School of Engineering
Tezpur University

B. Tech Programme

Curriculum Structure
&
Syllabi

(Prior to Autumn 2018)

Curriculum Structure

Time Duration

Minimum : 8 Semesters

Maximum : 12 Semesters

Credit Requirements

Minimum Total : 176

Core Courses : 149

Electives : 27

- Humanities : 3
- Science : 3
- Department : 12
- Open : 9

Semester-wise Distribution of Courses for B. Tech Programme
First Year (Common to all disciplines)

Semester I

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
MS 101	Mathematics I	3	1	0	4	4
PH 101	Physics I	2	1	1	4	5
CH 101	Chemistry	2	1	1	4	5
EL 101	Basic Electrical Engineering	2	1	1	4	5
CO 101	Introductory Computing	2	1	0	3	3
ME 101	Engineering Graphics	1	0	2	3	5
Humanities Elective EG101/ SO101/ BM 101	Communicative English/ Sociology/ Elementary Economics	3	0	0	3	3
	Total -	15	5	5	25	30

Semester II

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
MS 102	Mathematics II	2	1	0	3	3
PH 102	Physics II	2	1	1	4	5
ME 102	Engineering Mechanics	2	1	0	4	4
EL 102	Basic Electronics	3	1	1	5	6
CO 102	Computing Laboratory	0	0	2	2	4
ME 103	Workshop Practice	0	0	2	2	4
Science Elective BT 101/ ES 101/ CH 102	Elements of Modern Biology / Environmental Science / Introductory Material Science	3	0	0	3	3
	Total -	13	4	6	23	29

Second to Fourth Year
B. Tech. (Computer Science & Engineering)

Semester III

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
MS 201	Mathematics III	2	1	0	3	3
CO 201	Discrete Structures	3	1	0	4	4
CO 202	Digital Logic Design	2	1	1	4	5
CO 203	Data Structures	3	1	1	5	6
CO 204	Computer Architecture and Organization	2	1	1	4	5
EL 204	Signals and Systems	2	1	0	3	3
	Total -	14	6	3	23	26

Semester IV

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
CO 205	Formal Language & Automata	2	1	0	3	3
CO 206	Design and Analysis of Algorithms	3	0	1	4	5
CO 207	System Programming	2	0	1	3	4
CO 208	Object Oriented Programming	3	0	1	4	5
EL 221	Electronic Devices and Circuits	3	0	1	4	5
CO 213	Data Communication	3	0	1	4	5
	Total -	16	1	5	22	27

Semester V

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
CO 301	Operating Systems	3	0	1	4	5
CO 302	Database Systems	3	0	2	5	7
CO 303	Computer Graphics	3	0	1	4	5
CO 304	Principles of Programming Languages	3	0	0	3	3
CO 305	Computer Networks	3	0	1	4	5
BM 321	Fundamentals of Management	3	0	0	3	3
	Total -	18	0	5	23	28

Semester VI

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
CO 306	Embedded Systems	3	0	1	4	5
CO 307	Software Engineering	3	0	1	4	5
CO 308	Compiler Design	3	0	1	4	5
BM 322	Social Responsibility and Professional Ethics in Engineering	3	0	0	3	3
	CS Elective I	3	0	0	3	3
	Open Elective I *	3	0	0	3	3
	Total -	18	0	4	22	26

* Open Elective: Any course of level 400 and above offered in the University and recommended by the department.

Semester VII [$]

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
CO 401	Artificial Intelligence	3	0	0	3	3
-	CS Elective II	3	0	0	3	3
-	CS Elective III	3	0	0	3	3
-	Open Elective II	3	0	0	3	3
CO 471	Industrial Summer Training #	0	0	2	2	-
CO 481	Project I	0	0	6	6	12
	Total -	12	0	6	20	24

Semester VIII

Course No.	Course Title	Credit Structure				Contact Hours
		L	T	P	Total	
-	CS Elective IV	3	0	0	3	3
-	Open Elective III	3	0	0	3	3
CO 482	Project II	0	0	12	12	24
	Total -	6	0	12	18	30

CS Electives

CO 421	Graph Theory	3	0	0	3	3
CO 422	Theory of Computation	3	0	0	3	3
CO 423	Web Technology	3	0	1	5	4
CO 424	E-Commerce	3	0	1	5	4
CO 425	VLSI Design	3	0	1	5	4
CO 426	Advanced Computer Architecture	3	0	0	3	3
CO 427	Modeling & Simulation	3	0	1	5	4
CO 428	Computer Peripherals & Interfacing	3	0	1	5	4
CO 429	Computer Systems Performance Evaluation	3	0	0	3	3
CO 430	Management Information System	3	0	0	3	3
CO 431	System Analysis and Design	3	0	0	3	3
CO 432	Information Theory & Coding	3	0	0	3	3
CO 433	Digital Signal Processing	3	0	0	3	3
CO 434	Image Processing	3	0	0	3	3
CO 435	Mobile Computing	3	0	0	3	3
CO 436	Wireless Communication	3	0	0	3	3
CO 501	Network Management and Security	3	0	0	3	3
CO 502	Data Compression	3	0	0	3	3
CO 503	Fuzzy Logic and Neural Networks	3	0	0	3	3
CO 504	Natural Language Processing	3	0	0	3	3
CO 505	Advanced Database Management System	3	0	0	3	3
CO 506	Advanced Software Engineering	3	0	0	3	3
CO 507	Advanced Embedded Systems	3	0	0	3	3
CO 508	Grid Computing	3	0	0	3	3
CO 509	Computer Vision	3	0	0	3	3
CO 510	Robotics	3	0	0	3	3
CO 511	Ubiquitous and Pervasive Computing	3	0	0	3	3

Also any other course of level 400 and above offered in the department of CSE.

[$] The 7th semester will start a month later than usual and therefore be shorter by a month. To compensate for it there shall be 4 class hours per week for a 3 credit course.

\# Industrial Summer Training: Training shall be of 12 weeks duration carried out during the summer break after the 6th semester. The report will be submitted in the 7th semester.

Syllabi

First Year

Mathematics I — MS101

3 - 1 - 0 : 4 Credits : 4 Hours — *Prerequsites:* None

Rolle's theorem, Cauchy's mean value theorem (Taylor's and Maclaurin theorems with remainders, Indeterminate forms, Concavity and convexity of a curve, points of inflexion. Asymptotes and curvature.

Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutativity, Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables – Language's method of multipliers.

First order differential equations – exact, linear and Bernoulli's form, second order differential equations with constant coefficients, Euler's equations, system of differential equations.

Limit, continuity, differentiability and analyticity of functions Cauchy-Riemann eqations, Elementary complex functions, Line integrals, Cauchy's integral theorem, Cauchy's integral formula, Power series, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem.

Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals – reduction formulae.

Books:

1. Differential & Integral Calculus, Vol-I & II, Piskunov, Mir Publications.
2. Engineering Mathematics, B. S. Grewal, S. Chand & Co. New Delhi.

Physics - I — PH101

2 - 1 - 1 : 4 Credits : 5 Hours — *Prerequsites:* None

Conservation Principles, rotational Dynamics, free, forced and damped oscillations, coupled oscillations, wave motion, reflection and refraction, interference, diffraction, polarisation.

Vector calculus: Curvilinear co-ordinates, gradient of a scalar fields, divergence and curl of a vector field, Gauss's and Stoke's theorems.

Electrostatics, magnetostatics, motion of charges in electric and magnetic fields, electromagnetic induction, displacement current, Maxwell's equations, electromagnetic Waves.

Laboratory Experiments:

1. To determine the coefficient of viscosity of a liquid from its rate of flow through a capillary tube.
2. To determine the velocity of sound in a solid by Kundt's tube method.
3. To determine the acceleration due to gravity (g) by Kater's pendulum.

4. To determine the wavelength of a monochromatic light by Fresnel's biprism and Lloyd's mirror.
5. To determine the wavelength of light and radius of curvature of the convex surface of a lens by Newton's ring method.
6. To determine the wavelength of light by diffraction through a plane transmission grating.
7. To determine the value of Planck's constant using photocells.
8. To determine the melting point of a solid with a thermocouple.
9. To determine the value of e/m of an electron by using a cathode ray tube and a pair of bar magnets (Thompson's method).
10. To observe waveforms and to measure amplitude, frequency and phase with cathode ray oscilloscope.
11. To verify Thevenin's, Norton's and maximum power transfer theorems.
12. To study the performance of inverting and non-inverting amplifiers using an operational amplifiers.

Text/Reference Books:

1. Introduction to Electrodynamics-David J. Griffiths, Prentice-Hall of India Pvt. Ltd.
2. Electricity and Magnetism by A.S. Mahajan and A.A. Rangwala, Tata McGraw Hill Publishing Co. Ltd.
3. Optics-A.K. Ghatak, Tata McGraw Hill Publishing Co. Ltd.
4. Vibrations and Waves in Physics, Iain G. Main, Amazon Books
5. Fundamentals of Physics, D. Halliday and R. Resnick, John Wiley Publication

Chemistry CH101

2 - 1 - 1 : 4 Credits : 5 Hours *Prerequsites:* None

Thermodynamics of Chemical Processes : Concept of entropy, Chemical potential, Equilibrium conditions for closed systems, Phase and reaction equilibria, Maxwell relations, Real gas and real solution.

Electrochemical Systems : Electrochemical cells and EMF, Applications of EMF measurements: Thermodynamic data, activity coefficients, solubility product and pH, corrosion.

Kinetics of Chemical Reactions : Reversible, consecutive and parallel reactions, Steady state approximation, Chain reactions, Photochemical kinetics.

Bonding Models in Inorganic Chemistry : Molecular orbital theory, Valence-bond theory, Crystal field theory.

Fundamentals of Microwave, IR and UV-VIS Spectroscopy : Basic concepts of spectroscopy, Selection rule, Determination of molecular structure.

Coordination Chemistry : Coordination numbers, Chelate effect, Coordination complexes and application, Bio-inorganic chemistry : Metal ions in Biological systems., environmental aspects of Metals, NOx, CO, CO2.

Organic Reaction Mechanism : Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions.

Stereochemistry of Carbon Compounds : Selected Organic Compounds : Natural products and Biomolecules (Amino acids/nucleic acids/proteins).

***Laboratory Experiments* :**

(At least nine of the experiments listed below)

1. Surface tension and parachor
2. Measurement of the coefficient of viscosity.
3. Conductometric titration
4. pH-metric/potentiometric titration

5. Solubility product
6. Kinetics of ester hydrolysis
7. Estimation of Fe2+
8. EDTA titration
9. Estimation of base content and acid content of commercially available antacid and vitamin C respectively
10. Synthesis of Mohr's salt
11. Synthesis of aspirin
12.Demonstration of a few important physico-chemical processes. (e.g. Gel electrophoresis, Oscillatory reactions)
13. Determination of CMC of a surfactant

Books:

1. Physical Chemistry, Rakshit P. C.
2. Inorganic Chemistry, Dutta R. L.
3. Organic Chemistry, Finar I. L
4. Text Book of Physical Chemistry, Glasston Samuel
5. Concise Inorganic Chemistry, Lee J. D.

Communicative English EN 101

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* None

Objectives

1. To develop overall proficiency in English with a view to enabling the students to use English for communication and for study purposes;

2. To develop the student's interactive skills by developing their ability to listen to English for formal as in class lectures and informal as in face to face interactive situations) with a high degree of understanding, and helping them to speak English with a reasonable degree of fluency and with an acceptable pronunciation of the sounds of English;

3. To develop student's ability to read English texts-both of scientific and non-scientific nature silently with a high degree of comprehension;

4. To develop the student's skill of writing short paragraphs, formal and informal letters, curriculum vitae/resume, applications of various types, study notes, summery and appropriate words-both scientific and non-scientific.

Course content and activities

A. Oral Communicative Activities

Information transfer activities: Pair and group works involving transfer of information (reading a brochure and advertise/a notice a schedule or programme/drawing etc. and discussing these, finding a solution, arriving at a decision through speaking); extempore speech using clues, group discussion etc.

Pair work: describing pictures, interpreting diagrams, gleaning information from different types of written materials including articles etc and talking about them, formal seminar presentation, formal group discussion.

B. Reading

Reading and comprehension: global and local comprehension, drawing interferences Materials: Stories and essays (preferably a collection of comparatively short essays on scientific, interestingly written topics, biographical/autobiographical writtings, short stories-adventure and scientific fiction), Reading silently in class followed by short comprehension questions, brief writing exercises, summaries in brief, personal responses (not typical question-answer type)-both oral and written. Reading material from Internet and talking

and writing about them; reading scientific reports, articles collected from newspapers and magazines, Internet etc. and writing notes etc. on them

C. Writing

Preparing reports, project proposals. Writing applications of various types and for various purposes, curriculum vitae/resume, letters to the editors, letters to various agencies. Writing short notes on article/reports read summary of articles/paragraphs read, notes on lectures (talks-radio/TV/audio, video cassettes), opinions on discussions/letters heard, notice both formal and informal/friendly, notes to inform others etc., interpreting pictures, advertisements, visuals (video, TV etc.) and writing briefly about them.

D. Vocabulary and grammar:

Using useful but unfamiliar words and phrases in conversation and in writing; Group verbs, idiomatic expressions; synonyms and antonyms.

Structure of simple sentences; use of adverbials, longer sentences, combining sentences, Tenses, Use of passive in scientific discourse, various types of questions, direct and indirect narration.

Evaluation:

Oral skills: 15% of total marks
Interview/interacting; group discussion; formal seminar presentation
Reading-comprehension: 25% of total marks
Continuous text; chart/graph/drawing/pictures etc.
Vocabulary
Writing: 40% of total marks
Notes/summery/writing; letters; report writing; short essay
Grammar and usages 20% of total marks
Questions on grammar in use (using texts/passages from texts); questions to test knowledge of grammar.

Books and equipment:

1. Anna University, Madras. *English for Engineers and Technologists: a skill approach*. Vol 182. Hyderabad: Orient Longman, 1990.
2. *Collins Cobuild English Grammar*. Harper Collins India, 1990
3. Graves, Graham. *Foundation English for Science Students*. Delhi: Oxford University Press, 1975
4. *Oxford Advanced Learner's Dictionary* (with CD-ROM), 7th edition, 2005
5. Thomson and Martinet. *A Practical English Grammar*. Delhi Oxford ELBS, 1980
6. Sudarsanam, K., *Understanding Technical English*. New Delhi: Sterling Publishers Pvt. Ltd., 1988.

Sociology SO 101

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* None

1. **Society:** Meaning and element of society – Distinction between society, Aggregation and Organisation – Relationship between Individual and Society.
   Social Group **:** Meaning and brief classification of social group- Primary group- meaning, characteristic and importance of primary ground – method of making decision in a primary group – Secondary group- meaning and characteristics – Organization of authority in a Secondary group.
2. **Social Change :** Concepts and direction of social Change- Deterioration – and Cycle theory- Causes of social change- Deterministic theories of social change- a brief explanation of biological, physical, cultural and technical factors influencing the rate and direction of social change.

Social Disorganisation : Meaning, characteristics and causes- social problem- meaning classification and causes- methods for solving social problems.

3. **Personal Administration :** Concept, aims and objectives, functions and principles of personal administration. Interview- types of interview – training- importance and methods- induction.

4. **Human Relations & Behavioural Approach to Manpower :** Concept of Human relations- origin and growth- (a brief reference to the Hawthrone Experiments, Mechanical or Commodity concept and social or Human concept of Labour – Classification made by Doghlas Megxg theory – X and theory – Y – importance of Human Relations.
   Werlmotivation – Meaning and kinds – Baslow's need Hierarchy- Motivational techniques- meaning and significance of group Dynamics- Employees Morale – meaning and importance of and steps to promote employee morale

5. Concept, characteristics and techniques of leadership- types of leader- functions and qualities of a leader.

Books :

1. Induction of Sociology, Dr. Sachdeva and Vidya Bhusan
2. Business Administration and management, Dr. S.C. Saksena
3. Principle of Sociology, R.N. Sarma
4. Human Relation in Management, S. G. Huneryager & L.L. Hechkm.

Engineering Graphics — ME101

1 – 0 – 2 : 3 Credits : 5 Hours — *Prerequsites:* None

Introduction to IS code of drawing; Conics and Engineering Curves – ellipse, parabola, hyperbola, cycloid, trochoid, involute; Projection of lines – traces, true length; Projection of planes and solids; sold objects – cube, prism, pyramid, cylinder, cone and sphere; Projection on Auxiliary planes; Isometric projection, isometric scale; Section of solids – true shape of section; Introduction to CAD tools – basics; Introduction of Development and Intersection of surfaces.

Books:

1. Engineering Graphics, K. L. Narayana, P. Kannaaiah, Tata McGrawHill, New Delhi
2. Elementary Engineering Drawing, N. D. Bhatt, Charotar Book Stall, Anand.
3. Engineering Graphics, V. Lakshminarayanan, R. S. Vaish Wanar, Jain Brithers, New Delhi.
4. Engineering Graphics, A. M. Chandra, S. Chandra, Narosa.
5. Engineering Drawing and Graphics + AutoCAD, K. Venugopal, New Age International, New Delhi.

Basic Electrical Engineering — EL101

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* None

Engineering Circuit Analysis : Current, Voltage, Power, Circuit elements, Ohm's law, Kirchoff's law, Nodal Analysis, Mesh Analysis, Source transformations, Linearity and Superposition, Thevenin's and Norton's Theorems, Maximum power transfer theorem, Star-Delta and Delta-Star Conversion, Simple RL and RC Circuits, Unit Step Forcing Function, source free RLC Circuits, Sinusoidal Forcing Function, Complex Forcing Function, Phasor Concept, Impedance and Admittance, Phasor diagrams, Response as a Function of ω, Instantaneous Power, Average Power, RMS values of Current and Voltage, Apparent Power and Power Factor, Complex Power, Introduction to Three Phase Circuits.

AC Machines : Transformer **:** Working principle, Ideal Transformer, Equivalent Circuit, Transformer tests, Voltage regulation, Efficiency. Three Phase Induction Motor **:** Construction, Production of rotating field, Slip, Torque and Slip, Equivalent Circuit. Single Phase Induction Motor **:** Double field revolving theory, Equivalent circuit, Typical Applications, Stepper Motors.

DC Machines : Principle of DC Generator, Methods of excitation, Characteristics and Applications, Principle of DC Motor, Types, Speed – Torque Characteristic, Speed Control, Motor starting, Applications.

Electrical Measuring Instruments : Basic Characteristics of Measuring Devices, Error Analysis, Standards and Calibration, Moving Coil, Moving Iron and Electrodynamic Meters, AC/DC ammeters and voltmeters, Ohmmeters, Wattmeters, Watt-hour meter, AC bridges, Q.meter, Cathode Ray Oscilloscope.

Power System : Introduction to generations, Transmissions and Distribution Power Systems, Domestic Wiring, Safety measures.

Laboratory Experiments

Experiments on Circuits : Verification of Network Theorems, Design and Study on circuits using R, L and C, Power measurement in single phase A.C. Circuits.
Transformer: Open circuit and Short Circuit Tests.
D.C machines : Open Circuit Characteristic of Generator, Speed Control of D.C. motors.
Electrical Measuring Instruments : Calibration of meters, Power measurement in 3-phase circuits, AC bridges.
Power System : Design and Physical model of domestic wiring.

Text :

1. W.H. Hayt and J.E. Kemmerly : Engineering Circuit Analysis; Mc Graw-Hill, 1993
2. V. Del Toro : Electrical Engineering Fundamentals; PHI, 1994
3. R.J. Smith and R-C-Dorf : Circuits, Devices and Systems; John Wiley & Sons, 1992
4. D. Helfrick and W.D Copper : Modern Electronic Instrumentation and Measuring Techniques; PHI, 1990

Reference:

1. Golding and Widdis : Electrical Measurements and Measuring Instruments; A.H. Wheeler & Company, Calcutta, 1993.
2. H. Cotton, "Advanced Electrical Technology", Issac Pitman, London.
3. D.P. Kothari, I.J. Nagrath : Basic Electrical Engineering, 2nd Edition, Mc Graw-Hill, 2002
4. Rana : Basic Electrical Science

Workshop Practice ME103

0 - 0 - 2 : 2 Credits : 4 Hours *Prerequsites:* None

Machining: Introducing to various machine tools and demonstration on various machining process. Making jobs as per drawings

Fitting Practices: Study of different vices, power hammer. Making jobs as per drawing.

Welding Practice: Introduction to different welding processes. Practice on Oxy-acetylene gas welding and manual metal arc welding.

Carpentry: Introduction to different hand tools and wood turning lathe. Making jobs.

Books:

1. M. L. Begeman and B. H. Amstead, *Manufacturing Process*, John Wiley.
2. W. A. J. Chapman and E. Arnold, *Workshop Technology Vol. I & II*, Viva Low Priced Student Ed.
3. B. S. Raghuwanshi, *Workshop Technology Vol. I & II*, Dhanpat Rai & Sons.

Mathematics II MA102

2 - 1 - 0 : 3 Credits : 3 Hours *Prerequsites:* None

Vector spaces – Linear dependence of vectors, basis, linear transformations, rank and inverse of a matrix, solution of algebraic equations – cponsistency conditions. Eigenvalues and eigenvectors, Hermitian and skew Hermitian matrices.

Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line and surface integrals, theorems of Green. Gauss and Stokes, orthogonal curvilinear coordinates.

Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polymomials-Fourier Series, Fourier transforms, Laplace transform, z-transform, Wavelet transforms.

Finite differences, Newton's forward and backward interpolation formulae, Central difference interpolation. Trapezoidal rule and Simpson's 1/3rd rule of integration. Solution of polynomial and transcendental equations – bisection method, Newton Raphson method and Regula falsi method.

Books:

1. Advance Engineering Mathematics, Kreyszig E.
2. An Introduction to Linear Algebra, Krishnamurthy V., Mainra V. P., Arora J. L.
3. Engineering Mathematics, Grewal B. S.

Physics II PH102

3 - 0 - 1 : 4 Credits : 5 Hours *Prerequsites:* None

Elements of special theory of relativity: postulates, Galilean and Lorentz transformations, equivalence of mass and energy.

Introduction to quantum mechanics and applications: limitations and failure of classical physics, wave-particle duality, uncertainty Principle, atomic and molecular spectra, elements of lasers and holography.

Solid state physics: Bravais lattice, Reciprocal lattice, X-ray diffraction, Brillouin zones, Band theory of solids. Statistical physics: Quantum statistics, Fermi energy of metals.

Nuclear physics: Nuclear force, properties and models of nuclei, nuclear excitations and decay, nuclear reactions, elementary particles.

Laboratory Experiments:

1. To verify Hooke's law and determination the Young's modulus of elasticity of the material of a bar the method of flexure.
2. To determine the thermal conductivity of a bad conductor in the form of a disc by the Lees and Chorlton method.

3. To determine the thermal conductivity of a good conductor by Searle's method.
4. To determine the Rydberg constant by studying the Hydrogen spectrum.
5. B-H curve and determination of Curie temperature of a ferromagnetic material.
6. To determine the value of Stefan's constant.
7. To determine the Lande's g-factor with Electron Spin Resonance spectrometer.
8. To study the current-voltage, power output versus load, aerial characteristics and spectral response of the photoelectric solar cell.
9. To determine the Hall co-efficient of a given semiconductor.
10. To determine the band gap by measuring the resistance of a thermistor at different temperatures.
11. To construct AND, OR and NOT gates from NOR and NAND gates using IC chips.
12. To determine the dielectric constant of a given dielectric material.

Text Books:

1. Concepts of Modern Physics- Arthur Beiser, McGraw Hill, International Student Edition.
2. Introduction to Special Relativity-Robert Resnick

Reference:

1. Introduction to Solid State Physics VII Edition - C. Kittel, Wiley Eastern Ltd.
2. Quantum Mechanics - L.S.Schiff, Tata McGraw Hill
3. Quantum Mechanics - Ghatak and Lokanathan

Introductory Computing CO101

3 - 1 - 0 : 4 Credits : 4 Hours *Prerequsites:* None

Computer Fundamentals:

- History, Generations, Classification of Computers;
- Organization of a Computer;
- Concept of Programming and Programing Languages.

Introduction to Programming:

- Concept of Algorithm, Flow Chart, Pseudocode, Illustrative Problem Solving Examples.
- Features of a Programming Language: Character Set, Identifiers, Keywords, Data Types, Variables, Declarations, Operators & Expressions; Statements: Assignment, Input/Output; Flow Control- Conditionals and Branching; Iteration; Functions, Function Types, Scope Rule; Recursion; Arrays, Pointers, Structures. (A programming language like C/C++ shall be used as a basis language. The same language is to be used for the laboratory).

Books:

1. Programming in C, Balaguruswamy.
2. Let us C, Kanetkar Y.
3. Programming in C, Gotfreid, McGrawHill
4. Fundamentals of Computers, Rajaram, V.

Reference:

5. The Elements of Programming Style, Kerningham, B. W.
6. Techniques of Program Structures and Design, Yourdon, E.
7. Theory and Problems of Computers and Programming, Schied, F. S.
8. The C Programming Language, Kerningham & Ritchie.

Computing Laboratory CO102

0 - 0 - 2 : 2 Credits : 4 Hours *Prerequsites:* CO101

Laboratory exercises shall involve the following:

1. Familiarization of a computer and the environment and execution of sample programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structures
9. Linked lists
10. Data structures

It is suggested that some problems related to continuous domain problems in engineering and their numerical solutions are given as laboratory assignments. It may be noted that some of basic numerical methods are taught in the Mathematics course.

Books:

1. The Elements of Programming Style, Kerningham, B. W.
2. The C Programming Language, Kerningham & Ritchie.
3. Programming in C, Balaguruswamy.
4. Let us C, Kanetkar Y.
5. Programming in C, Gotfreid, McGrawHill

Basic Electronics EL102

3 - 0 - 2 : 5 Credits : 7 Hours *Prerequsites:* None

Diodes and Transistors : Semiconductor Materials, Semiconductor Diode, Equivalent Circuits, Diode Testing, Zener Diodes, Load Line Analysis, Rectifier Circuits, Wave Shaping Circuits, Bipolar Junction Transistors, Field-Effect Transistors, Transistors Biasing, Transistors Small Signal Analysis, Transistor Amplifier Circuits.

Operational Amplifiers : Operational Amplifier Basics, Equivalent Circuit, Practical Op-amp Circuits, DC Offset, Constant Gain Multiplier, Voltage Summing, Voltage Buffer, Controlled Sources, Instrumentation Amplifiers, Comparator, Oscillator Circuits.

Thysistors : Silicon Controlled Rectifier, Silicon Controlled Switch, Shockley Diode, DIAC, TRIAC.

Digital Systems: Number Systems and Codes, r's Complements and (r-1)'s Complements, Binary Addition and Subtraction, Representation of Negative Number, Floating Point Representation. Logic Gates: Basic and Universal, Boolean Theorems, De' Morgan's theorems, Sum-of-Products form, Algebraic Simplification, Karnaugh Map, Basic Combinational Circuit Concept : Half Adder, Full Adder, Sequential circuit concept : Basic Flip-Flops (RS, D, JK Flip-Flop).

Experiments using diodes and bipolar junction transistor (BJT) : diode characteristics, designs and analysis of half-wave and full-wave rectifiers, Clipping circuits and Zener regulators, BJT characteristics and BJT amplifiers.

Experiments using Operational amplifiers : Summing amplifier, Comparator, Oscillators.

Experiments using logic gates : Digital IC testing, Realization of Boolean Equation, Realization of Adder, Subtrator.

Experiments using flip-flops : Realization of Basic Flip-Flops.

Books :

1. R.L. Boylestad and L.Nashelsky : Electronic Devices and Circuit Theory; PHI, 6e, 2001.
2. R.J. Tocci : Digital Systems; PHI, 6e, 2001
3. A.P. Malvino : Electronic Principles; New Delhi, Tata Mc Graw-Hill, 1993
4. J. Millman & A. Grabel, "Micro electronics", 2nd Edition, Mc Graw-Hill, 1987
5. R.A. Gayakward, Op.Amps and Linear Integrated Circuits, New Delhi : PHI, 2002

Engineering Mechanics ME102

3 - 1 - 0 : 4 Credits : 4 Hours *Prerequsites:* None

Force systems: Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple.

Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses.

Friction: Laws of Coulomb friction., problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance.

Properties of areas: Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia.

Principle of Virtual Work

Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion.

Rigid Body Dynamics: Relative velocity, Translation, Pure rotation and plane motion of rigid bodies, D'Alembert's principle, linear momentum, principle of conservation of momentum, Impact of solid bodies, work, energy, power, principle of conservation of energy

Books:

1. F. P. Beer and F. R. Johnston, *Mechanics for Engineering*, McGraw Hill
2. I. H. Shames, *Engineering Mechanics*, Prentice Hall India.
3. Timoshenko and Young, *Engineering Mechanics*, McGraw Hill.

Reference:

1. R.C. Hibbler, *Engineering Mechanics*, McMillan
2. K.L. Kumar, *Engineering Mechanics*, Tata McGraw Hill

Elements of Modern Biology BT 101

3 – 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* None

Biological Structures and Organization :

- Biological macromolecules, Cellular Organization, Cell types, Membrane structures and functions.
- Cellular energetics: Structure of Mitochondria, Energy transduction; Structure of Plastids (chloroplast), Photosynthetic light and dark reactions.

Biological systems:

- Muscular skeletal system, Nervous system (Overview of the major human sensory organs and their functioning), Cardiovascular system.

Biological Information:

- DNA : Structure, Genetic code, Central dogma in Molecular biology.
- Protein synthesis.
- Biological data and Bioinformatics.
- Signal transduction in plants and animals – Basic concepts.

Text / Reference :

1. N. Hopkins, J. W. Roberts, J. A. Steitz and A. M. Weiner : Molecular Biology of the Gene, J. Watson, Fourth Ed, Benjamin Cummings, Singapore, 1987.
2. J. L. Tymoczko, L. Stryer, Biochemistry, J.M. Berg, Fifth Ed, W.H. Freeman & Co, New York, 2002.
3. Dr. C. C. Chatterjee, Human Physiology, 11th Ed, Vol. I and II, Medical Allied Agency, Kolkata, 1987.
4. Guyton, Human Physiology.

Environmental Science ES 101

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* None

General :

Basic ideas of environment, basic concepts related to environmental perspective, man, society and environment, their inter relationship. 1L

Mathematics of population growth and associated problems, definition of resource, types of resource, renewable, nonrenewable, potentially renewable, effect of excessive use vis-a-vis population growth, definition of pollutant and contaminant. Environmental impact assessment. 2L

Environmental degradation:
Acid rain, toxic element, particulates, noise pollution, air pollution and its effect on man. 1L
Overall methods for pollution prevention, environmental problems and sustainable development , components of environment. 1L

Ecology:

Elements of Ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem, biotic and abiotic components. Ecological balance and consequence of change: Effect of abiotic factor on population, flow chart of different cycles with only elementary reaction [oxygen, nitrogen, phosphate, sulphur], food chain [definition and one example of each food chain] 3L

Air Pollution and Control :

Atmospheric Composition: Troposphere, stratosphere, mesosphere, thermosphere, tropopause, stratopause and mesopause. 1L

Energy Balance: Conductive and convective heat transfer, radiation heat transfer, simple global temperature modal (Earth as a black body, earth albedo), problems. 3L

Green-house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. 1L

Climate, weather: Difference between climate and weather, Global warming and its consequence: Adiabatic lapse rate, atmospheric stability, temperature inversion, radiation inversion, Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, smokestack plumes and atmospheric lapse rate. 3L
The point-source Gaussian plume model excluded.

Source and effect of pollutants: Toxic chemicals in the environment, toxic chemicals in air, suspended particulate matter, carbon dioxide, sulphur dioxide, nitric oxide, lead, carbon monoxide. 2L

Primary and secondary pollutants: Emission standard, criteria pollutant, oxides of carbon, oxide of nitrogen, oxide of sulphur, particulate, PAN. 1L
Depletion Ozone layer: CFC, destruction of ozone lair by CFC, impact of other greenhouse gases, effect of ozone modification. 1L

Standards and control measures: Industrial, commercial and residential air quality air quality standard, Control measure (ESP, Cyclone separator, bag house, catalytic converter, scrubber (ventury). Statement with brief reference) 1L

Water Pollution and Control :

Hydrosphere: Hydrological cycle. 1L
Natural water, Pollutants : their origin and effects: Oxygen demanding wastes, pathogens, nutrients, salts, thermal application, heavy metals, pesticides, volatile organic compounds. 1L

River / lake / ground water pollution :
River : DO, 5day BOD test, BOD reaction rate constants, temperature dependents of BOD, effect of oxygen demanding wastes on river [Deoxygenation, reaeration], COD, Oil, Grease, pH. 2L

Lake : Eutrophication [Definition, source and effect] 1L

Ground Water: Aquifers, hydraulic gradient, ground water flow. (Definition only) 1L

Standard and control: Waste water standard [BOD,COD,Oil, Grease], Water treatment system [coagulation and flocculation, sedimentation and f1ltration, disinfection, hardness and alkalinity, softening], wastewater treatment, primary treatment, secondary treatmens [Trickling f1lters, rotating biological contractor, activated sludge, sludge treatment, oxidation ponds], tertiary treatment definition. 3L

Arsenic pollution: Biochemical effect, contamination, speciation 2L

Land Pollution:
Lithosphere Composition, Pollutants: Municipal, industrial, commercial, agricultural, hazardous solid wastes. 1L
Recovery and conversion method Waste and waste management Land filling, incineration, composting. 2L

Noise Pollution, Sources, effects: Definition of noise, effect of noise pollution, noise classification, transport noise, occupational noise, neighbourhood noise, definition of noise intensity, noise threshold limit value. 2L

Books:

1. Masters, G.M., "Introduction to Environmental Engineering and Science", Prentice Hall of India Pvt. Ltd., 1991

2. Nebel, B.J., "Environmental Science", Prentice Hall Inc., 1987
3. Odum, E.P., "Ecology: The Link between the natural and social sciences", IBH Publishing Co. Delhi.

Introductory Material Science — CH 102

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* Nil

Structure of Materials:
Atomic bonding and bonding types, Crystallography and x-ray diffaraction, Defect structures, Amorphous structures in metals, ceramics, and polymers.

Kinetics:
Diffusion and diffusion pathways, Fick's 1^{st} and 2^{nd} law, Avrami-rate equation, T.T.T. diagrams, specific attention shown to Fe-Fe_3C system.

Phase Equilibria:
Uniary and binary phase diagrams, Gibbs's phase rule, Cooling curves and setermination, Solid solution, eutectics, peritectics, eutectoids, peritectoid reactions.

Mechanical Properties
Elastic and plastic behaviour constrasted in ceramics, metals, and polymers, Stress-strain curves, Hardening mechanisms in polymers and metals, Time dependent mechanical properties, creep mechanisms,Fracture toughness.

Composite Materials:
Designing composite materials, Average property description, Connectivity.

Electrical Properties:
Conductivity (metals), Semiconductors, intrinsic versus extrinsic, Insulators, Superconductors, Magnetic materials, Optical materials, refractive indices, and colour.

Books:

1. J.F. Shakleford, *Introduction to Material Science and Engineering*
2. W. D. Callister, *Material Science and Engineering - An Introduction*, Wiley, 2002.
3. V. Raghavan, *Materials Science and Engineering*, Prentice Hall, 1996.

Reference:

1. W. F. Smith, *Principles of Materials Science*, McGraw Hill, 1996
2. G. E. Dieter, *Mechanical Metallurgy*, McGraw Hill, 1988

Second Year

Mathematics

Mathematics III — MS 201

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* MS 102

Discrete probability :
- Randomness, finite probability space, probability measure, events
- Conditional probability, independence, Bayes' theorem
- Discrete random variables
- Binomial, Poisson, geometric distributions
- Mean and variance: concepts, significance, computations, applications
- Integer random variables.

Continuous probability :
- Continuous random variables, the nature of these, illustrations of use
- Exponential and normal distribution: probability density functions, calculation of mean and variance
- The central limit theorem and the implications for the normal distribution
- Joint distribution.

Expectation :
- Moments, transform methods, mean time to failure
- Conditional expectation, examples
- Imperfect fault coverage and reliability.

Stochastic processes :
- Introduction: Bernoulli and Poisson processes, renewal process, renewal model of program behavior
- Discrete parameter Markov chains: transition probabilities, limiting distributions
- Queuing: M/M1 and M/G/1, birth and death process
- Finite Markov chains, program execution times

Sampling distributions :
- Purpose and the nature of sampling, its uses and applications
- Random approaches to sampling: basic method, stratified sampling and variants thereof, cluster sampling
- Non-random approaches: purposive methods, sequential sampling
- Data analysis; tools; graphical and numerical summaries
- Multivariate distributions, independent random variables

Estimation :
- Nature of estimates: point estimates, interval estimates
- Criteria to be applied to single point estimators: unbiased estimators, consistent estimators, efficiency and sufficiency of estimators
- Maximum likelihood principle approach, least squares approach; applicability conditions for these
- Confidence intervals
- Estimates for one or two samples.

Hypothesis tests :
- Development of models and associated hypotheses, the nature of these

- Hypothesis formulation: null and alternate hypotheses
- Testing hypothesis based on a single parameter, choice of test statistic; choice of samples and distributions
- Criteria for acceptance of hypothesis
- t-test, chi-squared test; applicability criteria for these.

Correlation and regression :

- The nature of correlation and regression, definitions
- Definition and calculation of correlation coefficients
- Approaches to correlation: the linear model approach, the least squares fitting approach, strengths and weaknesses of these and conditions for applicability.

Books:

1. Statistical Methods for Engineeris and Scientists, R. m. Bethea, B. S. Duran, T. L. Boullion, Marcell Dekker Inc.
2. Statistics : Concepts and Applications, H. Frank, S. C. Altheon, Cambridge Low Priced Edition.
3. Theory and Problems of Probablity and Statistics, M. R. Spiegel, Scaum's Outline Series, McGrawHill.
4. Probability, Random Variables, and Stochastic Processes, Papoulis, McGrawHill.

Mathematics IV — MS 202

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* MS 102

Partial differential equations: What are partial differential equations (PDEs), and where do they come from ? Flows, vibrations and diffusions. Second-order linear equations and their classification. Initial and boundary conditions, with an informal description of well-posed problems. D'Alembert's solution of the wave equation. Duhamel's principle for one dimensional wave equation.

Separation of variables: application of the method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates. Bessel functions. Legendre functions.

Boundary-value problems: Solution of boundary-value problems for various linear PDEs in various geometries. Fourier method for IBV problems for wave and heat equation, rectangular region, Fourier method for Laplace equation in 3 dimensions. Numerical methods for Laplace and Poisson's equation.

Conservation of mass; incompressibility; the continuity equation; streamfunctions;

Newton's laws applied to fluids; ideal fluids; the concept of pressure in fluids; Euler's equations of motion; simple hydrostatics; fluids in solid-body rotation; example of swinging bucket;

Energy equation; (steady) Bernoulli's theorem; simple pipe flows; examples of problems solvable using just Bernoulli' theorem and conservation of mass.

Introduction to vorticity; vorticity equation; the Rankine vortex (simple model of a tornado); Kelvin's circulation theorem; Helmholtz' laws; idea of vortex stretching (bath-tub vortices); irrotational flow; persistence of irrotational flow; extension of Bernoulli's theorem to unsteady irrotational case; example of expanding/ contracting gas bubble; example of steady flow past a cylinder and past a sphere;

Special solutions of the Navier-Stokes Equations, Navier-Stokes Equations in a Rotating Frame, Ekman Layer

Books:

1. Advanced Engineering Mathematics, Kreyszig, E
2. Advanced Engineering Mathematics, Vol II, Reza Malek-Madani, Addison Wesley Longman
3. Differential Equations of Applied Mathematics, Duff, G.F.D, & Naylor, D.

Computer Science Courses

Discrete Structures — CO 201

3 - 1 - 0 : 4 Credits : 4 Hours — *Prerequsites:* None

History and overview : Reasons for studying discrete structures, Some people who influenced or contributed to the area of discrete structures.

Sets, relations, and functions : Basic operations on sets, cartesian products, disjoint union (sum), and power sets. Different types of relations, their compositions and inverses. Different types of functions, their compositions and inverses.

Propositional Logic: Syntax and semantics, proof systems, satisfiability, validity, soundness, completeness, deduction theorem, etc. Decision problems of propositional logic. Introduction to first order logic and first order theory.

Partially ordered sets: Complete partial ordering, chain, lattice. Complete, distributive, modular, and complemented lattices. Boolean and pseudo boolean lattices.

Algebraic Structures : Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup, homomorphic subgroup. Congruence relation and quotient structures. Error correcting code. Algebric structures with two binary operations- ring, integral domain, and field. Boolean algebra and boolean ring. (Definitions and simple examples only).

Introduction to Counting: Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Introduction to recurrence relation and generating functrion.

Introductrion to Graph : Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Books:

1. Discrete Mathematical Structures, Trembly and Manohar, McGrawHill.
2. Introduction to Discrete Mathematics, C. L. Liu

Digital Logic Design — CO 202

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* EL 102

History and overview : Reasons for studying digital logic, Some people who influenced or contributed to the area of digital logic.

Switching theory: Number systems and codes, Binary arithmetic, Boolean and switching algebra, Representation and manipulation of switching functions, Minimization of switching functions, Incompletely specified switching

functions.

Combinational logic circuits: Basic logic gates (AND,OR,NOT,NAND,NOR,XOR), Realization of switching functions with networks of logic gates, 2-level networks: AND-OR,OR-AND,NAND-NAND, NOR-NOR, Multi-level networks, Physical properties of logic gates (technology, fan-in, fan-out, propagation delay), Elimination of timing hazards/glitches.

Modular design of combinational circuits: Design of medium scale combinational logic modules - Multiplexers, demultiplexers, decoders, encoders, comparators, Arithmetic functions (adders, subtracter, carry look ahead), Multipliers, dividers, Arithmetic and logic units (ALUs), Hierarchical design of combinational circuits using logic modules.

Memory elements: Unclocked and clocked memory devices (latches, flip flops), Level vs. edge-sensitive, and master-slave devices, Basic flip flops (SR, D, JK, T), Asynchronous flip flop inputs (preset, clear), Timing constraints (setup time, hold time) and propagation delays, Data registers (selection, clocking, timing), Random-access memory (RAM).

Sequential logic circuits : Finite state machines (FSMs), clocked and unclocked, Mealy vs. Moore models of FSMs, Modeling FSM behavior: State diagrams and state tables, timing diagrams, algorithmic state machine charts, Analysis of synchronous and asynchronous circuits, Design of synchronous sequential circuits: State minimization, state assignment, next state and output equation realization, Sequential functional units: Data registers, shift registers, counters, sequence detectors, synchronizers, debouncers, controllers.

Fault detection and Location: Fault models for combinational and sequential circuits, Fault detection in combinational circuits; Homing experiments, Distinguishing experiments, machine identification and fault detection experiments in sequential circuits.

Laboratory component:

Study of TTL gate characteristics, Open collector and Tri-state gates, Clock generator and timer circuit.

Synthesis of combinational circuits using NAND, NOR and Multiplexers, Decoder and driver circuits for 7-segment LED displays, D/A converter and 4-bit ALU realization. Synthesis of sequential circuits – study of various types of flip-flops, realization of counters, shift registers and sequence generators.

ASM chart based synthesis such as, Traffic light controller, Blackjack dealer and dice game ASM synthesis, etc.

Books :

1. Switching and Finite Automata Theory, Z. Kohavi, TMH.
2. Digital Circuits and Logic Design, S. Lee, PHI.
3. J.F. Wakerly, “Digital Design – Principles and Practices”, Pearson Education, 2001, 3/e.

Reference:

1. V.P. Nelson, H.T. Nagle, B.D. Carroll & J.D. Irwin, “Digital Logic Circuit Analysis and Design”, PHI, 1995.
2. Hatchel and Gray, Logic Synthesis and Verification Algorithms, Kluwer Academic
3. R. F. Tinder, “Engineering Digital Design,” Harcourt India, 2001 2/e.
4. F.J. Hill and GR Peterson, “ Computer Aided Logical Design,” John Willey, 1993, 4/e
5. M.D. Ercegovac, T Lang and JH Moreno, “Introduction to Digital Systems”, John Wiley, 2000
6. M. Mano, Digital Design, PHI, 1997.2/e
7. P. K. Lala, Practical Digital Logic Design and Testing, PHI, 1996,
8. D.D. Gajski, Principles of Digital Design, PHI, 1996

Data Structures — CO 203

2 - 1 - 2 : 5 Credits : 7 Hours — *Prerequsites:* CO 101

Time and Space analysis of Algorithms – Order Notations.

Linear Data Structures : Sequential representations – Arrays and Lists, Stacks, Queues, Strings; Link Representations – Linear linked lists, Circular linked lists, Doubly linked lists; Applications.

Recursion – Design of Recursive Algorithms, Tail Recursion.

Nonlinear Data Structures : Trees – Binary Trees, Traversals and Threads, Binary Search Trees, Insertion and Deletion algorithms, Height Balanced Trees and Weight Balanced Trees, B-trees, B+ trees, Application of trees; Graphs – Representations, Breadth-first and Depth-first Search.

Hashing – Hashing Functions, Collision Resolution Techniques.

Sorting and Searching Algorithms : Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Heap sort, Radix sort.

File Structures: Sequential and Direct Access, Relative files, Indexed files, B+ tree aas index, Multi-index files, Hashed files.

Books:

1. Data Structures and Algorithms, A. V. Aho, J. E. Hoppcroft, J. E. Ullman, Addision Wesley.
2. Fundamentals of Data Structures, E. Horowitzz, S. Sahni, Galgotia Publ.
3. Data Structures using C, A. S. Tanenbaum
4. Algorithms, Data Structures, and Problem Solving, Addision Wesley.
5. Data Management and File Structures, Loomis, Marry, PHI

Formal Languages & Automata Theory — CO 205

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 101

- Alphabet, languages and grammars.
- Production rules and derivation of languages.
- Chomsky hierarchy of languages.
- Regular grammars, regular expressions and finite automata (deterministic and nondeterministic). Closure and decision properties of regular sets. Pumping lemma of regular sets. Minimization of finite automata.
- Left and right linear grammars. Context free grammars and pushdown automata.
- Chomsky and Griebach normal forms. Parse trees, Cook, Younger, Kasami, and Early's parsing algorithms. Ambiguity and properties of context free languages. Pumping lemma, Ogden's lemma, Parikh's theorem.
- Deterministic pushdown automata, closure properties of deterministic context free languages.
- Turing machines and variation of Turing machine model, Turing computability ,
- Type 0 languages. Linear bounded automata and context sensitive languages.
- Primitive recursive functions. Cantor and Godel numbering. Ackermann's function, mu-recursive functions, recursiveness of Ackermann and Turing computable functions.

- Church Turing hypothesis. Recursive and recursively enumerable sets. Universal Turing machine and undecidable problems. Undecidability of post correspondence problem. Valid and invalid computations of Turing machines and some undecidable properties of context free language problems.

Books:

1. J. E. Hopcroft and J. D Ullman: Introduction to Automata Theory, Languages and Computation, Addison Wesley Publ., New York.
2. McNaughton R, Elementary Computability, Formal Languages and Automata, Prentice-Hall.
3. Martin J C, Introduction to Languages and the Theory of Computation, McGraw-Hill International Edition.

References:

4. Buchi A, Finite Automata, Their Algebras and Grammars: Towards a Theory of Formal Expressions, Springer-Verlag.
5. H. R. Lewis and C. H. Papadimitriou: Elements of the Theory of Computation, Prentice Hall, Englewood Cliffs.
6. F. Hennie: Introduction to Computability, Addison Wesley Publ., New York.

Computer Architecture & Organization — CO 204

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 101, CO102

Basic organization of the computer and block level description of the functional units from program execution point of view; Fetch, decode and execute cycle;

Assembly language programming: Instruction set, instruction cycles, registers and storage, addressing modes; discussions about RISC versus CISC architectures;

Inside a CPU: information representation, computer arithmetic and their implementation; control and data path, data path components, design of ALU and data path, control unit design;

Memory and I/O access: Memory maps, Read Write operations, Programmed I/O, Concept of handshaking, Polled and Interrupt driven I/O, DMA data transfer; I/O subsystems: Input-Output devices such as Disk, CD-ROM, Printer etc.; Interfacing with IO devices, keyboard and display interfaces;

Inside the Memory: memory organization, static and dynamic memory; Cache memory and Memory Hierarchy – Cache memory access techniques; Virtual memory;

Introduction to Parallel Architectures: Instruction Level Parallel Processors- Pipelined, VLIW, Superscalar; Multiprocessors & Multicomputer Architectures, Vector Processing.

Laboratory experiments:

The assignments should cover the following:

1. Assignments on assembly language programming;
2. Experiments on synthesis / design of simple data paths and control unit;
3. Assignments on interfacing devices and systems like data acquisition systems ;

Development kits as well as PCs/Workstations may be used for the laboratory, along with design / simulation tools as and when necessary.

Books:

1. Computer Architecture and Organization, Hayes J. P., McGrawHill
2. Computer Organization, Hamacher, Zaky, Vranesic, McGrawHill
3. Computer System Architecture, Mano M. M.

Design and Analysis of Algorithms — CO 206

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 203

Algorithms and Complexity – asymptotic notations, orders, worst-case and average-case, amortized complexity. Basic Techniques – divide & conquer, dynamic programming, greedy method, backtracking, branch and bound, randomization. Data Structures – heaps, search trees, union-find problems. Applications – sorting & searching, combinatorial problems, optimization problems, computational geometric problems, string matching. Graph Algorithms – BFS and DFS, connected components, spanning trees, shortest paths, max-flow. NP-completeness. Approximation algorithms.

Laboratory: The laboratory component will emphasize two areas:

.Implementation of algorithms covered in class: This will involve running the algorithms under varying input sets and measuring running times, use of different data structures for the same algorithm (wherever applicable) to see its effect on time and space, comparison of different algorithms for the same problem etc.

Books:

1. Introduction to Algorithms, Cormen et al., McGrawHill
2. Aho A, Hopcroft J., Ullman J., The Design and Analysis of Algorithms, Addison-Wesley.

System Programming — CO 207

2 - 0 - 1 : 3 Credits : 4 Hours — *Prerequsites:* CO 203, CO 205

Overview : Definition and classification of system software.

Assemblers : Assembly language, Assembly process, Assembler data structures, Assembler macros and macroprocessors.

Linkers and loaders : Basic concepts, Static and Dynamic linking, shared libraries, loaders, overlays. Case study of UNIX linking system, Windows DLL, OLE, ActiveX.

Debugger : Types, features, case study : sdb/dbx.

Editors : Types, Structure, case study of vi, sed and wordstar.

Unix Utilities: Make, RCS, sed, grep, awk, etc.

Compiler Principles.

Books:

1. Dhandhere, System programming and operating systems, Tata McGraw Hill.
2. System Software, Beck,
3. Sumitabha Das, Unix System V.4 Concepts and Applications, TMH.
4. Linux Manuals.
5. Windows Manuals.

Object Oriented Programming — CO 208

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 203

Data Abstraction : Class, object, constructors, destructors, memory allocations for objects, member functions, friend functions, templates.
Inheritance : Single & multiple inheritance, virtual base class.
Polymorphism : Compile time polymorphism : operator overloading, function overloading, static binding.
Run-time polymorphism : Virtual function, pure virtual function, abstract class, dynamic binding.
Exception handling.

Books:

1. Herbert Schild : The Complete Reference to C++, Osborne McGrawHill.
2. Bjarne Stroustrup: The C++ Programming Language, Addison Wesley
3. Rambaugh et al. : Object Oriented Modeling and Design, PHI(EEE).
4. Grady Booch: Object Oriented Analysis and Design, Pearson Education.

Data Structures & Object Oriented Programming — CO 221

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 101, CO 102

- Review of elementary programming
- Recursion: The concept of recursion; recursive specification of mathematical functions (such as factorial and Fibonacci); simple recursive procedures (Towers of Hanoi, permutations, fractal patterns); divide-and-conquer strategies; recursive backtracking; implementation of recursion
- Introduction to computational complexity: Asymptotic analysis of upper and average complexity bounds; big-O notation; standard complexity classes; empirical measurements of performance
- Fundamental computing algorithms: O(N log N) sorting algorithms (Quicksort, heapsort, mergesort); hashing, including collision-avoidance strategies; binary search trees
- Fundamental data structures: Linked structures; implementation strategies for stacks, queues, hash tables, graphs, and trees; strategies for choosing data structures
- Object-oriented programming: Object-oriented design; encapsulation and information-hiding; separation of behavior and implementation; classes, subclasses, and inheritance; polymorphism; class hierarchies; collection classes and iteration protocols; fundamental design patterns

Books:

1. Data Structures and Algorithms, A. V. Aho, J. E. Hoppcroft, J. E. Ullman, Addision Wesley.
2. Fundamentals of Data Structures, E. Horowitz, S. Sahni, Galgotia Publ.

3. Data Structures using C, A. S. Tanenbaum, PHI
4. Herbert Schild : The Complete Reference to C++, Osborne McGrawHill.
5. Bjarne Stroustrup: The C++ Programming Language, Addison Wesley

System Software & Operating Systems CS222

3 - 0 - 1 : 4 Credits : 5 Hours *Prerequsites:* CO 204

History and Overview *of system software and their classification.*

Language Processors : Compiler, Interpreter, Assembler, Linker and Loader – Functions and design principles.

Operating Systems : Overview of functions, types and organization. Process management, Memory management, Device management and File system – Basic concepts and algorithms.

Books:

1. Dhandhere, System programming and operating systems, Tata McGraw Hill.
2. System Software, Beck,
3. Sumitabha Das, Unix System V.4 Concepts and Applications, TMH.
4. Operating System Concepts, Silversatz,
5. Operating Systems, Tanenbaum, PHI
6. Operating Systems, Milenkovic, McGrawHill

Data Communication CO 213

3 - 0 - 1 : 4 Credits : 5 Hours *Prerequsites:* CO 102

Overview: Objectives and Applications of Computer Communication.

Computer Communication and Network Architecture: ISO-OSI reference model, design philosophy, layer, protocol, interface, and service concepts. Layer wise functionality.

Physical Layer: Concepts of data transmission: signal, communication channel, channel capacity, distortion & noise, line coding; modulation(analog and digital), modem; multiplexing- FDM, TDM, WDM, CDM etc; OFDM & spread spectrum techniques; switching, communication media—guides & unguided; standard protocols, RS-232C, RS-449, X.21, xDSL, SONET, Frame relay, ATM etc.

Medium Assess Control in broadcast networks: ALOHA, CSMA, CSMA/CD, CSMA/CA, token ring, token bus etc, Standard LAN Protocols: (IEEE 802.X), FDDI, satellite networks, LAN switching, VLAN, WLAN, PAN and WiMax.

Data link layer: Framing, Error control techniques, Data link protocols and their performance, HDLC and PPP protocol.

Network layer: Introductory concepts and issue: Routing, Congestion and deadlock control Algorithms, Internetworking issues and devices, gateways, bridges and routers, IP & X.25 protocols.

COMMUNICATION LABORATORY:

Laboratory: Generation, testing, of AM, FM, and PM, Transmitter and receiver, PCM codec; Flow control, Error Control and MAC protocols on LAN trainer kit.

Books:

[STA] Stalling, Data and Computer Communication, 8e, PHI (EEE)
[TAN] Tanenbaum A.S., Computer Network, 5e, PHI (EEE)

References:

[FOR] Forouzan B. A, Data Communication and Networking, 5e, Tata McGrawHill
[LEG] Leon-Garcia, Widijaja, I., Communication, 5e, PHI (EEE)
[LAT] B. P. Lathi, "Modern Analog and Digital Communication Systems", 3/e, Oxford University Press, 1998.

Third & Fourth Year
(Course Outline)

Computer Sc. & Engineering

Core Courses:

Operating Systems — CO 301

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 207

Evolution of Operating Systems, Structural overview, Concept of process and Process synchronization, Process Management and Scheduling, Hardware requirements: protection, context switching, privileged mode; Threads and their Management; Tools and Constructs for Concurrency, Detection and Prevention of deadlocks, Dynamic Resource Allocation, Design of IO systems, File Management, Memory Management: paging, virtual memory management, Distributed and Multiprocessor Systems, Case Studies.

Lab component: Familiarization with UNIX system calls for process management and inter-process communication; Experiments on process scheduling and other operating system tasks through simulation / implementation under a simulated environment (like Nachos).

Books:

1. Operating System Concepts, Silversatz,
2. Operating Systems, Tanenbaum, PHI
3. Operating Systems, Milenkovic, McGrawHill

Database Systems — CS302

3 - 0 - 2 : 5 Credits : 7 Hours — *Prerequsites:* CS 203

Course Outline :

- History and overview
- Database systems
- Data modeling
- Relational databases
- Database query languages
- Relational database design
- Transaction processing
- Distributed databases
- Physical database design

Books:

1. Silberschatz and Korth, Database system concepts, McGraw Hill.
2. Elmasri and Navathe, Fundamentals of database systems; Narosa Publishing Co.

Computer Graphics — CO 303

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 203

Course Outline :

- Fundamental techniques in graphics
- Graphic systems
- Geometric modeling
- Basic rendering
- Advanced rendering
- Advanced techniques

Books:

1. Hearn D., Baker P.M. : Computer Graphics, Prentice-Hall, 1986.
2. Foley, J.D., Van Dam A.: Fundamentals of Interactive Computer Graphics, Addison-Wesley, 1982.
3. Giloi, W.K. : Interactive Computer Graphics; Prentice-Hall, 1978.
4. Newman, W.,Sproule, R.F.: Principles of Interactive Computer Graphics, McGraw Hill, 1980.
5. Rogers, D.F. : Procedural Elements for Computer Graphics, Mc Graw-Hill, 1983.
6. Harrington, S. : Computer Graphics : A programming Approach, Tata Mc Graw Hill, 1983.

Principles of Programming Languages — CO 304

3 - 0 – 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 203

Course Outline :

- Overview of programming languages
- Virtual machines
- Declarations and types
- Abstraction mechanisms
- Type systems
- Programming language semantics
- Programming language design

Books:

1. Programming Languages-Design and Implementation, TW Pratt, MV Zelkowski, PHI.

2. Programming Languages-Principles and Practice, K. Louden, PWS, R Sethi, Addision Wesley.
3. Fundamentals of Programming Languages, Ellios Horotiz, Galgotia Publications.
4. Concept of Programming Languages, Sebesta, Addision Wesley.

Computer Networks — CO305

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* EC206

Introduction to Networks and Layered Architecture. Data Communication Concepts, Transmission Media and Topology, Multiplexing. Circuit switching & packet switching Data Link Layer. Layer 2 switches and ATM switches. SONET/SDH. Medium Access Control. CSMA/CD, TDMA, FDMA, CDMA. Network Layer and addressing, IP version 4 and 6. Routing Algorithms. Transmission Layer, TCP and UDP. Congestion Control Techniques. WAN, ATM. Internetworking. Wireless communications. Network Management and security.

Laboratory: Simulation Experiments for protocol performance, Configuring, testing and measuring Network devices and parameters/policies; Network management experiments; Exercises in Network programming.

Books:

1. Computer Networks, Tanenbaum, PHI
2. Data and computer Communication, W. Stallings, PHI
3. Data Networks, Black, PHI

Embedded Systems — CO 306

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 204, CO 301

Course Outline:

- History and overview
- Embedded microcontrollers
- Embedded programs
- Real-time operating systems
- Low-power computing
- Design methodologies

Software Engineering — CO 307

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 302

Course Outline:

- History and overview
- Software processes

- Software requirements and specifications
- Software design
- Software testing and validation
- Software evolution
- Software tools and environments
- Software project management
- Software fault tolerance

Compiler Design — CO 308

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 207

Overview of phases of a compiler, Languages and grammar.
Lexical analysis: Finite automata, Lexical analyzer, Lexical analyzer generator.
Parsing: Top-down and Bottom-up parsers, shift-reduce parser, recursive descent (operator precedence) parser, LL(1); LR(0), SLR, LALR parsers, Syntax-directed translation, Parser generator.
Semantic Analysis: Declaration processing, Type checking. Symbol tables.
Intermediate Code Generation: Run-time environments, translation of language constructs.
Code Generation: Flow-graphs; Register allocation, Code-generation algorithms.
Error handling and recovery.
Code optimization: An introduction to the techniques.

Books:

1. Aho, A.V., Sethi, and Ullman J.D: compiler design.
2. Jean-Paul Tremblay and Paul G. Sorrenson, The Theory and Practice of Compiler Writing, McGraw Hill Book Co.

Artificial Intelligence — CO 401

3 - 0 - 1 : 4 Credits : 5 Hours — *Prerequsites:* CO 203

- *Fundamental issues in intelligent systems:* History of artificial intelligence; philosophical questions; fundamental definitions; philosophical questions; modeling the world; the role of heuristics.
- *Search and constraint satisfaction:* Problem spaces; brute-force search; best-first search; two-player games; constraint satisfaction.
- *Knowledge representation and reasoning:* Review of propositional and predicate logic; resolution and theorem proving; non-monotonic inference; probabilistic reasoning; Bayes theorem.
- *Advanced search:* Genetic algorithms; simulated annealing; local search.
- *Advanced knowledge representation and reasoning:* Structured representation; non-monotonic reasoning; reasoning on action and change; temporal and spatial reasoning; uncertainty; knowledge representation for diagnosis, qualitative representation .
- *Agents:* Definition of agents; successful applications and state-of-the-art agent-based systems; software agents, personal assistants, and information access; multi-agent systems.
- *Machine learning and neural networks:* Definition and examples of machine learning;

supervised learning; unsupervised learning; reinforcement learning; introduction to neural networks.

- *AI planning systems:* Definition and examples of planning systems; planning as search; operator-based planning; propositional planning.

Books:

1. Nilsson, N. J, Principle of AI, Narosa Publ. House.
2. Pitterson, D.N, Introduction to AI & Expert Sys.
3. Jacson, P., Intro. To Ex. Sys., Addision Werley Publ. Co.
4. Clocksm & Mellish, Programming in PROLONG, Narosa Publ. House.
5. Norvig, Peter, Paradigms of AI Programming, Morgan Kauffman, 1992.
6. Rusell, Stuart & Norvig, Peter, Artificial Intelligence, Prentice Hall, 1995.
7. Rich & Knight, Artificial Intelligence, 2nd edition, TMH, 1991.

Industrial Summer Training — CO 471

0 - 0 - 1 : 1 Credits : 2 Hours — *Prerequsites:* -

Training will be of 12 weeks duration carried out during the summer break after the 6th semester.
The students will submit their reports in the 7th semester.

Project I — CO 481

0 - 0 - 6 : 6 Credits : 12 Hours — *Prerequsites:* CO 307

The students will carry out project works in groups of 2 or 3 students each under the guidance of a faculty member. The project shall consist of research/ design/ development/ implementation work.

Project II — CO 482

0 - 0 - 12 : 12 Credits : 24 Hours — *Prerequsites:* CO 481

The students will carry out project works in groups of 2 or 3 students each under the guidance of a faculty member. The project shall consist of research/ design/ development/ implementation work. It may also be a continuation of the Project II work.

CS Electives

Graph Theory — CO 421

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* CS101

Graph : Incidence and degree; Handshaking Lemma; Isomorphism; Subgraphs and Union of graphs; Connectedness; Walks, Paths and Circuits; Components and Connectedness; Walks, Walks, Paths and Circuits; Components and Connectedness algorithms; Shortest Path Algorithms, Eulerian graph, Fleury's algorithm and Chinese postman problem; Hamiltonian graph - necessary and sufficient conditions; Traveling salesman; Bipartite graph.

Tree : Properties of trees; Pedant vertices in a tree; Center of a tree; Rooted binary trees; Spanning trees - Spanning tree algorithms; Fundamental circuits; Spanning trees of a weighted graph; cut-sets and cut-vertices; Fundamental cut-sets; Connectivity and separativity; network flow; max-flow min-cut theorem.

*Planner graph***:** Combinatorial and geometric dual; Kuratowski's graph; detection of planarity; Thickness and crossings.

Matrix representations of graph: Incidence; Adjacency; matrices and their properties.

Colourings: Chromatic number : Chromatic polynomial; The six and five colour theorems; The four colour problem.

Directed graphs : Binary relations; Directed graphs and connectedness; directed trees; Aborecence; Polish method; Tournaments.

Counting of labeled trees : Cayley's theorem; Counting methods; Polya theory.

Books :

1. Deo, N.: Graph Theory with Applications to Engineering and Computer Science.
2. Harary : Graph Theory, PHI (EEE)

Theory of Computation CO 422

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* CO 206

Turning Machine(TM) - Model, Computable Languages and Functions, TM construction technique, Modification of TM, Church's Hypothesis; Undecidability – The Problem, Properties of Recursive & Recursively Enumerable Languages, Universal TM, Rice's Theorem, Post's Correspondence Problem; Intractable Problems, Polynomial Time and Space, The class *P* and the other problems, Boolean Satisfiability, The class *NP* , Polynomial-time Reduction, Introduction to Cook's Theorem, Some NP-Complete problems.

Books:

1. Lewis & Papadimitriou, Elements of The Theory of Computation, Pearson Education.
2. John C. Martin, Introduction to Languages and the Theory of Computation, TMH.

Web Technology CO 423

3 - 0 - 1 : 4 Credits : 5 Hours *Prerequsites:* CO 305

Basics Of Internet
Client/Server Computing: What is C/S Computing, Middleware, Fat client VS Fat Servers, N-tiered Software Architecture.
Markup Languages And Their Grammers: SGML, DTD Resouce; HTML, CSS; XML, XSL, Query Languages for XML W3schools xml validator script .

Web Browser: Browser Architecture, Configuration of Netscape and IE
Web Server Apache Architecture: Web Server Architecture, Server Features, Configuration of Apache and IIS .
Protocols: HTTP, FTP, SMTP, POP; JAVASCRIPT CGI PROGRAMMING JAVA
Overview of Java, JAVA Applet, JAVA Servlet;
ASP & JSP Search Engines; Web Database Connectivity;
CGI interface to Datatabase, JDBC interface to Database .
Web Security: S-HTTP, Fire Walls, Proxy Servers.
Distributed Object Models: CORBA, DCOM, EJB.

Books/References:
1. Shelly Powers et al., "Dynamic Web Publishing ", Techmedia, 1998.
2. Jamie Jaworski, "Java 1.2 Unleashed", Techmedia, 1998.
3. Robert Niles et.al., "CGI by Examples", Que, 1996.
4. Scot Johnson et.al., "Using Active Server Pages", Que,, Information Technology.

E-Commerce and Cyber Laws CO 424

3 - 0 - 1 : 4 Credits : 5 Hours *Prerequsites:* CO 305

Introduction to Electronic commerce: Defining e-commerce, History of money and electronic money.

The Network Infrastructure for Electronic Commerce: The Internet and WWW Technology, digital convergence and commerce.

Economics of Electronic Commerce: Transactions and Accounting Costs, Pricing of Goods and Services on the Internet.

Electronic Retailing: Web Based Business Models, Purchasing Agents, Online Shopping
Marketing and Advertising on the Net: Emerging marketing and advertising models.

Network Security: Firewalls, Encryption and Transaction Security (Secret Key and Public Key Cryptography), Digital Signatures, Certificates, Certificate Authorities.

Electronic Payment Systems: Tokenized vs. Notational systems, Credit Card based systems, Electronic Checks, Electronic Cash and Microtransactions, SmartCards, Protocols and Standards.

Privacy, Anonymity and Social Impacts of Electronic Cash Topics: Privacy, Anonymity, and traceable E-money.

Legal Issues: Electronic Contracting and Digital Signatures, Intellectual Property, Copyright, Trademark, and Patents, Cybercrime and Money Laundering.

Public Policy Issues: What is the Government's role?
Electronic Commerce and Financial Services Topics: Banking, Securities and Brokerage

International Issues/Commerce, Copyright and Online Publishing Topics: Commodification of Information, Property Rights vs. Freedom of Information, Electronic publishing and digital copyrights

Books:

1. Lynch/Lundquist , Digital Money: The New Era of Internet Commerce, Wiley Publications.
2. Joseph Migga Kizza, Computer Network Security and Cyber Ethics, McFarland & Company.
3. Donna L. Hoffman, Thomas P.Novak, A New Marketing Paradigm for Electronic Commerce.

VLSI Design — CO 425

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 206, EC 221

Introduction to VLSI Technology, Rules and Circuit Abstraction, Cell Generation, Layout Environment & Methodology, Algorithmic Paradigm and Computational Complexity; Partitioning, Kernighan-Liu Heuristic, Fiduccia-Mattheyeses Heuristic, Ratio Cut and I/O Constraint; Floor planning, Rectangular Dual Graph Approach, Hierarchical Approach, Simulated Annealing; Placement, Cost Function, Partitioning Placement, Regular Placement, Linear Placement; Fundamentals of Routing, Global Routing, Detailed Routing, Routing in FPGA; Performance Issues, Delay Models, Time-Driven Placement, Time-Driven Routing, Via Minimization, Power Minimization; 1D Compaction, Compression-Ridge Techniques, Graph-based, Wire-Length Minimization, 2D Compaction;

Books:

1. Weste & Eshraghian, Principles of CMOS VLSI Design: A System Perspective, Addison Wesley.
2. Sarrafzadeh & Wong, An Introduction to VLSI Physical Design, McGraw Hill.

Advanced Computer Architecture — CO 426

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 204

Definitions of Computer Architecture - Abstract Architecture & Concrete Architecture.
Concepts in Parallel Processing - Available Parallelism and Utilized Parallelism. Parallel Programming Models – PRAM, Shared Variable, Message Passing, Data Parallel.
Classification of Computer Architectures – Flynn's Classification – Classification of Parallel Architectures.
Instruction Level Parallel (ILP) Processors – Pipelined, VLIW, Super Scalar Processors – Instruction Dependencies, their Effect on Performance and Techniques to overcome them.
Basic Concepts and Techniques in Vector, Systolic and Dataflow architectures.
Multiprocessor Architectures – Synchronization and Cache Coherence Issues.
Multicomputer Architectures – Interconnection Networks, Routing and Data Communication Algorithms.

Books/References:

1. D. Sima, T. Fountain, P. Kacsuk, Advanced Computer Architectures – A Design Space Approach, Addision-Wesley.
2. K. Huang, F. A. Briggs, Computer Architecture and Parallel Processing, McGraw Hill.
3. V. Kumar et el. Parallel Computing, Klewer Publishers.

Modeling and Simulation — CO 427

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 203

Course Outline:

Random numbers:

- Pseudorandom number generation and testing
- Monte Carlo methods
- Introduction to distribution functions

Simulation modeling:

- Discrete-event simulation
- Continuous simulation

Verification and validation of simulation models:

- Input analysis
- Output analysis
- Queueing theory models
- Sample applications

Management Information System — CO 430

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 302

An overview of MIS – Structure of a MIS – Hardware, Software and Communication technology for information systems – concepts of information

Storage and retrieval of data – transaction processing – office automation and information processing - control functions – Decision making process – phases in the decision making process – Intelligence and design phases – concepts of decision making – Behavioral models of the decision maker/decision making.

System concepts – system concepts applied to management information systems – concepts of planning and control – Organizational structure and management concepts

Decision support systems – support systems for planning, control and decision making – support systems for management of knowledge work – Information systems requirements – strategies for the determination of Information requirements.

Data base requirements – user interface requirements – developing and implementing application systems – Quality assurance and evaluation of Information systems – future developments and their organizational and social implications.

Books:

1. Gordon B. Davis, Margrethe H. Olson , "Management Information Systems – Conceptual foundations, Structure and Development ", 2nd edition Mc-Graw Hill
2. James A. Senn , "Analysis & Design of Information System ", Second edition, McGraw Hill.

System Analysis and Design — CO 431

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 302

Overview of systems analysis and design; Information systems concepts; Systems development life-cycle; Project selection, feasibility analysis, design, implementation, testing and evaluation.

Project selection: Sources of project requests, managing project - review and selection; preliminary investigation.

Feasibility Study: Technical and economical feasibility; cost and benefit analysis.

System requirement specification and analysis: Fact finding techniques; data flow diagrams; data dictionaries; process organization and interactions; Decision analysis- decision trees and tables.

Detailed design: Modularization, module specification; file design; systems development involving databases.

System control and quality assurance: Design objectives; Reliability and maintenance; Software design and documentation tools; Top-down and bottom-up and variants; Units and integration testing; Testing practices and plans; System controls; Audit trails.

System administration and training, conversion, and operation plans.

Hardware and software selection: Hardware acquisition - memory, processors, peripherals, benchmarking, vendor selection; Software selection- Operating system, languages; Performance and acceptance criteria.

Books/References:

1. Senn J.A., Analysis and Design of Information Systems, McGraw Hill.
2. Awad, E.M, Systems Analysis and Design, Irwin series.
3. Lucas, H.C, The Analysis, Design and Implementation of Information Systems, McGGraw Hill.

Information Theory and Coding — CO 432

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 206

Concept of mutual information, Entropy and their properties,
Entropy based techniques of feature extraction in pattern recognition and image enhancements,
Noiseless coding, Huffman coding and its optimality, Kraft and McMillan's inequality, Shannon-Fano code, Elias code, Arithmetic coding and universal coding.
Ergodic and Markov sources and their entropy.
Algebraic codes-Linear Block codes, Cyclic codes-BCH codes, perfect code, galley codes, Finite geometry codes, Hadamard codes, Maximal distance separable codes, sphere packing and singleton bounds.
Codes for random access memories, tapes and disc, fault tolerant computation with arithmetic codes and redundant number systems. Exact techniques of decoding, relationship between complexity of algorithms in poly-digital circuits and VLSI with algebraic coding.
Cryptographic codes-Random number generation, DES scheme, RSA scheme and Diffie & Hellman's Public Key Crypto systems.

Books:

1. Blahut, R.E, Theory and practice of error correcting codes, Addison Wesley.
2. Blahut, R.E, Principles of transmission of digital information , Addison Wesley.

Digital Signal Processing — CO 433

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* EC 204

Course Outline:

- Discrete-time signals and systems.
- Difference equations, z-transform.
- Discrete-time processing of continuous-time signals, sampling, A/D and D/A, decimation and interpolation.
- Transform analysis of linear time-invariant systems.
- Structures of discrete time systems.
- Filter design techniques.
- Discrete Fourier series, DTFT, DFT, DFT properties, efficient computation of DFT, FFT, Goertzal algorithm, Chirp transform, decimation in time and decimation in frequency, DCT.
- Short-time Fourier analysis and filter banks.
- Hilbert transform, Cepstral analysis, Linear prediction.

Books:

1. Discrete-time Signal Processing, Oppenheim, Schafer, Buck, PH, 1999.
2. Digital Signal Processing: Principles, Algorithms, and Applications, Proakis, Manolakis, PH, 1999.
3. Digital Signal Processing : A Computer Based Approach, TMH, 1998.
4. Computer-Based Exercises for Signal Processing using MATLAB 5, PH, 1998.

Image Processing CO434

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* CO 433

Course Outline:

- Digital Image Fundamentals
- Image Transforms
- Image Enhancement
- Image Restoration
- Image Compression
- Image Segmentation
- Representations and Descriptions
- Recognition & Interpretation

Books/References:

1. Digital Image Processing : R.C. Gonzalez & R./E. Woods : Addison - Wesley Pub. comp.
2. Fundamentals of Digital Image Processing : A.K. Jain : PHI.

Mobile Computing CO 435

3 - 0 - 0 : 3 Credits : 3 Hours *Prerequsites:* CO 305

Course Outline:

- Overview of the history, evolution, and compatibility of wireless standards
- The special problems of wireless and mobile computing
- Wireless local area networks and satellite-based networks
- Mobile Internet protocol
- Mobile aware adaptations
- Extending the client-server model to accommodate mobility
- Mobile data access: server data dissemination and client cache management
- The software packages to support mobile and wireless computing
- The role of middleware and support tools
- Performance issues
- Emerging technologies

Network Management and Security — CO 501

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 305

Course Outline:

Management:

- Overview of the issues of network management
- Use of passwords and access control mechanisms
- Domain names and name services
- Issues for Internet service providers (ISPs)
- Quality of service issues: performance, failure recovery

Security:

- Fundamentals of secure networks; cryptography
- Encryption and privacy: Public key, private key, symmetric key
- Authentication protocols
- Packet filtering
- Firewalls
- Virtual private networks
- Transport layer security

Data Compression — CO 502

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 204

Course Outline:

- Analog and digital representations
- Encoding and decoding algorithms
- Lossless and lossy compression
- Data compression: Huffman coding and the Ziv-Lempel algorithm
- Audio compression and decompression

- Image compression and decompression
- Video compression and decompression
- Performance issues: timing, compression factor, suitability for real-time use

Books :

1. Introduction to Data Compression, Sayood, Morgan Kaufman/ Harcourt India.

Fuzzy Logic and Neural Networks — CO 503

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* **CO 206**

Overview of Crisp Sets and Fuzzy Sets:

Basic concepts of crisp sets and fuzzy sets, Types of fuzzy sets, Operation on fuzzy sets.

Fuzzy relations and fuzzy logic:

Crisp vs fuzzy relations, binary relations, equivalence relations, tolerance relations, composition of relations, fuzzy relational equations, fuzzy measure and possibility theory, classical logic and multivalued logic, fuzzy propositions and approximate reasoning.

Introduction to neural networks:

Biological and Artificial neurons, Learning in ANNs, Perceptrons – classification and linear separability, XOR problem, Network architechtures, Multilayer feed forward networks and recurrent networks, Generalized delta rule.

Multilayer networks:

Back propagation (BP) network, BP training algorithm, Radial basis function (RBF) networks, Applications of BP and RBF networks.

Recurrent networks and unsupervised learning, Hopfiled network - energy; stability; capacity; Application to optimization problems, Counter back propagation network, Bolzman machine, Kohonen's self organizing feature maps, Adaptive resonance theory.

Associative memory:

Matrix associative memory, Auto associative memories, hetero associative memories, Bi-directional associative memory, applications of associative memories.

Fuzzy Systems and Neuro fuzzy systems:

Relevance of Integration between fuzzy sets and neural network, Fuzzy neural network, Neuro fuzzy systems, Fuzzy associative memories.

Application of Fuzzy sets and Neural networks:

Application in pattern recognition, Image processing and computer vision, Application in control: Fuzzy controllers, neuro controllers and fuzzy neuro controllers, applications in expert systems and decision making systems, application in real world computing.

Reference books:

1. S. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall.
2. Limin Fu, Neural Networks in computer intelligence, McGraw hill Intl.
3. T Ross, Fuzzy logic with Engineering applications. ,
4. G Klir, B Yuan, Fuzzy sets and fuzzy logic : Theory and application, PHI.

Advanced Embedded Systems — CO 507

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 306

Course Outline:

- Reliable system design
- Tool support
- Embedded multiprocessors
- Networked embedded systems
- Interfacing and mixed-signal systems

High-performance computing — CO 512

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:* CO 426

Course Outline:

Introduction to high-performance computing :

- History and importance of computational science, Overview of application areas, Review of required skills.

High-performance computing :

- Processor architectures, Memory systems for high performance, Input/output devices, Pipelining, Parallel languages and architectures.

Scientific visualization :

- Presentation of results, Data formats, Visualization tools and packages

Sample problems :

- Ocean and atmosphere models, Seismic wave propagation, N-body systems (the Barnes-Hut algorithm), Chemical reactions, Phase transitions, Fluid flow

Human Computer Interaction — CO 513

3 - 0 - 0 : 3 Credits : 3 Hours — *Prerequsites:*

Course Outline:

- Foundations of human-computer interaction
- Building a simple graphical user interface
- Human-centered software evaluation
- Human-centered software development
- Graphical user-interface design
- Graphical user-interface programming
- HCI aspects of multimedia systems

- HCI aspects of collaboration and communication