4
	Total:	**44**

References:

1. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill.
2. Ellis Horowitz, SatrajSahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, W. H. Freeman and Company.
3. Goodrich, Michael T. & Roberto Tamassia, Algorithm Design, Wiley Singapore.
4. Cormen, Thomash H., Leiserson, Charles E., Rivest, Ronald L., & Stein, Clifford. Introduction to Algorithms.

DIGITAL LOGIC AND CIRCUIT DESIGN (IT 302)

Weekly contact: 3 – 1 – 0 (L – T – S) **Prerequisite: None** **Full Marks: 100**

Sl. No.	Module Name and Topics	No. of Classes
1.	Number systems and Codes: Number representation and Computer arithmetic (fixed and floating point), Codes	1
2.	Boolean Algebra and Minimization Techniques:Boolean Logic operations, Basic laws, De Morgan's theorems, SOP/POS, K-map, Quine-McCluskey or Tabular method of minimization	3
3.	Logic Gates:Logic Gates (OR, AND, NOT, NAND, NOR, Universal building blocks, XOR, XNOR), Mixed Logic,Multilevel Gating networks, Multilevel output gate networks	2
4.	Logic Families: Digital Integrated Circuits, Introduction to logic families, CMOS logic	2
5.	Combinational Circuits:Multiplexers, Demultiplexers, Decoders, Application to Liquid Crystal Display (LCD), Encoders, Parity Generator/Checker, Code converters, Magnitude comparators, Applications	6
6.	Arithmetic Circuits:Half adder, Full adder, Half subtractor, Full subtractor, Parallel binary adder, Controlled Inverter, 4-bit parallel adder/subtractor, Fast adder, Serial adder, Serial subtractor using 2's complement, 4-bit serial adder/subtractor, BCD adder, Binary multiplier, Binary divider	6
7.	Flip-Flops:Latches, Flip-Flops (Clocked SR, JK, D, T), Trigerring of Flip-flops, Asynchronous inputs in flip-flops, Master-slave flip-flops, Realization of one flip-flop using other, Flip-flop ICs, Applications	6
8.	Counters:Asynchronous (Ripple or Serial) counters: Ripple counter with decoded outputs, Ripple counter with modulus, Counter ICs, Asynchronous UP/DOWN counter, Propagation delay in ripple counters, Synchronous (Parallel) counter: Synchronous counter with ripple carry, Synchronous UP/DOWN counter, Applications	3
9.	Registers:Universal shift registers, Shift register counters, Sequence generator	2
10.	Memory devices:Classification, Basic memory structure, ROM, RAM, Memory decoding, Memory expansion, PLD	3
11.	D/A and A/D converters:Analog and digital data conversions, Specifications of D/A converter, Basic D/A conversion techniques (weighted resistor, R-2R ladder type etc.), MDAC, Sampling process, A/D converters, Different A/D converters (Successive approximation, Single slope, Dual slope)	4
12.	Applications of Digital Circuits:Frequency counter, Dot matrix display system, Digital multimeter etc.	2
	Total:	**40**

References:

Logic and Computer Design Fundamentals: by Mano, Kime: Pearson
Modern Digital Electronics: by Jain: TMH
Digital Design: by Mano
Digital Fundamentals: by Floyd, Jain: Pearson
Digital Circuits and Design: by Salivahanan, Arivazhagan: Vikas
Digital Principles and applications (5^{th} Edition) : Leach & Malvino
Digital Computer Electronics : Malvino

DISCRETE MATHEMATICS AND GRAPH THEORY (IT 303)

Weekly contact: 3 – 1 – 0 (L – T – S) **Full Marks: 100**

Prerequisite: Preliminary concepts of Sets

Sl. No.	Module Name and Topics	No. of Classes
1.	**Logic and Proofs:** Propositions, Conditional propositions and Logical Equivalence, Predicate calculus, quantifiers, Normalization of well-formed-formulas, Method of proofs, mathematical induction.	8
2.	**Language of Mathematics:** Sets, sequences and strings, Number systems, Relations, Equivalence relations, Matrices of relations, partial order sets, well order sets, quasi order sets, lattice. Application to relational Databases, Functions, Inverse and composition of functions, one-to-one correspondence.	6
3.	**Algebraic structures:** Algebraic structures with one binary operation - semigroups, monoids and groups. Free and cyclic monoids and groups, permutation groups, normal subgroups. Algebraic structures with two binary operations - rings, integral domains and fields. Boolean algebra and Boolean ring.	8
4.	**Counting methods:** Basic principles of counting (Inclusion- exclusion, addition and multiplication rules), permutations and combinations, algorithms for generating permutations and combinations, binomial coefficients and combinatorial identities, The pigeonhole principle. Introduction to Polya's theory of counting.	8
5.	**Recurrence relations:** Introduction, recursively defined sequences, solving recurrence relations: the characteristic polynomial and generating functions. Applications to analysis of algorithms.	6
6.	**Graph theory:** Introduction to graphs and their basic properties: degree, paths and cycles, subgraphs, isomorphism, Euler and Hamiltonian paths and cycles, representation of graphs, connected graphs, planar graphs. Basic graph searching algorithms: BFS and DFS. Basics of tree and spanning tree.	8
7	**Coloring of Graph:** graph coloring basics, chromatic number, 4-color problem.	4
	Total:	**48**

References:

1. Discrete Mathematics and its Applications by Kenneth H Rosen, PHI
2. Discrete MATHEMATICS FOR Computer Scientists, J L Mott, A Kandel, and T P Baker
3. Concrete Mathematics: A Foundation for Computer Science, by Ronald Graham, Donald Knuth, and Oren Patashnik
4. Graph Theory With Applications To Engineering And Computer Science, NarsinghDeo, Tata McGraw Hill
5. Graph Theory, F Harary, Narosa

IT-303: SIGNALS, SYSTEMS AND CIRCUITS

Weekly contact: 3 – 1 – 0 (L – T – S) Prerequisite: Vector space, probability and statistics Full Marks: 100

Objective:

- To be familiar with the Time and Frequency domain analysis of continuous and discrete signals.
- To study the behavior of Linear Time Invariant System. Laplace transforms, properties and Transient Analysis of the System.
- To be familiar with sampling, digitization and reconstruction of Analog Signals
- To be familiar with Random signals, properties, auto and cross-correlation, power spectral density

Sl. No.	Module Name and Topics	No. of Classes
1.	Introduction to signals: classification and representation, concepts of linear vector space and orthogonal signal representation.	4
2.	Fourier series, Fourier transform and its properties	6
3.	Parseval's theorem, Bandwidth of signals, duality of time and frequency representations of signals.	2
4.	Discrete time signal: sampling, digitization and reconstruction of analog signals.	6
5.	Introduction to random signals and their properties: random variables and processes for characterization and analysis of message signal and noise	6
6.	Random process, classification of random processes, geometric representation of random process, Gaussian random process, auto and cross-correlation, power spectral density.	10
7	Introduction to system and classification, discrete time system, signal distortion in transmission, distortionless conditions. linear time invariant (LTI) system, impulse response, convolution, transfer function, Bandwidth of systems. System response to random signals.	8
8	System realization as simple electrical circuit: Laplace transform and its properties, inverse Laplace transform, application of Laplace transform for analysis of RC, RL and RLC circuits, transient and steady state response.	6
	Total	**48**

References:

1) Modern Analog and Digital Communication Systems, 4th Edition-B. P. Lathi & Z. Ding, Oxford University Press
2) S. Haykin, Communication Systems- John Wiley
3) Linear Systems and Signals, B. P. Lathi, Oxford
4) Probability and Random Processes with Applications to Signal Processing- H. Stark, J. W. Woods, Pearson Education Asia
5) A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals & Systems, Pearson
6) S. Haykin & B.V.Veen, Signals and Systems- John Wiley

PROGRAMMING & DATA STRUCTURE LABORATORY (IT351)

Weekly contact: 0 – 0 –3 (L – T – S) **Full Marks: 100**

Prerequisite: Concepts of C Language

Module Number	Topics	No. of Classes
	Program related to	
1.	pointer, array, structure and union	6
2.	Stack and Queue	6
3.	Linked Lists	6
4.	Recursion and Binary Tree	12
5.	Search Methods	6
6.	Sorting	6
	Total:	42

References:

1. Seymour Lipschutz, Data Structures, Schaum's Outlines Series, Tata McGraw-Hill.
2. Ellis Horowitz, SatrajSahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, W. H. Freeman and Company.
3. Goodrich, Michael T. & Roberto Tamassia, Algorithm Design, Wiley Singapore.
4. Cormen, Thomash H., Leiserson, Charles E., Rivest, Ronald L., & Stein, Clifford. Introduction to Algorithms.

Detailed Syllabus
4th Semester

COMPUTER ORGANIZATION AND ARCHITECTURE (IT 401)

Weekly contact: 3 – 1 – 0 (L – T – S) **Full Marks: 100**

Prerequisite: (Digital Logic and Circuit Design(IT 302)

Sl. No.	Module Name and Topics	No. Of Classes
1.	**Computer function and Interconnection:** Computer Components, Computer function, Interconnection structures, Bus interconnection, PCI	2
2.	**Central Processing Unit:** **Computer Arithmetic:** ALU, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic.	2
3.	**Instruction Sets:** Machine instruction characteristics, types of operands, Types of operations, Assembly language, Addressing, Instruction formats.	4
4.	**Processor Design and Datapath:** Processor role, processor design goals, processor design process, datapath organization, main memory interface, local storage/register file, datapath for simple instructions, floating point unit datapath, advanced processors and datapaths.	6
5.	**Processor design and control unit:** Role of control unit, reset sequence, interrupt recognition and servicing, abnormal situation handling, instruction cycle and decisions involved, hardwired control unit, microprogrammed control unit.	6
6.	**Memory:** Overview of computer memory system, memory parameters, classification of memory, main memory allocation, static RAM IC, Dynamic RAM, ROM logic, multiple memory decoding.	4
7.	**Cache:** Cache memory principles, elements of cache design, Cache organization.	2
8.	**Internal memory:** Semiconductor main memory, error correction, advanced DRAM organization.	2
9.	**External memory:** Magnetic disk, RAID, optical memory, magnetic tape.	2
10.	**Input/Output:** External devices, I/O modules, Programmed I/O, Interrupt driven I/O, DMA, I/O channels and processors, External interface: Firewire, Infiniband, and USB.	4
11.	**Concurrency in Pipelining and Vector processing:** Performance enhancement strategies, classification of parallelism, multiple functional units, pipelining, vector computing, array processor.	**6**
	Total:	**40**

Suggested Reading:

1. Computer Architecture and Organization Design Principles and Applications: B. Govindarajalu: TMH
2. Computer Organization and Architecture Designing for Performance: William Stallings: Pearson
3. Computer Architecture A Quantitative Approach: John L. Hennessy and David A. Patterson: ELSEVIER
4. Computer Systems Architecture A Networking Approach: Rob Williams: 2nd Ed: PEARSON
5. Computer Organization and Design The Hardware Software Interface ARM Edition: David A. Patterson and John L. Hennessy: MK

COMMUNICATION SYSTEMS (IT 402)

Weekly contact: 3-1-0 **Full marks: 100**

Sl no.	**Topic**	Class hours
1	Introduction to communication systems	2
2	Basedand and carrier signal representation, concepts, PSD, Sampling theorem	4
3	Analog modulation and demodulation techniques, AM, FM, PM, their comparisons	4
4	SNR vs. Bandthwidth. Preemphasis, deemphasis.	2
5	Waveform coding, PCM, DPCM, Delta modulation, Performance studies	6
6	Base band shaping for data transmission, line coding, Calculation of power spectral density	4
7	Nyquist criterion for zero ISI and eye pattern, Equalizer, repeaters	6
8	Digital modulation techniques, coherent and non-coherent detection. ASK, FSK, PSK. MPSK, BER performance study. M-ary signal representation, PSD and bit error rate calculation.	8
9	Introduction to spread spectrum communication, jamming effect, DSSS, FHSS, THSS, process gain, demodulation techniques	4

References:

1. Modern Digital and Analog Communication System; B.P. Lathi
2. Principles of Communication Systems; Taub. Schilling
3. Communication Systems; A.B. Carlson
4. Digital and Analog communication Systems; K. Sam Sanmugam
5. Communication Systems, Simon Haykin

COMPUTER GRAPHICS(IT-403)

Section Number with name	Topics with Lecture Number	No. of Classes
Section 1 Introduction to Computer Graphics:	**Lecture 1:** Overview of Computer Graphics Computer Graphics Applications and Software	1
	Lecture 2: Basic graphics I/O devices, overview of Raster and vector graphics display working principle of CRT based display device,	2
	Lecture 3: LCD display device. Introduction to frame buffer, Colour Look Up Table etc..	2
Section 2 Scan conversion – lines, circles and Ellipses; Filling polygons and clipping algorithms	Lecture 4: Scan Converting Lines: DDA, Bresenham, Mid-point algorithms and Problems of Aliasing Scan Converting Circles and Ellipse	5
	Filling Polygons: Lecture 5: Flood fill, boundary fill, scan line fill,	2
	Lecture 6: Line clipping algorithms: Cyrus-Beck, Cohen-Sutherland Liang-Barsky	3
	Lecture 7: Polygon Clipping algorithms: Sutherland Hodgman and WeilerArtherton algorithm	2
Section 3 Graphics Programming using OPENGL:	**Lecture 8** Why OpenGL, Features in OpenGL, OpenGL operations, Abstractions in OpenGL – GL, GLU & GLUT 3D viewing pipeline, viewing matrix specifications Few examples and demos of OpenGL programs	4
Section 4 Two-Dimensional Transformations:	**Lecture 9:** Transformations and Matrices Transformation Conventions Basic 2D Transformations	2
	Lecture 10: Homogeneous Coordinates and Matrix Representation of 2D Transformations	1

	Lecture 11: Combined Transformations,	2
	Lecture 12: Window-to-Viewport Transformations.	2
Section 5 **Three-Dimensional Transformations and Projections:**	**Lecture 13:** Introduction, Basic transformation matrices in Three-Dimensional Space	2
	Lecture 14: Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane	2
	Lecture 15: Projections: Orthogonal, axonometric, and oblique.	3
Section 6 **Visible-Surface Determination:**	**Lecture 16:** Techniques for efficient Visible-Surface Algorithms, Categories of algorithms	1
	Lecture 17: Back face removal, The z-Buffer Algorithm, Scan-line method,	2
	Lecture 18: Painter's algorithms (depth sorting), Area sub-division methods:BSP trees, Visible-Surface Ray Tracing.	2
Section 7 **Plane Curves and Surfaces:**	**Lecture 19:** Curve Representation, Representation of Space Curves:Cubic Splines, Bezier Curves, B-spline Curves.	3

References:

1. Computer Graphics Principles & Practice by James D. Foley, Andries van Dam, Steven K. Feiner and John F. Hughes, 2nd Edition in C.
2. Computer Graphics with OpenGL (3/e), D. D. Hearn and M. P. Baker
3. Mathematical Elements for Computer Graphics by Rogers and Adams, McGraw Hill.
4. Computer Graphics (First Indian Edition), Peter Shirley and Steve Marschner, Cengage Learning Reprint of A. K. Peters
5. Computer Graphics Using OpenGL. F.S. Hill and S. M. Kelley, Pearson Education, 2009.
6. Interactive Computer Graphics: A Top-Down Approach with OpenGL. Edward Angel, Addison-Wesley
7. OpenGL Programming Guide. Jackie Neider et al., Addison-Wesley
8. OpenGL Reference Manual. Addison-Wesley

Formal language and Automata Theory: IT 404

Sl. No.	Module Name and Topics	No. of Classes
1.	**Language and Grammar:** definition, Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages	4
2.	**Finite State Machines:** Definition, concept of sequential circuits, state table and state assignments, capability and limitations of FSM, state equivalence & minimization.	6
3.	**Finite automata:** Definition, Characteristics, Transitional system, deterministic finite automata (DFA), Nondeterministic finite automata (NFA) , equivalence of DFA and NFA, Dead state, Finite Automata with output, Mealy machine and Moore machine, Conversion of one machine to another, Minimization of finite automata. Mihill-Nerode theorem, Two way finite automata, Application and limitation.	8
3.	**Regular Expression**: regular sets and regular expressions, regular grammars and equivalence with finite automata, NFA from regular expressions, regular expressions from DFA, ε-closure and conversion of NFA with ε move to equivalent DFA, pumping lemma for Regular expression, closure properties of regular expression, Application of RE.	8
4.	**Context-free languages and pushdown automata:** Left and right linear grammars. Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, parse trees, ambiguity in CFG, inherent ambiguity, closure properties of CFL, pumping lemma for CFL, CFG and RE, Application Pushdown Automata(PDA), language recognized by PDA, deterministic PDA, equivalence of PDA and CFL.	12
6.	**Context-sensitive languages:** Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	2
7	**Turing machines:** The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, concept of undecidability. Variation of Turing machine-Multi tape, multi head, two way infinite tape. Turing machine as an integer function.	8
	Total:	**48**

References:

1. "Introduction to Automata Theory, Languages & Computation", Hopcroft JE. and Ullman JD., Narosa.
2. "Elements of the theory of Computation", Lewis H. R. and Papadimitrou C. H., P.H.I.
3. "Introduction to Languages and Theory of Computation", Martin, McGraw Hill.
4. J. E. Hopcroft, J. D. Ullman and R. Motwani: Introduction to Automata Theory, Languages and Computation, Addison-Wesley, California, 2001.
5. "An Introduction to Formal Languages and Automata", Linz Peter, Narosa.
6. "Switching & Finite Automata", Kohavi ZVI, Tata McGraw Hill.
7. "Theory of Computer Science", K.L.P. Mishra & N. Chandrasekharan,PHI

Laboratories

Modelling and Simulation Lab (IT 455)

Prerequisite:

Basic Mathematics, Programming.

Detailed Syllabus:

Module Number	Topics	Class Load
1	Introduction to R, Octave, MATLAB,	3
2	Basic Mathematical Modeling; Vector and Matrix Analysis; Complex Analysis	3
3	Random Number Generation;	3
4	Solving Differential Equations; Simulating probabilistic Events; Bernoulli Trials	3
5	Curve and Surface Fitting; Optimization	3
6	Statistical Tests and Significance Analysis, Linear programming	3
7	Stochastic Models; Markov Models; Monte-Carlo Simulation; Growth Processes; Queuing Models	6
Total		21

Suggested Books:

1. Edward A. Bender. An Introduction to Mathematical Modeling. Dover Publications.
2. A. C. Fowler. Mathematical Models in Applied Sciences. Cambridge University Press.
3. Mark M. Meerschaert. Mathematical Modeling. Academic Press.

4. S.M. Ross. Simulation, Academic Press.
5. A. M. Law and W. D. Kelton. Simulation Modeling and Analysis, Tata McGraw-Hill.

Signal system and communication Lab (IT 452)

Module Number	Topics	Class Load
1	Experiments on various types of signals, time domain, frequency domain analysis	6
2	Continuous and discrete time domain signal analysis	3
3	Experiments on modulation techniques	6
4	Ideas on basic communication systems building blocks	3
5	Experiments based on Communication Systems theory.	3
Total		21

Computer Graphics Lab (IT 453)

Module Number	Topics	Class Load
1	Study of Graphics Card and related hardware	3
2	Overview of OpenGL	3
3	Programming for generating lines, curves and rendered surfaces;	9
4	Geometric transformations and clipping;	3
5	Modeling of objects	3
6	Computer animation	3
Total		24

Computer Organization and Architecture lab (IT 451)

Module Number	Topics	Class Load
1	Know your Computer and its Organization, Hands on demonstration of assembling and disassembling of PC.	3
2	Hands on experience with different components of computers of different generations, Basic troubleshooting with everyday usage of computer	3
3	Introduction to VHDL and Xilinx ISE, Tutorial on VHDL as Hardware Description Language, Tutorial with hands on demonstration in Xilinx ISE Design Tool (Programming Language: VHDL), Build your own	3

	Computing Units	
4	Experiments on different combinational design blocks and simulation using VHDL under ISE environment. Experiments on different sequential design blocks and simulation using VHDL under ISE environment.	6
5	Experiments on designing different computing units for processing, memory, and IO interfacing.	3
6	Mini project (Group activity) A small project related to Computing Unit design and Simulation.	3
7	Verify and Test your design Verification and test of simulated and synthesized design using FPGA Prototype Boards.	3
Total		21

Detailed Syllabus
5th Semester

Microprocessors (IT 501)

Weekly contact: 3 – 0 – 0 (L – T – S) **Full Marks: 100**

Prerequisite(s): Digital Logic & Circuit Design (IT-302), Computer Organization and Architecture (IT-401)

Sl. No.	Module Name and Topics	No. of Classes
1.	Introduction to 8085 CPU :- Pin description and features, architecture-register organization	2
2.	8085 Addressing modes, Instruction set, Instruction cycle, machine cycle, Timing diagram.	4
3.	8085 Assembly Language Programming	6
4.	Hardware Interfacing with memory, peripheral chips (IO mapped IO & Memory mapped IO), Interrupts and DMA.	4
5.	16 bit processors: 8086 architecture, memory organization and Interrupt processing.	6
6.	8086 Addressing modes, instruction set and Assembly Language programming with 8086.	10
8.	Overview of ARM RISC Architecture and its application development.	4
	Total:	**36**

References

1. Microprocessor Architecture, Programming, and Applications with the 8085: Ramesh Gaonkar (Penram International Publishing (India) Pvt. Ltd)
2. The Intel Microprocessors - Architecture, Programming, and Interfacing- BARRY B. BREY (Pearson – Prentice Hall)
3. Microprocessors & Interfacing: Programming & Hardware, - Douglas V. Hall, (Tata McGraw Hill)
4. Advanced Microprocessors and Peripherals - Ajoy Kumar Ray and K M Bhurchandi (TMH)
5. ARM System On Chip Architecture – Steve Furber (ARM Edition).
6. Microprocessors and Microcontrollers- N Senthil Kumar, M Saravanan, and S Jeevananthan, Oxford University Program

OPERATING SYSTEMS (IT-502)

Weekly contact: 3 – 1– 0 (L – T – P) Full Marks: 100

Prerequisite(s): Programming and Data Structure (IT-301), Computer Organization and Architecture (IT-401)

Sl. No.	Module Name and Topics	No. of Classes
1.Introduction	Operating System, Overview, Evolution of Operating Systems, Basic architectural concepts, concepts of batch-processing, multiprocessing, multiprogramming, timesharing, real-time operations; interrupt handler	4
2.Concept of a Process	States, operations with examples from UNIX (fork, exec) and/or Windows. Process scheduling, interprocess communication, UNIX signals.	4
3.Threads	Multithreaded model, scheduler activations, examples of threaded programs.	2
4.Scheduling	CPU scheduling— short term, medium term and long term scheduling, non-preemptive and preemptive algorithms;	6
5.Process Synchronization	critical sections, classical two process and n-process solutions, hardware primitives for synchronization, semaphores, monitors, Classical problems in synchronization	8
6.Deadlocks	Modeling, characterization, prevention and avoidance, detection and recovery.	5
7.Memory Management	Partitioning, paging, concepts of virtual memory, demand-paging, page replacement algorithms, working set theory, load control, segmentation, segmentation and demand-paging, Case studies, Windows. Current Hardware support for paging: e.g., Pentium/ MIPS processor etc.	8
8.Device Management	Scheduling algorithms -FCFS, shortest-seek-time-first, SCAN, C-SCAN, LOOK, C-LOOK algorithms, Device drivers, concept of driver routines.	3
9.Information Management	File concept, file support, directory structures, symbolic file directory, basic file directory, logical file system, physical file system, access methods, file protection, file allocation strategies.	6
10.Case Study	UNIX/Linux, Windows, and Android.	2
Total		46

References:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, John Wiley,

2. William Stallings, Operating Systems: Internals and Design Principles. Prentice-Hall
3. AS Tanenbaum, Modern Operating Systems, 3rd Ed., Pearson
4. AS Tanenbaum, AS Woodhull, Operating Systems Design and Implementation, Prentice Hall
5. M. J. Bach. Design of the Unix Operating System, Prentice Hall of India
6. Harvey M. Deitel (Author), Paul Deitel (Author), David R. Choffnes (Author), Operating Systems , Pearson

DATABASE MANAGEMENT SYSTEM (IT-503)

Weekly contact: 3L+ 1T **Full Marks: 100**

Prerequisite(s): Programming and Data Structure (IT-301), Discrete Mathematics and Graph Theory (IT-303)

Sl. No.	Module Name and Topics	No. of Classes
1	Introduction Database, Database Management Systems, Database Systems versus File Systems, View of Data, Database Languages, Database Users	4
2	Components of a Database Management System, Data Independence, Network, Relational, Hierarchical, Object Oriented Data Models	4
3	The Entity Relationship Model Basic Concepts, Constraints, Keys, Design Issues, Entity-Relationship Diagrams, Extended E-R Features, Relational Model - Structures of Relational Databases, Integrity Constraints, ER to Relational model	6
4	Relational Query Languages Relational Algebra, Relational Calculus, SQL and QBE.	4
5	Relational Database Design Functional Dependency, Armstrong's Axioms, Normal Forms, Dependency Preservation, Lossless design.	6
6	Storage Strategies Ordered, Unordered File, Hashing, Indexing, Single-Level, Multi-level Indexes, B tree and B+ tree	4
7	Query Processing Evaluation of Relational Algebra Expressions, Implementation of SELECT, JOIN, PROJECT Operations, Query Optimization Algorithms.	4
8	Transaction Processing Transaction concept, Schedule, Conflict & View serializabilty, Concurrency Control, Lock base and Timestamp based Protocols, Multiversion and Optimistic Concurrency Control schemes.	8
9	Recovery	2

	Causes of failures, Immediate and Deferred Update, Shadow paging	
10	Advanced Topics Introduction to Web Databases, Distributed Databases, Data Warehouse and Data Mining.	2

References:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill.
2. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Pearson.
3. C. J. Date, "An Introduction to Database System", Pearson.
4. Ivan Bayross, "SQL, PL/SQL: The Programming Language of Oracle" BPB Publications.

Elective I

Object Oriented Programming (IT521/1)

L-T-P 3-0-0 Full Marks: 100

Prerequisite(s): Programming and Data Structure (IT-301)

Sl. No.	Module Name and Topics	No. of Classes
1	Introduction: OOP vs POP, Features of OOP, Advantages	4
2	Class & Object Access Specifier, Accessing class members: Function, Type Cast Operator, Return by reference, Inline Function, Object as function argument, Array of Object, Friend Function	8
3.	Constructor and Destructor: Characteristics of constructor, Default Constructor, Parameterized Constructor, Copy Constructor, Dynamic Initialization of Object, Dynamic constructor, Destructor	6
4.	Operator Overloading : Definition, Process , Overloading Unary , binary operator	4
5	Type Conversion: Conversion from basic type to class type and vice versa, Conversion from one Class to another Class Type, conversion using constructor	2
6	Inheritance: Introduction, Types of inheritances, Abstract class	4
7	Pointer, Virtual Function and Polymorphism: Polymorphism, Pointer to Objects, Array of objects using pointer, Array of pointers to objects, this pointer, Pointer to base class, pointer to derived object, Virtual Function	4
8	Exception Handling: Introduction, Types of Exception, Exception Handling Mechanism, Throwing Mechanism, Catching mechanism	4
9	Template and namespace: Class template, Function Template, Concept of namespace	2
	Total	38

References:

1. Booch, Jacobsobn, Rumbaugh, Object Oriented analysis and design with application, Pearson.
2. Bjarne Stroustrup, *The C++ Programming Language,* Addison Wesley
3. Robert Lafore, Object-Oriented Programming in C++, Sams Publishing
4. Stanley B. Lippman, Josée Lajoie, Barbara E. Moo C++ Primer,
5. E . Balaguruswami, Object Oriented Programming C++. TMH.
6. Steve Oualline, Practical C++ Programming O'Reilly & Associates, Inc.

TELECOMMUNICATION AND TRAFFIC ENGINEERING [IT –521/2]

3-0-0 (L-T-P) Full Marks: 100

Prerequisite(s): Digital logic and Circuit Design (IT-302), Communication Systems (IT-402)

Sl. No.	Module Name and Topics	No. of Classes
1.	Introduction: Telecommunication systems, elements of Tele traffic	2
2.	Traffic models, Erlang's formulae	4
3.	Telephone networks: Signaling, DTMF techniques, transmission, digital transmission requirements.	4
4.	Switching : Switching Algebra Electronics switching, generic switch, Blocking, non-blocking switching network, types of switching networks, Clos criterion	4
6.	Switching systems: SD/TD/STS networks. Hybrid time and space division switching	4
7.	PSTN,Cellular Mobile Telephone System- Cell concepts, architecture, hardware procedures, GSM standard, call management	4
8.	Cellular Mobile Telephone System- GSM handover, authentication	2
9.	Data transfer Techniques in computer network: Data networks, Packet/Circuit Switching, ISDN	2
10.	Advanced data communications: ATM concept and functionality, Services- FAX, Cable TV, Video on demand.	6
	Total classes	32

References:

1. J. E. Flood, "Telecommunications, Switching, Traffic and Networks", Prentice Hall.
2. Thiagarajan Viswanathan, "Telecommunication Switching Systems and Networks", Prentice Hall India.
3. Mobile and Wireless Network, Ulyss Black.
4. Wireless Communications and Networks, William Stallings.
5. Mobile Communications, J. Schiller, Addison-Wesley.
6. William Stallings, Data and Computer Communications, Pearson.
7. Computer Networks by Andrew S. Tanenbaum, Pearson Eduction.
8. B. Forouzan, "Data Communication and Networking", McGraw-Hill.

Open Elective (IT 531/1)

Multimedia Systems

L-T-P 3 – 0 – 0 Full Marks: 100

Sl. No.	Module Name and Topics	No. of Classes
1	Introduction to Multimedia , Elements of Multimedia, Properties of multimedia system, Categories, Features, Application, Convergence of Multimedia System	2
2	Image: Raster and Vector, Types of image, Digital image representation, Color model, Image negation, change of dynamic range, Histogram, File system (TIFF, BMP, PCX, GIF etc.), System Architecture Compression: Advantages, disadvantages, Spatial and temporal redundancies, Lossless and Lossy compression, DPCM, Lampel-Ziv, Huffman coding, Arithmetic coding, GIF, JPEG.	8
3	Audio: Sound wave, Physical characteristic, Musical note, Components of Audio System, Microphone:moving coil, condenser, Amplifier :class A Class B, Speaker, Synthesizer, MIDI. Sound card, Digital Audio processing.	6
4	Video: Luminance & Chrominance, Luma and Chroma, Chroma Sub-sampling, Television Systems PAL, NTSC, Video Nomenclature	4

	HDTV, EDTV, Video Quality and Performance Measurements, Digital Video Processing Video capture, Video processing AVO/AVI file formats.	
5	MPEG standard Hypertext, hyper media. Virtual Reality and multimedia.	2
7.	Animation: Key frame and Tweening, Cell Animation, Rotoscoping, Stop-Motion Animation, Motion Cycling, Computer Based Animation, Path based animation, Client pull and server push,	2
7	Multimedia devices- Display devices, Optical Devices, CCD, Camera, DVD, Scanners	2
8	Multimedia Database-Image Representation, Segmentation, Similarity based retrieval, Image retrieval by color, Shape & texture, indexing – K-d-tree, R-tree, Video Content, Quad tree, Quarying, Video Segmentation, Indexing.	6
	Total:	32

References:

1) R. Steinmetz, K. Nahrstedt, "Multimedia Systems", Springer Science & Business Media.
2) J.F.K, Buford, Multimedia Systems, ACM Press.
3) Sloane, Multimedia Communication, McGraw Hill.
4) Boyle, Design for Multimedia Learning Prentice Hall.
5) B Prabhakaran, Kluwer, Multimedia Database Management Systems, Springer.

Laboratories

Microprocessors Lab (IT 551)

Weekly contact: 0– 0 – 3 (L – T – S) Full Marks: 100

Module Number	Topics	Class Load
1	Familiarization with 8085 trainer kits and hands on experience.	3
2	8085 Assembly Programming on small applications using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical).	3
3	Peripheral Programming using (i) 8255 PPI on the electronic systems, (ii) 8 bit latch (e.g., 74LS373), (iii) I/O modules (ADC, Speed control of mini DC motor using DAC, Keyboard, Multi-digit Display with multiplexing, Stepper motor).	6

4	Familiarization with 8086 trainer kits and hands on experience.	6
5	8086 Assembly Programming on small applications using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical).	6
Total		24

Operating Systems Lab (IT 552)

Weekly contact: 0– 0 – 3 (L – T – S) Full marks 100

Module Number	Topics	Class Load
1	Understanding the time sharing, multiprogramming nature of the operating system	3
2	Interprocess communication using shared memory and message passing	3
3	Thread related programs: scheduling of threads, master-slave model	6
4	Simulation of different scheduling algorithms	6
5	Solving different classical problems of synchronization using semaphores and monitors	3
6	Analysing the cache/memory behavior of systems (memory mountain etc.), File operation	3
Total		24

Database Management System lab (IT 553)

Weekly contact: 0– 0 – 3 (L – T – S) Full marks 100

Module Number	Topics	Class Load
1	Creation of Tables using Integrity Constraints in SQL	3
2	Execution of DML statements and Queries in SQL for Small Application.	6
3	PL/SQL Programming for Small Application.	6
4	Programming using Function, Procedure, Cursor and Trigger.	6
5	SQL Application Programming using JDBC/PHP.	3

Total	24

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Detailed Syllabus
6th Semester

Design and Analysis of Algorithms (IT 601)

3-0-0 (L-T-P) **F.M.: 100**

Prerequisite(s): Programming and Data Structures (IT-301)

Sl. No.	Module Name and Topics	No. of Classes
1.	Models of Computation; Algorithms and Complexity; Best case, worst case and average case; asymptotic notations	6
2.	Sorting and searching; search trees; balanced trees; hashing	6
3.	Advanced data structure: Red-Black trees, Fibonacci heaps, data structure for disjoint sets	4
4.	Lower bound theory	2
5.	Optimization problems; Dynamic programming and Greedy method; theoretical foundation of greedy methods	4
6.	Amortized analysis	2
7.	Introduction to graph; BFS and DFS, connected components, spanning trees, shortest paths, max flow	6
8.	Randomized algorithms: identity testing, primality and min-cut	4
9.	Number theoretic algorithms	6
10.	Introduction to complexity classes: P, NP and NP completeness	2
	Total	42

References:

1. T. H. Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, Prentice Hall of India, New Delhi.
2. A. Aho, J. Hopcroft and J. Ullman, The Design and Analysis of Computer Algorithms, A. W. L, International Student Edition, Singapore.
3. D. E. Knuth, The Art of Computer Programming, Narosa/Addison-Wesley, New Delhi/London.
4. E. Horowitz and S. Sahni, Fundamental of Computer Algorithms, Galgotia Pub. /Pitman, New Delhi/London.
5. Jon Kleinberg and ÉvaTardos, Algorithm Design, Pearson Education.

COMPILER DESIGN (IT 602)

3-0-0 (L-T-P) **F.M.: 100**

Prerequisite(s): Formal language and Automata Theory (IT-404)

Sl. No.	Module Name and Topics	No. of Classes
1.	Introduction: Compiler, phases and passes, finite state machines and regular expression sand their applications to lexical analysis, NFA, DFA, conversion, Token, Pattern and Lexeme, LEX compiler	06
2.		04
3.	Formal grammars, and their application to syntax analysis, BNF notation,	08
4.	ambiguity, Removal of left recursion and left factoring	04
5.	Bottom-up and top-down parsers, LL(1)parser, operator precedence parsing, simple precedence, recursive descent and predictive parsers, LR(k) parsers,	06
6.	parse table generation, YACC.	02
7.	Syntax directed translation: Quadruples, triples, 3-address code,	03
8.	codegeneration for standard constructswith top-down and bottom-up parsers, translation of procedure calls, record structuring.	03
9.	Code optimization: DAG analysis, data flow analysis, copy propagation, elimination of global sub-expressions, constant folding Run time system: storage organization, activation tree, activation record, parameter passing, symbol table, dynamic storage allocation. Intermediate code generation: intermediate representations, control flow, Boolean expressions and procedure calls. Code generation: Problems in code generation, code generator, register assignment and allocation problems, usage count, code generation from DAG, peephole optimization. Symbol table: runtime storage administration, error detection and recovery; Lexical, syntactic and semantic errors, case studies with real life compilers.	02
	Total	38

References:

1. A. V. Aho, R. Sethi and J. Ullman, Compilers: Principles, Techniques and Tools, Addison-Wesley.

2. Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers.
3. David Galles, Modern Compiler Design, Pearson Education.
4. C. Fischer and R. LeBlanc, *Crafting a Compiler*, Benjamin Cummings.
5. A. Appel, Modern Compiler Implementation in C, Cambridge Univ. Press, London.
6. C. Fischer and R. LeBlanc, *Crafting a Compiler in C*, Benjamin Cummings.

Computer Networks (IT 603)

3-1-0 (L-T-P) **F.M.:100**

Prerequisite(s): Communication Systems (IT 402), Programming and Data Structures (IT-301)

Sl No	Module Name and Topics	No. of Classes
.	Introduction: Computer networks and their types; a brief history of networking; data switching techniques; an introduction to virtual circuit switched networks and datagram networks; need of layered architecture; ISO-OSI and TCP/IP architecture; task of layers	6 2
2.	Media: Transmission media; bit rate, baud rate and bandwidth; bit encoding techniques; Network topology	8
3.	Data Link Layer: Data link layer (DLL) design issues; Error detection and correction; Flow control; Example DLL protocols – HDLC and PPP; Need of MAC sub-layer; ALOHA and CSMA protocols; Ethernet LAN; HUB, bridge and switch; Switched LAN; An introduction to Token ring LAN and FDDI; DQDB Wireless LAN	2 4 8 6 8
4.	Network Layer: Need of network layer; Routing algorithms and protocols – RIP, OSPF, BGP; router; routing in Internet; need of logical address; X.25 network, ARPANET and ERNET; internetworking; network layer in Internet – IP, ICMP, IGMP, ARP, RARP, DHCP; NAT and CIDR; IPv6	
5.	Transport Layer: Design issues of transport layer; socket address; congestion control; TCP and UDP	
6.	Application Layer Introduction to application layer protocols; SMTP, FTP, HTTP;	

	network management and security	
		44

References:

1. Peterson and Davie, "Computer Networks, A Systems Approach", Morgan Kaufmann.
2. Andrew S. Tanenbaum, "Computer Networks", Prentice Hall.
3. J. Kurose and K. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education.
4. W. Stallings, Data and Computer Communications, Prentice-Hall, Inc.
5. D. E. Comer and R. E. Droms, Computer Networks and Internets, Addison-Wesley, Inc.,
6. Behrouz A. Forouzan, Computer Networks, TMH.

Elective II (IT 621/X)

SYSTEM PROGRAMMING (IT-621/1)

(L-T-P: 3-0-0) Full marks – 100

Prerequisite(s): Programming and Data Structures (IT-301), Computer Organization and Architecture (IT-401), Microprocessors (IT-501)

Module Number	Topics	Lecture hour
Module 1	**Introduction: (5L)**	
	System Software and Application Software	1
	SIC Machine architecture with programming examples	2
2	**Assembler:(8L)**	
	Assembler Functions	2
	A Simple SIC Assembler	
	Assembler design algorithm and data structure (Two Pass)	
	Machine Dependent Features	2
	Instruction formats and addressing modes	
	Program Relocation	
	Independent Assembler Features	3
	Literals	
	Symbol-defining statements	
	Expressions	
	Program Blocks	
	Control Sections and Program Linking	1
	Assembler Design Options	
	One pass assembler	
	Multi-pass assembler	
3	**Loader: (8L)**	
	Loader Functions	2
	Machine-Dependent Features	2
	Machine Independent Features	2
	Design Options	2
4	**Linker: (4L)**	
	Linker Functions Machine-dependent Features	1 1
	Machine Independent Features	1
	Design Options	1
5	**Macro Processor: (5L)**	
	Macro Processor Functions	1
	Machine-Independent Features	2
	Design Options	2
6	**Device driver basics:(8L)**	
	Design and anatomy of UNIX device driver	2
	Types of device drivers	
	General design of UNIX device drivers	4
Total Lectures		34

References:

1. System Software: An Introduction to System Programming, L. L. Beck and D. Manjula, Pearson Education India.
2. System Programming, Srimanta Pal, Oxford University Press, India.
3. Introduction to System Software, Santanu Chattopadhyaya, Prentice Hall India.
4. System Programming and Operating Systems, D. M. Dhamdhere, Tata McGraw Hill
5. Writing UNIX Device Drivers, G. Pajari, Pearson Education Asia.

Advanced Computer Architecture (IT 621/2)

Weekly contact: 3 – 0 – 0 (L – T – S) **Full Marks: 100**

Prerequisite(s): 1. Digital Logic and Circuit Design (IT 302), 2. Computer Organization and Architecture (IT 401) 3. Microprocessors (IT 501)

Sl. No.	Module Name and Topics	No. of Classes
1.	**Parallel Computer Models, Programs, and Networks:** Introduction to parallel computing, Evolution, Parallelism in Uniprocessor Systems, Multiprocessors and Multicomputers, Multivector and SIMD, Classification of Parallel Architectures, Scalability, Performance metrics and measurement. Conditions of Parallelism, Hardware and Software parallelism, Program partitioning and scheduling.	6
2.	**System Interconnect Architectures:** Network properties, Static vs dymnamic interconnection network, Multiprocessor network topologies, interprocessor communication network, structure and comparison of different parallel computers.	6
3.	**Processor types:** ISA, overview of CISC, RISC, Superscalar, VLIW, vector, and symbolic processors, case study of CISC and RISC.	4
4.	**Memory architecture and system design:** Memory coherence, locality of reference, virtual memory technology, backplane bus, arbitration, cache addressing and performance issues, interleaved memory, multi-core architecture and cache coherence problems, Centralized shared-memory architecture, synchronization, memory consistency, Distributed shared-memory architecture.	6
5.	**Pipelining:** Linear and non-linear pipelining, classification, General pipeline design, Instruction pipeline design, Arithmetic pipeline design, pipeline hazards.	6

6.	**Parallel Architectures:** Limitations of scalar pipelines, Instruction level parallelism, superscalar architecture, dynamic pipelines, superscalar techniques, performance evaluation of superscalar architectures, VLIW architecture, data-level parallelism, thread-level parallelism, Simultaneous multi-threaded (SMT) architectures, Vector and symbolic processors; Case studies of contemporary microprocessors.	8
7.	**Advanced trends:** Multithreaded architectures, Cluster computing architectures, Grid computing architectures, Multi-core architectures, Operating system issues, OPENMP and MPI.	2
Total		38

References:

1. David A Patterson, John L Hennessy- Computer Organization and Design – The HW/SW Interface (The Morgan Kaufmann Series in Computer Architecture and Design).
2. David A Patterson, John L Hennessy- Computer Architecture-A Quantitative Approach- (The Morgan Kaufmann Series in Computer Architecture and Design).
3. Kai Hwang- Advanced Computer Architecture (Parallelism, Scalability, Programmability).
4. J.P. Shen and M.H. Lipasti, Modern Processor Design (McGraw Hill).
5. Rajiv Chopra, Advanced Computer Architecture (A Practical Approach), S. Chand & Company Pvt. Ltd.

Mobile Communication (IT 621/3)

(L-T-P: 3-0-0) **Full Marks:100**

Prerequisite(s): Communication Systems (IT-402), Signals Systems & Circuits (IT-303)

Sl. No.	Module Name and Topics	No. of Classes
1.	**Introduction:** Introduction to mobile and radio communication, radio communication principles, ideas on transmitters, receivers, medium of signal propagation	**2**
2.	**Cellular concept:** Frequency assignment, frequency reuse, concept of cell splitting, System capacity and interference	**4**
3.	**Mobile radio propagation:** Multipath signal propagation model and signal	**4**

	fading in mobile environment, large scale path loss	
4.	**Mobile radio propagation:** Small scale fading and multipath effect, Doppler effect	**2**
5.	Receiver techniques for fading dispersive channels: Channel equalization, adaptive equalization, diversity techniques.	**2**
6.	Communication channel, antenna link design: uplink, downlink, G/T ratio, C/N, performance	**4**
7.	**Multiple accessschemes in mobile communication:** TDMA, FDMA, CDMA, OFDM, Spread Spectrum Transmission and Reception.	**4**
8.	**GSM Architecture:** Mobility management, Handover in cellular systems , Soft handover, hard handover, Security, international roaming for GSM, Mobile Number portability, SMS in GSM, VoIP service for Mobile Networks, GPRS architecture	**6**
9.	**WLAN:** architecture Ideas on mobile ad-hoc networking, protocols	**6**
Total		**34**

References:

1. T. S. Rappaport, "Wireless Communication: Principles and Practice", PHI
2. Jochen Schiller, "Mobile Communications", PHI.
3. Jochen Burkhardt, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Addison Wesley Professional
4. T. Pratt, C. Bostian, "Satellite Communication", John Wiley Co.
5. William Stallings, "Wireless Communications and Networks", Pearson Education.

Elective - II: Distributed Database (IT 621/4)

Weekly contact: 3 – 0 – 0 (L – T – P) **Full Marks: 100**

Prerequisite(s): Operating Systems (IT 502), Database Management Systems (IT 503).

Sl. No.	Module Name and Topics	No. of Classes
1	Introduction Distributed Data Processing, Concepts of Distributed Database Systems	2
2	Distributed DBMS Architecture Transparency Issues, ANSI/SPARC standard, Global/Local/External/Internal Schemas, Architectural Models (including	4

	Client/Server Models)	
3	Distributed Database Design Distributed Design Issues, Top-down and Bottom-up Patterns, Fragmentation, Allocation, Replication of Fragments, Optimality, Heuristics, Integrity Constraints	6
4	Distributed Query Processing Layers of Query Processing, Query Decomposition and Data Localization, Normalization, Elimination of Redundancy, Rewriting, Reduction for Horizontal and Vertical Fragmentation	6
5	Distributed Query Optimization Centralized Query Optimization, Join Ordering, Distributed Query Optimization Algorithms (INGRES, System R, Hill Climbing, etc.)	6
6	Distributed Transaction Management and Concurrency Control Properties and Types of Transactions, Serializability Theory, Concurrency Control Algorithms, Execution Schedules, Locking based Algorithms, Timestamp Ordering Algorithms, Deadlock Management	6
7	Distributed DBMS Reliability Local Recovery Management, Distributed Reliability Protocols, 2PC Protocol	4
8	Case Study	2
Total		36

References:

7. Tamer Oszu and Patrick Valduriez, *Principles of Distributed Database Systems,* Prentice-Hall.
8. Bharat K. Bhargava (Ed.), *Concurrency Control and Reliability in Distributed Systems*, Van Nostrand Reinhold Publishers.
9. Jim Gray and Andreas Reuter, *Transaction Processing: Concepts and Techniques*, Morgan Kaufmann.

Laboratories

Design & Analysis of Algorithm Lab (IT 651)

(L-T-P: 0-0-3) **Full Marks: 50**

1. Study of time requirements of searching and sorting algorithms; Tally the experimental time requirement with the theoretical time complexity; Understanding of problem size
2. Text file compression using Huffman coding
3. Implementation of graph algorithms; Study of data structures' roles in developing efficient algorithms (in connection with graph algorithms)
4. Role of randomness in computing
5. Implementation of some of the number theoretic algorithms

Compiler Design Lab (IT 652)

(L-T-P: 0-0-3) **Full Marks: 50**

1. Understanding and implementation of LEX programming
2. Generating Tokens from a given program.
3. Programming to compute FIRST and FOLLOW
4. LL(1) parsing Table Construction, String parsing using LL(1) grammar
5. YACC programming
6. Design of a small compiler.

Computer Networks Lab (IT 653)

(L-T-P: 0-0-3) **Full Marks: 50**

1. Setting up of LAN
2. Internetworking using a router
3. Understanding and implementation of basic socket programming
4. Network analysis using raw sockets
5. Writing client server programs under various scenarios
6. Study and analysis of congestion control in a real scenario
7. Implementation of denial of service and other attacks