Course Curriculum and Detailed Syllabi

For

B. Tech. Computer Science & Engineering

Effective for

Students admitted in the

Academic Session 2017-18 onwards

Department of Computer Science & Engineering

School of Engineering

Harcourt Butler Technical University, Kanpur

Kanpur-208002

(Approved in the Meeting of the Board of Studies dated 18.06.2017)

1. **About the Department**

   The Department of Computer Science & Engineering was established in 1984 with a 4-year B. Tech. program in Computer Science & Engineering having an intake of 30 students. A 3-year Post Graduate Program, Master of Computer Application (MCA), with an intake of 60 students was introduced in 1987. Under IT task force recommendations, B. Tech. Information Technology Program with an intake of 60 students was introduced in the year 2000. Currently, the department is running B. Tech. Computer Science & Engineering, B. Tech. Information Technology and MCA with students' intake of 60, 30 and 60 respectively. One of the youngest, but among the most efficient departments, it is reputed for producing the best quality software engineers who serve in leading companies in India and abroad. The students have an in-depth exposure to computing environment consisting of state-of-the-art machines in different laboratories. In order to identify Industrial projects for the students and to expose them to the industrial environment, the department has continuous interaction with the Industries.

2. **Vision**

   To excel in Computer Science & Engineering education, research, innovation and global employability.

3. **Mission**

   1. Achieve academic excellence in Computer Science & Engineering through an innovative teaching-learning process.
   2. Inculcate technical competence and collective discipline in students to excel for global employability, higher education and societal needs.
   3. Establish focus research groups in leading areas of Computer Science & Engineering.
   4. Sustain quality in Computer Science & Engineering education & research through continuous & rigorous assessment.

4. **Program Educational Objectives (PEOs)**

   1. To inculcate professional culture amongst the students to take up technical/ professional positions for design, development, and problem solving in software industries and R&D organizations.
   2. To prepare students as technical, ethical, responsible solution providers and entrepreneurs in various areas of Computer Science & Engineering.
   3. To provide the necessary competence and capability in students to pursue higher studies in Institutions of International / National repute.
   4. To provide analytical and technical ability to develop and innovate systems and technologies in the leading areas of Computer Science & Engineering.

5. **Program Outcomes (POs)**

   Engineering Graduates will be able to:

   1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
   2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
   3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

6. Program Specific Outcomes (PSOs)

By the completion of B. Tech. Computer Science & Engineering program, the students will achieve the following program specific outcomes:-

1. The ability to understand, analyse and develop applications in the field of algorithms, system software, databases, web design, networking and artificial intelligence.
2. The ability to apply standard practices and strategies in software project development using suitable programming environment to deliver a quality product.
3. The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, and a zest for higher studies.
4. The ability to use research based knowledge to do literature survey, formulate problem, design & carry-out experimentation, analyse & interpret experimental results for complex research problems.

7. Consistency/Mapping of PEOs with Mission of the Department

PEO Statements	M1	M2	M3	M4
PEO1: To inculcate professional culture amongst the students to take up technical/ professional positions for design, development, and problem solving in software industries and R&D organizations.	2	3	2	3
PEO2: To prepare students as technical, ethical, responsible solution providers and entrepreneurs in various areas of Computer Science & Engineering.	3	3	1	2

PEO3: To provide the necessary competence and capability in students to pursue higher studies in Institutions of International / National repute.	2	3	3	2
PEO4: To provide analytical and technical ability to develop & innovate systems and technologies in the leading areas of Computer Science & Engineering.	3	3	3	2

1: Slight (Low)   2: Moderate (Medium)   3: Substantial (High)   "-": No correlation

8. Components of the curriculum
(*Program curriculum grouping based on course components)*

Sr. No.	Curriculum Content			
	Course Component	**% of total number of credits of the Program**	**Total number of contact hours**	**Total number of Credits**
1.	Basic Sciences (BSC)	14.53	28	25
2.	Engineering Sciences (ESC)	16.28	36	28
3.	Humanities and Social Sciences (HMSC)	6.98	13	12
4.	Program Core (PCC)	34.88	68	60
5.	Program Electives (PEC)	9.30	16	16
6.	Open Electives (OEC)	8.72	15	15
7.	Project(s) (PRC)	8.14	28	14
8.	Internships/Seminars (ISC)	1.16	04	02
9.	Any Other (Please Specify) (MDC)	0.00	06	00
10.	**Total Credits**		**214**	**172**

Department of Computer Science & Engineering

Course Structure (Semester wise)

B. Tech. Computer Science & Engineering

(Applicable w.e.f. the Session 2017-18)

Year I, Semester-I

Sr. No.	Course Type	Course Code	Course Name	Credits	Details of Sessional Marks				ESM	Total Marks
					CT	TA	Lab	Total		
1	BSC	BPH-101 / BPH-102	Physics	4 (3-0-2)	15	20 (10T+10P)	15	50	50	100
2	BSC	BMA-101	Mathematics-I	4 (3-1-0)	30	20	-	50	50	100
3	ESC	EEE-101 / EEE-102	Electrical Engineering	4 (3-0-2)	15	20 (10T+10P)	15	50	50	100
4	ESC	EME-101 / EME-102	Engineering Mechanics	3 (3-0-0)	30	20	-	50	50	100
5	HSMC	HHS-103 / HHS-104	Professional Communication	3 (2-0-2)	15	20 (10T+10P)	15	50	50	100
6	HSMC	HHS-101 / HHS-102	English Language & Composition	2 (2-0-0)	30	20	-	50	50	100
		Total Credits		20						

Year I, Semester-II

Sr. No.	Course Type	Course Code	Course Name	Credits	Details of Sessional Marks				ESM	Total Marks
					CT	TA	Lab	Total		
1	BSC	BCY-101 / BCY-102	Chemistry	4 (3-0-2)	15	20 (10T+10P)	15	50	50	100
2	BSC	BMA-102	Mathematics-II	4 (3-1-0)	30	20	-	50	50	100
3	ESC	EET-101 /EET-102	Electronics Engineering	3 (3-0-0)	30	20	-	50	50	100
4	ESC	ECE-101 / ECE-102	Engineering Graphics	3 (0-0-6)	15	20	15	50	50	100
5	ESC	ECS-101 / ECS-102	Computer Concepts & 'C' Programming	4 (3-0-2)	15	20 (10T+10P)	15	50	50	100
6	ESC	EWS-101 /EWS-102	Workshop Practice	2 (0-0-4)		20	30	50	50	100
7	MDC	ECE-103 / ECE-104	Environment & Ecology	0 (2-0-0)					50	50
		Total Credits		20						

Year II, Semester-I

Sr. No.	Course Type	Course Code	Course Name	Credits	Details of Sessional Marks				ESM	Total Marks
					CT	TA	Lab	Total		
1	PCC	ECS-201	Data Structure using C	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
2	PCC	ECS-203	Computer Organisation & Architecture	4 (3-1-0)	30	20	-	50	50	100
3	ESC	EET-201	Digital Electronics	4 (3-1-0)	30	20	-	50	50	100
4	BSC	BMA-203	Computer Oriented Numerical & Statistical Techniques	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
5	HSMC	HHS-201	Engineering Economics & Management	4 (3-1-0)	30	20	-	50	50	100
6	MDC	HHS-205	Indian Constitution	0 (2-0-0)					50	50
		Total Credits		22						

Year II, Semester-II

Sr. No.	Course Type	Course Code	Course Name	Credits	Details of Sessional Marks				ESM	Total Marks
					CT	TA	Lab	Total		
1	PCC	ECS-202	Software Engineering	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
2	PCC	ECS-204	Object Oriented Systems	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
3	ESC	EIT-202	Web Technology	4 (3-0-2)	15	20 (10T+10P)	15	50	50	100
4	BSC	BMA-204	Discrete Mathematical Structures	4 (3-1-0)	30	20	-	50	50	100
5	HSMC	HHS-204	Organisational Behaviour	4 (3-1-0)	30	20	-	50	50	100
6	MDC	ECS-206	Cyber Security	0 (2-0-0)					50	50
		Total Credits		22						

Year III, Semester-I

Sr. No.	Course Type	Course Code	Course Name	Credits	CT	TA	Lab	Total	ESM	Total Marks
						Details of Sessional Marks					
1	PCC	ECS-301	Design & Analysis of Algorithms	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
2	PCC	ECS-303	Database Management Systems	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
3	PCC	ECS-305	Theory of Automata & Formal Languages	4 (3-1-0)	30	20	-	50	50	100
4	PCC	ECS-307	Principles of Programming Languages	4 (3-1-0)	30	20	-	50	50	100
5	OEC (Maths)	BMA-341	Operation Research	4 (3-1-0)	30	20	-	50	50	100
	Total Credits			**22**						

Year III, Semester-II

Sr. No.	Course Type	Course Code	Course Name	Credits	CT	TA	Lab	Total	ESM	Total Marks
						Details of Sessional Marks					
1	PCC	ECS-302	Computer Networks	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
2	PCC	ECS-304	Operating Systems	5 (3-1-2)	15	20 (10T+10P)	15	50	50	100
3	PCC	ECS-306	Compiler Design	4 (3-1-0)	30	20	-	50	50	100
4	PCC	ECS-308	Computer Graphics	4 (3-0-2)	15	20 (10T+10P)	15	50	50	100
5	OEC (HSS)	HHS-342	Entrepreneurship Development	4 (3-1-0)	30	20	-	50	50	100
	Total Credits			**22**						

Year IV, Semester-I

Sr. No.	Course Type	Course Code	Course Name	Credits	Details of Sessional Marks				ESM	Total Marks
					CT	TA	Lab	Total		
1	PCC	ECS-401	Artificial Intelligence	4 (3-1-0)	30	20	-	50	50	100
2	PEC	ECS-	Elective-I	4 (3-1-0)	30	20	-	50	50	100
3	PEC	ECS-	Elective-II	4 (3-1-0)	30	20	-	50	50	100
4	OEC		Open Elective-I	4 (3-1-0)	30	20	-	50	50	100
5	ISC	ECS-451	Seminar & Industrial Report	2 (0-0-4)		50	-	50		50
6	PRC	ECS-497	Project	4 (0-0-8)			50	50		50
			Total Credits	**22**						

Year IV, Semester-II

Sr. No.	Course Type	Course Code	Course Name	Credits	Details of Sessional Marks				ESM	Total Marks
					CT	TA	Lab	Total		
1	PEC	ECS-	Elective -III	4 (3-1-0)	30	10	-	50	50	100
2	PEC	ECS-	Elective-IV	4 (3-1-0)	30	10	-	50	50	100
3	OEC		Open Elective-II	4 (3-1-0)	30	10	-	50	50	100
4	PRC	ECS-498	Project	10 (0-0-20)			50	50	50	100
			Total Credits	**22**						

Elective-I
1 Mobile Application Development (EIT-411)
2 Data Warehousing & Data Mining (ECS-411)
3 Cloud Computing (ECS-413)
4 Advance Computer Architecture (ECS-415)

Elective-II
1 Network Security (ECS-431)
2 Digital Image Processing (ECS-433)
3 Real Time Systems (ECS-435)
4 Machine Learning (ECS-437)

Elective-III
1 Mobile Computing (EIT-412)
2 Embedded Systems (ECS-412)
3 Big Data Analytics (ECS-414)
4 Distributed Systems (ECS-416)

Elective-IV
1 Internet of Things (EIT-432)
2 Software Project Management (ECS-434)
3 Software Quality Engineering (ECS-436)
4 Soft Computing (ECS-438)

Open Elective-I: (Can be opted by the students of other than CSE Branch)
1 Machine Learning (ECS-437)

Detailed Syllabus

Ist Year

PHYSICS (BPH-101/102)

	Type	L	T	P	Credits
	BSC	3	0	2	4

Prerequisite: Basic knowledge of Maths (12th level) and preliminary idea of Vector calculus

Course Content:

Unit-1: Introductory Mechanics & Theory of Relativity:(Lectures: 08)
Potential energy function $F = -\text{grad}\ (V)$, equipotential surfaces, meaning of gradient, divergence, curl and their physical significance, Conservative and Non-Conservative forces, Curl of a force, Central forces, Examples of Central forces, Conservation of Angular Momentum, Inertial and Non-Inertial Frames of reference, Galilean transformation, Michelson Morley Experiment, Lorentz Transformation, Length contraction, Time dilation and Evidences for time dilation, Relativistic velocity addition formula, Relativistic variation of mass with velocity, Evidence of mass variation with velocity, Einstein's Mass energy equivalence, Examples from nuclear physics, Relativistic energy momentum relation.

Unit-2: Quantum Mechanics-Schrodinger Equation and its Applications: (Lectures: 08)
Dual Nature of matter & Radiation, Heisenberg's uncertainty Principle and their applications, wave group concept, Davisson Germer experiment, Postulates of quantum mechanics, Significance of wave function, Derivation of Schrodinger equation for time independent and time dependent cases, Application of Schrodinger wave equation for a free particle, Particle in a box (one dimensional and three dimensional), Simple harmonic oscillator (one dimensional).

Unit-3: Electromagnetic Theory: (Lectures: 08)
Ampere's law and Faraday's law of electromagnetic induction, Maxwell's equations, Correction of Ampere's law by Maxwell (concept of displacement current), transformation from integral to differential form, Physical significance of each equation, Poynting theorem, Maxwell's equations in free space, velocity of electromagnetic wave, Transverse character of the wave and orthogonality of **E**, **H** and **V** vectors, Maxwell's equation in dielectric medium and velocity of e.m. wave, Comparison with free space, Maxwell's equations in conducting media, Solution of differential equation in this case, penetration depth, its significance.

Unit-4: Materials of Technological Importance: (Lectures: 09)
Dielectric Materials: Electric field in presence of dielectric medium, concept of electric polarization, different types of polarizations, dielectric in A. C. field, concept of dielectric loss and loss energy.
Semiconducting Materials: Concept of energy bands in solids, carrier concentration and conductivity in intrinsic semiconductors and their temperature dependence, carrier concentration and conductivity in extrinsic semiconductors and their temperature dependence, Hall effect in semiconductors, compound semiconductors.
Nano Materials: Basic principles of nano science and technology, preparation, structure and properties of fullerene and carbon nanotubes, applications of nanotechnology.

Unit-5: Statistical Mechanics & Lasers: (Lectures: 09)
Phase space, the probability of distribution, most probable distribution, Maxwell-Boltzmann Statistics, Applications of Maxwell-Boltzmann Statistics, derivation of average velocity, RMS velocity and most probable velocity in the above case, Bose-Einstein Statistics, application to black body radiation, distribution law of energy, Planck's radiation formula and Stefan's law, Fermi – Dirac statics, application in case of free electrons in metals, energy distribution, Fermi energy.
Lasers: Spontaneous and stimulated emission of radiations, Einstein's theory of matter-radiation interaction, Einstein's coefficients and relation between them, Population inversion, components of a laser, different kinds of lasers, Ruby laser, He-Ne laser, properties of laser beams, mono-chromaticity, coherence, directionality, and brightness, applications of lasers.

Text and Reference Books:

1. Physics, Marcelo Alonso, J. Finn Edwards, Addison Wesley
2. Perspectives of Modern Physics, Arthur Beiser, McGraw Hill
3. Engineering Physics, R. K. Shukla, Pearson Education
4. Electrical Engineering Materials, R.K. Shukla, McGraw Hill
5. Introduction to Electrodynamics, David Griffiths, Cambridge University Press
6. Principles of Engineering Physics, R.K. Shukla, Ira Books
7. Introduction to Solid State Physics, Charles Kittel, Wille**y**

Lab Work:

Any ten (10) experiments from the following
1. To determine the energy of band gap of a N-type Ge-semiconductor using four probe method
2. Verification of Stefan's fourth power law for black body radiation, determination of the exponent of the temperature
3. Study of thermoelectricity: Determination of thermo-power of Copper-constantan thermo-couple
4. To study the variation of magnetic field with distance along the axis of current carrying coil and then to estimate the radius of the coil
5. Study of Carrey Foster's bridge: determination of resistance per unit length of the bridge wire and of a given unknown resistance
6. Determination of specific charge (charge to mass ratio; e/m) for electron
7. Study of tangent galvanometer: determination of reduction factor and horizontal component of earth's magnetic field
8. Determination of the wavelength of sodium light using Newton Rings' method
9. To determine the concentration of sugar solution using half shade polarimeter
10. Determination of wavelength of spectral lines of mercury (for violet, green, yellow-1 and yellow-2) using plane transmission grating
11. Determination of charge sensitivity and ballistic constant of a ballistic galvanometer
12. To determine the wavelength of spectral lines of hydrogen & hence to determine the value of Rydberg Constant
13. Draw the V-I characteristic of Light Emitting Diode (LED) and determine the value of Planck's constant

Course Outcomes

1. To understand and to apply principle of conservation of momentum e.g. in rocket propulsion and in many other space applications. To understand the theory of relativity and to analyse how the physical quantities undergo drastic changes in their original value at very high velocities and also to see how its principles are applicable in particle accelerators, nuclear devices as an alternative sources of energy and for defense purpose.
2. To understand the basics of quantum mechanics, and to apply its principles to learn the phenomena that occur at subatomic dimensions.
3. To understand and to apply Maxwell's equations, which form the basis of electromagnetic theory. This has a wide application in communication systems. All the information propagating in the universe utilizes the principle of electromagnetic theory.
4. To study the fundamentals of material science especially dielectric materials, semiconducting materials and nanomaterial and to apply the knowledge to use how dielectrics are used for the storage of charge. infrared detectors, crystal oscillators, manufacture of microphones, headsets loudspeakers, transducers, ultrasound applications, gas ignitors, accelerometers etc.

Semiconductor material technology which has completely changed the scenario by replacing the older vacuum tube technology, are another technologically important materials which are widely used in LEDs, miniaturisation of electronic devices and to develop materials with improved efficiency and economy.

Nanotechnology is the most emerging field at present and is extremely important. It has got various applications in many areas including information technology, biomedical, energy-storage, automotive industry, electronics industry, textiles and chemical industries.

5. To understand the statistical behaviour of the constituent particles which give rise to form a material, and to apply the principles of statistical mechanics and to understand the basics of Laser.

MATHEMATICS (BMA-101)

Type	L	T	P	Credits
BSC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Functions of One Real Variable
Successive differentiation, Leibnitz theorem, Mean value theorems, sequences and series, Expansion of functions, Improper integrals and their convergence.

Unit-2: Functions of Several Real Variables
Limit, Continuity, Partial differentiation, Total differential and approximations, Jacobian, Euler's theorem Expansion of functions, Beta and Gamma Functions, Multiple integral, Change of order, Change of variables, Applications to area, volume, mass, surface area etc. Dirichlet's Integral & applications.

Unit-3: Vector Calculus
Point functions, differentiation, Gradient, Directional derivative, Divergence and Curl of a vector and their physical interpretations, Solenoidal & irrotational fields, Integration, Line, Surface and Volume integrals Green's. Stoke's and Gauss Divergence theorems (without proof) and applications.

Unit-4: Matrices and Linear Algebra
Vector space and subspace, linear dependence, dimensions and basis, Linear transformation and its matrix representation, Elementary transformations, Echelon form, rank & nullity, Consistency of linear system of equations and their solutions, characteristic equation, Cayley Hamilton theorem, Real and complex eigenvalues and eigenvectors, diagonalisation, quadratic forms, complex, orthogonal, and unitary matrices, Application to Cryptography, discrete, Compartmental models and system stability.

Unit-5: Optimization
Engineering applications of optimization, statement and classification of optimization problems, Optimization techniques, single variable optimization, multi variable optimization with no constraint, with equality and inequality constraints, Linear Programming Problems, Graphical method and Simplex method.

Text and Reference Books:

1. R. K. Jain & S. R. K. lyengar; Advanced Engineering Mathematics, Narosa Publishing House 2002.
2. Erwin Kreyszig: Advanced Engineering Mathematics. John Wiley & Sons 8th Edition.

3. Dennis G. Zill & Michael R Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers, 2nd
6. Edition.
4. S. S. Rao; Optimization: Theory & application Wiley Eastern Limited.
5. T. M. Apostol, calculus, Vol. I, 2nd ed., Wiley 1967.
6. T. M. Apostol, Calculus, Vol. II, 2nd ed., Wiley 1969.
7. Gilbert Strang, Linear Algebra & its applications, Nelson Engineering 2007.
8. Calculus & Analytic Geometry, Thomas and Finny.

Course Outcomes:

1. Calculus is one of the most intellectual achievements in the field of mathematics. It is a collection of fascinating and exciting ideas rather than a technical tool. In particular differential calculus i.e. derivative is useful to solve a variety of problems that arise in engineering, technology, science and fields including social sciences. The study of convergence of the infinite series as well as improper integral has vital importance in engineering & Technology.

2. The Study of partial differentiation and its applications be needful to solve such engineering problems improving quantity (functions) depends on more than one parametric (variable). Some special functions are represented by improper integrals such as beta & gamma functions which are very useful to solve concerned engineering problems. Multiple integrals have been found to be basic application in engineering such as to find areas and volume of various bodies, this is applicable in various fields like, while preparing a machine, or the parts to be fitted in any machine its size and volume etc. are very important.

3. Matrices have been found to be of great utility in many branches of applied mathematics such as algebraic and differential equations, mechanics theory, electrical circuits, nuclear physics, aerodynamics and astronomy. With the advent of computers, the usage of matrix methods has been greatly facilitated.

4. The Vector calculus extends the basic concepts of (ordinary) differential calculus to vector function, by introducing derivative of a vector function and the new concepts of gradient, divergence and curl. Vector integral calculus extends the concepts of (ordinary) integral calculus to vector functions. It has applications in fluid flow design of under-water transmission cables, study of satellites. Line integral is useful in the calculation of work done by variable forces along paths in space and the rates at which fluid flow along curve (circulation) and across boundaries (flux).

5. Optimization theory and methods have been applied in many fields to handle various practical problems. In light of advances in computing systems, optimization techniques have become increasingly important and popular in different engineering applications.

6. An important application of multivariable differential calculus is finding the maximum and minimum values of functions of several variables. Such as in the study of stability of the equilibrium states of mechanical and physical systems, determination of extrema is of greatest importance.

ELECTRICAL ENGINEERING (EEE-101/102)

	Type	L	T	P	Credits
	BSC	3	0	2	4

Prerequisite:

Course Content:

Unit-1: DC Circuit Analysis and Network Theorems: Circuit Concepts: Concepts of Network, Active and Passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements. R L and C as linear elements. Source Transformation. Kirchhoff's Law; loop and nodal methods of analysis; star – delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem. (Simple Numerical Problems)

Unit-2: Steady State Analysis of Single Phase AC Circuits: AC Fundamentals: Sinusoidal, Square and Triangular waveforms – average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel, and series – parallel RLC Circuits: Apparent, Active & Reactive Powers, Power factor, causes and problems of low power factor, power factor improvement. Resonance in Series and Parallel Circuits, Bandwidth and Quality Factor. (Simple Numerical Problems)

Unit-3: Three Phase AC Circuits: Three Phase System – its necessity and advantages, meaning of phase sequence and star and delta connections, balanced supply and balanced load, line and phase voltage / current relations, three phase power and its measurement. (Simple Numerical Problems)

Measuring Instruments: Types of instruments: Construction and Working Principles of PMMC and Moving Iron type Voltmeter & Ammeters, Single Phase Dynamometer Wattmeter and Induction Type Energy Meter, use of Shunts and Multipliers. (Simple Numerical Problems on Energy Meter, Shunts and Multipliers)

Unit-4: Introduction To Power System: General layout of Electrical Power system and functions of its elements, standard transmission and distribution voltages, concept of grid. Magnetic Circuit: Magnetic circuit concepts, analogy between Electric & Magnetic circuits, Magnetic circuits with DC and AC excitations, Magnetic leakage. B-H curve, Hysteresis and Eddy Current looses, Magnetic circuit calculations mutual Coupling. Single Phase Transformer: Principle of Operation, Construction, e.m.f. equation, equivalent circuit, Power losses, efficiency, introduction to auto transformer. (Simple Numerical Problems)

Unit-5: Electrical Machines: Principles of electro mechanical energy conversion.

DC Machines: Types of DC machines, e.m.f. equation of generator and torque equation of motor, characteristics and applications of dc motors. (Simple Numerical Problems). Three Phase Induction Motor: Types, Principle of Operation, Slip – torque Characteristics, applications. (Simple Numerical Problems). Single Phase Induction Motor: Principle of Operation and introduction to methods of starting, applications. Three Phase Synchronous Machines: Principle of Operation of alternator and synchronous motor and their applications.

Lab Work:

A minimum ten experiments out of the following list.
1. Verification of Kirchhoff's laws.
2. Verification of (1) Superposition Theorem (2) Thevenin's Theorem (3) Maximum Power Transfer Theorem.
3. Measurement of power and power factor in a 1 – Ø ac series inductive circuit and study improvement of power factor using capacitor.
4. Study of phenomenon of resonance in RLC series circuit and obtain the resonant frequency.

5. Measurement of power in 3 – Ø circuit by Two Wattmeter method and determination of its power factor.
6. Determination of parameter of ac 1 – Ø series RLC Circuit.
7. Determination of (1) Voltage Ratio (2) Polarity and (3) Efficiency by load test of a 1 – Ø Transformer.
8. To Study speed control of dc shunt motor using (1) Armature Voltage Control (2) Field Flux Control.
9. Determination of Efficiency of a dc shunt motor by load test.
10. To study running and speed reversal of a 3 – Ø induction motor and record its speed in both direction.
11. To measure energy by a 1 – Ø energy meter and determine error.
12. Department may add any three experiments in the above list.

Text and Reference Books:

1. V. Del Toro, "Principles of Electrical Engineering" Prentice Hall International
2. I. J. Nagarath, "Basic Electrical Engineering" Tata Mc - Graw Hill
3. D. E. Fitzgerald & A. Grabel Higginbotham, "Basic Electrical Engineering" Mc - Graw Hill
4. Edward Hughes, "Electrical Technology" Longman
5. T. K. Nagsarkar & M. S. Sukhija, "Basic Electrical Engineering" Oxford University Press
6. H. Cotton, "Advanced Electrical Technology" Wheeler Publishing
7. W. H. Hayt & J. E. Kennely, "Engineering Circuit Analysis" Mc - Graw Hill

Course Outcomes:

ENGINEERING MECHANICS (EME-101/102)

	Type	L	T	P	Credits
	ESC	3	0	0	3

Prerequisite: Class XII Mathematics & Physics

Course Content:

Unit-1:
Two Dimensional Force Systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations of Equilibrium, Applications.
Friction: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Applications.
Unit-2:
Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams.
Trusses: Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.
Unit-3:
Centroid and Moment of Inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.
Unit-4:
Simple Stress and Strain: Introduction, Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.
Compound stress and strains: Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle, Theories of Failure.
Unit-5:
Pure Bending of Beams: Introduction, Simple Bending Theory, Stress in beams of different cross sections.
Torsion: Introduction to Torsion of circular shaft, combined bending & torsion of solid & hollow shafts.

Text and Reference Books:

1. Engineering Mechanics by R.K.Bansal
2. Strength of Materials by R.K. Rajput
1. Engineering Mechanics by Irving H. Shames, Prentice-Hall
2. Mechanics of Materials by E. P. Popov, PHI
3. Strength of Materials by Ryder
4. Mechanics of Material by Gere & Timoshenko
5. Engineering Mechanics by A. Nelson
6. Engineering Mechanics by U.C. Jindal
7. Engineering Mechanics Statics by J. L. Meriam & L.G.Kraige

1. Apply basic principal of mechanics and its application in engineering problems.
2. Determine resultants and apply conditions of static equilibrium to plane force systems
3. Identify and quantify all forces associated with a static framework
4. Generate and sketch shear force and bending moment diagrams
5. Derive and apply stress and strain relationships in single and compound members subject to axial force, bending moment and torsion.
6. Stress analysis for two dimensional stress systems.

PROFESSIONAL COMMUNICATION (HHS-103/104)

Type	L	T	P	Credits
HSMC	2	0	2	3

Prerequisite: NIL

Course Content:

Unit-1: Fundamentals of Technical Communication:
Process of communication, language as a tool of communication, levels of communication, flow of communication, barriers to communication, communication across cultures; Technical Communication: meaning, significance, characteristics, difference between technical and general communication.

Unit-2: Elements of Written Communication:
Words and phrases, word formation, synonyms and antonyms, homophones, one word substitution, sentence construction, paragraph construction,

Unit-3: Forms of Technical Communication:
(A) Business letters, job application letter and resume, business letters: sales & credit letters, letters of enquiry, letters of quotation, order, claim and adjustment letters, official letters: D.O. letters, government letters, letters to authorities, etc.
(B) Technical Reports: general format of a report, formal and informal reports, memo report, progress report, status report, survey report, trip report, complaint report, , Joining Report ,laboratory report, research papers, dissertations and theses. E-mail writing, Technical Proposals: purpose, characteristics, types, structure.

Unit-4: Presentation Strategies:
Defining the subject, Scope and purpose, analysing audience & locale, collecting materials, preparing outlines, organising the contents, visual aids, nuances of delivery, extemporaneous, manuscripts, impromptu, non- verbal strategies.

Unit-5: Value-based Text Reading:
(A) Study of the following essays from the text book with emphasis on writing skills:
1. Man and Nature   by J. Bronowski
2. The Language of Literature and Science   by Aldous Huxley
3. The Aims of Science & the Humanities   by Moody E Prior
4. Gods in this Godless Universe   by Bertrand Russell
5. Science and Survival   by Barry Commoner

(B) Readings of selected short stories:
1. The Renunciation   by Rabindranath Tagore
2. The Lament   by Anton P. Chekhov
3. The Barber's Trade Union   by Mulk Raj Anand

4. The Eyes Are Not Here   by Ruskin Bond

Lab Work:

Interactive practical sessions with emphasis on oral presentations/ spoken communication:
1. Group Discussions: selected topical issues to be discussed in groups.
2. Mock interviews
3. Communication skills for seminars/conferences/workshops with emphasis on non-verbal skills.
4. Presentation skills for technical papers/project reports/professional reports.
5. Theme presentation/ key note presentation based on correct argumentation methodologies.
6. Argumentative skills
7. Role play
8. Comprehension skills based on reading and listening practice, asking questions.
9. Introduction to International Phonetics Alphabets
10. Audio Visual demonstration of effective communicative strategies & TED Talks

Text and Reference Books:

1. 'Improve Your Writing', V N Arora and Laxmi Chandra, Oxford University Press, New Delhi
2. 'An Anthology of English Short Stories', edited by R P Singh, Oxford University Press.
3. 'Technical Communication- Principles and Practices',Meenakshi Raman & Sangeeta Sharma, Oxford University Press, New Delhi.
4. Effective Technical Communication, by Barun K Mitra, Oxford University Press.
5. Business Correspondence & Report Writing by R.C. Sharma & Krishna Mohan, Tata McGraw Hill, N.D.
6. Developing Communication Skills by Krishna Mohan & Meera Banerjee, Macmillan India.
7. 'Technical Communication- Principles and Practices' by M R S Sharma, Oxford University Press, New Delhi.
8. Sethi and Dhamija, 'A Course in Phonetics and Spoken English', Prentice Hall of India, New Delhi.
9. Joans Daniel, 'English Pronouncing Dictionary', Cambridge University Press.
10. R. K. Bansal & J.B. Harrison, Spoken English for India, Orient Longman.
11. Excellence in Business Communication, Boeuve & Thill and Courtland.

Course Outcomes:

At the end of this course students should be able to:
1. Effectively communicate their ideas in the contemporary global competitive environment.
2. Convey their messages through constructive writing.
3. Draft potent E-Mails, letters, proposals and reports.
4. Present their presentations along with using all nuances of delivery with clarity and thoroughness.
5. Solve problems based on real time situations and articulate them eventually.

ENGLISH LANGUAGE AND COMPOSITION (HHS-101/102)

	Type	L	T	P	Credits
	HSMC	2	0	0	2

Prerequisite:

Course Content:

Unit-1: Basic Applied Grammar and Usage (Sentence Structure-1)
Constituent of a sentence- noun, verb, adjective, preposition, etc.; use of articles, adjectival forms, prepositions, adverbs; verb forms; finite and non-finite verbs, gerund and participles, auxiliary verbs. Tense and mood, Subject- verb concord, pronoun concord

Unit-2: Sentence Structure-2
(i) adverb clause, adjective clause, noun-clause; (ii) negation and interrogation; (iii) passive; (iv) exclamatory; (v) transformations; (vi) tense forms; (vii) varieties of sentences; (viii) placement of modifiers

Unit-3: Paragraph Writing
Structure of Paragraph, Topic Sentence, Construction of Paragraph, Technique of Paragraph writing, Unity, Coherence, Emphasis

Unit-4: Comprehension and Précis Writing
Reading and listening comprehension, improving comprehension skills, précis writing

Unit-5: Short Essay Writing
Dimension of essay writing- literary, Scientific, Comparison and Contrast, Narrative, Descriptive, Reflective, Expository, Argumentative and Imaginative

Text and References Books:

1. Das, B K and A David, 'A Remedial Course in English for Colleges', (Book -1, 2, 3) Oxford University Press, New Delhi.
2. Sinha, R P, 'Current English Grammar and Usage with Composition', Oxford University Press, New Delhi.
3. Wren, P C & Martin, 'English Grammar and Composition', S Chand & Co Ltd. New Delhi.
4. A. S. Horne, Guide to Pattern and usage in English, Oxford University Press, N.D.
5. M. L. Tickoo & A. E. Subramanian, Intermediate Grammar, usage & composition, Orient Longman

Course Outcomes:

1. Write professional statements & organizational communications.
2. Develop writing skills by applying different strategies on organisation system.
3. Develop the project reports, their relevance and significance.

CHEMISTRY (BCY-101/102)

	Type	L	T	P	Credits
	BSC	3	0	2	4

Prerequisite: Basic knowledge of Maths (12ᵗʰ Level)

Course Content:

Unit-1:
*Bonding***:** CFT, Electronic Spectra and Ligands (strong and weak field), Phosphorescence and Fluorescence, Jablonski diagram, hydrogen bonding and their effect on physical properties, Metallic bonds, Classification and Applications of Liquid crystals, Band Theory of Solids and superconductors.
(Lectures: 7-8)

Spectroscopy: Basic Principles, Instrumentation and Applications of UV-VIS and IR Spectroscopy.
(Lectures: 5-6)

Unit-2:
Chemical Kinetics: Second order reactions. Determination of order, Fast and slow reaction, steady state approximation, Temperature effect, Concept of Activated Complex/Transition State: Energy of activation, Potential energy surface, Theories of reaction rate: Collision and Transition State theories in terms of enzyme catalysis. (Lectures: 4-5)

Unit-3:
Electrochemistry: Dry and fuel cells, electrochemical cell, Solar cells, Disensitized cell, Photovoltaic cell. (Lectures: 3-4)

*Environmental Chemistry***:** Air and Water Pollution, analysis of gaseous effluents oxides of Nitrogen, oxides of Sulphur and H_2S, chemical analysis of effluents liquid streams, BOD, COD, control of pollution, Depletion of ozone layer. (Lectures: 5-6)

Unit-4:
*Stereochemistry***:** Stereoisomerism of organic compounds containing one & two chiral centers. Enantiomers & Diastereomers, E-Z nomenclature, R-S configuration, Atropisomerism, and Optical isomerism in Allenes, biphenyl and Spiranes, Circular Dichroism. (Lectures: 5-6)

Reaction Mechanism: Inductive, Electromeric and Mesomeric effects. Study of reaction intermediates (Carbanion, carbocation, carbene, nitrene and benzyne). Mechanism of nucleophilic and electrophilic substitution reactions. Mechanism and application of following reactions:
   a) Suzuki-Miyaura Cross coupling reaction
   b) Fries and Photo-Fries Rearrangement
   c) Wagner- Meerweir Rearrangement
   d) Umpolung Reactions
   e) Reaction of vision **(**Lectures: 4-5)

Unit-5:
Polymers: Introduction and their classifications, types of polymerization, Free radical, anionic and cationic polymerization, Preparation, Rheological properties and uses of some common polymers. Synthetic Polymers (carbon framework, silicon framework, fluorinated polymer), Conducting and Biodegradable polymers. (Lectures: 4-5)

*Water Analysis***:** Introduction; Hardness of Water- cause, types, units, Disadvantages of using hard water for domestic and industrial purposes, Softening of hard water, Chemical analysis of Water- estimation of free chlorine, total alkalinity, hardness, Numerical based on determination of hardness.
(Lectures: 4-5)

Lab Work:

1. Determination of alkalinity in given water sample.
   a. Sodium Carbonate & Sodium Bicarbonate
   b. Sodium Carbonate & Sodium Hydroxide
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of Chloride content of water by Mohr's Method.
4. Determination of Chlorine content in Bleaching powder.
5. Determination of strength of supplied Ferrous Ammonium Sulphate (FAS) solution in using external, internal indicators.
6. Determination of viscosity of a given liquid by Ostwald's viscometer.
7. Determination of surface tension of a given liquid by Stalagmometer.
8. pH determination of given sample.
9. Determination of iron content of water by Mohr's Method.
10. Determination of Dissociation constant of weak acids by conductometric Titration.

Text and Reference Books:

1. Advance Organic Chemistry by Jerry March, Third Edition Wiley Eastern Limited, New Delhi.
2. Organic Chemistry by Morrision & Boyd, Allyn and Bacon, Inc. Boston.
3. Physical Chemistry by Puri, Sharma & Pathania, Peter Atkins & Julio de Paula, Arun Bahl, B.S. Bahl & G.D.Tuli.
4. Textbook of Physical Chemistry by S. Glasstone, Macmillan and Co. Ltd., London.
5. Chemical Kinetics and Reaction Dynamics by Puri, Sharma & Pathania.
6. Principles of Polymerization by George Odian.
7. Polymer Science by V. R. Gowarikar, N. V. Vishwanathan and J. Shridhar, Wiley Eastern Ltd., New Delhi.
8. Principles of Instrumental Analysis by Douglas and Skoog, Saunder College Publishing Co., New York.
9. Engineering Chemistry by Jain & Jain, Dhanpat Rai Publication Co., New Delhi.
10. Application of Absorption Spectroscopy of Organic Compounds by John R. Dyer, Prentice Hall of India Pvt. Ltd., New Delhi.
11. Spectroscopy of Organic Compounds by P.S. Kalsi, Y.R. Sharma.

Course Outcome:

1. Interpret UV-Visible and IR–Spectra. (Apply)
2. Describe a reaction rate having various reaction orders. (Understand)
3. Understand different aspects of corrosion (Chemical and electrochemical corrosion, mechanism, factors affecting, protection and practical problems, prevention methods). Thermodynamic overview of electrochemical processes. Reversible and irreversible cells. (Understand)
4. Gain hands-on experience in making different polymers, distinguish between different polymeric structures, classify polymers and analyze the polymerization mechanism. The uses of polymers in different walks of life. (Apply)
5. Knowledge of conductivity polymers, bio-degradable polymers and fiber reinforced plastics. (Understand)
6. Acquire knowledge about water and treatment of municipal water. (Understand)

Experimental Outcome:

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
1. Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
2. Communicate the results of scientific work.
3. Measure molecular/system properties such as surface tension, viscosity, conductance of solution.
4. Chemical analysis of water-hardness, alkalinity, pH and chloride content.

Expected Experimental Learning Outcomes

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will be able to:
1. Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. (Apply, Analyse)
2. Be skilled in problem solving, critical thinking and analytical reasoning as applied to scientific problems. (Apply, Analyse)
3. Clearly communicate the results of scientific work in oral, written and electronic formats to both scientists and the public at large. (Apply)
4. Explore new areas of research in both chemistry and allied fields of science and technology. (Analyse)
5. Appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals, environmental issues and key issues facing our society in energy, health and medicine. (Understand)
6. Design and carry out scientific experiments as well as accurately record and analyze the results of such experiments. (Apply)
7. Communicate the results of scientific work. (Understand)
8. Measure molecular/system properties such as surface tension, viscosity, conductance of solution. (Apply)
9. Perform Chemical analysis of water-hardness, alkalinity, pH and chloride content.

MATHEMATICS-II (BMA-102)

Type	L	T	P	Credits
BSC	3	1	0	4

Prerequisite: NIL

Course Content:

Unit-1: Ordinary Differential Equations

First order ordinary differential equations, Existence and uniqueness of solutions of initial value problems, Solution of higher order linear differential equation with constant coefficients, Solution of second order differential equations by changing dependent and independent variables, Cauchy- Euler equations, Methods of diagonalization, undetermined coefficients and variation of parameters: Nonlinear equations, Linear and nonlinear models, Initial value and boundary value problems, Systems of equations. Application of differential equations as mathematical models, Models from population dynamics, Newton's Law of cooling, electric circuit, Oscillation of spring.

Unit-2: Series Solutions of Ordinary Differential Equations & Special Functions
Ordinary and singular points of an equation, Power series solutions, Frobenius method, Bessel's and Legendre's equations and their series solutions, Properties of Legendre's polynomials and Bessel's functions, Generating functions, Fourier- Bessel series and Fourier-Legendre series expansions, sturm-Liouville Problem and related theorems.

Unit-3: Laplace Transform
Laplace transform, Existence conditions and ROC, Inverse Laplace transform, Operational properties, Convolution, Unit step function, Dirac-Delta function, Periodic functions, Applications to solve IVP and BVP: Linear ordinary differential equations, Transfer function and control system analysis.

Unit-4: Fourier Series and Partial Differential Equations
Orthogonal functions, Fourier series, existence conditions, Fourier series of even and odd functions, convergence of Fourier series, Fourier half range series, Harmonic analysis, Complex Fourier series and frequency spectrum.
Development of partial differential equations and Solutions, Solution of first order partial differential equations, Solutions of linear higher order partial differential equations with constant coefficients.

Unit-5: Boundary-Value Problems
Classification of second order partial differential equations, Derivation of heat and wave equations, solutions in rectangular coordinates by separation variable method, solution of Laplace equation, D'Alemberts solution of wave equation, Non-homogeneous equations and boundary conditions, Orthogonal series expansions, Fourier series in two dimensions, Boundary value problems in polar, cylindrical and spherical coordinate systems and their solutions.

Text and Reference Books:

1. E. A. Coddington, An Introduction to Ordinary Differential Equations, Practice Hall, 1995.
2. I. N. Sneddon, Elements of Partial Differential equations, McGraw-Hill 1957.
1. Dennis G, Zill & Michael R. Cullen; Advanced Engineering Mathematics, Jones & Bartlett Publishers. 2nd Edition.
3. R. K. Jain & S.R.K. Iyengar; Advanced Engineering Mathematics, Narosa Publishing House, 2002.
4. Erwin Kreyszig; Advaced Engineering Mathematics, John Wiley & Sons 8th Edition.

Course Outcomes:

1. All the physical & engineering problems related to rate of change and many practical laws, used in engineering, are expressed mathematically in the form of differential equations so the primary use of differential equations is to serve as a tool for the study of problems regarding change in almost all the branches of engineering & technology.
2. The solutions of many differential equations arises from physical problems and important differential equations such as Bessel's equation and Legendre equation cannot be expressed in terms of elementary functions in closed form so in such cases, it is easier to find an approximate solutions in the form of the convergent infinite series. The series solutions many reveal important information's about the nature of solution such as passing through the origin even or odd, increasing & decreasing on a given interval and so on.
3. Laplace transform is a very powerful technique it replaces operations of calculus by operations of algebra. Laplace transform is useful since particular solution can be obtained without first determining the general solution of differential equation. Non-homogeneous equation also can be solved. Solution of mechanical and electrical problems involving discontinuous force function of periodic function are obtained easily.
4. Fourier series is the simple representation of a complicated periodic functions associated as the periodic phenomenon which occur frequently in many physical and engineering problems.

5. It is very useful in the study of heat conduction, mechanics, concentration of chemical and pollutants, electrostatics. The Fourier Transform and series and their analytic properties are very commonly used in telecommunications, digital signal processing, electronic design and more.
6. Several problems in fluid mechanics, solid mechanics, heat transfer, electromagnetic theory and other areas of physics & engineering are modeled as boundary value problems i.e. partial differential equations with boundary value conditions in the different coordinate systems.

ELECTRONICS ENGINEERING (EET-101/102)

Type	L	T	P	Credits
ESC	3	0	0	3

Prerequisite: NIL

Course Content:

Unit-1:
P-N Junction Diode, V-I Characteristics, Diode Application as Rectifier (Half Wave & Full Wave), Zener Diode and its Applications.

Unit-2:
Introduction of Bipolar Junction Transistor, FET: Applications, demo, explanation, OPAMP and its Applications.

Unit-3:
Boolean Algebra, Logic Gates, Concept of Universal Gate. Basic Combinational Circuits: Adder, Subtractor, Sequential Circuits: Flip-Flops, Registers.

Unit-4:
Functional Elements of Instruments, Classification & Characteristics, Types of Errors, Active and Passive Transducers and their Characteristics, LVDT

Unit-5:
Display Devices: Seven Segment Display, Alphanumeric Display, LCD, Dot Matrix Displays, Electronic Ammeter and Voltmeter, Digital Multi-meter, Cathode Ray Oscilloscope.

Text and Reference Books:

1. Malvino, A.P. / "Electronics Principles" / Tata McGraw-Hill / 6th Ed.
2. Boylestad, Robert & Nashelsky, Louis / "Electronic Devices & Circuit Theory" / Prentice Hall of India / 8th Ed.
3. H.S. Kalsi / "Electronic Instrumentation" / Tata McGraw-Hill
4. Malvino & Leach / "Digital Principles & Applications" / Tata McGraw-Hill / 5th Edition.
5. Sedra, Adel S., Smith, Kenneth C. / "Microelectronic Circuits"/ Oxford University Press / 5th Edition.
6. Sawhney AK/ "Electrical and electronic Measurement and Instrumentation"/ Dhanpat Rai & sons.
7. Lectures of NPTEL

Course Objectives:

1. To enhance the fundamental knowledge in electronics engineering and its application relevant to various streams of science and technology
2. To make student conversant with the basic knowledge of instrumentation devices.
3. To acquaint the students with basic knowledge of digital electronics.
4. To develop an understanding of the basic concepts of BJT, FET, CRO, ammeter & voltmeter

Course Outcomes:

The students will have basic knowledge of Electronics and instrumentation engineering related to Diode, BJT, FET, digital electronics, transducers, CRO etc. and they will apply fundamental principles of the related electronics circuit to solve practical problems related to engineering applications.

ENGINEERING GRAPHICS (ECE-101/102)

Type	L	T	P	Credits
ESC	0	0	6	3

Prerequisite: NIL

Course Content:

Unit-1: Lettering and Dimensioning
Introduction, lettering practice, Elements of dimensioning- system of dimensioning.
Geometric Construction: Free hand sketching, Conic section, Special curves.
Engineering scales.
Unit-2: Projection of points and Projection lines
Projection of Points: First and Third Angle projection; Projection of Points. Projection of Lines; Projection of straight lines (First angle projection only); Projection of lines inclined to one plane and both plane, true length and true inclinations.
Unit-3: Projection of Solids and section of solids
Projection of solids: Classification of solids, Projection of solids in simple position, Projection of solids inclined to one plane. Sections of solids: Right regular solids and auxiliary views for the true shape of the sections.
Unit-4: Development of surfaces
Development of surfaces for various regular solids.
Isometric Projection and Perspective projection
Isometric Projection: Isometric scales, Isometric projections of simple and combination of solids:
Perspective projection: Orthographic representation of perspective views – Plane figure and simple solids – Visual ray method.
Unit-5: Orthographic Projection
Conversion of pictorial views into orthographic projection.
Introduction to auto CAD

Text and Reference Book(s)

1. Venugopal K and Prabhu Raja V, " Engineering Graphics", New AGE International Publishers 2015.

2. N.D. Bhatt, Engineering Drawing, Charotar publishing House.
3. Natarajan , K.V., A Text book of Engineering Graphics, Dhanalakshmi Publishers, 2012.
4. K.L. Narayana , P. Kannaiah &K . Venkata Reddy New Age International Publishers.

Course Objectives:

1. To follow basic drawing standards and conventions.
2. To develop skills in three –dimensional visualization of engineering components.
3. To prepare sectional views of solids.
4. To draw the development of surfaces and estimate the sheet metal requirement.
5. To development an understanding of solid modeling using CAD software.

Course Outcomes:

1. Prepare drawing as per standards.
2. Solve specific geometrical problems in plane geometry involving lines, plane figures and special Curves.
3. Prepare sectional views of solids.
4. Draw isometric drawings of combined solids and simple components.
5. Produce orthographic projection of engineering components working from pictorial drawings.
6. Prepare solids modeling of machine components using CAD software.

CONCEPTS OF COMPUTER & 'C' PROGRAMMING (ECS-101/102)

Type	L	T	P	Credits
ESC	3	0	2	4

Prerequisite: NIL

Course Content:

Unit-1:
Introduction to Computers: Computer hardware Components, peripherals and their functions, Number Systems and conversion methods, Concept of an algorithm; termination and correctness. Algorithms to programs: specification, top-down development and stepwise refinement, Introduction to programming environment, use of high level programming language for the systematic development of programs. Introduction to the design and implementation of correct, efficient and maintainable programs, Structured Programming, Trace an algorithm to depict the logic.

Unit-2:
Basic operating System Concepts: Introduction of MS-DOS, WINDOWS, and LINUX Operating Systems, Functional Knowledge of these operating systems, Introduction of basic commands of LINUX and Editors, Managing Files and Directories in LINUX, Programming Environment in LINUX, Writing and executing programs in LINUX.

Unit-3:
Programming in C: History, Introduction to C Programming Languages, Structure of C programs, compilation and execution of C programs, Debugging Techniques, Data Types and Sizes, Declaration

of variables, Modifiers, Identifiers and keywords, Symbolic constants, Storage classes (automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.

Unit-4:

Operators: Unary operators, Arithmetic & logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation. Control statements: if-else, switch, break, and continue, the comma operator, goto statement. Loops: for, while, do-while. Functions: built-in and user-defined, function declaration, definition and function call, and parameter passing: call by value, call by reference, recursive functions, Multi-file programs. Arrays: linear arrays, multidimensional arrays, passing arrays to functions, Arrays and strings.

Unit-5:

Structure and Union: definition and differences, self-referential structure. Pointers: value at (*) and address of (&) operator, pointer to pointer, Dynamic Memory Allocation, calloc and malloc functions, array of pointers, function of pointers, structures and pointers. File Handling in C: opening and closing a data file, creating a data file, read and write functions, unformatted data files.

Lab Work:

1. Write C program to find largest of three integers.
2. Write C program to check whether the given string is palindrome or not.
3. Write C program to find whether the given integer is
   (i). a prime number
   (ii). an Armstrong number.
4. Write C program for Pascal triangle.
5. Write C program to find sum and average of n integer using linear array.
6. Write C program to perform addition, multiplication, transpose on matrices.
7. Write C program to find Fibonacci series of iterative method using user-defined function.
8. Write C program to find factorial of n by recursion using user-defined functions.
9. Write C program to perform following operations by using user defined functions:
   (i) Concatenation
   (ii) Reverse
   (iii) String Matching
10. Write C program to find sum of n terms of series: n –
    n*2/2! + n*3/3! - n*4/4! + ...
11. Write C program to interchange two values using
    (i). Call by value.
    (ii). Call by reference.
12. Write C program to sort the list of integers using dynamic memory allocation.
13. Write C program to display the mark sheet of a student using structure.
14. Write C program to perform following operations on data files:
    (i)   Read from data file.
    (ii)   Write to data file.
15. Write C program to copy the content of one file to another file using command line argument.

Text and References Books:

1. Kernighan, Ritchie, "The C Programming Language", PHI
2. V. Rajaraman, "Fundamentals of Computers", PHI
3. Peter Norton's, "Introduction to Computers", TMH
4. Gottfried, "Programming in C", Schaum's Series, Tata McGraw Hill
5. Yashwant Kanitkar, "Working with C", BPB
6. E. Balagurusamy, "Programming in ANSI C", TMH

Course Outcomes:

1. Identify the parts of the computer system and explain the functioning of its components alongwith the process of problem solving. (Remember, Understand)
2. Design an algorithmic solution for a given problem and translate it into a program. (Design)
3. Understand different operating systems, related concepts and their functions. (Understand)
4. Use the appropriate control statements to solve the given problem. (Apply)
5. Implement different Operations on arrays and use functions to solve the given problem. (Apply)
6. Understand pointers, structures and unions & Implement file Operations in C programming. (Understand, Apply)

WORKSHOP PRACTICE (EWS-101/102)

Type	L	T	P	Credits
ESC	0	0	4	2

Prerequisite:

Course Content:

1. Carpentry Shop:

Practice (I): To prepare half lap corner joint from given pieces of mango wood.

Practice (II): To prepare mortise and tenon joint from given pieces of mango wood.

Instructions: Description and demonstration of different tools, joints along with advanced Carpentry joints, classification and definition of timber, wood seasoning, demonstration of wood working lathe and advanced power tools used in carpentry work, safety precaution during actual working

2. Fitting and Bench working Shop:

Practice (I): To prepare male-female joint from given pieces of mild steel.

Practice (II): To prepare practice work piece involving marking, measuring, sawing, drilling and tapping operations.

Instruction: Classification and description of different tools used in fitting shop e.g. marking and measuring tools , holding and supporting tools, striking tools and cutting tools etc., safety precaution during actual working.

3. Black Smithy Shop:

Practice (I): To prepare 'L' shape job from given piece of mild steel rod by hand forging.

Practice (II): To prepare a 'Ring' from given piece of mild steel rod by hand forging.

Instructions: Description of various forging processes done in black-smithy work e.g. upsetting, drawing down, punching, bending, fullering etc, classification and description of different tools, equipments used in black smithy shop, safety precaution during actual working.

4. Welding Shop:

Practice (I): To prepare simple butt joint and lap joint by electric arc welding from given pieces of mild steel.

Practice (II): To prepare simple lap joint by oxy-acetylene gas welding and gas flame cutting practice.

Instructions: Concept of welding, classification and explanation of various types of welding with the help of flow chart, description of different tools. Equipment required for arc welding and gas welding, demonstration of various types of flames in Oxy-acetylene gas welding, setting of current and selection of electrodes along with different welding joints, safety precaution during actual working.

5. Sheet Metal Shop:

Practice (I): To prepare a funnel complete with soldering from given G.I. sheet.

Practice (II): To fabricate tray / tool box or electric panel box from given G.I. sheet.

Instructions: Classification and description of different types of tools, equipment used in sheet metal work, different types of metals used in sheet metal shop e.g. Galvanized iron, black iron, copper, aluminum etc, concept of development of surfaces along with different types of joints in sheet metal work, safety precaution during actual working.

6. Machine Shop:

Practice (I): To prepare a job by plain turning, facing, step turning and chamfering operation from given mild steel rod.

Practice (II): To prepare a job by taper turning, threading, knurling operations from given mild steel rod.

Instructions: Classification of lathe machines, different parts of lathe machine, tools and equipment used, explanation and demonstration of various operations on lathe machine, tool geometry of single point cutting tool, cutting speed, feed and depth of cut in turning, safety precaution during actual working.

7. Foundry Shop:

Practice (I): To prepare a mould of given pattern in Green Sand.

Practice (II): To prepare a mould with two step pulley with runner and riser.

Instructions: Description and use of various foundry tools, shovel, flat rammer, hand rammer, strike off bars, vent wire, trowels, hand riddle etc. Types of various molding sands, types of patterns, pattern materials, pattern allowances, safety precautions during actual working.

ENVIRONMENT AND ECOLOGY (ECE-103/104)

Type	L	T	P	Credits
MDC	2	0	0	0

Prerequisite: NIL

Course Content:

Unit-1:
Definition, Scope and importance, Need for Public awareness, Environment definition, Ecosystem, Concept of ecosystem, Structure and function of an ecosystem, Energy flow in ecosystem, Ecological succession, Balanced ecosystem, Human activities, Food shelter, Economic and Social Security.
Effects of Human Activities on Environment: Agriculture, Housing Industry, Mining and Transportation Activities, Basic of Environmental Impact Assessment, Sustainable Development.
Unit-2:
Natural Resources: Water Resources – Availability and Quality Aspects, Conservation of water, Water Borne Diseases, Water induced Diseases, Fluoride problems in Drinking water, Mineral Resources, Forest Wealth, Material Cycles- Carbon, Nitrogen and Sulphur Cycles.
Energy – Different Types of Energy, Electro-magnetic Radiation, Conventional and Non-Conventional Sources, Hydro Electric Fossil Fuel Based, Nuclear, Solar, Biomass, Bio-gas, Hydrogen as an Alternative Future Sources of energy.
Unit-3:
Environmental Pollution: Water Pollution, Land Pollution, Noise Pollution , Public health aspects, Air Pollution, Soil pollution, Marine Pollution, Thermal Pollution, Nuclear Hazards.
Solids Waste Management: Cause, effects and control measures of urban and industrial wastes, Role of an Individual in prevention of pollution, Pollution case studies, Disaster management: Floods, earthquake, cyclone and landslides.
Unit-4:
Current Environmental Issue of Importance, Population Growth, Variation among nations, Population explosion , family welfare Programme, Climate Change and Global Warming- Effects, Urbanization, Automobile pollution, Acid Rain, Ozone Layer Depletion.
Environmental Protection –Role of Government, Legal Aspects, Initiatives by Non- Government Organization (NGO), Environmental Education, Value Education, Human Rights, HIV/AIDS, Women and child welfare, Case Studies.

Course Objectives:

1. To make students understand and appreciate the unity of life in all its forms, the implication of the life style on the environmental.
2. To understand the various causes for environmental degradation.
3. To understand individual contribution in the environmental pollution.
4. To understand the impact of pollution at the global level and also in the local environment.
5. To understand the concept of sustainable development.

Course Outcomes:

1. Understand the need for eco-balance.
2. Acquire basic knowledge about global climate change with a particular reference to the Indian context.
3. Find ways to protect the environment and play pro-active roles.
4. Involve themselves in activities for environment protection.

Detailed Syllabus

II Year

DATA STRUCTURE USING C (ECS-201)

	Type	L	T	P	Credits
	PCC	3	1	2	5

Prerequisite: Computer Concepts & 'C' Programming (ECS-101/102)

Course Content:

Unit -1:
Introduction: Basic Terminology, Elementary Data Organization, Structure operations, Algorithm Complexity and Time-Space trade-off.
Arrays: Array Definition, Representation and Analysis, Single and Multidimensional Arrays, address calculation, application of arrays, Character String in C, Character string operation, Array as Parameters, Ordered List, Sparse Matrices and Vectors.
Stacks: Array Representation and Implementation of stack, Operations on Stacks: Push & Pop, Array Representation of Stack, Linked Representation of Stack, Operations associated with Stacks, Applications of stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of postfix expression using stack, Applications of recursion in problems like 'Tower of Hanoi'.
Unit-2:
Queues: Array and linked representation and implementation of queues, Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, D-queues and Priority Queues**.**
Linked list: Representation and Implementation of Singly Linked Lists, Two-way Header List, Traversing and Searching of Linked List, Overflow and Underflow, Insertion and deletion to/from Linked Lists, Insertion and deletion Algorithms, Doubly linked list, Linked List in Array, Polynomial representation and addition, Generalized linked list, Garbage Collection and Compaction.
Unit-3:
Trees: Basic terminology, Binary Trees, Binary tree representation, algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary trees, Traversing Binary trees, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm**.**
Searching and Hashing: Sequential search, binary search, comparison and analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation.
Unit-4:
Sorting: Insertion Sort, Bubble Sort, Quick Sort, Two Way Merge Sort, and Heap Sort, Sorting on Different Keys, Practical consideration for Internal Sorting**.**
Binary Search Trees: Binary Search Tree (BST), Insertion and Deletion in BST, Complexity of Search Algorithm, Path Length, AVL Trees, B-trees.
Unit-5:
Graphs: Terminology & Representations, Graphs & Multi-graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees.
File Structures: Physical Storage Media File Organization, Organization of records into Blocks, Sequential Files, Indexing and Hashing, Primary indices, Secondary indices, B+ Tree index Files, B Tree index Files, Indexing and Hashing Comparisons.

Text and Reference Books:

1. Horowitz and Sahani, "Fundamentals of data Structures", Galgotia Publication Pvt. Ltd., New Delhi.
2. R. Kruse et. al, "Data Structures and Program Design in C", Pearson Education Asia, Delhi-2002

3. A. M. Tenenbaum, "Data Structures using C & C++", Prentice-Hall of India Pvt. Ltd., New Delhi.
4. K Loudon, "Mastering Algorithms with C", Shroff Publisher & Distributors Pvt. Ltd.
5. Bruno R Preiss, "Data Structures and Algorithms with Object Oriented Design Pattern in C++", Jhon Wiley & Sons, Inc.
6. Adam Drozdek, "Data Structures and Algorithms in C++", Thomson Asia Pvt. Ltd.(Singapore)

Lab Work:

Write Program in C or C++ for the following
1. Array implementation of Stack, Queue, Circular Queue, List.
2. Implementation of Stack, Queue, Circular Queue, List using Dynamic memory Allocation.
3. Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search Tree, Insertion and Deletion in BST.
4. Implementation of Searching and Sorting Algorithms.
5. Graph Implementation, BFS, DFS, Min. cost spanning tree, shortest path algorithm.

Course Outcomes:

1. Analyze the algorithms to determine the time and computation complexity and justify the correctness. (Analyze)
2. Implement Arrays, Stacks, Queues and linked list based problems and analyze the algorithm to determine the time complexity. (Apply, Analyze)
3. Implement search and traversal algorithms on Trees and Graphs and determine the time complexity. (Apply, Analyze)
4. Algorithms for Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of space and time complexity. (Apply, Analyze, Evaluate)
5. Understand file structures and file handling. (Understand)

COMPUTER ORGANIZATION & ARCHITECTURE (ECS-203)

Type	L	T	P	Credits
PCC	3	1	0	4

Prerequisite: Computer Concepts & 'C" Programming (ECS-101/102)

Course Content:

Unit-1:
Representation of Information and Basic Building Blocks: Introduction to Computer, Computer hardware generation, Number System: Binary, Octal, Hexadecimal, Character Codes (BCD, ASCII, EBCDIC), Logic gates, Boolean Algebra, K-map simplification, Half Adder, Full Adder, Subtractor, Decoder, Encoders, Multiplexer, De-Multiplexer, Carry look ahead adder, Combinational logic Design, Flip-Flops, Registers, Counters (synchronous & asynchronous), ALU, Micro-Operation, ALU Chip, Faster Algorithm and Implementation (Multiplication & Division).

Unit-2:

Basic Organization: Von Neumann Architecture, Operational flow chart, Instruction Cycle, Organization of Central Processing Unit, Hardwired & micro programmed control unit, Single Organization, General Register Organization, Stack Organization, Addressing modes, Instruction formats, data transfer & Manipulation, I/O Organization, Bus Architecture, Programming Registers

Unit-3:

Memory Organization: Memory Hierarchy, Main memory (RAM/ROM chips), Auxiliary memory, Associative memory, Cache memory, Virtual Memory, Memory Management Hardware, hit/miss ratio, magnetic disk and its performance, magnetic Tape etc.

Unit-4:

I/O Organization: Peripheral devices, I/O interface, Modes of Transfer, Priority Interrupt, Direct Memory Access, Input Output Processor and Serial Communication. I/O Controllers, Asynchronous data transfer, Strobe Control, Handshaking.

Unit-5:

Process Organization: Basic Concept of 8-bit micro Processor (8085) and 16-bit Micro Processor (8086), Assembly Instruction Set, Assembly language program of (8085): Addition of two numbers, Subtraction, Block Transfer, find greatest number, Table search, Numeric Manipulation, Introductory Concept of pipeline, Flynn's and Feng's Classification, Parallel Architectural classification, Concept of Pipelining and Multi-Core Architecture.

Text and References Books:

1. William Stalling, "Computer Organization & Architecture", Pearson education Asia
2. Mano Morris, "Computer System Architecture", PHI
3. Zaky & Hamacher, "Computer Organization", McGraw Hill
4. B. Ram, "Computer Fundamental Architecture & Organization",
5. New Age, A.S. Tannenbaum, "Structured Computer Organization", PHI.

Course Outcomes:

1. Understand Number systems, Logic Gates, Boolean algebra, Design of Combinational and sequential circuits. (Understand)
2. Understand Von Neumann architecture, instruction cycle and the concept of Hardwired and Micro programmed control unit, addressing modes, register organization. (Understand)
3. Apply the concepts of memory organization in calculating hit-miss ratio and access time of magnetic disks. (Apply)
4. Understand the working of various I/O devices, buses, interrupt and interfaces etc. (Understand)
5. Understand the basics of pipelining and Multicore architecture. (Understand)
6. Design and implement systems using 8085 and 8086 microprocessor with the knowledge of pin diagram, interrupts and instruction format by writing assembly language programming. (Analyze)

DIGITAL ELECTRONICS (EET-201)

	Type	L	T	P	Credits
	ESC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
Logic Families: CMOS Logic, CMOS Dynamic Electrical Behaviour, Bipolar Logic: Diode Logic, Transistor Logic Inverter, TTL Logic, NMOS, CMOS / TTL Interface, ECL
Minimization Techniques & logic gates:
Minimization Techniques: Boolean postulates and laws – De-Morgan‟s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don‟t care conditions – Quine - Mc Cluskey method of minimization. Number System: Representation of Negative Numbers & 1's Complement, 10's Complement, Arithmetic Using 2's Complement.

Unit-2:
Combinational Circuits: Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator

Unit-3
Sequential Circuits: Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

Unit-4:
VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data typesand objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits

Unit-5:
Memory Devices: Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

Text and Reference Books:

1. Wakerly, John F. / "Digital Design Principles & Practices" / Pearson Education / 3rd Ed.
2. Bartee , Thomas C. / "Fundamentals of Digital Computers"/ Tata McGraw-Hill.
3. Gopalan, K. "Gopal" / "Introduction to Digital Microelectronic Circuits" / Tata McGraw-Hill.
4. Taub, Herbert & Schilling, Donald / "Digital Integrated Electronics"/ Tata McGraw-Hill.

5. Millman, Jocob & Taub, Herbert / "Pulse, Digital & Switching Waveforms" / Tata McGraw-Hill.
6. Mano, M. Morris / "Digital Design"/ Prentice Hall
7. Malvino, A.P. & Leach, Donald P. / "Digital Principles & Applications" / Tata McGraw-Hill.
8. Mano, M. Morris / "Digital Logic and Computer Design"/ Prentice Hall (India).
9. Tokheim, H. Roger L. /"Digital Electronics Principles & Application"/ Tata McGraw-Hill / 6th Ed.
10. John F. Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
11. John. M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
12. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
13. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011 6.
14. Donald D. Givone, "Digital Principles and Design", TMH, 2003.
15. Lectures of NPTEL

Course Objectives:

1. To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
2. To introduce the methods for simplifying Boolean expressions
3. To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
4. To introduce the concept of memories and programmable logic devices.
5. To illustrate the concept of synchronous and asynchronous sequential circuits

Course Outcomes:

1. Analyse different methods used for simplification of Boolean expressions. (Analyse)
2. Design and implement Combinational circuits. (Apply, Analyse)
3. Design and implement synchronous and asynchronous sequential circuits. (Apply, Analyse)
4. Write simple HDL codes for the circuits. (Apply)

COMPUTER ORIENTED NUMERICAL & STATISTICAL TECHNIQUES (BMA-203)

Type	L	T	P	Credits
BSC	3	1	2	5

Prerequisite:

Course Content:

Unit-1: Nonlinear Equations and Simultaneous Linear Equations

Roots of nonlinear equation, Methods of solution, Order of convergence of iterative methods, Simple roots: Bisection, False position, Secant, Newton-Raphson, Chebyshev, Iteration and multi point iteration methods, Multiple roots: Newton-Raphson and Chebyshev, Complex roots: Newton-Raphson and Muller's method, a system of nonlinear equations: Newton-Raphson and iteration methods, Polynomial equations: Bairstow's method, convergence analysis of above methods.

Linear systems: Introduction, Direct methods, Operation count, Pivoting, III conditioned linear systems & condition number, Iteration methods: Jacobi, Gauss-Seidel, SOR methods, convergence conditions. Special system of equations: Thomas algorithm. Eigen value problems: Power methods.

Unit-2: Interpolation, Differentiation and Integration
Curve fitting: Polynomial interpolation, error, Existence and Uniqueness, Truncation error bounds, difference operators, Newton forward and backward difference interpolations, Lagrange, Newton divided difference and Iterated interpolations, Stirling and Bessel's interpolations, Spline interpolation, Least squares and Chebyshev approximations. Numerical Differentiation: Methods based on interpolation, Error analysis.
Numerical Integration: Methods based on interpolations (Trapezoidal, Simpson's 1/3, Simpson's 3/8 rule), Gauss quadrature methods, Romberg integration, Error bounds and estimates.

Unit-3: Numerical Solution of Ordinary Differential Equations
Initial-value problems, Single step methods; Taylor's, Picard's, Modified Euler's method and Runge-Kutta method (fouth order), Error estimates, Multi-step methods: Adam's –Bashforth and Milne's methods, convergence and stability analysis, simultaneous and Higher equations: RK Fourth order method.

Unit-4: Curve- Fitting, Correlation, Regression and Probability
Curve-fitting, method of least- squares, fitting of straight lines, polynomials, non-linear and exponential curves etc., correlation analysis, linear, non-linear and multi- regression analysis, probability, random variables and probability distributions, expectation, moments and transform methods, Binomial, Poisson and Normal distributions, overview of t-distribution, F-distribution and χ^2-distribution.

Unit-5: Statistical Methods
Sampling theory (small and large), parameter estimation, confidence intervals, tests of hypotheses and significance; z-, t-, F-, and χ^2 tests, goodness of fit test-χ^2 test, analysis of variance, non-parametric tests (Simple application), time series analysis, index numbers, quality control charts.

Lab Work:

Develop programs for the following techniques in C/C++ Language:
1. To implement iterative methods to solve nonlinear equations.
2. To implement iterative methods to solve a system of linear equations.
3. To implement Newton's divided difference and Lagrange's interpolation formulae.
4. To implement Numerical differentiation.
5. To implement Numerical integration using Trapezoidal, Simpson 1/3 and Simpson 3/8 rules.
6. To implement single step/multi step methods to solve initial value problems.
7. To implement least squares method for curve fitting.
8. To find correlation coefficient, regression coefficients and lines of regression.
9. To implement tests of hypothesis and significance.
10. To implement non parametric tests.
11. To determine the confidence interval to implement ANOVA.

Text and Reference Books:

1. M.K. Jain, S.R.K. Iyengar & R.K. Jain, Numerical methods for Scientific and Engineering Computation, New age international Publication.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Eastern Economy Edition.
3. S. Rajasekaran, Numerical Method in Science and Engineering, Wheeler Publishing House.
4. B. S. Grewal, Numerical Method in Engineering & Science, Khanna Publishers.
5. D.L. Harnett, Statistical methods.
6. J.N. Kapur and H. C. Saxena, Mathematical, S. Chand, & Co., 2001.
7. H.C. Saxena, Practical Mathmatical Statistics, S. Chand & Co., 2000.

Course Outcomes:

1. Using Mathematical Modeling, most of the problems in Engineering, physical and Economical sciences can be formulated in terms of systems of linear or non-linear equations, ordinary or partial differential equations or integral equations. In majority of the cases, the solutions to these problems in analytical form are difficult or not amenable for direct interpretation. In all such problems, Numerical Analysis provides approximate solutions, practical and amenable for analysis. (Apply)

2. Numerical Methods provide easier computational process to solve various mathematical problems like Interpolation, Differentiation, Integration, ODE & PDE and Initial & Boundary value problems. (Apply)

3. Analytical solutions can be obtained only for selected class of ODE and PDE. For certain problems, analytical solutions cannot be obtained. However numerical solutions can be obtained to the desired degree of accuracy using computers. (Understand)

4. In many engineering problems to establish a linear, quadratic, cubic or exponential relationship between two quantities, it is required two or more unknowns in such a way that these follow whole data such situations occur in the problems of curve fitting etc. Correlation and regression are the most commonly used techniques for investigating the relationship between two quantitative variables. The theory of probability is the study of such random phenomena which are not deterministic. In analyzing and interpreting data that involves an element of "chance" or uncertainty, probability theory plays a vital role in the theory and application of statistics. (Analyse)

5. Probability distribution is the theoretical counterpart of frequency distribution and plays an important role in the theoretical study of populations. (Understand)

6. Statistical methods are useful in engineering, medical sciences, industries, banking, and economics. These methods are used to present the data effectively, help in critical analysis of information and summarizing the large data into a simple form using the frequency distribution and graph. In many situations, assumptions are made about the population parameters involved in order to arrive at decisions related to population on the basis of sample information. Quality control and process control use statistics as a tool to manage conformance to specifications of manufacturing processes and their products. (Apply)

ENGINEERING ECONOMICS & MANAGEMENT (HHS-201/202)

Type	L	T	P	Credits
HSMC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Introduction to Economics
Overview: production possibility curve, choices-what, how and for whom, micro- and macro-economics, inflation, unemployment, GDP and business cycle; demand and supply, elasticity of demand, consumer surplus and its applications, utility theory.

Unit-2: Production and Cost
Factors of production, production function, law of variable proportion, isoquant analysis, return to scale, economies of scale; Types of costs: direct and indirect costs, explicit and implicit costs, opportunity cost, economic cost, fixed cost and variable costs, average and marginal costs, short-run and long-run costs, optimal combination of factor-inputs.

Unit-3: Market Structure
Perfectly Competitive Market, Imperfect market: Monopoly, Oligopoly, Monopolistic Market

Unit-4: Fundamentals of Management:
Development of Management Thoughts, Objectives, Functions of Management: Planning, Organising, Directing, Controlling and Coordination.

Unit-5: Business Enterprises-
Business Ownership: Sole Proprietorship, Partnership, Company: Promotion, Formation & Development, Cooperative Firms.

Text and Reference Books:

1. Koutsoyiannis, A., 'Modern Microeconomics', English Language Book Society, Macmillan.
2. Joseph, L Massod, "Essential of Management", Prentice Hall, India.
3. Armstrong, Michel, "A Handbook of Management Techniques", Kogan Page Limited.
4. Babcock, D L and Lucy C Morse, "Managing Engineering and Technology", third edition, Pearson Education, 2006.
5. Pindyck, R S, Rubinfeld, D L & Mehta, 'Microeconomics', 6 th Edition, Pearson Education India.
6. Barthwal, R R , Microeconomic Analysis.
7. Samuelson, Paul A, 'Economics', 5th edition, McGraw Hill New York.
8. Henderson, J M and Quadnt, R E, 'Microeconomic Theory: A Mathematical Approach', Tata MacGraw Hill, New Delhi, 2003.
9. H. Varian, 'Intermediate Micro Economics'.
10. G. Mankiw,''Principles of Micro Economics.

Course Outcomes:

1. Understanding essential economic principle for solving economic problem with suitable policy alternatives and know how rational consumers can maximize their satisfaction with limited incomes and make best use of their resources. (Understand)
2. Understand production principles and cost analysis. (Understand)
3. Gain market knowledge and study the contemporary market situations, market strategy to manage the industries. (Understand, Apply)
4. Understand and gain basic knowledge of management technique. (Understand)
5. Develop Entrepreneurship skills towards formation of partnership, companies and their functions. (Apply)

INDIAN CONSTITUTION (HHS-205/206)

Type	L	T	P	Credits
HSMC	2	0	0	0

Prerequisite:

Course Content:

Unit-1: Indian Constitution
Sources and Features, Preamble, Fundamental Rights, Fundamental Duties and Directive Principles of State Policy

Unit-2: Union Executive
President, Vice President, Prime Minister, Council of Ministers, State Executives- Governor, Chief Minister and Council of Ministers

Unit-3: Union Legislature
Parliament- Composition and Functions, Speaker of Lok Sabha, Amendment Process, State Legislature- Vidhaan Sabha, Panchaayati Raj, Institutions- History, Basic Features and 73rd Amendment

Unit-4: Judiciary
Supreme Court, High Courts, Judicial Review and Judicial Activism

Unit-5: Election Commission
Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the Welfare of SC/ST/OBC and Women.

Text and Reference Books:
1. Indian Constitution: D.D Basu.
2. Indian Administration: Avasthi and Avasti.
3. The Indian Constitution: Corner Stone of a Nation, G. Austin, Oxford University Press.
4. Indian Politics: Contemporary Issues and Concerns, M. P. Singh and Rekha Saxena, Prentice Hall of India, Delhi.

Course Outcomes:
1. Configure the preambles & fundamental rights.
2. Actuate the governance & functioning of constitutional functionaries.
3. Describe the functions of legislative bodies.
4. Decipher the judiciary system & its role in governance.
5. Develop a democratic process through electoral mechanism into system.

SOFTWARE ENGINEERING (ECS-202)

	Type	L	T	P	Credits
	PCC	3	1	2	5

Prerequisite:

Course Content:

Unit-1:
Introduction to Software Engineering, Software Components, Software Characteristics, Software Crisis, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes, Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Evolutionary Development Models, Iterative Enhancement Models, Selection of Software Development Models,

Unit-2:
Software Requirement Specifications (SRS) Requirement Engineering Process: Elicitation, Analysis, Documentation, Review and Management of User Needs, Feasibility Study, Information Modeling, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS, Estimation of various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO), Resource Allocation Models, Software Risk Analysis and Management.

Unit-3:
Software Design Basic Concept of Software Design, Architectural Design, Low Level Design: Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures, Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design. Software Measurement and Metrics: Various Size Oriented Measures: Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs.

Unit-4:
Software Testing Objectives, Unit Testing, Integration Testing, Acceptance Testing, Regression Testing, Testing for Functionality and Testing for Performance, Top-Down and Bottom-Up Testing Strategies: Test Drivers and Test Stubs, Structural Testing (White Box Testing), Functional Testing (Black Box Testing), Test Data Suit Preparation, Alpha and Beta Testing of Products. Static Testing Strategies: Formal Technical Reviews (Peer Reviews), Walk Through, Code Inspection, Compliance with Design and Coding Standards.

Unit-5:
Software Maintenance: Software as an Evolutionary Entity, Need for Maintenance, Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering, Software Configuration Management Activities, Change Control Process, Software Version Control, Defect Detection and Removal: Defect Amplification Model, An Overview of CASE Tools.

Lab Work:

Lab exercises or a Mini Project (as per list given below) to be carried out using languages like C++, Java, C# and tools like Visio, ARGOUML, Rational Rose etc. Design and Implementation of an Object based application using any one of the above languages/tools is desirable.

- Hotel Automation System
- Book Shop Automation Software
- Word processing Software
- Software Component Cataloguing Software
- Payroll System
- Banking System
- Purchase Order System
- Library Management System
- Railway Reservation System
- Bill Tracking System
- University Admission System
- Estate Management System.

Text and References Books:

1. R. S. Pressman, Software Engineering: A Practitioners Approach, McGraw Hill.
2. K. K. Aggarwal and Yogesh Singh, Software Engineering, New Age International Publishers.
3. Ian Sommerville, Software Engineering, Addison Wesley.
4. Pankaj Jalote, Software Engineering, Narosa Publication
5. Pfleeger, Software Engineering, Macmillan Publication.

Course Outcomes:

1. Understand and explain various concepts of software engineering and software life cycle development models. (Understand)
2. Prepare SRS and Compute cost and effort required to complete a given project, using various estimation techniques and models. (Apply)
3. Understand various concepts of Software design and Construct Data Flow Diagrams, Data Dictionaries and UML diagrams for a given software requirement specification. (Understand, Apply)
4. Understand various testing techniques and use these concepts to design optimal test cases. (Understand, Apply, Analyze)
5. Understand software configuration management, version control, reverse engineering, defect tracking etc. (Understand)
6. Build a project report as a team which contains the requirement specification, plan, schedule and design documents based on the knowledge of software development lifecycle. (Apply)

OBJECT ORIENTED SYSTEM (ECS-204)

	Type	L	T	P	Credits
	PCC	3	1	2	5

Prerequisite:

Course Content:

Unit-1:
Object Oriented Design and Modeling: Object oriented fundamentals, Objects and Classes, Object-Oriented Design Process, importance of modeling, principles of modeling, OOAD Methods, Software Development Life Cycle, Introduction to Unified Process, Introduction to UML: UML Terminology, conceptual model of the UML, Use of UML in Unified Process.

Unit-2:
Basic Structural Modeling: Classes, Relationships, common Mechanisms, and diagrams. Class & Object Diagrams: Terms, concepts, modeling techniques for Class & Object Diagrams, Links and Associations, Link Attributes and Link Classes, Generalization and Inheritance, Aggregation and Composition, Qualified Association, Handling multiplicity in Object creation, Abstract Classes, Specifying constraints in Class Diagrams, Advanced Structural Modeling: Advanced classes, advanced relationships, Interfaces, Types and Roles, Packages, Use Case Modeling: Use Cases and Use Case Diagrams, Use Case driven Methodology.

Unit-3:
Behavioral Modeling: Interactions and Interaction Diagrams, Use-Case Realization: Scenario, Events Trace Diagram, Collaboration Diagrams, State Chart Diagrams, Nested State Diagrams, Activity Diagrams, Advanced Behavioral Modeling Concepts, Architectural Modeling: Component, Deployment, Component diagrams and Deployment diagrams. Elementary Design Patterns, The MVC Architecture Pattern, Features of Elegant Software Design: Elegant variable, Elegant Classes, Elegant Methods, Elegant Packages, Introduction to Object Oriented Software Quality Metrics.

Unit-4:
Java Programming: Introduction to Java Programming, Operator, Data type, Variable, Arrays, Control Statements, Methods & Classes, Inheritance, Package and Interface, Exception Handling, Multithread programming, I/O, Java Applet, String handling, Networking, Event handling.

Unit-5:
Introduction to Advance Java Programming: Demonstration of concepts through example programs for AWT, Java Swing, Java Beans, Java Servlets, JSP, Modern Object Technologies and Web Services.

Lab Work:

1. Write a program in Java, to implements the Stack data Structure.
2. Write a program in Java to implement a simple Bank Account.
3. Write a program in Java showing the action from three threads using a suitable example
4. Write a program of threads in Java showing inter leaving of actions from two threads: t1 & t2 synchronizing on a shared object. Let t1 print message Ping → and t2 prints message ← Pong. Take as command line arguments the following inputs to the program:
   > Sleep interval for thread t1
   > Sleep interval for thread t2
   > Messages per cycle
   > Number of Cycles
5. Write a program in Java which converts a text file into all capital letters.

6. Write a program to create a sequential file that could store details about five products. Details include product code, cost, no. Of items available and number of items available and are provided through keyboard.
7. Create a Person class with private instance variables for Person's name and birth date. Add appropriate accessor methods to access the variables. Then create a subclass CollegeGraduate with private instance variables for the student's GPA and year of graduation and appropriate accessors for these variables. Don't forget to include appropriate constructors for your classes. Then create a class with a main() method that manages your classes.
8. Develop an applet that receives three numeric values from the user and displays the largest of the three on the screen. Write a HTML page that embeds this applet.
9. Write an applet which draws a human face with ovals and arcs.
10. Write servlets that accepts user preferences (color, hobby etc.) from user, saves it as cookie on user machine and reads the cookie from the user machine.
11. Write an AWT application with checkbox such that all cable TV channels will be displayed from the selected category.
12. Create a simple Swing based applet that displays two buttons. Each time a button is clicked, a message is displayed that states which button was clicked.
13. Create JSP code that uses a persistant cookie (i.e. a cookie with an expiration date in the future) to keep track of how many times the client computer has visited the page. Use setMaxAge method to remain on the client's computer for one month. Display the number of page hits (i.e. cookie's value) every time the page loads.
14. Write JSP program that asks user his favourite color as request parameter and sets it as the background color of the page or sets the background color white if the parameter value is null.
15. Write a program in Java to show the mouse click event. The program should change the background colour of window randomly at each mouse click.

Text and Reference Books:

1. Balagurusamy E, "Programming in JAVA", TMH
2. Herbert Schildt, "The Complete Reference JAVA", TMH
3. Bruce Eckel, "Thinking in Java", Prentice Hall PTR.
4. Grady Booch, James Rumbaugh, Ivar Jacobson: The Unified Modeling Language User Guide, Pearson Education.
5. Mark Priestley: Practical Object-Oriented Design with UML, TATA Mc-GrawHill.
6. Meilir Page-Jones: Fundamentals of Object Oriented Design in UML, Pearson Education.
7. Pascal Roques: Modeling Software Systems Using UML2, WILEY-Dreamtech India Pvt. Ltd.
8. Appling UML and Patterns: An introduction to Object – Oriented Analysis and Design and Unified Process, Craig Larman, Pearson Education.
9. Atul Kahate: Object Oriented Analysis & Design, The McGraw-Hill Companies.

Course Outcomes:

1. Analyse information systems in real-world settings and use an object-oriented method for analysis and design. (Analyse)
2. Understand features of object-oriented design such as encapsulation, polymorphism, inheritance, and UML. (Understand)
3. Understand and prepare different types of UML diagrams like use case diagrams, interaction diagrams, nested state diagrams, state chart diagrams, activity diagram etc. (Understand, Apply)
4. Understand and appreciate the use of Design Patterns in the Software Development. (Understand, Apply)

5. Understand the core and advance Java Programming features and apply them in complex problem solving. (Understand, Apply)

WEB TECHNOLOGY (EIT-202)

Type	L	T	P	Credits
ESC	3	0	2	4

Prerequisite:

Course Content:

Unit-1:
History of the web, Protocols governing the web, Growth of the Web, Web 2.0 and its features. Introduction to Cyber Laws in India, Introduction to International Cyber laws, Web project, Web Team, Team dynamics, Communication Issues, the Client, Multi departmental & large scale Websites, Quality Assurance and testing, Technological advances and Impact on Web Teams.

Unit-2:
HTML: Formatting Tags, Links, List, Tables, Frames, forms, Comments in HTML, DHTML, and Introduction to HTML 5, JavaScript: Introduction, Documents, Documents, forms, Statements, functions, objects in JavaScript, Events and Event Handling, Arrays, FORMS, Buttons, Checkboxes, Text fields and Text areas, Introduction to j-Query.

Unit-3:
XML: Document type definition, XML Schemas, Document Object model, Presenting XML, Using XML Processors: DOM and SAX parsers, Java Beans: Introduction to Java Beans, Advantages of Java Beans, BDK, Introspection, Using Bound properties, Bean Info Interface, Constrained properties , Persistence, Customizes, Java Beans API, Introduction to EJBs.

Unit-4:
Web Servers and Servlets: Tomcat web server, Introduction to Servelets: Lifecycle of a Serverlet, JSDK, The Servelet API, The javax.servelet Package, Reading Servelet parameters, Reading Initialization parameters, The javax.servelet HTTP package, Handling Http Request & Responses, Using Cookies-Session Tracking, Security Issues. Introduction to JSP: The Anatomy of a JSP Page. JSP Application Design with MVC, JSP Application Development: Generating Dynamic Content, Using Scripting Elements Implicit JSP Objects, Conditional Processing   Sharing Session and Application Data Memory Usage Considerations

Unit-5:
Database Access: Database Programming using JDBC, Studying Javax.sql.* package, Accessing a Database from a JSP Page, Application – Specific Database Actions, Deploying JAVA Beans in a JSP Page, Introduction to struts framework. Semantic Web: Introduction, growth and evolution, goals and vision, need, problems, Architecture, applications.

Lab Work:

1. Design a HTML page to display your CV.
2. Design a HTML form to reserve a railway ticket.
3. Write a Java Script program that finds the greatest common divisor of two numbers.
4. In the form mentioned in problem 2 to reserve a railway ticket add the following validations using java Script.
   - From city and to city are two different cities.
   - Age of passengers should not be greater than 150.
   - Name of the passenger should be a string of a maximum length
5. Write a program for illustrating client/server side scripting with help of ASP.
6. Write a piece of code in XML for creating DTD, which specifies set of rules.
7. Create style sheet in CSS/XSL and display the document in Internet Explorer.

Text and References Books:

1. Burdman, "Collaborative Web Development", Addison Wesley.
2. Ivan Bayross, "Web Technologies Part II", BPB Publications.
3. Deitel & Deitel, "Internet and World Wide Web – How to Program", Goldberg, Pearson Education.
4. Eric Ladd, Jim O' Donnel,Using HTML 4, XML and JAVA", Prentice Hall of India
5. Hans Bergsten, Java Server Pages, SPD O'Reilly
6. Patrick Naughton and Herbert Schildt, The complete Reference Java 2 Fifth Edition by TMH
7. Michael C Daconta, Leo, Kelvin Smith, "The Semantic Web: A guide to the future of XML, Web services, and knowledge management", Wiley.

Course Outcomes:

1. Understand the basics of web and apply the web concepts for web application development. (Understand, Apply)
2. Understand, apply and analyze mark-up languages like HTML, DHTML, and XML for development of different web applications. (Understand, Apply, Analyze)
3. Develop interactive web applications using client-side scripting languages. (Apply)
4. Develop three-tier applications using PHP, JSP and servlets. (Apply)
5. Construct interoperable web applications using XML and related technologies. (Apply)
6. Develop and deploy web services to build the server side components in web applications. (Apply)

DISCRETE MATHEMATICAL STRUCTURES (BMA-204)

	Type	L	T	P	Credits
	ESC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Fundamentals of Logic
Propositional Logic: Propositions, Basic logic operations and truth tables, Tautologies, Contradictions, Contigency, Algebra of propositions, Logical equivalence: the laws of logic, Logical implication: Rules of inference, Logical analysis of argument, Some computing application (Normal forms), Functionally complete set of operations, Formal proofs.

First Order Predicate Logic: Predicates & quantifiers, Nested quantifiers, Use of quantifiers, Rules of inference, Validity of arguments and proof methods.

Unit-2: Set Theory, Relations and Functions
Set Theory: Sets & subsets, Venn diagrams, set operations and laws, countable set, Cartesian product, Cardinality, Principle of inclusion- exclusion.

Relations: Relation, Representation & properties, n-ray relations and applications, Composition of relations, Closures of relations, Equivalence relation & partitions, partial orders, compatibility relation.

Functions: Functions and its types, Inverse function, Composition of functions, Special functions, Recursively defined functions, Computational Complexity, Analysis of algorithms.

Theorem Proving Techniques: Mathematical induction (weak, strong, structural) and its applications, Proof by contradiction, Pigeonhole principle.

Unit-3: Algebraic Structures and Coding Theory
Algebraic Structures: Definition, Properties, Semi group, Monoid, Group, properties of groups, Subgroup, Cyclic group, Cosets and Lagrange's theorem, Permutation groups, Normal subgroup, Homomorphism and isomorphism of groups, Congruence relation, Rings and Fields. Example and standard results.

Coding Theory: Elements of coding theory, Hamming matric, Parity-check and generator matrices, Coding and error detection, Group codes: decoding with coset leaders and error correction, Hamming matrices.

Unit-4: Partially Ordered Structures
Posets: Definitions, ordered set, Hasse diagram, isomorphic ordered set, well ordered set, Minimal and Maximal elements, LUB &GLB etc.

Lattices: Definition & Properties, Product Lattices, Isomorphic Lattices, Applications, Types of Lattices.

Boolean Algebra: Definitions & Properties, SOP & POS forms, Logic gates and minimization of circuits, Karnaugh maps, Quine-McClusky method.

Trees: Definition & Examples and Properties, Rooted tree, Binary tree, Tree traversal, application in computer science and engineering.

Unit-5: Combinatorics and Graph Theory
Combinatorics: Discrete numeric functions and properties, Recurrence relations and their applications (modeling), various methods of solutions, system of recurrence relations, OGF & EGF, properties, applications: solution of recurrence relations and combinatorial problems.

Graphs: Graphs and graph models, terminology, matrices associated with graphs, Isomorphism, Special types of graphs, connectedness, Euler and Hamilton graphs with their applications, trees with properties, MST, planer graphs and applications, criteria of planarity, Graph coloring and coloring models, directed graphs.

Text and Reference Books:

1. Trembley, J.P. & R. Manohar, "Discrete Mathematical Structures with applications to Computer Science", McGraw Hill.
2. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw Hill.
3. Ralph, P. Garimaldi, "Discrete& Combinatorial Mathematics" Pearson Publication, Asia.
4. Deo, narsingh, "Graph Theory with applications to Engineering & Computer Science", PHI.
5. Krishnamurthy, V., "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi.

Course Outcomes:

1. Understand concepts of Logic and various inference mechanisms using logic. (Understand)
2. Understand Set theory, functions, relations and the concepts of theorem proving. (Understand)
3. Explain algebraic structure and coding theory. (Understand)
4. Understand and apply concepts of partially ordered structures, Boolean algebra and trees in various application of computer science domain. (Understand, Apply)
5. Understand and apply graph theory and concepts of recurrence relation in system modeling. (Understand, Apply)

ORGANISATIONAL BEHAVIOUR (HHS-204)

Type	L	T	P	Credits
HSMC	3	1	0	4

Prerequisite:

Course Content:

Unit 1: Introduction to organizations
What is an organization, components of organization, nature and variety of organizations (in terms of objectives, structure etc.), models of analyzing organizational phenomena, organizational and business variables, organizations in the Indian context, institutions and structures.

Unit 2: Dimensions of Individual Behavior
Individual Behavior, Dimensions of individual behavior: Perceptions, Learning, Motivation, Personality, Commitment, Attitudes, Values & Ethics, Stress Management

Unit 3: Dimensions of Interpersonal Behavior
Transactional Analysis, Interpersonal communication, Listening, Feedback, Counseling,

Unit 4: Group Behavior
Leadership, Communication, Group: Formal Vs Informal Groups, Group Decision making, Team: Team building, team problem solving.

Unit 5: Organizational Dimensions
Organizational Structure: Elements of Organizational Structure, Dimensions of Organizational Structure, Organizational change, Organizational Development, Power, Authority, Politics

Note:- *Integrating cases: Case method and lectures should be supplemented with a variety of other methodologies such as feedback on questionnaires and tests, role plays, and behavior simulation exercise.*

Text and Reference Books:

1. Luthans Fred., "Organizational Behavior", McGraw Hill, 1998
2. Pareek, Udai, "Understanding Organizational Behavior, Oxford university press.
3. Robbins (4th ed.), "Essentials of organizational behavior", Prentice Hall of India Pv1. Ltd., New Delhi, 1995.
4. Keith Davis, "Organisational Behaviour.
5. Hersey and Blanchard (6th ed.). "Management of organizational behavior L utilising human resources", Prentice Hall of India Pv1. Ltd., New Delhi, 1996.
6. Nancy J. Adler, "International Organisational Behaviour', Cengage Learning.
7. Nelson Quick, 'Organizational Behaviour Function Learning', Fifth Edition

Course Outcomes:

1. Apply organizational objectives, components and models in Indian context for better results for attaining organizational goals. (Apply)
2. Demonstrate individual behavioural dimensions, learning theories, perceptual process, values & ethics with motivational techniques in stressed situations. (Apply)
3. Identify mechanism for conducive survival of individual in an organization with interpersonal understanding. (Remember)
4. Ascertain group, group behaviour, Team & Team building with its key role in organization. (Understand)
5. Demonstrate organisational structure, organisational change, organisational development for achieving higher productivity and accomplishing goals of organisation. (Apply)

CYBER SECURITY (ECS-205/206)

Type	L	T	P	Credits
MDC	2	0	0	0

Prerequisite:

Course Content:

Unit-1:
Introduction to information systems, Types of information systems, Development of Information systems, Introduction to information security, Need for Information security, Threats of Information Systems, Information Assurance, Cyber Security and Security Risk Analysis.

Unit-2
Application security (Database, E-mail and Internet), Data Security Considerations - Backups, Archival Storage and Disposal of Data, Security Technology - Firewall and VPNs, Intrusion Detection, Access Control, Security Threats - Viruses, Worms, Trojan Horse, Bombs, Trapdoors, Spoofs, E-mail viruses, Macro viruses, Malicious Software, Network and Denial of Services Attack,

Security Threats to E-Commerce – Electronic Payment System, e-Cash, Credit/Debit Cards, Digital Signature, public Key Cryptography.

Unit-3

Developing Secure Information Systems, Application Development Security, Information Security Governance & Risk Management, Security Architecture & Design, Security Issues in Hardware, Data Storage & Downloadable devices, Physical Security of IT Assets, Access Control, CCTV and intrusion Detection Systems, Backup Security Measures.

Unit-4

Security Policies, why Policies should be developed, WWW Policies, Email Security Policies, Policy Review Process- Corporate policies- Sample Security Policies, Publishing and Notification requirement of the Policies. Information Security Standards- ISO, IT Act, Copyright Act, Patent Law, IPR. Cyber Laws in India: IT Act 2000 Provisions, Intellectual Property Law: Copy Right Law, Software License, Semiconductor Law and Pattern Law.

Text and Reference Books:

1. Charles, P., and Shari Lawrence Pfleeger, "*Analyzing Computer Security*". Pearson Education India.
2. V.K. Pachghare, "*Cryptography and information security*", PHI Learning Pvt. Ltd., Delhi India.
3. Dr Surya Prakash Tripathi, Ritendra Goyal, and Praveen Kumar Shukla, "Introduction to Information Security and Cyber Law", Willey Dreamtech Press.
4. Schou, Shoemaker, "Information Assurance for the Enterprise", Tata McGraw Hill.
5. Chander Harish, "Cyber Laws and their Protection", PHI Learning Private Limited, Delhi, India.

Course Outcomes:

1. Understand information, information systems, information security, Cyber Security and Security Risk Analysis. (Understand)
2. Understand and apply application security, data security, security technology, security threats from malicious software. (Understand, Apply)
3. Understand the concepts of security threats to e-commerce applications such as electronic payment system, e-Cash, Credit/Debit Cards etc. (Understand)
4. Understand and apply Information Security Governance & Risk Management, Security of IT Assets and Intrusion Detection Systems. (Understand, Apply)
5. Understand various types of Security Policies, Cyber Ethics, IT Act, IPR and Cyber Laws in India. (Understand)

Detailed Syllabus

III Year

DESIGN & ANALYSIS OF ALGORITHMS (ECS-301)

Type	L	T	P	Credits
PCC	3	1	2	5

Prerequisite:

Course Content:

Unit-1:
Algorithms definition and introduction, Analysis of algorithms, Growth of Functions, Master's Theorem, Designing of Algorithms, Partitioning Algorithms, Divide and Conquer design and analysis techniques: Merge Sort and Quick Sort, Sorting and order Statistics: Heap sort, Sorting in linear time, Medians and Order Statistics.

Unit-2:
Advanced Data Structures: Introduction of Red-Black Trees, Augmenting Data Structure, B-Trees, Binomial Heaps, Fibonacci Heaps, Data Structure for Disjoint Sets, Amortized Analysis.

Unit-3:
Advanced Design and Analysis Techniques: Dynamic Programming, Greedy Algorithms, Back Tracking, Branch and Bound with their applications.

Unit-4:
Graph Algorithms: Elementary Graphs Algorithms, Minimum Spanning Trees, Single-source Shortest Paths, All-Pairs Shortest Paths, Traveling Salesman Problem and Maximum Flow

Unit-5:
Selected Topics: Randomized Algorithms, String Matching, Non-deterministic Algorithms: P, NP, NP Hard and NP Completeness, Approximation Algorithms, PRAM Algorithms.

Lab Work:

Programming assignments on each of the following algorithmic strategy:
1. Divide and conquer method (quick sort, merge sort, Strassen's matrix multiplication).
2. Greedy method (knapsack problem, job sequencing, optimal merge patterns, minimal spanning trees).
3. Dynamic programming (multistage graphs, OBST, 0/1 knapsack, traveling salesperson problem).
4. Back tracking (n-queens problem, graph coloring problem, Hamiltonian cycles).
5. Sorting: Insertion sort, Heap sort, Bubble sort.
6. Searching: Sequential and Binary Search.
7. Selection: Minimum/ Maximum, K_{th} smallest element.

Text and References Books:

1. Coreman, Rivest, Lisserson: "Algorithm", PHI.
2. Basse, "Computer Algorithms: Introduction to Design & Analysis", Addison Wesley.
3. Horowitz & Sahni, "Fundamental of Computer Algorithm", Universities Press

1. Understand and apply mathematical preliminaries to the analysis and design stages of different types of algorithms. (Understand, Apply)
2. Analyze worst-case time complexity of various algorithms using asymptotic methods. (Analyze)
3. Understand and apply the divide-and-conquer paradigm and synthesize divide-and-conquer algorithms on problems of Sorting, Searching, finding MST etc. (Understand, Apply)
4. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms. (Apply, Analyze)
5. Apply the dynamic-programming paradigm to model engineering problems using graph and write the corresponding algorithm to solve the problems. (Apply)
6. Explain the ways to analyze randomized and approximation algorithms (Apply, Analyze)

DATABASE MANAGEMENT SYSTEMS (ECS-303)

Type	L	T	P	Credits
PCC	3	1	2	5

Prerequisite:

Course Content:

Unit-1:
Introduction: An overview of database management system, database system Vs file system, Database system concepts and architecture, data models schema and instances, data independence and database language and interfaces, Data definitions language, DML, Overall Database Structure. Data Modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, mapping constraints, keys, Concepts of Super Key, candidate key, primary key, Generalization, aggregation, reduction of an ER diagrams to tables, extended ER model, relationships of higher degree.

Unit-2:
Relational data Model and Language: Relational data model concepts, integrity constraints: entity integrity, referential integrity, Keys constraints, Domain constraints, relational algebra, relational calculus, tuple and domain calculus, Introduction to SQL: Characteristics of SQL, Advantage of SQL.SQL data types and literals, Types of SQL commands, SQL operators and their procedure, Tables, views and indexes. Queries and sub queries, Aggregate functions. Insert, update and delete operations, Joins, Unions, Intersection, Minus, Cursors in SQL.

Unit-3:
Data Base Design & Normalization: Functional dependencies, normal forms, first, second, third normal forms, BCNF, inclusion dependences, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design.

Unit-4:
Transaction Processing Concepts: Transaction system, Testing of serializability, Serializability of schedules, conflict & view serializable schedule, recoverability, Recovery from transaction failures, log based recovery, checkpoints, deadlock handling.

Unit-5:
Concurrency Control Techniques: Concurrency control, locking Techniques for concurrency control, Time stamping protocols for concurrency control, validation based protocol, multiple granularity, Multi version schemes, Recovery with concurrent transaction.

Lab Work:

1. Write the queries for Data Definition and Data Manipulation language.
2. Write SQL queries using Logical operators (=, <, >, etc.).
3. Write SQL queries using SQL operators (Between…. AND, IN(List), Like, ISNULL and with negating expressions).
4. Write SQL query using character, number, date and group functions.
5. Write SQL queries for Relational Algebra (UNION, INTERSECT, and MINUS, etc.).
6. Write SQL queries for extracting data from more than one table (Equi-Join, Non-Equi-Join, Outer Join)
7. Write SQL queries for sub queries, nested queries.
8. Write programs by the use of PL/SQL.
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS.
10. Create VIEWS, CURSORS, and TRIGGRS & write ASSERTIONS.
11. Create FORMS and REPORTS.

*Students are advised to use **Developer 2000/Oracle-9i** version or other latest version for above listed experiments. However depending upon the availability of software's, students may use **Power Builder /SQL SERVER**. Students may also work on a Mini Project to understand the important concepts of Database.

Text and References Books:

1. Date C J, "An Introduction to Database System", Addision Wesley
2. Korth, Silbertz, Sudarshan, "Database Concepts", McGraw Hill
3. Elmasri, Navathe, "Fundamentals of Database Systems", Addision Wesley
4. Leon & Leon, "Database Management System", Vikas Publishing House.
5. Bipin C. Desai, "An introduction to Database Systems", Galgotia Publication
6. Majumdar & Bhattacharya, "Database Management System", TMH
7. Ramakrishnan, Gehrke, "Database Management System", McGraw Hill
8. Kroenke, "Database Processing: Fundamentals, Design and Implementation", Pearson Education.
9. Maheshwari Jain, "DBMS: Complete Practical Approach", Firewall Media, New Delhi.

Course Outcomes:

1. Understand and Develop Entity Relationship (ER) and Relational Models for a given application. (Understand, Apply)
2. Develop and manipulate relational database using Structured Query Language and relational languages. (Apply)
3. Develop a normalized database for a given application by incorporating various constraints like integrity and value constraints. (Apply)
4. Understand and apply transaction processing concepts and convert schedules to serializable schedules. (Understand, Apply)
5. Illustrate different concurrency control mechanisms to preserve data consistency in a multi-user environment. (Apply)

THEORY OF AUTOMATA & FORMAL LANGUAGES (ECS-305)

	Type	L	T	P	Credits
	PCC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
Defining Languages and Grammars, Chomsky hierarchy, Kleene closures, Regular Expressions, Finite Automata (FA), Transition Graph, Generalised Transition Graph.

Unit-2:
Nondeterministic finite Automata (NFA), Deterministic finite Automata (DFA), Construction of DFA from NFA and optimization, Partitioning Algorithm, Equivalence of DFA and NFA and their optimization, FA with output: Moore machine, Mealy machine and their Equivalence, Applications and Limitation of FA.

Unit-3:
Arden Theorem, Pumping Lemma for regular expressions, Myhill-Nerode theorem, Context free grammar: Ambiguous Grammars and Simplification, Normal forms for CFGs, Pumping lemma for CFLs, Decidability of CFGs, Ambiguous to Unambiguous CFG.

Unit-4:
Push Down Automata (PDA): Description and definition, Working of PDA, Acceptance of a string by PDA, PDA and CFG Equivalence, Deterministic and non-deterministic PDA, Introduction to auxiliary PDA and Two Stack PDA.

Unit-5:
Turing machines (TM): Basic model, definition and representation, Language acceptance by TM, TM and Type – 0 Grammar, Integer function computation by TM, Halting problem of TM, Modifications in TM, Universal TM, Properties of recursive and recursively enumerable languages, decision problem, Un-decidability of Post Correspondence Problem, Church's Thesis, Recursive function theory, Godel Numbering.

Text and References Books:

1. Hopcroft, Ullman, "Introduction to Automata Theory, Language and Computation", Nerosa Publishing House
2. K.L.P. Mishra and N. Chandrasekaran, "Theory of Computer Science (Automata, Languages and Computation)", PHI.
3. Martin J. C., "Introduction to Languages and Theory of Computations", TMH
4. Papadimitrou, C. and Lewis, C.L., "Elements of theory of Computations", PHI
5. Cohen D. I. A., "Introduction to Computer theory", John Wiley & Sons
6. Kumar Rajendra, "Theory of Automata (Languages and Computation)", PPM

Course Outcomes:

1. Describe the capabilities and limitations of the abstract machines including finite automata, pushdown automata, and Turing machines and their associated languages. (Understand)

2. Construct finite automata, pushdown automata, Turing machines for the given grammar and vice versa. (Apply)
3. Show that a language is not regular / not context-free using pumping lemma. (Apply)
4. Outline the characteristics of P, NP and NP Complete problems in the context of Turing machines. (Understand)

PRINCIPLES OF PROGRAMMING LANGUAGES (ECS-307)

Type	L	T	P	Credits
PCC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
Introduction: Characteristics of programming Languages, Factors influencing the evolution of programming language, developments in programming methodologies, desirable features and design issues. Programming language processors: Structure and operations of translators, software simulated computer, syntax, semantics, structure, virtual computers, binding and binding time.

Unit -2:
Elementary and Structured Data Types: Data object variables, constants, data types, elementary data types, declaration, assignment and initialization, enumeration, characters, strings. Structured data type and objects: Specification of data structured types, vectors and arrays, records, variable size data structure, pointers and programmer constructed data structure, Sets files. Sub Program and programmer defined data types: Evolution of data types, abstractions, encapsulations, information hiding, sub programs, abstract data types.

Unit -3:
Sequence Control; Implicit and Explicit sequence control, sequence control with within expression and statements, recursive sub programs, exception handling, co routines, Scheduled sub programs, concurrent execution. Data control referencing environments, static and dynamic scope, local data local data referencing environment, shared data: Explicit common environment dynamic scope parameter passing mechanism.

Unit-4:
Storage Management: Major run time requirements, storage management phases, static storage management, stack based, heap based storage management. Syntax and translation: General syntactic criteria, syntactic element of a language, stages in translation, formal syntax and semantics.

Unit-5:
Operating and Programming Environment: Batch Processing Environments, Embedded system requirements, Theoretical models, Introduction to Functional Programming, Lambda calculus, Data flow language and Object Oriented language, Comparison in various general and special purpose programming languages e.g. Fortran, C, Pascal, Lisp, etc.

Text and References Books:

1. Terrance W. Pratt, "Programming Languages: Design and Implementation" PHI
2. Sebesta, "Concept of Programming Language", Addison Wesley
3. E Horowitz, "Programming Languages", 2nd Edition, Addison Wesley

Course Outcomes:

1. Understand the evolution of programming languages alongwith the desirable features and design issues. (Understand)
2. Understand the requirement of elementary and structured data types in programming languages and analyze their features. (Understand, Analyze)
3. Understand and apply the concept of various program development constructs/mechanisms such as sequence control, recursion, scope rules, co-routines, parameter passing, exception handling etc. (Understand, Apply)
4. Understand the concept of storage management and language translation issues as applicable to a programming language. (Understand)
5. Understand and compare features of various types of general/specific purpose programming languages and their programming environment. (Understand, Analyze)

OPERATION RESEARCH (BMA-341)

Type	L	T	P	Credits
OEC	3	1	0	4
(Maths)				

Prerequisite:

Course Content:

Unit-1: Linear Programming Problems (LPP)

OR model, Formulation of LPP. model, Graphical LPP solution and sensitivity analysis, simplex method, M-method, Two-phase method, Special cases in simplex method application, Duality theory, Dual simplex method, Revised simplex method, Degeneracy, Sensitivity analysis, Various industrial application of LP.

Unit-2: Transportation Models, Assignment Models and Integer Programming

Formulation and Optimal solution of transportation models, Assignment models, Transshipment models, Degeneracy in TP model, Industrial application, Formulation and Solution of integer linear programming problems; Cutting-plane algorithm, Branch and Bound algorithm, 0-1 ILPP, applications, Knapsack problem, facility-location problem.

Unit-3: Sequencing and Scheduling Model

Sequencing problems- Travelling salesman problem, Machine-scheduling problem (Job shop), Network based planning models, Objectives of CPM and PERT, Characteristics of CPM/PERT projects, Network diagram, Terminology, Critical path, Project duration, PERT Network, Activity time, Probabilities of project completion, Optimal crashing of project activities.

Unit-4: Replacement and Inventory models

Replacement Problems: Optimal age of equipment replacement, capital equipment discounting cost, Replacement of items that fail, Individual and group replacement policies.

Inventory Models: Deterministic inventory models, Classic EOQ model, EOQ with price breaks, Multi-term, stochastic inventory models under probabilistic demand and lead times.

Unit-5: Dynamic Programming and Genetic Algorithms

Dynamic programming: Bellman's principle of optimality, computations in DP, Forward and Backward recursions, Dynamic Programming formulations, Investment problem, General allocation problem, Storage coach problem, Production scheduling.

Genetic Algorithms: Working principles, similarities and differences between Gas and Traditional methods, Gas for constrained optimization, Applications of Gas to solve simple problems.

Text and Reference Books:

1. S. S. Rao, "Optimization: Theory and Applications" Willey Eastern Limited.
2. H.A. Taha, "Operations Research- AN Introduction", Macmillan.
3. Hiller, F. S., G.J. Lieberman, "Introduction to Operations Research", Hoiden-Day.
4. Kalyanmoy Deb, "Optimization for Engineering Design: Algorithms & Examples "Prentice-Hall of India.
6. B. E. Gillet, Introduction Operations Research- A Computer Oriented Algorithmic Approach, McGraw Hill 1989.

Course Outcomes:

1. Operation Research is the application of modern methods of mathematical science to complex problems involving management of large systems of men, machines, materials and money in industry, business, government and defence. Operations research has wide scope and has been successfully applied in the following areas: (Apply)
   - ➢ Financial Management
   - ➢ Inventory Control
   - ➢ Simulation Technique
   - ➢ Capital Budgeting
   - ➢ Decision Making
2. Linear programming has been used to solve problems involving assignment of jobs to machines, blending, product mix, advertising media selection, least cost diet, distribution, transportation, investment portfolio selection and many others. (Apply)
3. Transportation problem is the most useful model of L.P.P. which simplify calculation to find solution of L.P.P. containing more number of variables and constraints. It deals with the transportation of a product available at several sources to a number of different destination. Transportation model can be used for a wide variety of situations such as scheduling, production, investment, plant location, inventory control, employment scheduling, personnel assignment, product mix problems and many others. (Apply)
4. Sequencing and Scheduling Model has been helpful to solve problems of appropriate selection of the number of jobs (operations) which are assigned to a finite number of service facilities (machines or equipment) so as to optimize the output in items of time, cost or profit. Network techniques of PERT and CPM have been used in planning, scheduling and controlling construction of dams, bridges, roads, highways and development and production of aircrafts, ships, computers, etc. (Analyze)
5. Inventory control models have been used to determine economic order quantities, safety stocks, reorder levels, minimum and maximum stock levels. (Understand)
6. Replacement theory has been extensively employed to determine the optimum replacement interval for three types of replacement problems. (Understand, Apply)
7. Dynamic programming has been applied to capital budgeting, selection of advertising media, employment smoothening, cargo loading and optimal routing problems. (Apply)

COMPUTER NETWORKS (ECS-302)

	Type	L	T	P	Credits
	PCC	3	1	2	5

Prerequisite:

Course Content:

Unit-1:
Introduction Concepts: Goals and Applications of Networks, Network structure and architecture, The OSI reference model, services, Network Topology Design – Delay Analysis, Back Bone Design, Local Access Network Design. Physical Layer Transmission Media, Switching methods, ISDN, Terminal Handling.

Unit-2:
Medium Access sub layer: Medium Access sub layer - Channel Allocations, LAN protocols - ALOHA protocols - Overview of IEEE standards - FDDI. Data Link Layer - Elementary Data Link Protocols, Sliding Window protocols, Error Handling.

Unit-3:
Network Layer: Network Layer - Point - to Pont Networks, routing, Congestion control Internetworking -TCP / IP - IP packet, IP address, IPv6. '

Unit-4:
Transport Layer: Transport Layer - Design issues, connection management, session Layer-Design issues, remote procedure call. Presentation Layer-Design issues, Data Compression techniques, cryptography - TCP - Window Management.

Unit-5:
Application Layer: Application Layer: File Transfer, Access and Management, Electronic mail, Virtual Terminals, Other application, Example Networks - Internet and Public Networks.

Lab Work:

1. Implementation of the Data Link Layer framing method such as character stuffing and bit stuffing in C.
2. Implementation of CRC algorithm in C.
3. Implementation of a Hamming (7, 4) code to limit the noise. We have to code the 4 bit data in to 7 bit data by adding 3 parity bits. Implementation will be in C.
4. Implementation of LZW compression algorithm in C.
5. Write a socket program in C to implement a listener and a talker.
6. Simulation of a network of 3 nodes and measure the performance on the same network using network simulator ns3.
7. Simulation of wireless network and its performance evaluation using network simulator ns3.
8. Write a program in C to encrypt and decrypt 64-bit text using DES algorithm.

Text and References Books:

1. Forouzen, "Data Communication and Networking", TMH
2. A.S. Tannenbaum, "Computer Networks", 3rd Edition, Prentice Hall India, 1997.

3. S. Keshav, "An Engineering Approach on Computer Net working", Addison Wesley, 1997
4. W. Stallings, "Data and Computer Communication", Mac-millan Press, 1989

Course Outcomes:

1. Explain the functions of the different layer of the OSI Protocol. (Understand)
2. Design of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) based on available network devices. (Apply, Analyze)
3. Develop network programing application for a given problem related to TCP/IP protocol stack. (Apply, Analyse)
4. Understand and analyze different routing algorithms. (Understand, Analyze)
5. Understand the use of IP addressing schemes as per IPV4 and IPV6. (Understand)
6. Modify the existing protocols of TCP/IP protocol stack for performance improvement. (Apply, Analyze)

OPERATING SYSTEMS (ECS-304)

Type	L	T	P	Credits
PCC	3	1	2	5

Prerequisite:

Course Content:

Unit-1:
Introduction: Operating System and its functions, Evolution of Operating System, Batch, Interactive, Time Sharing and Real Time Operating System, System Protection. Operating System Structure: System Components, System Structure, Operating System Services.

Unit-2:
Process Management: Process Concept, Process State, Process Control Block, Threads. Concurrent Processes: Principle of Concurrency, Mutual Exclusion, Inter Processes Communication, Critical Section Problem, Semaphores, Classical Problems in Concurrency, Producer / Consumer Problem, Readers-Writers Problem, Dining Philosophers Problem.

Unit-3:
CPU Scheduling: Scheduling Concept, Scheduling Techniques, Performance Criteria for Scheduling Algorithm, Evolution, Multiprocessor Scheduling. Deadlock: System Model, Deadlock Characterization, Prevention, Avoidance and Detection, Recovery From Deadlock Combined Approach.

Unit-4:
Memory Management: Basic Machine, Resident Monitor, Multiprogramming with Fixed Partition, Multiprogramming With Variable Partition, Multiple Base Register, Paging, Segmentation, Paged Segmentation. Virtual Memory: Virtual Memory Concept, Demand Paging, Performance, Paged Replaced Algorithm, Allocation of Frames, Thrashing, Cache Memory Organization, Impact on Performance.

Unit-5:
I/O Management & Disk Scheduling: I/O Devices, Organization of I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling (FCFS, SCAN, CSCAN). File Management: File Concept, File Organization, File Directories, File Sharing, Allocation Methods, Free Space Management, and Implementation Issues.

Lab Work:

1. Simulation of the CPU scheduling algorithms a) Round Robin b) SJF c) FCFS d) Priority Simulation of MUTEX and SEMAPHORES.
2. Simulation of Bankers Deadlock Avoidance and Prevention algorithms.
3. Implementation of Process Synchronization (Reader-Writer, Sleeping Barber and Dining Philosopher's Problem)
4. Simulation of page Replacement Algorithms a) FIFO b) LRU c) LFU
5. Simulation of paging techniques of memory management.
6. Simulation of file allocation Strategies a) Sequential b) Indexed c) Linked
7. Simulation of file organization techniques a) Single Level Directory b) Two Level c) Hierarchical d) DAG

Text and References Books:

1. Milenekovik, "Operating System Concept", McGraw Hill.
2. Petersons, "Operating Systems", Addison Wesley.
3. Dietal, "An Introduction to Operating System", Addison Wesley.
4. Tannenbaum, "Operating System Design and Implementation", PHI.
5. Gary Nutt, "Operating System, A Modern Perspective", Addison Wesley.
6. Stalling, Williams, "Operating System", Maxwell Macmillan
7. Silveschatz, Peterson J., "Operating System Concepts", Willey.
8. Crowley, "Operating System", TMH.

Course Outcomes:

1. Understand types and structure of operating systems. (Understand)
2. Develop programs using system-calls related to process, memory and file management. (Apply)
3. Construct solutions for problems related to process scheduling, deadlocks and synchronization in a multi-programmed operating system. (Apply)
4. Develop appropriate solutions for memory management considering challenges due to multi-programming and virtual memory. (Apply)
5. Apply knowledge of various software and hardware synchronization tools for solving critical section problem in concurrent processes. (Apply)
6. Construct solutions for problems related to secondary storage management with an understanding of file systems and disk scheduling. (Apply)
7. Design various system protection and security mechanisms in order to design efficient software system. (Apply)

COMPILER DESIGN (ECS-306)

	Type	L	T	P	Credits
	PCC	3	1	0	4

Prerequisite: Theory of Automata and Formal Languages (ECS-305)

Course Content:

Unit-1:
Introduction to Compiler, Phases and passes, Bootstrapping, Finite automata & regular expressions and their applications to lexical analysis, Implementation of lexical analyzers, lexical-analyzer generator, LEX-compiler, The syntactic specification of Programming languages: Context free grammars, derivation and parse trees, capabilities of CFG, Application of grammars in syntax analysis, ambiguity and BNF notation, YACC.

Unit-2:
Basic Parsing Techniques: Parsers, top down parsing, Shift reduces parsing, operator precedence parsing, predictive parsers. Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables, constructing LALR sets of items.

Unit-3:
Syntax-directed Translation: Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declarations, Case statements.

Unit-4:
Symbol Tables: Data structure and representing scope information, Run-Time Administration: Implementation of simple stack allocation scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors.

Unit-5:
Introduction to code optimization: Loop optimization, the DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.

Text and References Books:

1. Aho, Sethi & Ullman, "Compiler Design", Addition Wesley.
2. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Thomson Brooks Publication.
3. Allen I. Holub, "Compiler Design in C", PHI Publications.

Course Outcomes:

1. Describe the role of each phase of a compiler with its construction tools. (Understand)
2. Develop a Lexical Analyzer for recognizing tokens of a given language with an understanding of symbol table management and error handling. (Apply)
3. Construct top-down, bottom-up, operator precedence and SLR parsers with an understanding of Context Free Grammars and syntax analysis. (Apply)
4. Design and develop semantic analyzers for type-checking and intermediate code generators to translate the source program into an intermediate code. (Apply)
5. Construct code optimizers to optimize the target code generated. (Apply)

COMPUTER GRAPHICS (ECS-308)

	Type	L	T	P	Credits
	PCC	3	0	2	4

Prerequisite:

Course Content:

Unit-1:
Line generation: Points and Lines, Planes, Pixels and Frame buffers, vector and character generation. Graphics Primitives: Display devices, Primitive devices, Display File Structure, Display control text, Line-drawing Algorithms**:** DDA Algorithm Bresenham's line Algorithm, Circle-generating Algorithm**:** Midpoint Circle of Algorithm, Polygon Filling Algorithm.

Unit-2:
2-D Viewing and Clipping: Point Clipping, Line Clipping, Cohen-Sutherland Line Clippings, Cyrus-Beck Line Clipping Algorithm, Polygon Clipping: Sutherland Hodgman Algorithm, Polygon: Polygon Representation, Entering polygons, Filling polygons, Segments: Segments table, Creating deleting and renaming segments, Visibility.

Unit-3 :
2-D and 3-D Transformations: Basic Transformations: Translation, Rotation, Scaling, Shear, Composite Transformations: Rotations about a point, Reflection about a line, Homogeneous Coordinate Systems, 3-D Transformations, 3-D geometry primitives, Viewing Transformation, Projections: Parallel Projection, Orthographic & Oblique Projections, Perspective Projections. Interaction: Hardware input devices handling algorithms, Event handling echoing, Interactive techniques.

Unit-4:
Hidden Line and Surface: Back face removal algorithms, hidden line methods, Rendering and Illumination: Introduction to curve and Surfaces generation, Bezier, Hermite and B-spline algorithms and their comparisons.

Unit-5:
Multimedia and Animation: Basic of Animation, Types of Animation, Simulating, Accelerations, Computer Animation Tools, Multimedia Applications, Concepts of Hypertext/Hypermedia, Images, Audio and Video**,** Multimedia Tools.

Text and Reference Books:

1. Rogers, "Procedural Elements of Computer Graphics", McGraw Hill
2. Baker and Hearn, "Computer Graphics", PHI Publication.
3. Newman and Sproul, "Principle of Interactive Computer Graphics", McGraw Hill
4. Steven Harrington, "Computer Graphics", A Programming Approach, 2nd Edition
5. Rogar and Adams, "Mathematical Elements of Computer Graphics", McGraw Hill.

Lab Work:

Write Program in C or C++ for the following.
1. Implementation of line generation using slope's method, DDA and Bresenham's algorithms.
2. Implementation of circle generation using Mid-point method and Bresenham's algorithm.
3. Implementation of ellipse generation using Mid-point method.
4. Implementation of polygon filling using Flood-fill, Boundary-fill and Scan-line algorithms.
5. Implementation of 2-D transformation: Translation, Scaling, Rotation, Mirror Reflection and Shearing (write a menu driven program).

6. Implementation of Line Clipping using Cohen-Sutherland algorithm and Bisection Method.
7. Implementation of Polygon Clipping using Sutherland-Hodgman algorithm.
8. Implementation of 3-D geometric transformations: Translation, Scaling and rotation.
9. Implementation of Curve generation using Interpolation methods.
10. Implementation of Curve generation using B-spline and Bezier curves.
11. Implementation of any one of Back face removal algorithms: Depth-Buffer algorithm, Painter's algorithm, Warnock's algorithm, Scan-line algorithm.

Course Outcomes:

1. Understand and use various mathematical concepts and supporting composite 2-D & 3-D graphics transformations for hidden surface detection/ removal and various graphical algorithms. (Understand, Apply)
2. Design algorithms for various graphics shapes like ellipse, hyperbola, triangle etc. (Apply)
3. Use of various graphical tools and software in 3D Graphics API (e.g. OpenGL or DirectX). (Apply)
4. Understand and apply geometrical transformation and computer graphics in multidisciplinary field of engineering. (Apply)
5. Understand the hardware system architecture for computer graphics - graphics pipeline, frame buffers, and graphic accelerators/co-processors. (Understand)
6. Analyze and implement interactive graphics applications using programming language and graphics application programming interfaces. (Apply, Analyze)

ENTREPRENEURSHIP DEVELIPMENT (HHS-341/342)

Type	L	T	P	Credits
OEC	3	1	0	4
(HSS)				

Prerequisite:

Course Content:

Unit-1: Entrepreneurship
Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.
Entrepreneurial Motivation: motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.
Unit-2: Business Enterprises and Ownership Structure
Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, companies and co-operatives firms: their formation, capital structure and source of finance.
Unit-3: Project Management:
Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit-4: Management of Enterprises
Strategy & policy, introduction to human resource management, marketing strategies, financial management & strategies: raising and managing capital, shares, debentures and bonds, cost of capital; break- even analysis.

Unit-5: Institutional Support and Policies
Institutional support towards the development of entrepreneurship in India: Institutional framework, venture capitalist; technical consultancy organizations (TCOs), government policies for small scale enterprises.

Text and Reference Books:

1. **Khanka, S S**. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi
2. **Desai, Vasant**, 'Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. **Gupta and Srinivasan**, 'Entrepreneurial Development', S Chand & Sons, New Delhi.
4. **Ram Chandran**, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
5. **Saini, J. S**. 'Entrepreneurial Development Programmes and Practices', Deep & Deep Publications (P), Ltd.
6. **Holt, Davis, '**Entrepreneurship : New Venture Creations, PHI

Course Outcome:
1. Describe what it takes an Entrepreneur; describe multiple ways to become an entrepreneur; including, intrapreneur manager, woman entrepreneur rural & urban: highlights motives to become entrepreneur. (Understand)
2. Apply the beginner concept, ownership and various forms with focus on small scale enterprises. (Apply)
3. Identify opportunities using identification; project conceptualisation, formulation & evaluation. (Remember, Understand)
4. Identify potential contribution of human resources, marketing, financial and strategic management with fund, opportunities. (Remember)
5. Decipher the role of Institution support and policy framework of Government for enterprises in India. (Apply)

Detailed Syllabus

IV Year

ARTIFICIAL INTELLIGENCE (ECS-401)

Type	L	T	P	Credits
PCC	3	1	0	4

Prerequisite: Discrete Mathematical Structures (BMA-204)

Course Content:

Unit-1:
Introduction to Artificial Intelligence, Brief history, Various approaches to AI, Areas of application, Simulation of sophisticated & Intelligent Behavior in different area, Problem solving in games, natural language processing, automated reasoning, and visual perception, Knowledge and its role in AI, Heuristic algorithm versus solution guaranteed algorithms, Introduction to soft computing.

Unit-2:
Representing problems in state space, Informed versus uninformed search, Production System Model, Evaluation of the Production System, Depth First Search and Breadth First Search, Heuristics, Heuristic Search Techniques: Hill Climbing, Best First search, A* Algorithm, Branch and Bound, Cryptarithmatic Problem, Means End Analysis, AO* Algorithm, Game Playing: MINMAX Search, Alpha-Beta Pruning, Heuristic Estimation.

Unit-3:
Knowledge Representation and Reasoning : Propositional Logic, First Order Predicate Logic, Graphs, Associative Network, Semantic Networks, Conceptual Dependencies, Frames, Scripts, Horn Clauses, Introductory Examples from PROLOG, Case Grammar Theory, Production Rules Knowledge Base, The Interface System, Forward & Backward Deduction, Inference System in Propositional and Predicate Logic, Reasoning under Uncertainty.

Unit-4:
Understanding Natural Languages, Various Approaches of NLP, Parsing techniques, Context free and transformational grammars, Transition nets, Augmented transition nets, Fillmore's grammars, Grammar free analyzers, Sentence generation, and translation, Introduction to Pattern Recognition, Structured Description, Symbolic Description, Machine Perception, Object Identification, Speech Recognition.

Unit-5:
Expert Systems: Architecture of Expert System, Representing and using domain knowledge, Expert System Shell, Explanation System, Knowledge Acquisition System, Case study of Existing Expert Systems like DENDRAL, MYCIN, Development of a small Expert System using programming Languages and tools like LISP, PROLOG, JESS.

Text and References Books:

1. N. J. Nilsson, "Artificial Intelligence: A New Synthesis", Elsevier Publications.
2. Charnick, "Introduction to A.I.", Addison Wesley.
3. Rich & Knight, "Artificial Intelligence", McGraw-Hill Publication.
4. Winston, "LISP", Addison Wesley
5. Marcellous, "Expert System Programming", PHI
6. Elamie, "Artificial Intelligence", Academic Press

7. Lioyed, "Foundation of Logic Processing", Springer Verlag
8. D. W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", PHI.

Course Outcomes:

1. Understand different types of AI agents (Understand).
2. Understand and apply various AI search algorithms (uninformed, informed, heuristic, constraint satisfaction, genetic algorithms) (Understand, Apply).
3. Understand the fundamentals of knowledge representation, reasoning, and machine learning techniques and apply them to real world problems. (Understand, Apply)
4. Know how to build simple knowledge based systems using languages like LISP, Prolog, and AI tools like JESS. (Apply)
5. Carry out independent (or in a small group) research and communicate it effectively in a seminar. (Apply, Analyze)

ELECTIVE-I

MOBILE APPLICATION DEVELOPMENT (EIT-411)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Operating Systems (ECS-304)

Course Content:

Unit-1
Introduction to mobile computing, Characteristics of mobile applications, History of mobile application frameworks, Android Development Environment, Factors in Developing Mobile Applications, Mobile Software Engineering, Frameworks and Tools, Generic UI Development, VUIs and Mobile Apps, Text-to-Speech Techniques, Designing the Right UI, Multichannel and Multi modal UIs.

Unit-2
Overview of mobile application development languages: Java and Android Studio.

Unit-3:
Application models of mobile application frameworks, User-interface design for mobile applications, Managing application data, Integrating with cloud services, Integrating networking, OS and hardware into mobile-applications

Unit-4:
Addressing enterprise requirements in mobile applications – performance, scalability, modifiability, availability and security, Security and Hacking, Active Transactions, Hacking Android

Unit-5:
Testing methodologies for mobile applications, Publishing, deployment, maintenance and management, Platforms and Additional Issues, Development Process, Architecture, Design, Technology Selection, Mobile App Development Hurdles.

Text and Reference Books:

1. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, Android SDK 3 for Dummies, Wiley.

2. Bill Phillips, Chris Stewart, Brian Hardy, and Kristin Marsicano, Android Programming: The Big Nerd Ranch Guide, Big Nerd Ranch LLC, 2nd edition, 2015.
3. Christian Keur and Aaron Hillegass, iOS Programming: The Big Nerd Ranch Guide, 5th edition, 2015.
4. Valentino Lee, Heather Schneider, and Robbie Schell, Mobile Applications: Architecture, Design and Development, Prentice Hall, 2004.
5. Tomasz Nurkiewicz and Ben Christensen, Reactive Programming with RxJava, O'Reilly Media, 2016.
6. Raoul-Gabriel Urma, Mario Fusco, and Alan Mycroft, Java 8 in Action: Lambdas, Streams, and Functional-Style Programming, Manning Publications, 2015.
7. Benjamin J. Evans and Martijn Verburg, The Well-Grounded Java Developer: Vital Techniques of Java 7 and Polyglot Programming, Manning Publications, 2013.
8. Brian Fling, Mobile Design and Development, O'Reilly Media, Inc., 2009.

Course Outcomes

1. Understand technology and business trends impacting mobile applications. (Understand)
2. Understand and implement mobile application development languages. (Understand, Apply)
3. Understand the characterization and architecture of mobile applications. (Understand)
4. Understand and design enterprise scale requirements of mobile applications. (Understand, Apply, Analyze)
5. Design and develop mobile applications using application development framework. (Apply, Analyze)

DATA WAREHOUSING & DATA MINING (ECS-411)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Database Management Systems (ECS-303)

Course Content:

Unit-1:
Overview, Motivation (for Data Mining),Data Mining-Definition & Functionalities, Data Processing, Form of Data Preprocessing, Data Cleaning: Missing Values, Noisy Data, Binning, Clustering, Regression, Computer and Human inspection, Inconsistent Data, Data Integration and Transformation. **Data Reduction**:-Data Cube Aggregation, Dimensionality reduction, Data Compression, Numerosity Reduction, Clustering, Discretization and Concept hierarchy generation.

Unit-2:
Concept Description:- Definition, Data Generalization, Analytical Characterization, Analysis of attribute relevance, Mining Class comparisons, Statistical measures in large Databases. Measuring Central Tendency, Measuring Dispersion of Data, Graph Displays of Basic Statistical class Description, Mining Association Rules in Large Databases, Association rule mining, mining Single-Dimensional Boolean Association rules from Transactional Databases: Apriori Algorithm, Mining Multilevel Association rules from Transaction Databases and Mining Multi-Dimensional Association rules from Relational Databases

Unit-3:
Classification and Predictions:
What is Classification & Prediction, Issues regarding Classification and prediction, Decision tree, Bayesian Classification, Classification by Back propagation, Multilayer feed-forward Neural Network, Back propagation Algorithm, Classification methods K-nearest neighbor classifiers, Genetic Algorithm.
Cluster Analysis:
Data types in cluster analysis, Categories of clustering methods, partitioning methods. Hierarchical Clustering- CURE and Chameleon. Density Based Methods-DBSCAN, OPTICS. Grid Based Methods- STING, CLIQUE. Model Based Method –Statistical Approach, Neural Network approach, Outlier Analysis
Unit-4:
Data Warehousing: Overview, Definition, Delivery Process, Difference between Database System and Data Warehouse, Multi-Dimensional Data Model, Data Cubes, Stars, Snow Flakes, Fact Constellations, Concept hierarchy, Process Architecture, 3-Tier Architecture, Data Mart.
Unit-5:
Aggregation, Historical information, Query Facility, OLAP function and Tools, OLAP Servers, ROLAP, MOLAP, HOLAP, Data Mining interface, Security, Backup and Recovery, Tuning Data Warehouse, Testing Data Warehouse.

Text and Reference Books:

1. M. H. Dunham, ”Data Mining: Introductory and Advanced Topics”, Pearson Education
2. Jiawei Han, Micheline Kamber, ”Data Mining Concepts & Techniques”, Elsevier
3. Sam Anahory, Dennis Murray, “Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems, 1/e “ Pearson Education
4. Mallach, ”Data Warehousing System”, McGraw –Hill

Course Outcomes:

1. Understand importance of abstraction of Knowledge from unstructured sources at sufficient level. (Understand)
2. Use of high level operational skills and real world case studies for knowledge discovery and data warehousing based principles. (Apply)
3. Understand the areas of probability, statistics and machine learning algorithms which underpin the knowledge discovery enterprise. (Understand)
4. Design data mining and data warehousing systems and solutions to meet user requirements and specifications. (Apply, Analyze)
5. Compare and contrast OLAP and data mining as techniques for extracting knowledge from a data warehouse. (Evaluate)

CLOUD COMPUTING (ECS-413)

	Type	L	T	P	Credits
	PEC	3	1	0	4

Prerequisite: Computer Networks (ECS-302)

Course Content:

Unit-1
Distributed computing models and technologies, Enabling Technologies and System Models for Cloud Computing, techniques, and architectures, Introduction to Cloud Computing including benefits, challenges, and risks.

Unit-2
Cloud Computing Models including Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS), virtualization, security and privacy issues, performance and systems issues, capacity planning, disaster recovery, Public cloud, private cloud and hybrid clouds.

Unit-3
Cloud OS, Cloud architectures including federated clouds, challenges in implementing clouds, data centers, hypervisor CPU and memory management, Scalability, Performance, and QoS.

Unit-4
Cloud hosted applications, Data centers for Cloud Computing, Principles of Virtualization platforms and other advanced and research topics in cloud computing.

Unit-5
Security and Privacy issues in the Cloud, VM Ware ESX Memory Management, Capacity Planning and Disaster Recovery in Cloud Computing.

Text and Reference Books:

1. Distributed and Cloud Computing, 1st edition, Morgan Kaufmann, 2011.
2. Technical papers from major journals and major conferences on computing, networking, cloud computing.

Course Outcomes

1. Understand various basic concepts related to cloud computing technologies. (Understand)
2. Understand the architecture and concept of different cloud models: IaaS, PaaS, SaaS. (Understand)
3. Apply the underlying principle of cloud virtualization, cloud storage, data management and data visualization. (Apply)
4. Use different cloud programming platforms and tools. (Apply)
5. Design and deploy cloud application using cloud platforms (Analyze)

ADVANCE COMPUTER ARCHITECTURE (ECS-415)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Computer Organisation & Architecture (ECS-203)

Course Content:

Unit-1: Introduction
Introduction to parallel computing, need for parallel computing, parallel architectural classification schemes, Flynn's, Feng's classification, performance of parallel processors, distributed processing, processor and memory hierarchy, bus, cache & shared memory, introduction to super scalar architectures, quantitative evaluation of performance gain using memory, cache miss/hits.

Unit-2: Multi-core Architectures
Introduction to multi-core architectures, issues involved into writing code for multi-core architectures, development of programs for these architectures, program optimizations techniques, building of some of these techniques in compilers, OpenMP and other message passing libraries, threads, mutex etc.

Unit-3: Multi-threaded Architectures
Parallel computers, Instruction level parallelism (ILP) vs. thread level parallelism (TLP), Performance issues: Brief introduction to cache hierarchy and communication latency, Shared memory multiprocessors, General architectures and the problem of cache coherence, Synchronization primitives: Atomic primitives; locks: TTS, ticket, array; barriers: central and tree; performance implications in shared memory programs; Chip multiprocessors: Why CMP (Moore's law, wire delay); shared L2 vs. tiled CMP; core complexity; power/performance; Snoopy coherence: invalidate vs. update, MSI, MESI, MOESI, MOSI; performance trade-offs; pipelined snoopy bus design; Memory consistency models: SC, PC, TSO, PSO, WO/WC, RC; Chip multiprocessor case studies: Intel Montecito and dual-core, Pentium4, IBM Power4, Sun Niagara

Unit-4: Compiler Optimization Issues
Introduction to optimization, overview of parallelization; Shared memory programming, introduction to OpenMP; Dataflow analysis, pointer analysis, alias analysis; Data dependence analysis, solving data dependence equations (integer linear programming problem); Loop optimizations; Memory hierarchy issues in code optimization.

Unit-5: Operating System Issues and Applications
Operating System issues for multiprocessing Need for pre-emptive OS; Scheduling Techniques, Usual OS scheduling techniques, Threads, Distributed scheduler, Multiprocessor scheduling, Gang scheduling; Communication between processes, Message boxes, Shared memory; Sharing issues and Synchronization, Sharing memory and other structures, Sharing I/O devices, Distributed Semaphores, monitors, spin-locks, Implementation techniques on multi-cores; OpenMP, MPI and case studies Case studies from Applications: Digital Signal Processing, Image processing, Speech processing.

Text and Reference Books:

1. Kai Hwang," Advance Computer Architecture", TMH
2. Matthew, "Beginning Linux Programming", SPD/WROX
3. Hennessy and Patterson," Computer Architecture: A Quantitative Approach", Elsevier
4. Dezso and Sima, "Advanced Computer Architecture", Pearson
5. Quinn, "Parallel Computing: Theory & Practice", TMH
6. Quinn, "Parallel Programming in C with MPI and Open MP", TMH
7. Open MP Specification and Usage (www.openmp.org)

1. Understand different processor architectures, system-level design processes and apply the concepts of cache memory & virtual memory to high performance computer architecture. (Understand, Apply, Analyze)
2. Understand pipelining and apply the concept to design pipelined logic/pipelined processors. (Understand, apply)
3. Understand the principles of I/O in computer systems, including viable mechanisms for I/O and secondary storage organisation. (Understand)
4. Analyse various multiprocessing configurations. (Analyse)
5. Develop systems programming skills in the context of computer system design and organisation. (Apply)

ELECTIVE-II

NETWORK SECURITY (ECS-431)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Computer Networks ((ECS-302)

Course Content:

Unit-1:
Introduction to security attacks, services and mechanism, introduction to cryptography. Conventional Encryption: Conventional encryption model, classical encryption techniques substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers. Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, differential and linear crypt analysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

Unit-2:
Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primality testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms. Principals of public key crypto systems, RSA algorithm, security of RSA, key management, Diffle-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.

Unit-3:
Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code, hash functions, birthday attacks, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA). Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.

Unit-4:
Authentication Applications: Kerberos and X.509, directory authentication service, electronic mail security-pretty good privacy (PGP), S/MIME.

Unit-5:

IP Security: Architecture, Authentication header, Encapsulating security payloads, combining security associations, key management. Web Security: Secure socket layer and transport layer security, secure electronic transaction (SET). System Security: Intruders, Viruses and related threads, firewall design principals, trusted systems.

Text and References Books:

1. William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersy.
2. Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag.
3. Bruce Schiener, "Applied Cryptography".

Course Outcomes:

1. Understand and deploy cryptographic techniques to secure data in networks. (Understand, Apply)
2. Analyze the vulnerabilities in any computing system and design a security solution. (Apply, Analyse)
3. Understand and use standard algorithms for confidentiality, integrity and authenticity. (Understand, Apply)
4. Apply various key distribution and management schemes in network system. (Apply)
5. Apply security protocols in various IT applications. (Apply)

DIGITAL IMAGE PROCESSING (ECS-433)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:

Introduction and Fundamentals Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization. Image Enhancement in Spatial Domain Introduction; Basic Gray Level Functions–Piecewis e-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations–Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Unit-2:

Image Enhancement in Frequency Domain Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters–Gaussian Lowpass Filters; Sharpening Frequency Domain Filters – Gaussian Highpass Filters; Homomorphic Filtering. Image Restoration A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering–Bandpass Filters; Minimum Mean-square Error Restoration.

Unit-3:
Color Image Processing Color Fundamentals, Color Models, converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation, Morphological Image Processing Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms–Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Unit-4:
Registration Introduction, Geometric Transformation – Plane to P lane transformation, Mapping, Stereo Imaging – Algorithms to Establish Correspondence, Algorithms to Recover Depth Segmentation Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Unit-5:
Feature Extraction Representation, Topological Attributes, Geometric Attributes Description Boundary-based Description, Region-based Description, Relationship, Object Recognition Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching.

Text and Reference Books:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
2. Digital Image Processing and Computer Vision, R.J. Schalkoff Published by: John Wiley and Sons, NY.
3. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.

Course Outcomes:

1. Apply sampling and quantization techniques for conversion of an analog image into digital form. (Apply)
2. Enhance the image using various types of filtering, segmentation and edge detection techniques. (Apply)
3. Analyze and interpret the effects of high pass and low pass filter in an image. (Analyse)
4. Restore the image in the presence of noise by using modern restoration software. (Apply)
5. Use the techniques of morphological image processing, image registration and image recognition. (Apply)
6. Apply various tools and techniques in multidisciplinary engineering and medical fields like embedded programming, CAD, web applications, MRI, CT-Scan, Angiography etc. (Apply)

REAL TIME SYSTEMS (ECS-435)

	Type	L	T	P	Credits
	PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Introduction
Definition, Issues in Real-Time Computing, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Characterizing Real-Time System and Tasks, Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Modeling Real Time Systems.

Unit-2: Real Time Scheduling
Common Approaches to Real Time Scheduling: Clock Driven Vs Event Driven Approach, Rate Monotonic Scheduling Algorithm, Preemptive Earliest Deadline First Algorithm, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Allowing for Precedence Constraints, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.

Unit-3: Resources Access Control
Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Use of Priority-Ceiling Protocol in Dynamic n-Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Unit Resources, Controlling Concurrent Accesses to Data Objects, Real Time Databases

Unit-4: Multiprocessor and Distributed System Environment
Multiprocessor and Distributed System Model, Task Assignment Issues and Challenges, Utilization Balancing Algorithm, A Next-Fit Algorithm for RM Scheduling, A Bin-Packing Assignment Algorithm for EDF, Focused Addressing and Bidding Algorithm, The Buddy Strategy, Assignment with precedence condition. Fault Tolerant Scheduling, Clock Synchronization in Distributed Real Time Systems

Unit-5: Real Time Communication
Network Topologies, Protocols, Real Time Communication over LAN and Internet, Routing, Resource Reservation, Traffic Shaping and Policing, Quality of Service Model.

Text and Reference Books:

1. Real Time Systems by Jane W. S. Liu, Pearson Education Publication.
2. Real-Time Systems: Scheduling, Analysis, and Verification by Prof. Albert M. K. Cheng, John Wiley Publications.
3. Real Time Systems, C.M. Krishna, Kang G. Shin, Tata McGraw Hill.
4. Real Time Systems: Theory and Practice by Rajib Mall, Pearson.

Course Outcomes:

1. Understand the characteristics of Real Time Systems and their applications in various fields, (Understand)
2. Understand various Scheduling Algorithms for real time systems and apply the appropriate one to prepare a feasible Schedule for given task set. (Understand, Apply)
3. Apply precedence constraints and mutual exclusion constraints to a given Real Time Schedule. (Apply)

4. Understand various Scheduling Algorithms for Multiprocessor Real Time Systems and apply the appropriate one to prepare a feasible Schedule for given task set. (Understand)
5. Understand Distributed and Network related issues for Distributed Real Time Systems. (Understand)

MACHINE LEARNING (ECS-437)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Introduction to Machine Learning
Why Machine learning, Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection.

Unit-2: Classification and Regression
Classification: Binary Classification- Assessing Classification performance, Class probability Estimation- Assessing class probability Estimates, Multiclass Classification. Regression: Assessing performance of Regression- Error measures, Overfitting: Catalysts for Overfitting, Case study of Polynomial Regression. Theory of Generalization: Effective number of hypothesis, Bounding the Growth function, VC Dimensions, Regularization theory.

Unit-3: Linear Models
Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.

Unit-4: Logic Based and Algebraic Models
Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, Rule Based Models: Rule learning for subgroup discovery, Association rule mining. Tree Based Models: Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees.

Unit-5: Probabilistic Models
Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood, Probabilistic Models with Hidden variables: Estimation-Maximization Methods, Gaussian Mixtures, and Compression based Models.
Trends in Machine Learning: Model and Symbols- Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Data Streams and Active Learning, Deep Learning, Reinforcement Learning.

Text and Reference Books:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
2. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition-2012.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
4. Ethem Alpaydin, Introduction to Machine Learning, PHI 2nd Edition-2013.

5. Parag Kulkarni, Reinforcement and Systematic Machine Learning for Decision Making, Wiley, IEEE Press, Edition July 2012.

Course Outcomes:

1. Understand Machine learning and Machine Learning Models. (Understand)
2. Apply various classification and regression techniques and assess their performance. (Apply)
3. Apply various clustering algorithms for the problems to be solved with machine learning. (Apply)
4. Assessment of various machine learning models. (Analyze)
5. Understand probabilistic learning models and trends in machine learning. (Understand)

OPEN ELECTIVE-I*

*(Students may opt a course offered as Open Elective by any Department other than CSE. The CSE Department offers the following Course as Open Elective)

MACHINE LEARNING (ECS-437)

Type	L	T	P	Credits
OEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Introduction to Machine Learning
Why Machine learning, Examples of Machine Learning Problems, Structure of Learning, Learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection.

Unit-2: Classification and Regression
Classification: Binary Classification- Assessing Classification performance, Class probability Estimation- Assessing class probability Estimates, Multiclass Classification. Regression: Assessing performance of Regression- Error measures, Overfitting: Catalysts for Overfitting, Case study of Polynomial Regression. Theory of Generalization: Effective number of hypothesis, Bounding the Growth function, VC Dimensions, Regularization theory.

Unit-3: Linear Models
Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification, Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.

Unit-4: Logic Based and Algebraic Models
Distance Based Models: Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, Rule Based Models: Rule learning for subgroup discovery, Association rule mining. Tree Based Models: Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees.

Unit-5: Probabilistic Models

Normal Distribution and Its Geometric Interpretations, Naïve Bayes Classifier, Discriminative learning with Maximum likelihood, Probabilistic Models with Hidden variables: Estimation-Maximization Methods, Gaussian Mixtures, and Compression based Models.

Trends in Machine Learning: Model and Symbols- Bagging and Boosting, Multitask learning, Online learning and Sequence Prediction, Data Streams and Active Learning, Deep Learning, Reinforcement Learning.

Text and Reference Books:

1. Peter Flach, Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Cambridge University Press, Edition 2012.
2. Hastie, Tibshirani, Friedman: Introduction to Statistical Machine Learning with Applications in R, Springer, 2nd Edition-2012.
3. C. M. Bishop, Pattern Recognition and Machine Learning, Springer 1st Edition-2013.
4. Ethem Alpaydin, Introduction to Machine Learning, PHI 2nd Edition-2013.
5. Parag Kulkarni, Reinforcement and Systematic Machine Learning for Decision Making, Wiley, IEEE Press, Edition July 2012.

Course Outcomes:

1. Understand Machine learning and Machine Learning Models. (Understand)
2. Apply various classification and regression techniques and assess their performance. (Apply)
3. Apply various clustering algorithms for the problems to be solved with machine learning. (Apply)
4. Assessment of various machine learning models. (Analyze)
5. Understand probabilistic learning models and trends in machine learning. (Understand)

SEMINAR & INDUSTRIAL REPORT (ECS-451)

Type	L	T	P	Credits
Seminar	0	0	4	2

Prerequisite:

Course Content:

As a part of academic curriculum, students undergo industrial training/internship of 4-6 weeks after completion of III year B. Tech. program during summer vacations. The main objectives of the industrial training are:-

1. To give students the opportunity to apply the acquired knowledge and skills in development of a real-life project.
2. To provide students with an opportunity of practical and hands-on learning from practitioners in the students' field of study.
3. To provide the students the exposure of the work environment, common practices, employment opportunities and work ethics in the relevant field of study.
4. To inculcate presentation and soft skills relevant to the needs of employers.
5. To provide an opportunity of offered jobs in the organization where they undergo Industrial Training.

1. Improve their knowledge and skills relevant to their area of study.
2. Relate the knowledge and skills acquired at the workplace, to their on-campus studies.
3. Compete effectively in the job market, because they have been equipped with the requisite knowledge, skills, attitudes and practical experience

PROJECT (ECS-497)

Type	L	T	P	Credits
Project	0	0	8	4

Prerequisite:

Course Content:

The practical implementation of theoretical knowledge gained during the study from first year to third year. Students are required to implement their original ideas, modification/enhancement of the existing engineering techniques, real time industrial problems, and current applications of their courses of study. Projects work can be of two types: Projects based on implementation of any application oriented problem which will be more or less experimental in nature and the others will be based on some innovative/ theoretical work.

The project work may be carried out in two modes:-
1. **In-house Project:** The project work assigned by some Faculty member of the department which will have to be carried out during VIIth and VIIIth semester alogwith regular course of study. It is expected that the complete SRS document will be prepared during VIIth semester and design & implementation work will be done in the VIIIth semester.
2. **Industrial Project:** Student will work on a problem assigned by some industry under the guidance and supervision of some industrial practitioner. The first phase of the work related to SRS document etc. will be completed during VIIth semester in the department alongwith the regular course of study. But, the design & implementation work will be done in the respective industry itself during the VIIIth semester.

Course Outcomes:

1. Show preparedness to work independently on real time problem scenarios to be addressed using knowledge of fundamentals, techniques, programming languages and tools in the area of Computer Science & Engineering. (Analyze, Create)
2. Use the innovative ideas and thoughts to address real life issues and provide efficient solutions for process oriented works.

MOBILE COMPUTING (EIT-412)

	Type	L	T	P	Credits
	PEC	3	1	0	4

Prerequisite: Computer Networks (ECS-302)

Course Content:

Unit-1:
Introduction to Network Technologies and Cellular Communications: HIPERLAN: Protocol architecture, physical layer, Channel access control sub-layer, MAC sub-layer, Information bases and networking WLAN: Infrared vs. radio transmission, Infrastructure and ad hoc networks, IEEE 802.11. Bluetooth: User scenarios, Physical layer, MAC layer, Networking, Security, Link management GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services. Mobile Computing (MC): Introduction to MC, novel applications, limitations, and architecture.

Unit-2:
Wireless Medium Access Control: Motivation for a specialized MAC (Hidden and exposed terminals, Near and far terminals), SDMA, FDMA, TDMA, CDMA, Mobile Network Layer: Mobile IP Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunneling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).

Unit-3:
Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP.

Unit-4:
Database Issues: Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware and context-aware computing, transactional models, query processing, recovery, and quality of service issues. Data Dissemination: Communications asymmetry, classification of new data delivery mechanisms, push-based mechanisms, pull-based mechanisms, hybrid mechanisms, selective tuning (indexing) techniques.

Unit-5:
Mobile Ad hoc Networks (MANETs): Overview, Properties of a MANET, spectrum of MANET applications, routing and various routing algorithms, security in MANETs. Protocols and Tools: Wireless Application Protocol-WAP, (Introduction, protocol architecture, and treatment of protocols of all layers), Bluetooth (User scenarios, physical layer, MAC layer, networking, security, link management) and J2ME**.**

Text and References Books:

1. Jochen Schiller, "Mobile Communications", Addison-Wesley. (Chapters 4, 7, 9, 10, 11), second edition, 2004.
2. Stojmenovic and Cacute, "Handbook of Wireless Networks and Mobile Computing", Wiley, 2002, ISBN 0471419028. (Chapters 11, 15, 17, 26 and 27)
3. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", ISBN: 0521817331, Cambridge University Press, October 2004

Course Outcomes:

1. Understand and apply the knowledge of working, characteristics and limitations of mobile hardware devices including their user-interface modalities. (Understand)
2. Understand the GSM, GPRS, CDMA and Bluetooth software models for mobile computing. (Understand)
3. Identify the root causes of call dropping, and concept of call forwarding in roaming. (Understand)
4. Understand the impact of mobile communication on society either economic or health related issues. (Understand)
5. Apply the techniques to configure adhoc network for various real time applications. (Apply)

EMBEDDED SYSTEMS (ECS-412)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
Introduction to Embedded Systems Definition and Classification – Overview of Processors and hardware units in an embedded system – Software embedded into the system – Exemplary Embedded Systems – Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits.

Unit-2:
Devices and Buses for Devices Network I/O Devices -Device I/O Types and Examples – Synchronous -Iso-synchronous and Asynchronous Communications from Serial Devices -Examples of Internal Serial-Communication Devices -UART and HDLC -Parallel Port Devices -Sophisticated interfacing features in Devices/Ports-Timer and Counting Devices -'12C', 'USB', 'CAN and advanced I/O Serial high speed buses-ISA, PCI, PCI-X, cPCI and advanced buses.

Unit-3:
Programming Concepts and Embedded Programming in C, Programming in assembly language (ALP) vs. High Level Language, C Program Elements, Macros and functions -Use of Pointers -NULL Pointers-Use of Function Calls–Multiple function calls in a Cyclic Order in the Main Function Pointers – Function Queues and Interrupt Service Routines Queues Pointers – Concepts of 'C' Program compilers–Cross compiler–Optimization of memory codes.

Unit-4:
Real Time Operating Systems Timing and clocks in embedded system, Task modelling and management: RTOS Task scheduling models -Handling of task scheduling and latency and deadlines as performance metrics – Co-operative Round Robin Scheduling – Cyclic Scheduling with Time Slicing (Rate Monotonics Co-operative Scheduling) – Preemptive Scheduling Model strategy by a Scheduler – Critical Section Service by a Pre emptive Scheduler – Fixed (Static) Real time scheduling of tasks

Unit-5:
Embedded control and control hierarchy, communication strategies for embedded system: encoding and flow chart. Fault tolerance and formal verification.

Text and References Books:

1. William Stalling, "Computer Organization & Architecture", Pearson education Asia
2. Mano Morris, "Computer System Architecture", PHI

Course Outcomes:

1. Understand the difference between general computing system and embedded system. (Understand)
2. Understand the working of devices, buses and types of communications like serial, parallel etc. (Understand)
3. Understand cross compiler and implement embedded programming using assembly and C languages. (Understand, Apply)
4. Understand real time operating system concepts and develop real time embedded systems. (Understand, Apply)
5. Understand and apply the concept of embedded control and communication. (Understand, Apply)

BIG DATA ANALYTICS (ECS-414)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1: Introduction
Introduction– Big Data: Issues and Challenges, Traditional Business Intelligence (BI) versus Big Data, Distributed file system–Big Data and its importance, Four Vs, Drivers for Big data, Big data analytics, Big data applications, Introduction to Data Science.

Unit-2: Introduction to Hadoop and Hadoop Architecture
Big Data – Apache Hadoop & Hadoop EcoSystem, Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce -, Data Serialization.

Unit-3: HDFS, HIVE AND HIVEQL, HBASE
HDFS-Overview, Installation and Shell, Java API; Hive Architecture and Installation, Comparison with Traditional Database, HiveQL Querying Data, Sorting And Aggregating, Map Reduce Scripts, Joins & Sub queries, HBase concepts, Advanced Usage, Schema Design, Advance Indexing, PIG, Zookeeper , how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.

Unit-4: SPARK
Introduction to Data Analysis with Spark, Natural Language Processing with SPARK 2.0. Downloading Spark and Getting Started, Programming with RDDs, Machine Learning with MLlib.

NoSQL
What is it? Where It is Used Types of NoSQL databases, Why NoSQL?, Advantages of NoSQL, Use of NoSQL in Industry, SQL vs NoSQL, NewSQL

Unit-5: Data Base for the Modern Web
Introduction to MongoDB key features, Core Server tools, MongoDB through the JavaScript's Shell, Creating and Querying through Indexes, Document-Oriented, principles of schema design, Constructing queries on Databases, collections and Documents, MongoDB Query Language.

Text and References Books:

1. Radha Shankarmani, M.Vijayalakshmi, Big Data Analytics; Wiley.
2. Nathan Marz, Big Data: Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems, Shroff/O'Reilly.
3. Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley.

Course Outcomes:

1. Appreciate the need for Big Data with reference to Google Search, You Tube, Facebook etc. (Understand)
2. Understand concepts of Big Data, Business Intelligence, and Data Science. (Understand)
3. Understand Hadoop, Hadoop Architecture, and Data Serialization (Understand)
4. Apply Big Data analysis in Web applications. (Apply)
5. Use NoSQL and SPARK for Big Data analysis. (Apply)

DISTRIBUTED SYSTEMS (ECS-416)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. **System Models:** Architectural models, Fundamental Models **Theoretical Foundation for Distributed System**: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks, Causal ordering of messages, global state, termination detection.
Distributed Mutual Exclusion: Classification of distributed mutual exclusion, Requirement of mutual exclusion theorem, Token based and non-token based algorithms, Performance metric for distributed mutual exclusion algorithms.
Unit-2:
Distributed Deadlock Detection: System model, resource vs communication deadlocks, deadlock prevention, avoidance, Detection & resolution, centralized dead lock detection, distributed dead lock detection, Path pushing algorithms, Edge chasing algorithms, **Agreement Protocols**: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system.
Unit-3:
Distributed Objects and Remote Invocation: Communication between distributed objects, Remote procedure call, Events and notifications, Java RMI case study. **Security**: Overview of security techniques, Cryptographic algorithms, Digital signatures Cryptography pragmatics, Case studies:

Needham Schroeder, Kerberos, SSL & Millicent. **Distributed File Systems**: File service architecture, Sun Network File System, The Andrew File System, Recent advances.

Unit-4:

Transactions and Concurrency Control: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. **Distributed Transactions**: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery. Replication: System model and group communication, Fault - tolerant services, highly available services, Transactions with replicated data.

Unit-5:

Distributed Algorithms: Introduction to communication protocols, Balanced sliding window protocol, Routing algorithms, Destination based routing, APP problem, Deadlock free Packet switching, Introduction to Wave & traversal algorithms, Election algorithm. **CORBA Case Study**: CORBA RMI, CORBA services.

Text and References Books:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Ed.
3. Gerald Tel, "Distributed Algorithms", Cambridge University Press
4. Nancy A. Lynch, "Distributed Algorithms", Elsevier Publication

Course Outcomes:

1. Understand the concepts of distributed systems in solving real world problems. (Understand)
2. Understand and apply various concepts of synchronization and agreement protocols. (Understand, Apply)
3. Understand and develop various distributed applications using remote procedure calls and remote method invocation for real time problems. (Understand, Apply)
4. Configure, deploy and access network file system. (Understand, Apply)
5. Develop distributed algorithms for MAC, routing and transport layer protocols. (Apply)

ELECTIVE-IV

INTERNET OF THINGS (EIT-432)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Computer Network (ECS-302)

Course Content:

Unit-1: Introduction

What is the Internet of Things? : History of IoT, About IoT, Overview and Motivations, Examples of Applications, Internet of Things Definitions and Frameworks: IoT Definitions, IoT Architecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic Nodal Capabilities

Unit-2: Fundamentals of IoT Mechanisms and Key Technologies

Identification of IoT Objects and Services, Structural Aspects of the IoT, Environment Characteristics, Traffic Characteristics, Scalability, Interoperability, Security and Privacy, Open

Architecture, Key IoT Technologies, Device Intelligence, Communication Capabilities, Mobility Support, Device Power, Sensor Technology, RFID Technology, Satellite Technology,

Unit-3: Radio Frequency Identification Technology
RFID: Introduction, Principle of RFID, Components of an RFID system, Issues EPC Global Architecture Framework: EPCIS & ONS, Design issues, Technological challenges, Security challenges, IP for IoT, Web of Things. Wireless Sensor Networks: History and context, WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, challenges: Security, QoS, Configuration, Various integration approaches, Data link layer protocols, routing protocols and infrastructure establishment.

Unit-4: Resource Management in the Internet of Things
Clustering, Software Agents, Clustering Principles in an Internet of Things, Architecture, Design Guidelines, and Software Agents for Object Representation, Data Synchronization. Identity portrayal, Identity management, various identity management models: Local, Network, Federated and global web identity, user-centric identity management, device centric identity management and hybrid-identity management, Identity and trust.

Unit-5: Internet of Things Privacy, Security and Governance
Vulnerabilities of IoT, Security requirements, Threat analysis, Use cases and misuse cases, IoT security tomography and layered attacker model, Identity establishment, Access control, Message integrity, Non-repudiation and availability, Security model for IoT. Business models for Internet of Things: Business Models and Business Model Innovation, Value Creation in the Internet of Things, Business Model Scenarios for the Internet of Things.

Text and Reference Books:

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications
2. Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3642-19156-5 e-ISBN 978-3-642-19157-2, Springer.
3. Parikshit N. Mahalle& Poonam N. Railkar, "Identity Management for Internet of Things", River Publishers, ISBN: 978-87-93102-90-3 (Hard Copy), 978-87-93102-91-0 (ebook).
4. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN: 978-184821-140-7, Willy Publications.
5. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2nd Edition, Willy Publications.
6. Daniel Kellmereit, Daniel Obodovski, "The Silent Intelligence: The Internet of Things",. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 9780989973700. 4. Fang Zhaho, Leonidas Guibas, "Wireless Sensor Network: An information processing approach", Elsevier, ISBN: 978-81-8147-642-5.

Course Outcomes:

1. Understand framework and architecture of Internet of Things. (Understand)
2. Understand key technologies in Internet of Things. (Understand)
3. Explain wireless sensor network architecture and its framework along with WSN applications. (Understand)
4. Explain resource management in the Internet of Things. (Understand)
5. Understand Security measures and design applications based on Internet of Things. (Understand, Apply)

SOFTWARE PROJECT MANAGEMENT (ECS-434)

	Type	L	T	P	Credits
	PEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
Introduction and Software Project Planning: Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, Project Management Cycle, SPM Objectives, Management Spectrum, SPM Framework, Software Project Planning, Planning Objectives, Project Plan, Types of project plan, Structure of a Software Project Management Plan.

Unit-2:
Project Organization and Scheduling: Project Elements, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts.

Unit-3:
Project Monitoring and Control: Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Budgeted Cost for Work Scheduled (BCWS), Cost Variance (CV), Schedule Variance (SV), Cost Performance Index (CPI), Schedule Performance Index (SPI), Interpretation of Earned Value Indicators.

Unit-4:
Software Quality Assurance: Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, Software Quality Assurance (SQA), SQA Activities, SQA Plans, Software Quality Frameworks, ISO 9000 Models, SEI Capability Maturity Model (CMM), Software verification and validation, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Clean room process.

Unit-5:
Software project estimation, Estimation methods, Estimation models, Decision process. Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools like MS-Project.

Text and References Books:

1. Software Project Management, M. Cotterell, Tata McGraw-Hill Publication.
2. Information Technology Project Management, Kathy Schwalbe, Vikas Pub. House.
3. Software Project Management, S. A. Kelkar, PHI Publication

Course Outcomes:

1. Understand various concepts of Software Project Planning and Management. (Understand)

2. Understand various techniques of Human Resource Organization and Develop schedule of software projects using PERT/CPM. (Understand, Apply)
3. Understand cost benefit analysis, risk management and techniques of monitoring & control of software projects. (Understand)
4. Use concepts of software quality assurance in the development of software projects. (Apply)
5. Assess the project to develop the scope of work, provide accurate size, cost, time and effort estimates for software projects. (Apply, Analyze)

SOFTWARE QUALITY ENGINEERING (ECS-436)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Software Engineering (ECS-202)

Course Content:

Unit-1:
Introduction: Defining Software Quality, Software Quality Attributes and Specification, Cost of Quality, Defects, Faults, Failures, Defect Rate and Reliability, Defect Prevention, Reduction, and Containment, Overview of Different Types of Software Review, Introduction to Measurement and Inspection Process, Documents and Metrics.

Unit-2:
Software Quality Metrics: Product Quality Metrics: Defect Density, Customer Problems Metric, Customer Satisfaction Metrics, Function Points, In-Process Quality Metrics: Defect Arrival Pattern, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness, Metrics for Software Maintenance: Backlog Management Index, Fix Response Time, Fix Quality, Software Quality Indicators.

Unit-3:
Software Quality Management and Models: Modeling Process, Software Reliability Models: The Rayleigh Model, Exponential Distribution and Software Reliability Growth Models, Software Reliability Allocation Models, Criteria for Model Evaluation, Software Quality Assessment Models: Hierarchical Model of Software Quality Assessment.

Unit-4:
Software Quality Assurance: Quality Planning and Control, Quality Improvement Process, Evolution of Software Quality Assurance (SQA), Major SQA Activities, Major SQA Issues, Zero Defect Software, SQA Techniques, Statistical Quality Assurance, Total Quality Management, Quality Standards and Processes.

Unit-5:
Software Verification, Validation & Testing: Verification and Validation, Evolutionary Nature of Verification and Validation, Impracticality of Testing all Data and Paths, Proof of Correctness, Software Testing, Functional, Structural and Error-Oriented Analysis & Testing, Static and Dynamic Testing Tools, Characteristics of Modern Testing Tools.

Text and References Books:

1. Jeff Tian, Software Quality Engineering (SQE), Wiley-Inter Science, 2005; ISBN 0-471-71345-7.
2. Metrics and Models in Software Quality Engineering, Stephen H. Kan, Addison-Wesley (2002

Course Outcomes:

1. Understand the concept of quality, quality attribute, quality metrics and software technical reviews. (Understand)
2. Understand and discuss the needs for software quality assessment models and apply professional practices in the development of quality software. (Understand, Apply)
3. Understand and apply Software Quality Management Models in the development of software. (Understand, Apply)
4. Understand the concept of software quality assurance and use software quality standards in the development of software. (Understand)
5. Apply the concepts of software verification & validation, error tracking to enforce quality into the software. (Apply)

SOFT COMPUTING (ECS-438)

Type	L	T	P	Credits
PEC	3	1	0	4

Prerequisite: Artificial Intelligence (ECS-401)

Course Content:

Unit 1: Introduction to Intelligent Systems and Soft Computing
Characteristic behavior of Intelligent systems, Knowledge based systems, Knowledge Representation and Processing, Soft Computing characteristics, Constitutes of Soft Computing-Fuzzy Logic and Computing, Neural Computing, Evolutionary Computing, Rough Sets, Probabilistic Reasoning and Machine Learning.

Unit 2: Neuro Computing - Supervised Learning
Biological background, Pattern recognition tasks, Features of artificial neural networks, Activation functions, Perceptron model, Perceptron for classification and its limitations, Architectures of multilayer feed-forward neural networks, Back-propagation learning algorithm, Limitations of MLP.

Unit 3: Neuro Computing - Unsupervised Learning
Hebb's learning rule for competitive learning, Kohonen's self-organizing map and network topology, applications of SOM, Hopfield network and its topology, Boltzman Machines, Adaptive Resonance Theory.

Unit 4: Fuzzy Logic and Fuzzy Systems
Evolution of fuzzy logic, fuzzy sets, fuzzy logic operations, fuzzy relations, Fuzzy arithmetic and fuzzy measures. Fuzzy rules and reasoning, Fuzzy inference systems, Fuzzy modeling and decision making, Neuro-fuzzy modeling.

Unit 5: Evolutionary Computing
Biological background and Overview of evolutionary computing, Genetic algorithm and search space, Operators in genetic algorithm- encoding, selection, crossover, and mutation, Classification of GA,

Evolutionary Programming and Strategies, Applications of fuzzy in pattern recognition-character recognition. Applications of evolutionary computing in Image processing and computer vision, applications of Soft computing in mobile ad-hoc networks, Information Retrieval, Semantic web, and Software Engineering.

Text and Reference Books:

1. Fakhreddine O. Karray, Clarence De Silva, 'Soft Computing and Intelligent systems design' Pearson Education, ISBN 978-81-317-2324-1.
2. B. K. Tripathy, J. Anuradha, 'Soft Computing: advances and applications', Cengage learning, ISBN-13: 978-81-315-2619-4.
3. S. N. Sivanandam, S. N. Deepa, Principles of Soft Computing, Wiley publications, 2nd Edition.
4. J. S. R. Jang, C. T. Sun, E. Mizutani, 'Neuro-Fuzzy and Soft Computing- A computational approach to Learning and Machine Intelligence' PHI.
5. David E. Goldberg, Genetic Algorithms - Pearson Education, 2006.
6. Satish Kumar, "Neural Networks - A Classroom Approach", Tata McGraw-Hill.

Course Outcomes:

1. Understand differential behavior of Human and Intelligent Systems. (Understand)
2. Understand and use supervised and un-supervised learning techniques in ANN. (Understand)
3. Understand and apply different soft computing techniques like Genetic Algorithms, Fuzzy Logic, Neural Network and their combination. (Understand, Apply)
4. Correlate human-like processing in problem solving with current technologies in various domains like Bio Informatics, Multimedia Systems, Big Data Analytics, etc.
5. Apply evolutionary computing techniques in real life problems. (Apply)

OPEN ELECTIVE-II*

*(Students may opt a course offered as Open Elective by any Department other than CSE including the following Course offered by the IT Department)

HUMAN COMPUTER INTERACTION (EIT-440)

Type	L	T	P	Credits
OEC	3	1	0	4

Prerequisite:

Course Content:

Unit-1:
User Centered Design of Systems & Interfaces, Autonomy & Rational of WIMP (Window, Icon, Menus & Pointing Devices) Interfaces.

Unit-2:
Dialogue Design, Presentation Design, User Documentation, Evaluation/Usability Testing of User Interfaces.

Unit-3:
Ergonomics and Cognitive Issues, Hypertext and World Wide web, Cognitive Models, Communication and Collaboration Models, Dialogue Notation and design, Modeling Rich Interaction.
Unit-4:
User Centered Design, Human Factors in User Centered Design, Development & Evaluation, Interactive Design, Rapid Prototyping, Groupware, Ubiquitous Computing, and Augmented Realities.
Unit-5:
Designing of Usability, Effectiveness, Learning, Flexibility, Attitude and Usability Goals, Criteria for Acceptability.

Text and Reference Books:

1. Sudifte A.G., "Human Computer Interface Design", 2nd Ed. MacMillan Pub., 1995.
2. Sheiderman B., "Designing the User Interface", Strategies for Effective Human Computer Interaction, 2nd Ed., Addition Wesley, 1992.

Course Outcomes:

1. Understand and apply User Centered Design of Systems & Interfaces. (Understand)
2. Explain dialogue & presentation design and Testing of User Interfaces. (Understand)
3. Identify Ergonomics & Cognitive Issues and develop cognitive, collaboration, and communication models. (Understand, Apply)
4. Development & Evaluation of Interactive Design, Rapid Prototyping, Groupware, Ubiquitous Computing, and Augmented Realities. (Apply)
5. Consideration of various factors such as effectiveness, learning, flexibility, attitude and usability goals, criteria for acceptability in designing usability of interfaces. (Apply)

PROJECT (ECS-498)

	Type	L	T	P	Credits
PROJECT		0	0	20	10

Prerequisite:

Course Content:

The practical implementation of theoretical knowledge gained during the study from first year to third year. Students are required to implement their original ideas, modification/enhancement of the existing engineering techniques, real time industrial problems, and current applications of their courses of study. Projects work can be of two types: Projects based on implementation of any application oriented problem which will be more or less experimental in nature and the others will be based on some innovative/ theoretical work.

The project work may be carried out in two modes:-
1. **In-house Project:** The project work assigned by some Faculty member of the department which will have to be carried out during VIIth and $VIII^{th}$ semester alogwith regular course of study. It is expected that the complete SRS document will be prepared during VIIth semester and design & implementation work will be done in the $VIII^{th}$ semester.

2. **Industrial Project:** Student will work on a problem assigned by some industry under the guidance and supervision of some industrial practitioner. The first phase of the work related to SRS document etc. will be completed during VIIth semester in the department alongwith the regular course of study. But, the design & implementation work will be done in the respective industry itself during the VIIIth semester.

Course Outcomes:

1. Show preparedness to work independently on real time problem scenarios to be addressed using knowledge of fundamentals, techniques, programming languages and tools in the area of Computer Science & Engineering. (Analyze, Create)
2. Use the innovative ideas and thoughts to address real life issues and provide efficient solutions for process oriented works.