Bachelor of Technology Program in Computer Science & Engineering

July 2015

Indian Institute of Technology Jodhpur

Bachelor of Technology (B.Tech.) Program in Computer Science & Engineering

Curriculum

Cat.	Course Title	L-T-P	Credits	Cat.	Course Title	L-T-P	Credits
I Semester				***II Semester***			
H	ME111 System Exploration — Drawing	3-0-3	4	H	ME121 System Exploration — Workshop	3-0-3	4
H	CS111 Computer Programming	3-1-3	5	H	EE121 Basic Electronics Engineering	3-1-3	5
B	PH111 Electromagnetism and Optics	3-1-3	5	H	ME122 Engineering Mechanics	3-1-3	5
B	MA111 Linear Algebra and Calculus	4-1-0	5	B	MA121 Complex Analysis & Differential Equation	4-1-0	5
C	CS112 Discrete Mathematics	3-1-0	4	C	CS121 Data Structures and Algorithms	3-1-3	5
L	HS111 English / Foreign Language	3-0-0	3	L	HS121 Rights, Responsibilities, Law and Constitution	3-0-0	3
S	PE111 Physical Exercises I		0	S	PE121 Physical Exercise II		0
	Total	**32**	**26**		**Total**	**35**	**27**
III Semester				***IV Semester***			
H	EE211 Basic Electrical Engineering	3-1-3	5	B	MA221 Probability Statistics and Random Processes	4-1-0	5
H	CS211 Digital Logic and Design	3-0-3	4	C	CS221 Computer Organization and Architecture	3-0-0	3
B	CY211 Chemistry	3-0-3	4	C	CS222 Theory of Computation	3-0-0	3
C	CS212 Object Oriented Analysis and Design	3-0-3	4	C	CS223 Software Engineering	3-0-3	4
C	EE213 Signals and Systems	3-1-0	4	P	CS299 B. Tech. Project	0-0-9	3
L	HS211 Introduction to Economics	3-0-0	3	L	HS221 Introduction to Management	3-0-0	3
	Total	**32**	**24**		**Total**	**29**	**21**
V Semester				***VI Semester***			
C	CS311 Data Communication	3-1-0	4	C	CS321 Computer Networks	3-0-3	4
C	CS312 Compiler Design	3-0-3	4	C	CS322 Database Systems	3-0-0	3
C	CS313 Operating Systems	3-0-3	4	C	CS323 Artificial Intelligence	3-0-0	3
C	CS314 Algorithm Design and Analysis	3-0-0	3	E	Elective	3-0-0	3
P	CS398 B. Tech. Project	0-0-12	4	P	CS399 B. Tech. Project	0-0-12	4
L	HS311 Introduction to Psychology	3-0-0	3	L	HS321 Introduction to Journalism	3-0-0	3
	Total	**34**	**22**		**Total**	**30**	**20**
VII Semester				***VIII Semester***			
E	Elective	3-0-0	3	E	Elective	3-0-0	3
E	Elective	3-0-0	3	E	Elective	3-0-0	3
E	Elective	3-0-0	3	E	Elective	3-0-0	3
P	CS498 B. Tech. Project	0-0-24	8	P	CS499 B. Tech. Project	0-0-24	8
L	HS411 Introduction to Leadership	3-0-0	3	L	HS421 Development of India	3-0-0	3
	Total	**36**	**20**		**Total**	**36**	**20**
					GRAND TOTAL	**264**	**180**

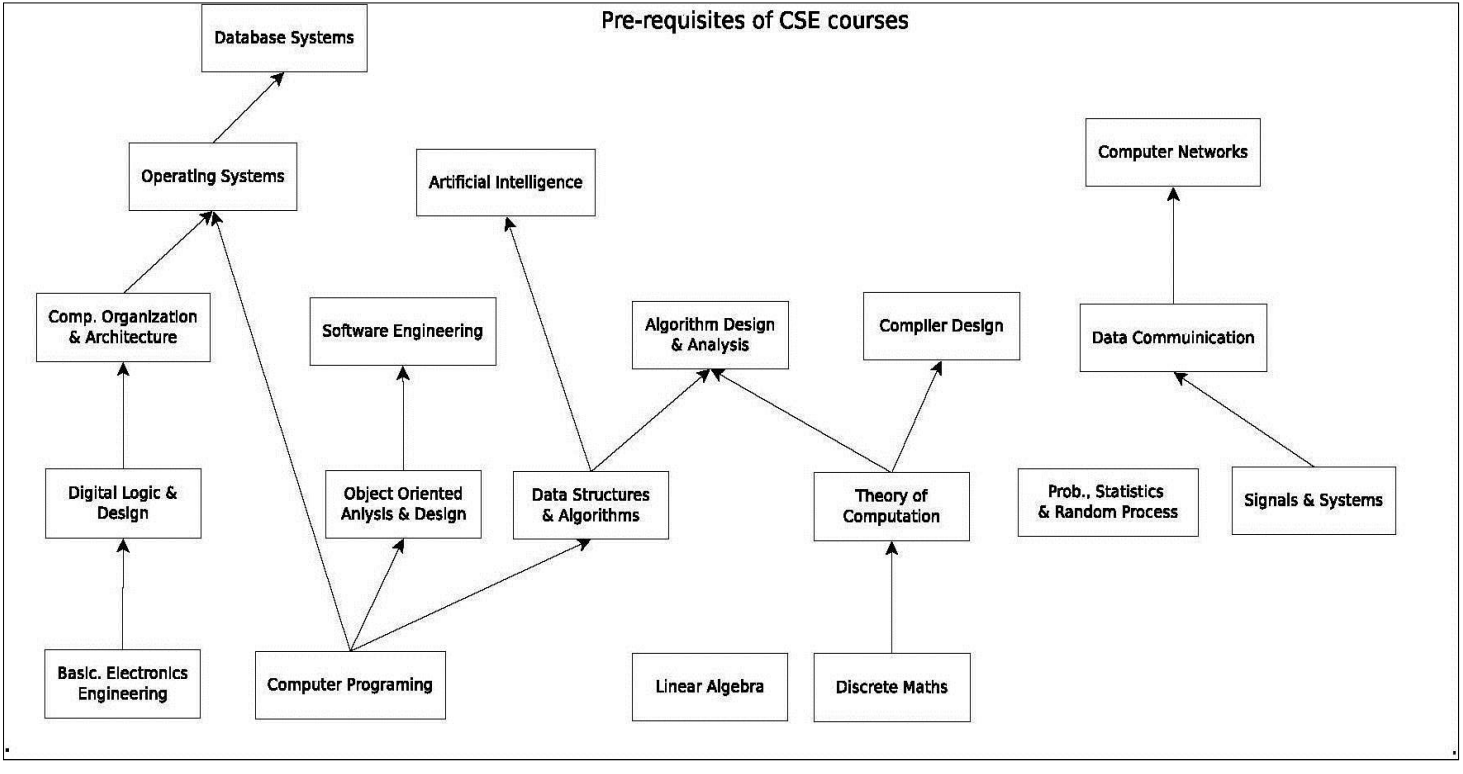
S. No.	Category	Course Category Title	Total Courses	Total Credits
1	H	*Hands-on Experience*	7	32
2	B	*Basics*	5	24
3	C	*Technology Compulsory*	14	52
4	E	*Electives*	7	21
5	P	*Hands-on Project*	5	27
6	L	*Life Skills*	8	24
7	S	*Games & Sports/Social Service*	2	0
		Total	**48**	**180**

Important note: - LTPC calculation for students enrolled before July 2014 will be as per their regulations

Curriculum Components

S. No.	Course Category	Course Category Title	Description
1	H	Hands-on Technology Experience	These courses provide the first brush-up for the incoming students to any stream. This is to be hand-on in-order to provide a feel of the stream but also build the basic foundations.
2	B	Technology Basics	These courses basically re-affirm what students have learnt as pre-requisites for a B. Tech program admission and may provide applied foundations in Mathematics and Sciences.
3	C	Technology Compulsory	These courses form the backbone of the technical program and encompass all its different sub-areas within the specific program.
4	E	Technology Electives	These courses form the backbone of the technical program and encompass all electives offered in the Institute.
5	P	Hands-on Technology Project	These courses help students to specialize in their areas of interest for future studies and research.
6	L	Life Skills	These courses will prepare students to be able to face the real world.
7	D	Introduction to Professional Work and Technology Industries	These courses will be taken in summer months after completing the first, second, and third year, respectively, for Industrial training. This 2 Semester or 10 course equivalents will provide students with rigorous industrial training and practice on the field. The work done by the students at the Industry will be in synergy with the supportive course work back at IIT Jodhpur. No grades and credits are assigned to this set of course equivalents.

Basics	Hands-on Experience
1. Electromagnetism and Optics 2. Linear Algebra and Calculus 3. Complex Analysis and Differential Equation 4. Chemistry 5. Probability, Statistics and Random Processes	1. System Exploration - Drawing 2. Computer Programming 3. System Exploration - Workshop 4. Basic Electronics Engineering 5. Engineering Mechanics 6. Basic Electrical Engineering 7. Digital Logic and Design
Technology Compulsory	**Electives: Any six**
1. Discrete Mathematics 2. Data Structures and Algorithms 3. Signals and Systems 4. Theory of Computation 5. Operating Systems 6. Database Systems 7. Data Communication 8. Software Engineering 9. Computer Organization and Architecture 10. Algorithm Design and Analysis 11. Computer Networks 12. Compiler Design 13. Object Oriented Analysis and Design 14. Artificial Intelligence	1. Advanced Computer Networks 2. Pattern Recognition 3. Selected Topics in Algorithms 4. Selected Topics in Networking & Communication 5. Digital Image Analysis 6. Computational Complexity Theory 7. Machine Learning 8. Wireless Data Networks 9. Mobile Communication Systems 10. Computer Vision
Life Skills	
1. English / Foreign Language 2. Right, Responsibilities, Law and Constitution 3. Introduction to Economics 4. Introduction to Management 5. Introduction to Psychology 6. Introduction to Journalism 7. Introduction to Leadership 8. Development of India	


Pre-requisites of CSE courses
Database Systems
Operating Systems
Artificial Intelligence
Computer Networks
Comp. Organization & Architecture
Software Engineering
Algorithm Design & Analysis
Compiler Design
Data Communication
Digital Logic & Design
Object Oriented Anlysis & Design
Data Structures & Algorithms
Theory of Computation
Prob., Statistics & Random Process
Signals & Systems
Basic. Electronics Engineering
Computer Programing
Linear Algebra
Discrete Maths

I Semester

Course Title	**System Exploration - Drawing**	Course No.	**ME111**
Focus Group	Mechanical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Hands-on Experience
Pre-requisite	-	To take effect from	July 2014

Objectives

1. To inculcate how to expresses ideas of technical nature with a pragmatic intention.
2. To explore from the first idea and intuitive concepts to the final development and evaluation of the quality of a product.
3. Helping students understand the role of engineering graphics in a product design process.

Learning Outcomes

1. To distinguish between the different types of projections, indicate the dimensions and tolerance of technical products, read print, and change drawings according to specific requirements.
2. To visualize, and communicate product design using graphics.
3. To enable, optimize and digitize manufacturing of devices and components through graphic modeling.

Contents

1. Lettering Two dimensional geometrical constructions Conics Representation of three-dimensional objects Principles of projections Standard codes Projection of points.
2. Projection of straight lines Projection of planes - Projection of solids Auxiliary projections
3. Spatial geometry for design and analysis-Sections of solids and development of surfaces
4. *Conversion of Projections:* Orthographic projection Isometric projection of regular solids and combination of solids.
5. Pictorial representation-Axonometric projection, Oblique projections and Perspective projections
6. General dimensioning practices, limit dimensioning and cylindrical fits, tolerances of location/form/profile/orientation, designation of surface texture.
7. Plan, Elevation and section of single storied residential (or) office building with flat/ with electrical wiring diagram
8. Fundamental practices of computer aided design and drafting
9. Introduction to AutoCAD/ Solid works Commands, Applied geometry using CAD, Technical Sketching, Editing techniques and commands in CAD
10. Orthographic projection; graphical analysis, Sectional views, Basic dimensioning methods, Primary and secondary auxiliary views in descriptive geometry
11. Definition of point, line, plane, Pictorial drawings, 3D drawings, Solid Modeling,
12. Electronic drawings, typical block diagrams, control circuit layouts, Wiring diagrams, connection layout diagrams, printed circuits.

Reference Books

1. Luzzader, W. J. and Duff, J. M., (2008), *Fundamentals of Engineering Drawing*, Prentice Hall
2. Bhatt, N. D., (2002), *Elementary Engineering Drawing*, Charoter Publishing
3. Bethune, J. D., (2007), *Engineering Graphics with Autocad,* Prentice Hall

Course Title	**Computer Programming**	Course No.	**CS111**
Focus Group	Computer Science and Engineering	L-T-P [C]	3-1-3 [5]
Offered for	B.Tech.	Type	Hands-on Experience
Pre-requisite	-	To take effect from	July 2014

Objectives

1. To understand computer programming and its roles in problem solving
2. To understand and develop well-structured programs using C language
3. To learn the basic data structures through implementing in C language

Learning Outcomes

1. Problem solving through computer programming
2. Familiarity of programming environment in Linux operating system
3. Ability to use different memory allocation methods
4. Ability to deal with different input/output methods
5. Ability to use different data structures

Contents

1. Introduction to digital computers, Number systems - binary, octal, hexa, and conversion between the number systems, binary arithmetic
2. Introduction to programming, Problem solving and expression of solution through flow chart and algorithm
3. Parts of a program - primitive data types, variables, operators and their precedence, expressions, input/output, conditionals and branching, looping statements
4. Functions, Storage classes - scope and life time, recursion
5. Arrays, Pointers, User defined data types - structures, unions, Dynamic allocation, File Handling, Linear data structures List, Stack, and Queue, Time and space requirements

Laboratory

1. Understanding Linux working environment, Practicing Linux commands related to file system, file handling, editors, gcc compiler, gdb debugger;
2. Basic data types, variables, input and output statements;
3. Conditional and control structures;
4. Arrays (one and two dimensional);
5. Functions and Recursion;
6. Structures, Unions and Enumeration;
7. Pointers;
8. File handling;
9. Dynamic memory allocation;
10. Linked Structures

Reference Books

1. Kernighan, B. W. and Ritchie, D. M. (1998), *The C Programming Language*, Prentice Hall of India
2. Balaguruswamy, E., (2008), *Programming in ANSI C*, Tata McGraw Hill
3. Gottfried, B., (2000), *Schaum's Outline of Programming with C*, McGraw Hill
4. Lipschutz, S., (2011), *Data Structures, Schaum's Outlines Series*, Tata McGraw Hill

5. Horowitz, E., Sahni, S. and Anderson-Freed, S., (2008), *Fundamentals of Data Structures in C,* W. H. Freeman and Company
6. Dromey, R. G., (2008), *How to Solve it by Computer*, Prentice-Hall of India
7. Budd, T., (2009), *Exploring Python,* McGraw Hill Education

Course Title	**Electromagnetism and Optics**	Course No.	**PH111**
Focus Group	Physics	L-T-P [C]	3-1-3 [5]
Offered for	B.Tech.	Type	Basic
Pre-requisite	-	To take effect from	July 2014

Objective

To develop an understanding of the foundations of optics and electromagnetism.

Learning Outcome

The students will be able to relate theoretical concepts with problem solving approach in electrodynamics and optics.

Contents

1. *Electromagnetism*
2. *Vector Calculus:* Physical interpretation of Gradient, Divergence and Curl, Line, Surface, and Volume integrals.
3. *Electrostatics:* Coulomb's law, Gauss's theorem, electrostatic potential, Laplace's equation, conductors, capacitors and dielectrics.
4. *Magnetostatics:* Biot Savart's law, Ampere's law, Lorentz force.
5. *Magnetic Induction:* Faraday's law, Lenz's law, Self and Mutual inductance, energy stored in magnetic field.
6. *Maxwell's equations:* Displacement current, electromagnetic waves, plane wave solutions of Maxwell's equation, Poynting vector.
7. *Optics*
8. *Wave Nature of Light:* Interference, Fresnel and Fraunhoffer diffraction, ordinary and extraordinary rays, Plane, circular and elliptically polarized light, Birefringence, half wave plates.

Reference Books

1. Ghatak, A. K., (2007), *Optics,* Tata McGraw Hill
2. Griffiths, D. J., (2005), *Introduction to Electrodynamics,* Prentice Hall of India

Course Title	**Linear Algebra and Calculus**	Course No.	**MA111**
Focus Group	Mathematics	L-T-P[C]	4-1-0[5]
Offered for	B.Tech.	Type	Basic
Pre-requisite	-	To take effect from	July 2014

Objectives

1. To train the undergraduate students towards basic understanding of Mathematics.
2. To provide student with sufficient knowledge in calculus, which can be used by the students in their respective fields.
3. To develop a working knowledge of central ideas of Linear Algebra.

Learning Outcomes

1. Understanding of different structures and their properties like, Dependence, Basis and Dimension.
2. Linear transformations between two structures and its representation by Matrices.
3. Integration in higher dimension and Vector Calculus.

Contents

1. *Linear Algebra:* Fields, Matrices, Elementary Matrices, Row-reduced Echelon Form, System of Linear equations, Vector spaces, Subspaces, Linear Independent set, Basis, Dimension, Direct sum, Quotient spaces, Linear Transformations, Range Space, Null Space, Rank-Nullity Theorem, Algebra of Linear Transformations, Inner product space, Orthogonal sets, Cauchy-Swartz Inequality, Orthonormal sets, Gram-Schmidt Orthogonalization Process. Eigenvalues and eigenvectors of a linear operator, Characteristic polynomials, Minimal polynomial, Cayley-Hamilton theorem, Diagonalization, Singular value Decomposition.
2. Sequences, Series, Power series, Limit, Continuity, Differentiability, chain Rule, Partial Derivatives, Gradient, Directional Derivative, Mean value theorems and applications; Linear Approximation, fundamental theorems of calculus, Newton and Picard method; Taylors theorem, Approximation by polynomials, Bisection method, false position method, fixed point method, Newton-Raphson method, secant method, Critical points, convexity, maxima and minima, Trapezoidal and Simpsons rule, Curve tracing, length, Area, Volume, Double and triple integrals, Differentiability of vector functions, arc length, Curvature, Continuity and Differentiability of vector functions, Vector Calculus, Greens Theorem, Gauss Theorem, Stokes Theorems.

Reference Books

1. Hoffman, K. & Kunze, R., *Linear Algebra*, 2nd Edition, Prentice Hall of India
2. Strang, G., *Linear Algebra and its Applications*, 4th Edition
3. Ghorpade, S. R. & Limaye, B. V., (2006), *A Course in Calculus and Real Analysis,* Springer Verlag
4. Ghorpade, S. R. & Limaye, B. V., (2009), *A Course in Multivarible Calculus and Analysis,* Springer Verlag
5. Thomas, G. B. & Finney, R. L., (1992), *Calculus and Analytic Geometry,* 9th Edition, Addison Wesley Publishing Company

Course Title	**Discrete Mathematics**	Course No.	**CS112**
Department	Computer Science and Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	-	To take effect from	July 2014

Objectives

1. To learn about proof techniques
2. To learn about combinatorics and graph theory
3. To learn about abstract algebra

Learning Outcomes

1. To be able to model the computer science problems using discrete mathematical structures

Contents

1. *Mathematical Logic:* Propositional Logic, First Order Logic, Proof techniques, Mathematical Induction
2. *Set Theory and Algebra:* Sets, Relations, Functions, Partial Orders, Lattice, Boolean Algebra, Groups and Rings, Error-correcting codes, Secret sharing
3. *Combinatorics:* Recurrence relations, common techniques for solving recursions, Permutations, Combinations, Counting, Polya Counting, Stirling numbers, Bell numbers, Combinatorial Sums
4. *Graph Theory:* Connectivity, Trees and its properties, Cut vertices & edges, Covering, Matching, Independent sets, Colouring, Planarity, Isomorphism
5. *Discrete Probability:* Linearity of expectation, Bayes Theorem

Reference Books

1. Rosen, K. H., (1999), *Discrete Mathematics and Its Applications*, McGraw-Hill
2. Van Lint, J. H. and Wilson, R. M., (2009), *A Course in Combinatorics*, Cambridge University Press
3. Shoup, V., (2008), *A Computational Introduction to Number Theory and Algebra*, Cambridge University Press
4. Cameron, P. J., (1996), *Combinatorics -- Topics, Techniques, Algorithms.* Cambridge University Press
5. Matousek, J. and Nesetril, J., (2008), *Invitation to Discrete Mathematics*, Oxford University Press

Course Title	**English Language and Communication Skills**	Course No.	**HS111**
Focus Group	Humanities and Social Sciences	L-T-P-C	3-0-0-3
Offered for	B.Tech. 1st year	Type	Life Skill
Pre-requisite		To take effect from	July 2014

Objectives

1. To enable students to gain competence in English and to use language effectively in a number of contexts.
2. The course focuses on the four basic skills of language learning Reading, Writing, Listening and Speaking and trains the student to employ the above skills in both personal and professional settings.
3. Methodologies that are employed by the instructors include extensive use of audio, visual and print medium, exposes students from diverse backgrounds to both the creative and critical use of language.

Learning Outcomes

1. The course helps students to speak and write better English.
2. The course helps to integrate classroom learning into an everyday communicative activity.
3. Written work and interactive sessions facilitates the students to hone their communication skills in more ways than one.

Contents

1. English is a Crazy Language by Richard Lederer
2. The Snake by D. H. Lawrence
3. Kubla Khan by S. T. Coleridge
4. Short stories of Sherlock Holmes
5. Akeela and the Bee (film)
6. In Pursuit of Happyness (film)
7. Trumans Show (film)
8. Invictus (film)
9. Grammar exercises
10. Presentation Skills
11. Public Speaking
12. Group Discussion
13. Language Lab sessions

References

1. Raman, M. & Sharma, S., (2011), *Technical Communication: Principles and Practice*, Oxford University Press
2. Regional Institute of English, (2006), *English for Engineers*. Cambridge University Press
3. Rizvi, A. M., (2005), *Effective Technical Communication*, Tata McGraw-Hill
4. Rutherford, A. J., (2001), *Basic Communication Skills for Technology*, Pearson Education

II Semester

Course Title	**System Exploration - Workshop**	Course No.	**ME121**
Focus Group	Mechanical Engineering	L-T-P[C]	3-0-3[4]
Offered for	B.Tech.	Type	Hands-on Experience
Pre-requisite	-	To take effect from	July 2014

Objectives

1. To develop basic knowledge of handling tools in different areas of manufacturing.
2. To provide a practical exposure to the vocational trades within basic practical activities associated with all branches of engineering.
3. To instill confidence to manufacture, assess quality and to perform maintenance or correction in product design.

Learning Outcomes

1. The importance of quality and design of the product with respect to material use, design dimensions and tolerances.
2. Understanding the activities and practical difficulties of skilled workman who ultimately are involved in producing all goods in any industry.
3. Understanding the various aspects of materials.

Contents

1. *Introduction:* Classification of engineering materials and their important mechanical and manufacturing properties, Phase diagrams, Gibbs phase rule, Lever rule, Iron-Iron carbide Phase diagram, T-T-T Diagram, General classification of manufacturing processes, Selection of manufacturing processes, Manufacturing attributes of manufacturing processes. Introduction to bulk property enhancement and surface property enhancement processes.
2. *Casting:* Principles of metal casting (Alloy solidification, homogenous and heterogeneous nucleation, cooling curve, concept of supercooling, grain growth, avrami equation), Patterns, Types of Patterns, Pattern Materials and pattern allowances, Types of Sands, Characteristics of molding sand, Types of cores, Chaplets and chills, their materials and functions, Casting Defects.
3. *Geometric Tolerance design:* Concept of limits fits and tolerances, hole based system, shaft based system, different types of fits
4. *Metal Forming and Sheet metal operations:* Basic Operations and their description (Forging, Rolling, Drawing, Extrusion, Bending, Spinning, Stretching, Embossing and Coining, Die and Punch operation in press work, Shearing, Piercing and blanking, Notching, Lancing.)
5. *Material Removal Processes:* Principles of metal cutting, Introduction to orthogonal and oblique cutting, Chip formation, Cutting tools, their materials and applications, Geometry and nomenclature of single point cutting tool, Tool life, Cutting fluids and their functions, Basic machine tools (Lathe, milling machine, Drilling Machine, Shaper, Planer) and their applications, Introduction to grinding processes. Introduction to non-traditional machining processes (EDM, USM, CHM, ECM, LBM, AJM, and WJM).
6. *Joining Processes:* Fundamentals of Electric arc welding (MMAW, SAW, GMAW, GTAW, PAW) Gas welding and cutting, Resistance welding and Thermit welding, Soldering, Brazing and Braze welding, Adhesive bonding, Mechanical fastening (Riveting,

Screwing, etc.). Plastic Processing: Plastics, their types and manufacturing properties, Introduction to Compression molding, Injection molding and Blow molding, Additives in Plastics. Modern Trends In Manufacturing: Introduction to numerical control (NC) and computerized numerical control (CNC) machines and Rapid Prototyping Techniques

Laboratory Work

Woodworking (Pattern making exercise), Preparation of aluminum casting, Machining exercise (turning operations), Welding exercise (Preparation of square butt joints, T-joints using arc welding), Sheet metal fabrication (Preparation of tray, funnel, etc.), Fitting exercise and heat treatment of steels, Demonstration on CNC Lathe, CNC Milling. Demonstration on Rapid Prototyping Technique and Electric Discharge Machine.

Reference Books

1. Degarmo, E. P., Kohser, R. A. and Black, J. T., (2008), *Materials and Processes in Manufacturing*, 8th Edition, Prentice Hall of India
2. Kalpakjian, S. & Schmid, S. R., (2006), *Manufacturing Processes for Engineering Materials*, 4th Edition, Dorling Kindersley
3. Chapman W. A. J., (2001), *Workshop Technology* (3 Vols.), 5th Edition, CBS Publishers & Distributors
4. Groover, M. P., (1996), *Fundamentals of Modern Manufacturing*, Prentice Hall International
5. Campbell, J. S., (1999), *Principles of Manufacturing, Materials and Processes*, Tata McGraw Hill Company

Course Title	**Basic Electronics Engineering**	Course No.	**EE121**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-3 [5]
Offered for	B.Tech.	Type	Hands-on Experience
Pre-requisite		To take effect from	July 2014

Objectives

1. To introduce different components used in electronic circuits and explain their terminal characteristics
2. To teach various methods of electronic circuit analysis and design

Learning Outcomes

1. Ability to do time-domain analysis of electronic circuits for various branch currents and node voltages
2. Ability to appreciate the use of discrete components in designing application specific circuits

Contents

1. *Components and Sources:* Passive components, Resistance, Inductance, Capacitance; lumped element model; series, parallel combinations; Kirchhoffs law: voltage, current, linearity, Voltage and current sources; non ideal sources; representation under assumption of linearity; controlled sources: VCVS, CCVS, VCCS, CCCS; concept of gain, transconductance, transimpedance.
2. *Basic Circuit and Transient Analysis:* Node and loop analysis; Choice of nodes and branches for efficient analysis. Superposition theorm; Thevenin's theorm; Norton's theorem, RL and RC Circuits, Sinusoidal Steady State Analysis, RLC circuits, Time domain response of RL and RC circuits, Two-port Networks and Transfer Function, Sinusoidal steady state response; phasor; impedance; transfer function of two port networks. Frequency response: concept; amplitude and phase response; Bode plots.
3. *Discrete components and Circuits:* Discrete electronic devices: Diode, zener diode, BJT (Bipolar junction transistor), LED, Photodiode, Phototransistor, varactor; characteristics and operation using equivalent circuits, Diode circuits; clipper, clamper circuits. DC power supply: rectifier- half wave, full wave (center tapped, bridge), zener regulated power supply, regulation, BJT biasing; CE-biasing circuits, operating point; large/small signal models of CE-BJT amplifier.
4. *Operational Amplifiers:* Basic model; virtual ground concept; inverting amplifier; non-inverting amplifier, Integrator; differentiator; Basic feedback theory; +ve and -ve feedback; concept of stability; oscillator. Waveform generator for Square wave, triangular wave, Wien bridge oscillator, Schmitt trigger; astable multivibrator, Introduction to active filters, 555 timer: description and data sheet.
5. *Logic gates and Applications:* Numbering system, OR, NOT, AND, NOR and NAND; universal gates; XOR and XNOR gate; Truth tables, Combinational circuits. Designing combinational circuits: SOP, POS form; K-map; Optimization, Multiplexer; Gate base implementation. Logic function representation using truth table, Sequential circuits, flip-flops, S-R flip-flop; JK master slave flip flop; D-flip flop,

Laboratory

Using Laboratory Instruments; Characterization of Passive Circuit Elements (R, L, C); Time

Response of RC and RL Circuits; Frequency Response of RC and RLC Circuits; Equivalent Circuits and Audio Signals; Diode Characteristics and DC Power Supply; Bipolar Junction Transistor (BJT) Circuits: Inverter and Common Emitter Amplifier; Operational Amplifiers; Basic Combinatorial Circuits; Any new circuit.

Reference Books

1. Smith, R. J. & Dorf, R. C., (2009), *Circuits, Devices and Systems*, 5th Edition, John Wiley
2. Hayt, W. H., Kemmerly, J. E. and Durbin, S. M., (2010), *Engineering Circuit Analysis*, 7th Edition, Tata McGraw Hill
3. Boylestad, R. L. & Nashelsky, L., (2009), *Electronic Devices and Circuit Theory*, 10th Edition, Prentice Hall
4. Sedra, A. S. & Smith, K. C., (2011), *Microelectronic Circuits*, 6th Edition, Oxford University Press

Course Title	**Engineering Mechanics**	Course No.	**ME122**
Focus Group	Mechanical Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Hands-on Experience
Pre-requisite		To take effect from	July 2014

Objectives

1. To provide practice to apply knowledge in work, energy and momentum to study rigid body mechanics
2. To educate about the forces and inertia and its effect of motion of rigid bodies.

Learning Outcomes

1. To analyse forces and moments on static rigid body, moments on or between multiple static rigid bodies and internal forces or moment within them
2. To model practical structural problems using concepts of free body diagrams and equilibrium conditions

Contents

1. Basic dimensions in Mechanics, Law of dimensional homogeneity, Vector and Scalar Quantities, Elements of vector algebra. Moment of force about a point/axis, Couple, Moment of Couple about a line. Free Body Diagram, Equations of Equilibrium, Static indeterminacy, Equilibrium in three dimensions Coulomb Fraction, Surface contact friction, Transmission of power through belt. Screw jack, screw thread. Moment of area and centroid, Pappus-Guldinus Theorems, Second moments and product of Area, Transfer theorems, Principal axes. Inertial quantities, Mass-Inertia/Area-Inertia terminology, Translation of coordinate axes.
2. Kinematics of particles, Velocity and acceleration in terms of path variables, simple relative motion, motion of particle relative to a pair of translating axes Newtons laws of rectangular coordinates/rectilinear translation, cylindrical coordinate/Central force motion. Conservation of Mechanical Energy, Work-energy equations, Center of mass based Kinetic energy, Principle of virtual work. Impulse and Momentum relation of particles, Moment of momentum equations-single particle/system of particles Translation/Rotation of rigid bodies, Charles theorem, time derivative of vector for different references. Parallel axis theorems, Rotational Pure rotation of a body of revolution about its axis of revolution/combined with translation. Three dimensional rotation, moment of inertia tensor, relation between angular momentum and torque in three dimensions, Gyroscopic forces. Simple harmonic oscillator, phase and phase difference, phasor diagram, oscillator with constant friction/velocity dependent damping. Forced Oscillations, power adsorption, lightly damped oscillator Motion in non-inertial frames, centrifugal foce, Coriolis force/acceleration, rate of change of vector in inertial and rotating frames.
3. *Experiments:* Vector Analysis with force table; Motion Studies Position Vs time, Velocity Vs Time; Measuring Acceleration due to gravity; Projectile launch; Centripetal motion of Pendulum; Dynamics Atwood Machine; Dynamics experiments with Friction; Sound Waves Frequency analysis.

Reference Books

1. Shames, I. (2003) *Engineering Mechanics*, Prentice Hall
2. Gross, D., Hauger, W. & Schrder J. (2012) *Engineering Mechanics*, Springer
3. Meriam, J. L., Kraige, L. G. (2002) *Engineering Mechanics*, John Wiley and Sons

Course Title	**Complex Analysis and Differential Equations**	Course No.	**MA121**
Focus Group	Mathematics	L-T-P [C]	4-1-0 [5]
Offered for	B.Tech.	Type	Basic
Pre-requisite	-	To take effect from	July 2014

Objectives

1. Understanding of fundamentals of complex analysis.
2. Understanding of fundamentals of differential equations.

Learning Outcomes

1. Techniques for differentiation and integration of complex valued functions.
2. Finding analytical and series solution for ordinary and partial differential equations.

Contents

1. Complex numbers, algebra of complex numbers, functions, continuous and analytic functions, Cauchy Riemann Equations, elementary functions, Integral of a complex function, Cauchy-Goursat theorem, Cauchys Integral formula, derivatives of analytic functions, Moreras Theorem, Liouvilles theorem, maximum modulus principle, Taylor series, singularity, types of singularities, Laurant series, Cauchys Residue Theorem, Jordans Lemma, Evaluation of Real integrals.
2. First Order Ordinary Differential Equations, Geometrical interpretation of solution, Solution methods for separable equations, Exact equations, Linear equations, Picards Theorem for IVP, Picards iteration method, Eulers Method, Improved Eulers Method. Second Order Linear differential equations: General solution of homogeneous equation, Existence and uniqueness of solution of IVP, Wronskian and general solution of nonhomogeneous equations, Euler-Cauchy Equation, Extensions of the results to higher order linear differential equations; Power Series Method- application to Legendre equation, Legendre Polynomials, Frobenius Method, Bessel equation, Properties of Bessel functions, Sturm-Liouville BVP, Orthogonal functions, System of first order ODE and its stability, Laplace Transform and Fourier series.
3. Partial Differential equations of first order, solution to pde of first order, Cauchys method for first order pde, Charpits method, Classification of second order equations, characteristics, Riemann Method, uniqueness theorem for hyperbolic equations with given initial and boundary conditions, Dirichlet and Neumann problems, Poisson Integral, Green and Neumanns Function, Heat Equation.

Reference Books

1. Ahlfors, L. A. (2013) *Complex Analysis,* 3rd Edition, Tata McGraw Hill
2. Brown, J. W., & Churchill, R. V. *Complex Variables and Applications*, 7th Edition
3. Lang, S. *Complex Analysis*, 4th Edition.
4. Simmons, G. F. *Differential Equations with applications and Historical Notes*, 2nd Edition, Tata McGraw Hill
5. Boyce, W. E. & DiPrima, R. C. *Elementary Differential Equations and Boundary Value Problems,* 10th Edition.
6. Rao, K. S. *Introduction to Partial Differential Equations*

Course Title	**Data Structures and Algorithms**	Course No.	**CS121**
Department	Computer Science and Engineering	L-T-P [C]	3-1-3 [5]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS111	To take effect from	July 2014

Objectives

1. To introduce algorithms analysis and design techniques
2. To understand algorithms of various data structures used for searching, sorting, indexing operation

Learning Outcomes

1. Ability in using the appropriate algorithm for searching, sorting, indexing operations
2. Designing of new algorithms
3. Analyzing complexity issues of algorithms

Contents

1. *Algorithm analysis and complexity:* Big/little -Oh, Omega, Theta notation, Recurrence equations
2. Sorting algorithms: Bubble, Selection, Insertion, Shell, Quick, Merge sorting algorithms, Internal and external, stable sorting techniques
3. Abstract data types: List, Stack, Queue, Circular Queues, Tree, Binary trees and Tree traversal and applications of various ADTs
4. Search trees: Binary search trees, Balanced search trees, AVL trees, Splay trees, B-Trees
5. Heaps: Heap order property and min/max heaps; Sets: and basic operations on Sets
6. Hashing: Hash tables, hash function, Hash table ADT and operations, Open and closed hashing, External and internal hashing, Closed hashing - Collision resolving methods, Rehashing, External hashing algorithms - extendible hashing
7. Graph algorithms: Definitions, Representation, Traversal, Shortest-path algorithms, Minimum spanning tree algorithm, Topological sorting
8. Algorithm design techniques: Divide and Conquer, Greedy, Dynamic Programming technique

Laboratory

1. Implementation of data structures using object oriented programming language
2. Verifying run time performance and asymptotic behavior of various data structures and related algorithms
3. Live applications of data structures

Reference Books

1. Aho, A. V., Ullman, J. D., and Hopcroft, J. E. (1985), *Data Structures and Algorithms*, Addison-Wesley
2. Weiss, M. A. (2007), *Data Structures and Algorithm Analysis in C++*, Addison-Wesley
3. Goodrich, M. T. and Tamassi, R., (2010), *Data Structures and Algorithms in Java*, Wiley Publications
4. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., (2009), *Introduction to Algorithms*, MIT Press

III Semester

Course Title	**Basic Electrical Engineering**	Course No.	**EE211**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-3 [5]
Offered for	B. Tech.	Type	Hands-on Experience
Pre-requisite	-	To take effect from	July 2014

Objective

1. Basic Electrical Engineering is designed to provide the basic concepts of electrical power circuits and system, and operational principles of dc and ac machines and their applications.

Learning Outcome

1. This course provides the basic knowledge of electrical power system. By the end of the course, the student must be able to analyse any ac circuit and familiar with the operation and applications of various ac and dc machines.

Contents

1. Introduction to Power Systems, Distinction between Generation, Transmission and Distribution, Power Grid and its advantages, Smart Grid Concept.
2. Introduction to alternating electrical quantities, Vector, Complex and Phasor diagrams, Polar Notations.
3. Impedance and Power diagrams, Real and Reactive Power in ac circuits.
4. Star-Delta conversion, Three-phase ac circuit analyses, Measurement of three phase power, Neutral Grounding, Grounding for Protection in single phase ac.
5. Applied Electromagnetic theory and Single-phase Transformers, equivalent circuit of transformer, SC/OC tests.
6. Basic principles of Electro-Mechanical Energy Conversion.
7. DC Machines, Types, Torque-Speed characteristics, Universal Motors, their applications and limitations.
8. Induction Motors- Single and Three-phase, their Starting and Speed Control methods and their applications, Doubly Excited Induction Generators (DEIS).
9. Synchronous machines, Generator-Motor operations, Excitation, equivalent circuit.
10. Introduction to, Variable Reluctance Machines (VRMs), Brushless dc Motors Permanent Magnet ac Motors, Stepper and Linear Induction Motors.

Reference Books

1. Kothari, D. P. and Nagrath, I. J., (2008), *Basic Electrical Engineering*, 3rd Edition, Tata McGraw-Hill
2. Sukhija, M. S. , Nagsarkar, T. K., (2012), *Basic Electrical and Electronics Engineering*, Oxford University Press
3. Fitzgerald, A. E., Kingsley, K. Jr., and Umans, S. D., (2003), *Electric Machinery*, 6th Ed. Tata McGraw-Hill (McGraw-Hill Series in Electrical Engineering)

Course Title	**Digital Logic and Design**	Course No.	**EE222**
Focus Group	Computer Science & Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Hands-on Experience
Pre-requisite	EE121	To take effect from	July 2014

Objectives

1. To introduce the basic concepts of digital system and the use of Boolean algebra in logic analysis and design
2. Understand the principles and methodology of digital logic design at the gate and switch level, including both combinational and sequential logic elements.
3. To introduce basic tools of logic design and provide hands-on experience designing digital circuits and components through simple logic circuits to hardware description language and interface programming in C.
4. To appreciate the uses and capabilities of a modern FPGA platform

Learning Outcomes

Students will be able to

1. Apply Boolean algebra and other techniques to express and simplify logic expressions.
2. Analyze and design combinational and sequential digital systems.
3. Use different techniques among them a hardware description language and a programming language, to design digital systems.

Contents

1. *Number system:* binary numbers, 1s and 2s complement, arithmetic operations in integer and floating point systems; ASCII, binary and gray codes;
2. *Boolean algebra:* Boolean Equations, Minimization of Boolean functions; Designing combinational Circuits using gates and/or Multiplexers
3. *Combinational circuit:* Adder, decoder, multiplexers, code converters (binary, gray and BCD);
4. *Iterative circuits (spatial iteration) and its relationship with temporal iteration*
5. *Sequential circuit:* Latches and flip-flops, counters, shift register;
6. *Finite state machine;* representation and synthesis
7. *Hardware Description Languages:* Combinational Logic, Structural Modeling, Sequential Logic, More Combinational Logic, Finite State Machines, Parameterized Modules, Test benches
8. *ADC and DAC:* Sample and hold circuits, ADCs, DACs.
9. *Memories:* semiconductor memories, PALs, PLAs and FPGAs; Pipelining and timing issues, PROMs (DRAMs, Flash etc.);
10. *Small algorithm synthesis:* Data and control parts

Laboratory

1. Design AND, OR and EX_ OR gates using Nand gates and verify them.
   a. Design a BCD to 6-3-1-1 Code converter and verify.
   b. Design a 6-3-1-1 to Gray Code converter and verify.
2. Design a 4 - Bit comparator using logic gates.
3. Design a priority multiplexer for 8 Devices. Each device has one data output line, a request output line, and an acknowledgement input line. The data from the highest

priority device has to be made available at the output of the priority multiplexer, and an acknowledgement has to be sent to that device. The circuit may be designed using priority encoder, multiplexer and decoder.

4. Design a Bi - directional counter using J-K Flip-flops.
5. Design a Counter which counts the following arbitrary sequence: 0101, 0001, 1000, 1001, 1010, 0000, 0101... (First starting from FSM)
6. Design a Pseudo-random bit generator and check its performance
7. Write and verify a VHDL code for simulation of an 8-bit signed integer multiplier using carry save adders.
8. Design and implement a small algorithm (example: GCD computation)

Reference Books

1. Tocci, R. J., Widmer, N. & Moss, G. (2009) *Digital Systems: Principles and Applications*, 10th Edition, Pearson
2. Mano, M. M. & Ciletti, M. D. (2012) *Digital Design: With an Introduction to the Verilog HDL*, 5th Edition, Prentice Hall
3. Harris, D. M. & Harris, S. L., *Digital Design and Computer Architecture,* 2nd Edition, Morgan Kaufman

Course Title	**Chemistry**	Course No.	**CY211**
Focus Group	Chemistry	L-T-P [C]	3-0-3 [4]
Offered for	B.Tech.	Type	Basic
Pre-requisite	-	To take effect from	July 20, 2014

Objectives

1. This is a course designed to relate the fundamental principles of chemistry with practical problems encountered for engineers. Emphasis will be placed on problem-solving.
2. This course will enable the students to scientific logics of various laboratory safeties and fire in different type of labs. Laboratory will correlate with lecture material.

Learning Outcomes

1. Understanding the behavior of matter and materials using fundamental knowledge of their nature
2. Predict potential complications from combining various chemicals or metals in an engineering setting.
3. Maintaining safe laboratory practice while working in lab and otherwise.
4. Keep notebooks of laboratory experiments and be able to evaluate results based on their own notes.

Contents

1. *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.
2. Electrochemical Systems: Electrochemical cells and EMF, Applications of EMF measurements: Steady state approximation, Chain reactions, photochemical kinetics
3. Basic Spectroscopy - Fundamentals of Microwave, IR and UV-VIS Spectroscopy: Basic concepts of spectroscopy, Selection rule, Determination of molecular structure.
4. Coordination Chemistry: Coordination numbers, Chelate effect, Coordination complexes and application.
5. Bio-inorganic chemistry: Metal ions in Biological systems, environmental aspects of Metals, NOx, CO, CO_2
6. Organic Reaction Mechanism: Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions.
7. Stereochemistry of Carbon Compounds: Selected Organic Compounds: Natural products and Biomolecules
8. Organic material: polymers, synthetic and natural polymers and their applications

Laboratory

1. Aldol condensation (preparation of tetra phenyl cyclo pentadienone)
2. Preparation of complex salt of (Co (en) 6) Cl_3
3. Preparation of double salt crystal of ammonium copper (II) sulphate hexahydrate
4. Saponification (Preparation of soap)
5. Preparation of Nylon-6, 6
6. To prepare hexamine coblt (III) Chloride (Co (NH_3) 6)Cl_3
7. Determination of dissolved oxygen in a water by Winklers method
8. To use Fourier transform infrared (F. T. I. R) spectroscopy in combination with A. T. R.

(Attenuated total reflectance) technique for bio analysis of caffine in tea & coffee and also get IR spectrum of Aldol product and analysis of the spectrum.

9. To plot the excitation and emission spectrum of curcumin in solvents respectively ethanol and hexane and find stokes shift by using fluorescence spectroscopy.
10. To determine the heat capacity, glass transition temperature and the change in heat capacity for glass transition temperature for polystyrene by using Differential scanning calorimetry (DSC).
11. To understand the theory and working principle of cyclic voltammetery and to perform CV on ferricyanide solution and to know its electrical properties for example Ep, Ip and diffuse rate etc.
12. Determine of the Enantiomeric Purity of Naproxen and Ibuprofen.
13. A General chemistry laboratory Experiment relating Electron configuration and Magnetic Behaviour.

Reference Books

1. Silberberg, M., *Chemistry: The Molecular Nature of Matter and Change*, 6th Edition, McGraw Hill Education
2. McMurry, J. E. & Fay, R. C. *Chemistry*, 5th Edition, Pearson
3. Hill, R. H. & Finster, D. (2010) *Laboratory Safety for Chemistry Students Laboratory Safety for Chemistry Students,* Wiley

Course Title	**Object-Oriented Analysis and Design**	Course No.	CS212
Department	Computer Science and Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS111	To take effect from	July 2015

Objectives

1. To understand the Object-based view of Systems
2. To develop robust object-based models for Systems
3. To inculcate necessary skills to handle complexity in software design

Learning Outcomes

1. Ability to analyze and model software specifications.
2. Ability to abstract object-based views for generic software systems.
3. Ability to deliver robust software components.

Contents

1. Introduction to OOAD: Basic notion of objects, Multiple Views of Objects, Contrasting with Procedural Computation – Client-Server/Message Passing, Principles of OOAD – Abstraction Hierarchy, Decomposition Hierarchy, Member-Of
2. Overview of Object-based Modeling – Unified Modified Language (UML): Structural Diagrams, Behavioural Diagrams,
3. Overview of C++: Procedural Extension of C, Objects, Classes and Encapsulation, Overloading, Inheritance& Polymorphism, Type Casting.
4. Design-by-Contract: Introduction to Concepts of Design-by-Contract, Separation of Interface and Implementation by Design, Illustration of Design-by-Contract through Data Structure examples like Stack, Queue
5. Standard Library of C++: *Input / Output Streams*, *Strings*: string, *Data structures*: *Sequence containers*, *Container adaptors*, *Associative containers*, *Unordered associative containers*
6. Handling the Breakdown of Design-by-Contract: Exceptions to handle Contract violations, Exception handling in C, Exception handling in C++, Exception Classes in C++ Standard Library
7. Templates: Function Templates, Class Templates, Partial Template Instantiation, Generic, Programming through Template Meta-Programming
8. Design Patterns: Introduction to DP through Iterator Pattern, DP Schema and Pattern Formulation, Common Patterns – Iterator, Singleton, Visitor, Abstract Factory, Factory Method
9. Generic Programming in Standard Library of C++: Iterators, functional operators, algorithms

Laboratory

1. Java Programming for 2 simple applications
2. C++ Programming for Building Special Types (like Complex, Fractions, Polynomial, Matrix)– robust with failure (exceptions) and generic with type (like Polynomial of Complex should be allowed)
3. C++ Programming for Data Structure (Stack, Tree, or Graph) – robust with failure (exceptions) and generic with type (for example, Stack of Complex should be allowed)

4. Simple Design Patterns – Singleton, Iterators & Visitors in multiple hierarchy domains like automobiles

Reference Books

1. Gamma, E., Helm, R., Johnson, R., and Vlissides, J., (1994). *Design Patterns: Elements of Reusable Object-Oriented Software*, Addison-Wesley
2. Miles, R. & Hamilton, K., (2006), *Learning UML 2.0 – A Pragmatic Introduction to UML.* O'Reilly Media
3. Stroustrup, B., *The C++ Programming Language*, 4th Edition. Addison-Wesley
4. Meyers, S., (2008), *Effective C++ & More Effective C++*, Pearson Education
5. Sutter, H., (1999), *Exceptional C++ & More Exceptional C++*, Addison-Wesley
6. Arnold, K., Gosling, J., and Holmes, D. (2005), *The Java Programming Language,* Addison-Wesley
7. Alexandrescu, A., (2001), *Modern C++ Design*, Addison-Wesley
8. Kernighan, B. W., & Ritchie, D. M., (1998), *The C Programming Language*, Prentice Hall
9. Horowitz, E., Sahni, S., and Anderson-Freed, S., (2008), *Fundamentals of Data Structures in C*, W. H. Freeman and Company

Course Title	**Signals and Systems**	Course No.	**EE213**
Focus Group	Electrical Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B.Tech.	Type	Compulsory
Pre-requisite	-	To take effect from	July 2014

Objectives

1. Fundamentals of continuous-time and discrete-time linear systems and their dynamical properties.
2. Understanding of frequency domain transform analysis of LTI systems.
3. State space analysis of I/O systems.
4. Design and analysis of various Filters.

Learning Outcomes

1. Understanding the practical relevance of system properties such as linearity, time invariance, stability and causality and use of mathematical transform methods to analyze LTI systems.
2. Analyzing continuous time systems using Fourier transform as well as Laplace transform and discrete time systems using Discrete Time Fourier Transform as well as Z-transform.
3. Fundamentals of filter concepts

Contents

1. *Continuous and discrete time signals:* Classification of signals, Signal Energy, Signal Power, Useful operation on signals and signal models, even and odd functions
2. *Frequency Domain Representation:* Fourier series, Fourier, Laplace and Z transform techniques, DTFT, DFT.
3. *Sampling:* Sampling Theorem, Signal Reconstruction, Application of the sampling theorem, Analog to Digital Conversion.
4. *LTI systems:* Classification of Systems, I/O description, impulse response and system functions, pole/zero plots, state space description, block diagram representation, Time and Frequency domain analysis, FIR and IIR Systems
5. *Analog Filters:* Low-pass, high-pass, band-pass and band-stop (band-reject) filters. Filter characteristics, filter circuit transfer function, and its poles and zeros. First order, second order active and passive filters and building blocks to construct higher order filters.

Reference Books

1. Lathi, B. P. (2009) *Principles of Linear Systems and Signals*, 2nd Edition, Oxford University Press
2. Haykin, S. & Veen, B. V. (2008) *Signals and Systems,* 2nd Edition, Wiley
3. Ziemer, R. E., Tranter, W. H. & Fanin, D. R. (1998) *Signals and Systems: Continuous and Discrete,* 4th Edition, Prentice Hall
4. Kamen, E. W. & Heck, B. S. (2000) *Fundamentals of Signals and Systems Using the Web and MATLAB,* 2nd Edition, Prentice-Hall
5. Oppenheim, A. & Wilsky, A. S. *Signals and Systems*, 2nd Edition, Prentice-Hall

IV Semester

Course Title	**Probability, Statistics and Random Processes**	Course No.	**MA221**
Focus Group	Mathematics	L-T-P[C]	4-1-0[5]
Offered for	B.Tech.	Type	Basic
Pre-requisite	-	To take effect from	July 2014

Objectives

1. To equip the students with the broad perspective of probability theory.
2. To develop the understanding of various discrete and continuous distributions along with their properties.
3. To understand and differentiate among various statistical and random processes techniques.

Learning Outcomes

1. Ability to analyze and differentiate between deterministic and random environment.
2. Ability to select an appropriate distribution for analyzing data specific to an experiment.
3. Understanding of various statistical and random processes techniques which can be applied to data arising in various applications.

Contents

1. Introduction to Probability, axioms of probability, Conditional probability, Bayes Theorem, Random Variable, Discrete and Continuous random variables, Distribution Function and Probability Density (Mass) Function, Expectation and Moments of random variables, Moment Generation Function and Characteristic Function, Jointly distributed random variable, Transformation of Random Variables, Special Discrete distributions, Special Continuous distributions, Chebyshevs inequality, Law of large numbers, Central Limit Theorem
2. Regression Analysis, Parameter Estimation, Maximum Likelihood Estimator, Confidence Interval, Hypothesis Testing, Goodness of Fit test
3. Stochastic Processes, Markov Chain, Markov Processes, Queuing models.

Reference Books

1. Ross, S. M., (2012), *Introduction to probability and statistics for engineers and scientists*, Elsevier
2. Rohatgi, V. K. & Ehsanes Saleh, A. K. Md., (2011), *An Introduction to Probability and Statistics,* Wiley
3. Johnson, R. A., (2010), *Miller & Freund's Probability and Statistics for Engineers,* PHI Learning
4. Papoulis, A. & Pillai, U. S., (2002), *Probability, Random Variables, and Stochastic Processes,* Tata Mc-Graw Hill

Course Title	**Computer Organization and Architecture**	Course No.	**CS221**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS211	To take effect from	July 2015

Objectives

1. To understand aspects of computer architecture and program performance
2. To provide essential understanding of different subsystems of modern computer system and design aspects these subsystems
3. To understand the stages in instruction life cycle
4. To understand performance enhancement methods in instruction execution

Learning Outcomes

1. Ability to identify the basic components and design of a computer, including CPU, memories, and input/output units
2. Ability to identify the issues involved in the instruction execution and various stages of instruction life stage
3. Ability to identify the issues related to performance improvement
2. Ability to distinguish performance tradeoff between different memory units and instruction sets

Contents

1. *Basic functional blocks of a computer:* CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set, Instruction set architecture CISC, RISC, Case study – instruction sets of common CPUs
2. CPU Subblock, Datapath – ALU, registers, CPU buses; Control unit design: hardwired and micro-programmed design approaches
3. *Memory system design:* semiconductor memory technologies, memory organization, cache memory hierarchy
4. *Peripheral devices and their characteristics:* Input-output subsystems, I/O transfers – program controlled, interrupt driven and DMA, Secondary storage devices
5. Privileged and non-privileged instructions, software interrupts and exceptions, Programs and processes – role of interrupts in process state transitions
6. *Pipelining:* Basic concepts of pipelining, throughput and speedup, pipeline hazards
7. *Introduction to superscalar processors architecture:* parallel pipelines, out of order execution, branch prediction
8. Introduction multithreaded processors architecture and multicore processors architecture

   (Introduce use of architecture simulation, debugging as well as performance analysis tools.)

Reference Books

1. Patterson, D. A. & Hennessy, J. L. (2013), *Computer Organization and Design: The Hardware/ Software Interface*, Elsevier Science
2. Hamachar, C., Vranesic, Z. and Zaky, S., (2002), *Computer Organization*, McGraw-Hill

3. Hayes, J. P., (1998), *Computer Architecture and Organization*, McGraw-Hill
4. Stallings, W. (2008), *Computer Organization and Architecture: Designing for Performance*, Pearson Education
5. Heuring, V. P. & Jordan, H. F., (2008), *Computer Systems Design and Architecture*, Pearson Education
6. Shen, J. P. & Lipasti, M. H., (2013), *Modern Processor Design: Fundamentals of Superscalar Processors*, Tata McGraw-Hill

Course Title	**Theory of Computation**	Course No.	**CS222**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS112	To take effect from	July 2015

Objectives

1. To learn about languages, grammars, and computation models
2. To learn about computability
3. To learn about computational complexity

Learning Outcomes

1. To be able to distinguish between computable and un-computable problems
2. To be able to distinguish between tractable and intractable problems

Contents

1. *Finite Automata and Regular Languages:* DFA, NFA, Regular expressions, Equivalence of DFA and NFA, Closure properties of Regular Languages, Regular Pumping lemma, Myhill-Nerode theorem and State minimization
2. *Push-Down Automata and Context Free Languages:* Designing CFGs, Ambiguity, Chomsky Normal Form, Closure properties, CF Pumping Lemma
3. *Computability:* Turing Machines, Church-Turing Thesis, Variants of Turing machines, non-determinism, enumerators, Decidability, Halting problem, Reducibility, Rice's theorem, Undecidability, Godel's incompleteness theorem
4. *Computational Complexity:* The classes P and NP, Boolean circuits, NP Completeness (example problems: SAT)

Reference Books

1. Hopcroft,J. E., Motwani, R., and Ullman, J. D., (2007), *Introduction to Automata Theory, Languages, and Computation*, Pearson
2. Sipser, M., (2013), *Introduction to the Theory of Computation*, Cengage Learning
3. Lewis, H. R. & Papadimitriou, C. H. (1997), *Elements of the Theory of Computation*, Prentice Hall
4. Kozen, D. C., (2006), *Theory of Computation,* Springer

Course Title	**Software Engineering**	Course No.	**CS223**
Department	Computer Science and Engineering	L-T-P [C]	3-0-3[4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS212	To take effect from	July 2015

Objectives

1. To understand the best practices in software engineering.
2. To develop the necessary skills to handle software projects in a principled way.

Learning Outcomes

1. Ability to analyze and specify software requirements.
2. Ability to apply software engineering principles and techniques to develop large-scale software systems.
3. Ability to plan and work effectively in a team.

Contents

1. *Introduction:* Problem of software development, problem of scale, basic process approach, etc.
2. *Software Process Models:* concept of processes, process specification, process models & utilities
3. *Advanced Object-based Modeling – Unified Modified Language*
   a. *Structural Diagrams*: Profile, Component, Package, Deployment, and Composite Structure
   b. *Behavioral Diagrams*: Timing, Communication, and Interaction Overview
4. *Requirement analysis and specification:* the basic problem, the sub-phases in the phase, analysis techniques (structured analysis), specification, validation, function point analysis, coding requirement specification in UML.
5. *Design principles and structured design methodology:* partitioning, top-down and bottom-up, step-wise refinement, coupling and cohesion, design on UML
6. *Coding:* style, structured programming, verification concepts
7. *Testing:* testing purpose, levels of testing, black box testing, white box testing, different test case generation approaches, test planning, test scenarios, regression testing
8. *Project planning:* effort, schedule, quality, project monitoring, and Configuration Management
9. *Agile Software Development*: The agile philosophy, agile process models, agile project management, SCRUM, SPRINT.
10. *Test-Driven Development*: Test case design, workflow, refinements

Laboratory

1. Software Requirements Specification: Prepare SRS for the given systems like Leave Management System, Assignment Management System, Story Management System (Newspaper House) etc. (Every student works with her / his partner with one specified system – chosen from a set of 20 systems)
2. HDL and LLD of the Systems under Development
3. Coding and implementation of the System
4. Test Modeling with UML – Test Plan, Test Scenarios, Regression Test

5. Deployment and Customer Feedback
6. Requirements Migration and Version Management

Reference Books

1. Jalote, P., (2005), *An Integrated Approach to Software Engineering*, Narosa Publishing House
2. Pressman, R. S., (2009), *Software Engineering: A Practitioner's Approach*, Tata McGraw-Hill
3. Mall, R. (2014), *Fundamentals of Software Engineering*, Prentice Hall
4. McConnell, S., (2014), *Code Complete: A Practical Handbook of Software Construction* (2nd Ed.), Microsoft Press
5. Ahmed, A., (2011), *Software Project Management: A Process-Driven Approach*, Auerbach Publications
6. Beck, K., (2002), *Test Driven Development: By Example*, Addison-Wesley Professional
7. Williams, L. & Kessler, R., (2002), *Pair Programming Illuminated*, Addison-Wesley Professional

Course Title	**B. Tech. Project**	Course No.	**CS299**
Department	Computer Science and Engineering	L-T-P [C]	0-0-9 [3]
Offered for	4^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

V Semester

Course Title	**Data Communication**	Course No.	**CS311**
Department	Computer Science and Engineering	L-T-P [C]	3-1-0 [4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	EE213	To take effect from	July 2015

Objectives

1. To understand basic components of a data communication system, the transmission and reception techniques for communications, and the channel impairments and their influence on data transmission
2. To understand different types of channel, medium, resource sharing and access techniques
3. To understand issues of flow control and error control
4. To introduction principles of packet switching techniques and data networking

Learning Outcomes

1. Ability to identify basic components of data communication system
2. Ability to distinguish various data transmission and modulation techniques
3. Ability to analyse the impact of various channel impairments on data transmission
4. Ability to identify different data networks and the networking hardware

Contents

1. Communication problem and system models, components of communication systems, communication channels and their characteristics, mathematical models for communication channels, multiple access techniques, link budget analysis
2. Representation of deterministic and stochastic signals, random noise characterization in communication systems, signal-to-noise ratio, characterization of communication signals and systems: signal space representations, representation of analog and digitally modulated signals, spectral characteristics of modulated signals
3. *Optimal receivers:* Receivers for signals corrupted by AWGN, Error performance Analysis of receivers for memory-less modulation, optimal receivers for modulation methods with memory, OFDM, MIMO
4. *Source coding:* Huffman, Lempel-Ziv, runlength coding, PCM, ADPCM, DM, ADM
5. *Channel coding:* Linear block codes, CRC, convolution codes, Viterbi decoding algorithm
6. Principles of switching; Local area networks: Ethernet, Fast Ethernet, Token Ring, Introduction to Gigabit Ethernet and Wireless LANs; Hubs, bridges and switches

Reference Books

1. Madhow, U., (2008), *Fundamentals of Digital Communication*, Cambridge University Press
2. Lathi, B. P. & Ding, Z., (2010), *Modern Digital and Analog Communication Systems*, Oxford University Press
3. Stallings, W., (2010), *Data and Computer Communications*, Prentice Hall
4. Proakis, J. G. & Salehi, M., (2008), *Digital communications*, McGraw-Hill Higher Education

Course Title	**Compiler Design**	Course No.	**CS312**
Department	Computer Science and Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS222	To take effect from	July 2015

Objectives

1. To learn about different types of grammars used in Compilers
2. To learn about different phases of a Compiler

Learning Outcomes

1. Ability to use Lex for designing lexical analyzers
2. Ability to use Yacc for designing syntax Analyzers
3. Ability to design parsing tables from grammars

Contents

1. *Introduction:* Structure of a Compiler, Different types of Programming Languages: Imperative Languages, Block Structured Languages, Functional Programming Languages, Declarative Programming Languages, Object-oriented Programming Languages
2. *Lexical Analysis:* Input Buffering, Token Specification, Token Recognition, Lex
3. *Syntax Analysis:* Context Free Grammars, Top-Down Parsing, Bottom-Up Parsing, SLR Parser, LR(1) Parser, LALR Parser, Removing Ambiguity in Grammar, Yacc
4. *Syntax Directed Translation:* Syntax Directed Definition, Syntax Directed Translation, L-attributed SDD
5. *Run Time Environments:* Storage Organization, Stack Allocation, Heap Management, Garbage Collection
6. *Intermediate Code Generation:* Syntax Trees, Three Address Code, Expression Translation, Control Flow
7. *Code Generation:* Programs, Instructions, Addresses, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Register Allocation and Assignment
8. *Machine Independent Optimizations:* Sources of Optimization, Data Flow Analysis

Laboratory

1. Understanding x86 assembly language
2. Designing a Lexical Analyzer in C
3. Designing a Lexical Analyzer using Lex
4. Using Yacc to design an Intermediate Code Generator
5. Target code generation to x86 assembly language

Reference Books

1. Aho, A. V., Lam, M. S., Sethi, R. and Ullman, J. D., (2006), *Compilers Principles Techniques and Tools*, Addison Wesley

Course Title	**Operating Systems**	Course No.	**CS313**
Department	Computer Science and Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS111, CS221	To take effect from	July 2014

Objectives

1. To learn about design principles of operating systems
2. To do a case study of Operating System

Learning Outcomes

1. Ability to modify and compile OS
2. Ability to solve synchronization problems in Operating Systems

Contents

1. *Overview of Operating Systems:* Types of Operating Systems, System calls and OS structure
2. *Processes Management:* Process, Threads, CPU Scheduling
3. *Process Coordination:* Mutual Exclusion, Mutex Implementation, Semaphores, Monitors and condition variables, Deadlocks
4. *Memory Management:* Swapping, Paging, Segmentation, Virtual Memory, Demand Paging, Page Replacement Algorithms
5. *Storage Management:* I/O devices and drivers, Disks and File Systems, File layout and Directories, File system performance, File system reliability
6. *Protection and Security:* System Protection, System Security

Laboratory

1. Designing a shell in Minix 3
2. Multithreaded programming using pthread
3. Solving the Sleeping-Barber problem
4. Modification of scheduling algorithm in Minix 3
5. Solving the Producer-Consumer problem over a network
6. Finding text, data, and stack segments of a process in Minix 3
7. Implementation of page replacement algorithms
8. Changing file attributes in Minix 3
9. Implementing an encrypted file system in Minix 3
10. Implementing symbolic links in Minix 3

Reference Books

1. Silberschatz, A., Galvin, P. B., and Gagne, G., (2009), *Operating System Concepts*, John Wiley & Sons Inc.
2. Tanenbaum, A. S. & Woodhull, A. S., (2006), *Operating Systems Design and Implementation*, Pearson Prentice Hall
3. Stallings, W., (2012), *Operating Systems Internals and Design Principles*, Prentice Hall

Course Title	**Algorithm Design and Analysis**	Course No.	**CS314**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	B. Tech.	Type	Compulsory
Pre-requisite	CS112, CS121, CS222	To take effect from	July 2015

Objectives

1. To learn about various algorithm design techniques
2. To learn about advanced data structures
3. To learn about complexity analysis of algorithms

Learning Outcomes

1. Ability to apply randomization to design algorithms
2. Ability to solve intractable problems using approximation algorithms
3. To model optimization problems as Linear Program

Contents

1. *Advanced Data Structures:* Amortized analysis, Binomial heaps, Fibonacci heaps, Splay Trees etc.
2. *Dynamic programming*
3. *Lower bounds and NP-completeness*
4. *Linear-programming:* Definitions of canonical and standard forms, feasibility and optimization, Structure of Optima, Duality Theory, Duality Applications, Simplex Algorithm
5. *Approximation Algorithms:* Relative Approximations, PAS and FPAS Scheduling, etc.
6. *Randomized algorithms:* Kargers min-cut, Balls and Bins model and its applications, Hashing, Bloom filters, , Quick sort, Quick select, Markov, Chebyshev and Chernoff and their applications in finding upper bounds on algorithm errors
7. *String matching algorithms*
8. *Network flows and matching*

Reference Books

1. Kleinberg, J. and Tardos, E., (2014), *Algorithm Design*, Pearson Education
2. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., (2009), *Introduction to Algorithms*, MIT Press

Course Title	**B. Tech. Project**	Course No.	**CS398**
Department	Computer Science and Engineering	L-T-P [C]	0-0-9 [3]
Offered for	4^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

VI Semester

Course Title	**Computer Networks**	Course No.	**CS321**
Department	Computer Science and Engineering	L-T-P [C]	3-0-3 [4]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS311	To take effect from	July 2014

Objectives

1. To understand the organization of computer networks, factors influencing on the performance of computer networks, and the reasons for having variety of different types of networks
2. To understand the Internet structure, various protocols of the Internet and how these protocols address the standard problems of networking and the Internet
3. Hands-on experience on networking fundamentals through practical sessions

Learning Outcomes

1. Familiarity with the essential protocols of computer networks and their operations
2. Design and implementation of computer networks
3. Identifying various design parameters such as latency, bandwidth, error rate, throughput, and their influence on node/link utilization and performance

Contents

1. Layer approach, Packet switching techniques, Performance metrics delay, loss, throughput, bandwidth delay product, latency
2. *Applications:* Network programming, socket abstraction, client server architecture, naming and addressing, electronic mail, file transfer, remote login, world wide web, domain name service, journey of a packet
3. *Transport Layer:* Transmission Control Protocol flow control, error control, congestion control, header, services, connection management, timers, congestion control; User Datagram Protocol
4. *Network Layer:* Internetworking, Tunneling, Encapsulation, Fragmentation, Internet Protocol and its operation, etc. , Routing algorithms distance vector and link state algorithm and Routing protocols, the related protocols, ICMP, ARP, RARP, DHCP, IPv6, RIP, OSPF
5. Advanced Internetworking, Multicast routing, Queuing disciplines and buffer management techniques
6. *Data link layer:* framing, medium access mechanism
7. *Network security:* Public key and private key cryptography, digital signature, firewalls
8. *Advanced topics, SDN and Open flow Architectures*

Laboratory

1. Networking hardware
   a. Understanding cables, switches, routers
   b. Setting up switching network
   c. Setting up subnets and routing across the subnets
2. Socket programming - Development of client-server application using sockets (possible examples, file transfer, peer-peer applications, chat, network monitor etc.)

3. Networking commands - ifconfig, route, arp, arping, ping, netstat. tcpdump, host, nslookup, dig, ftp, scp, ssh, finger, dhclient, dhcrelay etc. ,
4. Protocol analyzer - closely looking at protocols (HTTP, TCP, UDP, ICMP, 802. 3, DHCP, DNS etc.) headers and analyzing the interactions between client and server of different applications
5. QualNet simulator/Packet Tracer
   a. Implementation of ARQs - Stop-and-wait, Sliding Window goback N etc.
   b. Verifying operations of routing protocols
   c. Verifying influence of congestion on end users performance
   d. Verifying basic congestion control algorithms Reno, New Reno, Cubic
   e. Verifying router buffer size on end users performance

Reference Books

1. Stallings, W., (2010), *Data and Computer Communications*, Prentice Hall
2. Peterson, L. L. & Davie, B. S., (2008), *Computer Networks: A Systems Approach*, Morgan Kaufmann
3. Ross, K. W. & Kurose, J. F., (2010), *Computer Networks: A Top Down Approach*, Pearson Education

Course Title	**Database Systems**	Course No.	**CS322**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS313	To take effect from	July 2014

Objectives

1. To understand the concepts of database management system and its applications, data modeling, database design, and query languages.
2. To understand different files structures, transaction management, concurrency control, database recovery, query processing and optimization.

Learning Outcomes

1. Ability to apply different data modeling methods in requirement analysis, design, and implementation of database system.
2. Ability to apply the normal forms for efficient designing of relational database
3. Ability to use appropriate storage and access structures
4. Ability to use techniques for transaction management, concurrency control, and recovery
5. Ability to analyze complexity issues of query execution

Contents

1. Database System Concepts and Architecture, Data Modeling Using the Entity-Relationship (ER) Model, The Enhanced Entity-Relationship (EER) Model
2. Relational Data Model and Relational Database Constraints, Relational Database Design by ER-and EER-to-Relational Mapping, Relational Algebra and Relational Calculus, SQL: Schema Definition, Constraints, Queries, and Views
3. Functional Dependencies and Normalization, Algorithms for Query processing and optimization
4. Disk Storage, Basic File Structures, and Hashing, Indexing Structures for Files
5. Transaction Processing Concepts and Theory, Concurrency Control Techniques and Protocols, Database Recovery Techniques
6. Glimpses – Distributed Database, Handling Unstructured Data, Big Data, no SQL

Reference Books

1. Elmarsi, R. & Navathe, S. B., (2007), *Fundamental of Database System*, Pearson Education
2. Ramakrishna, R. & Gehrke, J., (2003), *Database Management Systems*, McGraw-Hill
3. Molina, H. G., Ullman, J. D., and Widom, J., (2001), *Database Systems The Complete Book*, Pearson Education
4. Raj, P., Raman, A., Nagaraj, D., and Duggirala, S., (2015), *High-Performance Big-Data Analytics: Computing Systems and Approaches,* Springer
5. Sabharwal, N. & Edward, S. G., (2014), *Big Data NoSQL Architecting MongDB,* CreateSpace Independent Publishing Platform

Course Title	**Artificial Intelligence**	Course No.	**CS323**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	B. Tech. CSE	Type	Compulsory
Pre-requisite	CS121	To take effect from	July 2014

Objectives

1. To provide the foundations for AI problem solving techniques and knowledge representation formalisms

Learning Outcomes

1. Ability to identify and formulate appropriate AI methods for solving a problem
2. Ability to implement AI algorithms
3. Ability to compare different AI algorithms in terms of design issues, computational complexity, and assumptions

Contents

1. *Un-informed search strategies:* Breadth first search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, bidirectional search
2. *Informed search and exploration:* Greedy best-first search, A* search, Memory-bounded heuristic search
3. *Local search algorithms and Optimization:* Hill climbing, Simulated Annealing, Local beam search, Genetic Algorithms
4. *Constraint Satisfaction Problems:* Backtracking search for CSPs, Local search for CSPs
5. *Adversarial Search:* Optimal Decision in Games, The minimax algorithm, Alpha-Beta pruning
6. *Knowledge and Reasoning:* Propositional Logic, Reasoning Patterns in propositional logic; First order logic: syntax, semantics, Inference in First order logic, unification and lifting, backward chaining, resolution
7. *Knowledge Representation:* Ontological engineering, categories, objects, actions, situations, Situation Calculus, semantic networks, description logics, reasoning with default systems
8. *Planning:* Planning with state space search, Partial-Order Planning, Planning Graphs, Planning with Propositional Logic, hierarchical task network planning, non-deterministic domains, conditional planning, continuous planning, multi-agent planning
9. *Miscellaneous Topics:* Fuzzy logic systems, Natural Language Processing

Reference Books

1. Russel, S. & Norvig, P., (2009), *Artificial Intelligence: A Modern Approach,* Pearson Education
2. Rich, E., Knight, K., and Nair, S. B., (2008), *Artificial Intelligence*, Tata McGraw-Hill

Course Title	**B. Tech. Project**	Course No.	**CS399**
Department	Computer Science and Engineering	L-T-P [C]	0-0-9 [3]
Offered for	4^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

VII Semester

Course Title	**B. Tech. Project**	Course No.	**CS498**
Department	Computer Science and Engineering	L-T-P [C]	0-0-23 [7]
Offered for	4^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

VIII Semester

Course Title	**B. Tech. Project**	Course No.	**CS499**
Department	Computer Science and Engineering	L-T-P [C]	0-0-24 [8]
Offered for	4^{th} to 8^{th} Semester	Type	Compulsory
Pre-requisite		To take effect from	July 2014

Objectives

1. To gain hands on experience on innovative technology project
2. To prepare the students to solve/work on the real world/practical/theoretical problems involving issues in computer science and engineering

Learning Outcomes

1. Ability to design and model a system
2. Ability to plan and execute well defined objective
3. Ability to work in team at component level and system level
4. Ability to troubleshoot
5. Ability to reuse- or integrate with- existing components
6. Ability to derive performance metrics and assess quantitatively the performance of system
7. Ability to report and present the findings in standard formats

Elective Courses

Course Title	**Advanced Computer Networks**	Course No.	**CS651**
Department	Computer Science and Engineering	L-T-P [C]	3-0-3 [4]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To understand the algorithms for Routing, Forwarding, Lookup, Resource management in packet switching networks
2. To understand different quality of service and transport frameworks
3. To understand the Internet architecture and router internals
4. To understand the limitations of current Internet architecture
5. To introduce the new networking architectures

Learning Outcomes

1. Ability to identify the essential components of networking
2. Ability to analyze the algorithms for routing, forwarding, lookup with respect to stability, robustness, scalability, security
3. Ability to analyze the performance of congestion control and resource management techniques
4. Ability to carry out further research in recent networking architectures

Contents

1. Introduction to Packet Switching, Networking and Network Routing
2. *Network Routing Algorithms:* Routing in IP Networks, Internet Routing Architecture, Intra-and Inter- Domain Routing, BGP Internals, Approaches to achieve reliable, scalable, and secure routing
3. *IP Multicasting:* Group Management and Membership, Multicast Routing Protocols
4. *Router Internals:* Functions of a Router, Elements of a router, packet flow, packet processing fast and slow paths, data and control planes, Router architectures
5. *IP Address Lookup Algorithms:* Longest prefix matching, Binary and Multibit tries, Compressing multibit tries, Hardware algorithms
6. *Resource Management:* Queuing disciplines, Active Queue Management techniques, Scheduling algorithms, Congestion control mechanisms, Congestion avoidance mechanisms
7. *Internet Service models:* Quality of Services (InterServ, DiffServ RSVP), Multiprotocol Label Switching, VoIP
8. *Recent networking architectures:* Software defined networks, Data center networks, Content delivery networks, Peer-to-peer networks

Laboratory

1. Analysis of protocol headers and journey of a packet through wireshark
2. Implementation of ARP queries and responder, IP packet forwarder, AQM RED router
3. Performance analysis of scheduling algorithms (WFQ,DRR,RR), traffic shaping algorithms, congestion control techniques
4. Working with intra-domain and inter-domain routing protocols

Reference Books

1. Medhi, D. & Ramasamy, K., (2007), *Network Routing: Algorithms, Protocols & Architectures*, Morgan Kaufmann
2. Peterson, L. L. & Davie, B. S., (2011), *Computer Networks : A Systems Approach*, Morgan Kaufmann
3. Stallings, W., (2010), *Data and Computer Communications*, Prentice Hall
4. Research papers from Conferences/Journals (ex. IMC, ANCS, NSDI, SIGCOMM, CoNext, ToN, JSAC)

Course Title	**Pattern Recognition**	Course No.	**CS652**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To familiarize with the mathematical and statistical techniques used in pattern recognition.
2. To understand and differentiate among various pattern recognition techniques.

Learning Outcomes

1. Ability to formulate high dimensional feature vectors from observations.
2. Ability to select an appropriate pattern analysis tool for analysing data in a given feature space.
3. Ability to apply pattern analysis tools to practical applications and detect patterns in the data.

Contents

1. *Introduction:* Definitions, data sets for Pattern Recognition, Different Paradigms of Pattern Recognition
2. *Bayes Decision Theory:* Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions, Bayesian networks
3. *Generative Methods:* Maximum Likelihood and Bayesian Parameter Estimation, Non-parametric techniques
4. *Discriminative Methods:* Distance-based methods, Linear Discriminant Functions, Artificial Neural Networks, Support Vector Machines
5. *Clustering:* k-means clustering, Gaussian Mixture Modeling, EM-algorithm
6. *Principal Component Analysis:* PCA, Kernel PCA, Probabilistic PCA
7. *Combining Classifiers:* Bagging and Boosting, Adaboost, Bayesian Model Averaging

Reference Books

1. Duda, R. O., Hart, P. E. and Stork, D., (2002), *Pattern Classification*, Wiley
2. Bishop, C., (2006), *Pattern Recognition and Machine Learning*, Springer
3. Cristianini, N. & Taylor, J. S., (2000), *An Introduction to Support Vector Machines*, Cambridge University Press

Course Title	**Digital Image Analysis**	Course No.	**CS654**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To introduce the origin and formation of digital imaging.
2. To develop the understanding of different types of imaging techniques for different purposes.
3. To equip the students with various possible applications of the image analysis.

Learning Outcomes

1. Ability to enhance image in spatial and frequency domain.
2. Ability to implement various aspects of image segmentation and compression.

Contents

1. *Digital Image Fundamentals:* Image modeling, Sampling and Quantization, Imaging Geometry, Digital Geometry, Image Acquisition Systems, Different types of digital images.
2. *Bi-level Image Processing:* Basic concepts of digital distances, distance transform, medial axis transform, component labeling, Histogram of grey level images, Optimal thresh holding.
3. *Images Enhancement:* Point processing, enhancement in spatial domain, enhancement in frequency domain
4. *Detection of edges and lines in 2D images:* First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves.
5. *Color Image Processing:* Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection.
6. *Image compression:* Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard.
7. *Segmentation:* Segmentation of grey level images, Watershed algorithm for segmenting grey level image.
8. *Morphology:* Dilation, erosion, opening, closing, hit and miss transform, thinning, extension to grey scale morphology.
9. *Feature Detection:* Fourier descriptors, shape features, object matching/features.

Reference Books

1. Gonzalez, C. & Woods, R. E., (2008), *Digital Image Processing*, Prentice Hall
2. Jain, A. K., (2001), *Fundamentals of Digital Image Processing*, Prentice Hall

Course Title	**Computational Complexity Theory**	Course No.	**CS655**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To learn about different complexity classes and how they are related to each other
2. To learn about reducing one problem to another problem

Learning Outcomes

1. To be able to identify the problems according to their complexity classes

Contents

1. *Turing Machines and Diagonalization:* Turing Machine, Universal Turing Machine, Uncomputability Deterministic Time Hierarchy Theorem, Nondeterministic Time Hierarchy Theorem, Ladner's Theorem, Oracle Machines
2. *Time Complexity Classes: P, NP, coNP, EXP, and NEXP* Time complexity classes, P, NP, coNP, EXP, and NEXP
3. Reducibility and NP-Completeness, Cook-Levin Theorem, Some examples of NP-Complete Problems
4. *Space Complexity Classes: PSPACE, and NL* Space Complexity Classes PSPACE, and NL PSPACE Completeness, NL Completeness
5. *The Polynomial Hierarchy and Alternating Turing Machines:* Polynomial Hierarchy, Alternating Turing Machines, Polynomial Hierarchy using Oracle Machines
6. *Circuit Complexity Classes: P/poly*: Boolean Circuits and P/poly, P/poly and NP, Nonuniform Hierarchy Theorem
7. *Randomized Complexity Classes: RP, coRP, ZPP, and BPP,* Probabilistic Turing Machines, The Complexity Class BPP, The Complexity Classes RP, coRP, and ZPP
8. *Interactive Proofs: IP = PSPACE*, Interactive Proofs, Public Coins and AM, IP = PSPACE
9. *Applications to cryptography:* Computational Security, One-Way Functions, and Pseudorandom Generators, Zero Knowledge
10. *Quantum Complexity Classes: BQP,* Definition of Quantum Computation and BQP, Quantum Algorithms, BQP and Classical Complexity Classes
11. *Hardness of Approximation: Applications of PCP Theorem*: PCP Theorem, Hardness of Approximation for Vertex Cover and Independent Set

Reference Books

1. Arora, S. & Barak, B., (2009), *Computational Complexity: A Modern Approach*, Cambridge University Press

Course Title	**Machine Learning**	Course No.	**CS656**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To develop a broad perspective about the applicability of ML algorithms in different fields.
2. To understand the major ML algorithms, the problem settings, and assumptions that underlies them.

Learning Outcomes

The student will be able to:

1. Identify the machine learning algorithms which are more appropriate for various types of learning tasks in various domains
2. Implement machine learning algorithms on real datasets

Contents

1. *Introduction:* Well-posed learning problems, Designing a Learning System, Perspectives and Issues in Machine learning
2. *Concept Learning and General-to-specific Ordering*: A concept learning task, Concept learning as Search, Finding a maximally specific hypothesis, Version Spaces and Candidate elimination algorithm, Inductive Bias
3. *Decision Tree Learning:* Decision tree learning algorithm, Hypothesis space search in decision tree
4. *Evaluating Hypothesis:* Estimating Hypothesis accuracy, Basics of sampling theory, Deriving confidence intervals, Hypothesis testing, comparing learning algorithms
5. *Bayesian Learning:* Bayes theorem and concept learning, Maximum likelihood and least square error hypotheses, Minimum description length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier
6. *Computational Learning Theory:* Probably learning an approximately correct hypothesis, PAC learnability, The VC dimension, the mistake bound model for learning
7. *Linear Models for Regression:* Linear basis function models, The Bias-Variance decomposition, Bayesian Linear Regression, Bayesian Model comparison
8. *Kernel Methods:* Constructing kernels, Radial basis function networks, Gaussian Processes
9. *Approximate Inferencing:* Variational inference, Variational mixture of Gaussians, Variational linear regression, Variational logistic regression
10. *Hidden Markov Models:* Learning algorithms for HMM, The Viterbi algorithm, Linear Dynamical Systems
11. *Reinforcement Learning:* The learning task, Q learning, Non-deterministic rewards and action, Temporal difference learning, Generalizing from examples

Reference Books

1. Mitchell, T. M., (1997), *Machine Learning,* McGraw-Hill
2. Bishop, C. M., (2007), *Pattern Recognition and Machine Learning,* Springer

Course Title	**Selected Topics in Algorithms**	Course No.	**CS660**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To pursue deeper selected topics in algorithms

Learning Outcomes

1. Ability to address research level problem in Algorithms

Course Title	**Selected Topics in Networking and Communication**	Course No.	**CS661**
Department	Computer Science and Engineering	L-T-P [C]	3-0-0 [3]
Offered for	M. Tech. / B. Tech final year	Type	Elective
Pre-requisite	Consent of Teacher	To take effect from	July 2014

Objectives

1. To pursue deeper selected topics in data communication & networking

Learning Outcomes

1. Ability to address research level problem in data communication & networking

…

CSE1

Course Booklet for B.Tech.

(Computer Science & Engineering)

2015