Curriculum for B.Tech. in Computer Science and Engineering

(Applicable from the academic session 2018-2019)

(Department of Computer Science and Engineering)

Government College of Engineering & Ceramic Technology

73, A. C Banerjee Lane

Kolkata-700010

Definition of Credit:

1 Hr. Lecture (L) per week	1 credit
1 Hr. Tutorial (T) per week	1 credit
1 Hr. Practical (P) per week	0.5 credits

MOOCs for B. Tech Honours:

Additional 20 credits are to be acquired through MOOCs for obtaining **B.** Tech. with Honours.

Guidelines for completing MOOCs (Courses of 8-12 weeks' duration): -

In 1S^{t} year: 8 credits

In 2nd year: 4 credits

In 3rd year: 4 credits

In 4th year: 4 credits

In the first year of study, students have to earn a total of 8 credit points, taking ONE course from Science and Engineering Group and ONE course from Humanities Group.

For the subsequent three years of study, students have to earn a total of 12 credit points by successfully completing one course in each year of study.

1st Semester for CSE/IT							
Mandatory Induction Program- 3 weeks duration							
Sl. No.	Type of course	Course Code	Course Title	Hours per week			Credits
				Lecture	Tutoria l	Practical	
Theory							
1	Basic Science course	BS(CS/IT) 101	Mathematics - I	3	0	0	3
2	Basic Science course	BS(CS/IT) 102	Physics	3	1	0	4
3	Engineerin g Science Course	ES(CS/IT) 101	Basic Electrical Engineering	3	1	0	4
Sessional							
1	Basic Science course	BSL(CS/IT) 103	Physics Laboratory	0	0	3	1.5
2	Engineerin g Science Course	ESL(CS/IT) 102	Basic Electrical Engineering Laboratory	0	0	2	1
3	Engineerin g Science Course	ESL(CS/IT) 103	Engineering Graphics & Design	1	0	4	3
Practical							
1		CLA(CS/IT)1	Comprehensive Laboratory Assessment	-	-	-	1
				Total credits			**17.5**

The course teacher shall assess the students for Serial Nos. 1, 2, 3 under Sessional/Practical before commencement of Semester End Examination. A student has to secure at least 50% marks in Serial Nos. 1, 2, 3 under Sessional/Practical, failing which the student would be debarred from sitting in the Semester End Examination.

A student has to secure at least 50% marks in rest of the courses (Theory papers and CLA), failing which he/she would carry backlog(s).

Name of the course		Mathematics-I	
Course Code: BS(CS/IT) 101		Semester: 1st	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Two Mid Term Exams: 30 Marks	
Tutorial: NIL		Assignments , Quiz etc.: 20 Marks	
Credit Points: 3			
Objective:			
1.	To learn evaluation techniques of evolute, involute and can use concept of improper integrals.		
2.	To explain the meaning of Mean value theorem, Rolle's theorem and can recognize when to apply L'Hospital rule.		
3.	To learn different types of matrices, concept of rank, methods of matrix inversion and their applications.		
4.	To understand linear spaces, its basis and dimension with corresponding applications in the field of computer science.		
5.	To learn the concept of eigen values, eigen vectors, diagonalisation of matrices for understanding engineering problems.		
Pre-Requisite:			
1.	10+2 Mathematics		
Module	Content	Hours	Marks.
1	Module 1: Calculus(Integration): Evolutes and Involutes; Evaluation of definite and Improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	8	
2	Module 2: Calculus (Differentiation): Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin's theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.	6	
3	Module 3: Matrices: Matrices, Vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear Independence, rank of a matrix, determinants, Cramer's Rule, inverse of a matrix by Gauss elimination and Gauss-Jordan elimination.	7	
4	Module 4: Vector Spaces (I): Definition, linear dependence of vectors, Basis, Dimension; Linear transformations (maps), Range and Kernel of a linear map, Rank and Nullity, Inverse of a linear transformation, Rank-Nullity theorem, composition of linear maps, Matrix associated with a linear map.	8	
5	Module 5: Vector Spaces (II): Eigen values, Eigen vectors, Symmetric, Skew-symmetric, and Orthogonal Matrices, Eigen bases. Diagonalisation; Inner product spaces, Gram-Schmidt orthogonalization.	7	
Course Outcomes			
After completion of the course, a student would be able to:			
CO 1	apply the concept and techniques of differential and integral calculus to determine curvature and evaluation of different types of improper integrals		
CO 2	identify the domain of applications of mean value theorems to engineering problems		
CO 3	analyze different types of matrices, concept of rank, methods of matrix inversion and their applications.		
CO 4	describe linear spaces and evaluate its basis and dimension with corresponding applications in the field of computer science.		
CO 5	use the concept of eigen values, eigen vectors, diagonalisation of matrices and orthogonalization in inner product spaces for understanding physical and engineering problems.		
Learning Resources:			
1.	Reena Garg, Engineering Mathematics-I, Khanna Publishers.		
2.	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.		
3.	Kanti B. Dutta, Mathematical Methods of Science and Engineering, Cenage Learning.		

4.	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, NewDelhi.
5.	S.K. Mapa, Higher Algebra: Abstract and Linear, Sarat Book House Pvt.Ltd.
6.	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
7.	Michael Greenberg, Advanced Engineering Mathematics, Pearson.
8	Hoffman and Kunze, Linear algebra, PHI.
9	Friedberg, Insel, Spence, Linear algebra, Pearson

Name of the course		Physics	
Course Code: BS(CS/IT) 102		Semester: 1st	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignments, Quiz etc.: 20 Marks	
Credit: 4			
Objective:			
1.	The objective of the course is to provide an exposure to - the Old Quantum Theory including the dual nature of radiation and particle, the Schrodinger theory of Quantum Mechanics, the fundamentals of statistical description of a system of particles, the development of the classical free electron theory of metals, the basic properties of semiconductors and related devices.		
2.	This course also provides an understanding of practical problem-solving techniques for the chapters covered in the course.		
Pre-Requisite:			
1.	Class 11th and 12th standard knowledge of Physics.		
2	Class 11th and 12th standard knowledge of Mathematics.		
Module	Content	Hours	Marks.
1	Quantum Mechanics: Introduction to quantum physics, Black body radiation, Photoelectric Effect and Compton Effect and their explanation using the photon concept. De Broglie hypothesis, wave particle Duality. Born's interpretation of the wave function, verification of matter waves, uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic Oscillator, hydrogen atom..	14	
2	Statistical Mechanics: Statistical description of a system of particles, Phase space, Microstates and macrostates, Boltzmann's formula for the entropy, Boltzmann distribution function (derivation not reqd.), Classical ideal gas, Qualitative treatment of Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics.	8	
3	Electronic Materials: Free electron theory of metals, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirect band gaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level, Effective mass, Phonons.	10	
4	Semiconductors: Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-njunction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.	10	
Course Outcomes			
After completion of the course, a student would be able to:			
CO 1	Recall the Old Quantum Theory including the dual nature of radiation and particle. Apply the wave particle duality principle for an understanding of the Uncertainty Principle of quantum mechanics.		
CO 2	Analyze the Schrodinger theory of Quantum Mechanics and apply it for different potentials.		
CO 3	Develop the statistical description of a system of particles and discuss different kinds of Statistics.		
CO 4	Discuss the successes and failure of free electron theory of metals and develop the band theory of solids		

	using Kronig Penny Model
CO 5	Discuss various properties of semiconductors and related devices and develop mathematical interrelation between properties of interest
Learning Resources:	
1.	S.N Ghosal: Introduction to Quantum Mechanics
2.	Dr. Amal Kr. Chakraborty : Integrated Engineering Physics
3.	Sujay Kumar Bhattacharya: Engineering Physics
4.	Hitendra K. Malik: Engineering Physics.
5.	J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995)
6.	B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007)
7.	S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
8	A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007)
9	P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997)

Name of the course	BASIC ELECTRICAL ENGINEERING
Course Code: ES(CS/IT) 101	Semester: 1st
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: 1 hr./week	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 4	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:	
1.	Impart a basic knowledge of several electrical quantities such as current, voltage, power, energy, frequency etc. to the students
2.	Provide the basic difference between DC and AC and provide basic principles to solve DC and AC circuits used in electrical devices
3	Explain the working principle, construction, characteristics and applications of transformer and different DC and AC rotating electrical machines
4	Explain the working principles of different power converters and other low tension switchgear and protective devices; as well as, make the students acquainted with the calculations for energy consumption, especially for household applications
Pre-Requisite:	
1.	Class 12th standard knowledge of Mathematics and Physics

Module	Content	Hours	Marks.
1	DC Circuits Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Super position, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.	8	
2	AC Circuits Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	8	
3	Transformers Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.	6	
4	Module 4: Electrical Machines Generation of rotating magnetic fields, Construction and working of a	8	

	three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction		
5	Power Converters DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.	6	
6	Electrical Installations Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.	6	
Course Outcomes			
After completion of the course, a student would be able to:			
CO 1	explain the overall electrical power system, its different parameters, components, protective elements and power converters.		
CO 2	solve problems of DC and AC circuits using different methods and network theorems.		
CO 3	derive different expressions to evaluate performance of electrical machines.		
CO 4	analyze electric machines and circuits using equivalent circuits, phasor analysis etc.		
CO 5	identify different electric machines with the help of different characteristics and parameters for appropriate applications.		
CO 6	calculate energy consumption in an electrical circuit.		
Learning Resources:			
1.	D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.		
2.	D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.		
3.	L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.		
4.	E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.		
5.	V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.		

Name of the course	Physics Laboratory
Course Code: BSL(CS/IT) 103	Semester: 1st
Duration: 6 months	Maximum Marks: 100

Teaching Scheme	Examination Scheme
Theory: Nil	Attendance: 10
Tutorial: Nil	Preparation of Lab Report: 30
Practical: 3 hrs./week	Precision of work done: 30
Credit Points: 1.5	Presentation/ analysis of the result: 10
	Viva Voce: 20
	Total: 100

Unit	Content	Hours	Marks
1	Determination of an unknown resistance using Carey Foster Bridge	3	
2	Determination of energy band gap by four-probe method	3	
3	Determination of Planck's constant using photocell	3	
4	Verification of Stefan's law of blackbody radiation	3	
5	Verification of Bohr's atomic orbital theory through Frank-Hertz experiment	3	
6	Determination of wavelength of light by Newton's ring method	3	

Course Outcome:

After completion of the course, a student will be able to:

CO	Statement
CO1	identify different equipment and accessories as per specification needed to conduct a particular experiment
CO2	calibrate very small resistance using Carey Foster Bridge
CO3	estimate the band gap of any semiconductor using four probe method
CO4	estimate the temperature of an approximate black body
CO5	apply Einstein equation of Photoelectric effect to evaluate Planck constant
CO6	estimate the radius of curvature of a curved surface using Newton's Ring experiment
CO7	validate Bohr's hypothesis using Frank-Hertz experiment
CO8	develop skill to work in a team

Learning Resources:

Separate manuals associated to each experiment are provided to students

Name of the course	BASIC ELECTRICAL ENGINEERING LAB
Course Code: ESL(CS/IT) 102	Semester: 1st
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	
Theory: Nil	Attendance: 10
Tutorial: Nil	Preparation of Lab Report: 30
Practical: 2 hrs./week	Experimental data/ Precision of work done: 30
Credit Points: 1	Presentation/ analysis of the result: 10
	Viva Voce: 20

Unit	Content	Hours	Marks
1	First activity: Introduction to basic safety precautions and mentioning of the do's and Don'ts. Noting down list of experiments to be performed, and instruction for writing the laboratory reports by the students. Group formation. Students are to be informed about the modalities of evaluation.	3	
2	Introduction and uses of following instruments: (a) Voltmeter (b) Ammeter (c) Multimeter (d) Oscilloscope Demonstration of real-life resistors, capacitors with color code, inductors and autotransformer.	3	
3	Demonstration of cut-out sections of machines: DC machine, Induction machine, Synchronous machine and single-phase induction machine.	3	
4	Calibration of ammeter and Wattmeter.	3	
5	Determination of steady state and transient response of R-L, R-C and R-L-C circuit to a step change in voltage.	3	
6	Determination of steady state response of R-L and R-C and R-L-C circuit and calculation of impedance and power factor.	3	
7	Determination of resonance frequency and quality factor of series and parallel R-L-C circuit.	3	
8	(a) Open circuit and short circuit test of a single-phase transformer (b) Load test of the transformer and determination of efficiency and regulation	3	
9	Demonstration of three phase transformer connections. Voltage and current relationship, phase shifts between the primary and	3	
10	Measurement of power in a three-phase unbalanced circuit by two wattmeter method.		
11	Determination of Torque —Speed characteristics of separately excited DC motor.		
12	Determination of Torque speed characteristics and observation of direction reversal by change of phase sequence of connection of Induction motor.		
13	Determination of operating characteristics of generator.		

14	Demonstration of operation of (a) DC-DC converter (b) DC-AC converter (c) DC-AC converter for speed control of an Induction motor.		
15	Demonstration of components of LT switchgear.		

Course Outcome:

After completion of the course, a student will be able to:

CO	Statement
CO1	identify different equipment and accessories as per specification needed to conduct a particular experiment.
CO2	set up an electric wiring for household application.
CO3	calibrate of different measuring instruments viz ammeter, voltmeter, wattmeter.
CO4	verify three network theorems (Thevenin, Norton and Superposition) using different combination of circuits.
CO5	determine the steady & transient response of AC networks.
CO6	determine different operating characteristics viz load characteristics of motors and generators.
CO7	estimate parameters of transformers by open circuit and short circuit tests.
CO8	develop skill to work in a team.

Learning Resources:

1	S. K. Bhattacharya and K. M. Rastogi, "Experiments in Basic Electrical Engineering", New Age International (P) Limited, Publishers, 2003
2	A. Chakrabarti, S. Debnath and C. K. Chandra, "Basic Electrical Engineering", Tata McGraw Hill, 2009
3	D. P. Kothari and B. S. Umre, "Laboratory Manual for Electrical Machines", I.K. International Publishing House Pvt. Limited, 2017

Name of the course	ENGINEERING GRAPHICS AND DESIGN
Course Code: ESL(CS/IT) 103	Semester: 1ST
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	
Theory: 1 hr./week	Attendance: 10
Tutorial: Nil	Preparation of Lab Report: 30
Practical: 4 hrs./week	Experimental data/ Precision of work done: 30
Credit Points: 3	Presentation/ analysis of the result: 10
	Viva Voce: 20

Unit	Content	Hours	Marks
1	Introduction to Engineering Drawing Principles of Engineering Graphics and their significance, Drawing instruments and their uses; Different types of lines and their uses; Lettering; Dimensioning; Drawing standards and codes; Scales: concept of R.F, plain and diagonal scales.	2L+8P	

2	Geometrical Construction and Curves used in Engineering Practice Construction of polygons, conic sections including the rectangular hyperbola (General method only); Cycloidal curves: cycloid, epicycloid, hypocycloid; Involute.	1L+4P	
3	Orthographic Projections of Points, Lines, Planes Principles of orthographic projections, conventions; Projections of points; Projections of lines inclined to both reference planes; Projections of planes like circle, polygons etc.	1L+4P	
4	Projections of Regular Solids Projections of regular solids like cone, pyramids, prisms etc.	1L+4P	
5	Sections of Right Regular Solids and Development of Surfaces Section of solids like cylinder, prism, pyramid, cone etc. Development of surfaces of right regular solids: cylinder, prism, pyramid and cone.	1L+4P	
6	Isometric Projections Principles of isometric projection, isometric scale, isometric views, conventions; Isometric views of planes, simple and compound solids; Conversion of isometric views to orthographic views and vice-versa.	1L+4P	
7	Overview of Computer Graphics, Customisation & CAD Drawing Listing the computer technologies communication; Demonstrating knowledge of the theory of CAD software [such as: the menu system, toolbars (standards, object properties, draw, modify and dimension), drawing area (background, crosshairs, coordinate system), dialog boxes and windows, shortcut menus (button bars), the command line (where applicable), the status bar, different methods of zoom as used in CAD, select and erase objects. Setting up of the drawing page and the printer, including scale settings; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.	1L+4P	
8	Annotations, Layering & Other Functions Applying dimensions to objects; Applying annotations to drawings; Setting up and use of layers, layers to create drawings; Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; Orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-Aided Design (CAD) software modelling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multi view, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.	2L+8P	
9	Demonstration of a Simple Team Design Project Geometry and topology of engineered componen	2L+8P	

	engineering models and their presentation in standard 2D blueprint form and as 3D wire frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).		

Course Outcome:

After completion of the course, a student will be able to:

CO	Statement
CO1	apply basics of Engineering Graphics standards for interpreting Engineering Drawing
CO2	apply features of Engineering Graphics to create working drawings
CO3	draw and explain plan and elevation of different solid objects
CO4	develop solid model with Computer Aided Design (CAD) software
CO5	communicate to other engineering personnel via engineering graphics language

Learning Resources:

1	Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2	Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3	Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4	Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
5	(Corresponding set of) CAD Software Theory and User Manuals

2nd semester for CSE/IT							
Sl. No.	Type of course	Course Code	Course Title	Hours per week			Credits
				Lecture	Tutorial	Practical	
Theory							
1	Basic Science course	BS(CS/IT) 204	Chemistry	3	0	0	3
2	Basic Science course	BS(CS/IT) 205	Mathematics-II	3	1	0	4
3	Engineering Science Course	ES(CS/IT) 204	Programming for Problem Solving	3	0	0	3
4	Humanities & Social Sciences including Management	HS(CT/IT/ CS) 201	English	2	0	0	2
Sessional							
1	Basic Science course	BSL(CS/IT) 206	Chemistry Laboratory	0	0	3	1.5
2	Engineering Science Course	ESL(CS/IT) 205	Programming for Problem SolvingLaboratory	0	0	4	2
3	Engineering Science Course	ESL(CS/IT) 206	Workshop /Manufacturing Practices	1	0	4	3
4	Humanities & Social Sciences including Management	HSL(CT/IT/ CS) 202	Language Lab	0	0	2	1
Practical							
1		CLA(CS/IT) 2	Comprehensive Laboratory Assessment	-	-	-	1
						Total credits	**20.5**

Name of the course		Chemistry	
Course Code: BS(CS/IT) 204		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	The objective of the course is to provide an exposure to the atomic bonding, atomic and crystal structure, crystalline defects and various properties of chemistry.		
2.	This course also provides an understanding of practical problem-solving techniques for the chapters covered in the course.		
Pre-Requisite			
1.	This course also provides an understanding of practical problem-solving techniques for the chapters covered in the course.		
Module	Content	Hours	Marks.
1	Chemical bonding in molecules : MO theory, Structure, bonding and energy levels of bonding and shapes of many atom molecules, Chemistry of coordination compounds reactivity and stability: Determination of configuration of cis- and trans- isomers by chemical methods. Labile and inert complexes, substitution reaction on square planer complexes, trans effect (example and applications). Structure and bonding: VB description and its limitations. Elementary Crystal Field Theory: Splitting of d^n configurations in octahedral, square planar and tetrahedral fields, crystal field stabilization energy in weak and strong fields; pairing energy. JahnTeller distortion.	6	
2	Spectroscopic techniques and applications Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering. d-d transitions; selection rules for electronic spectral transitions; spectrochemical series of ligands; charge transfer spectra (elementary idea).	2	
3	Periodic properties Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.	4	
4	Chemical Thermodynamics Concept of Thermodynamic system: Definition with example of diathermal wall, adiabatic wall, isolated system, closed system, open system, extensive property, intensive property. Introduction to first law of thermodynamics: different statements, mathematical form. Internal energy: Definition, Example, Characteristics, Physical significance, Mathematical expression for change in internal Energy, Expression for change in internal energy for ideal gas. Enthalpy: Definition, Characteristics, Physical significance, Mathematical expression for change in Enthalpy, Expression for change in enthalpy for ideal gas. Heat Capacity: Definition, Classification of Heat Capacity (Cp and CV): Definition and General expression of Cp - C_V. Expression of Cp - C_V for ideal gas. Reversible and Irreversible processes: Definition, Work done in Isothermal Reversible and Isothermal Irreversible process for Ideal gas, Adiabatic changes: Work done in adiabatic process, Interrelation between thermodynamic parameters (P, V and T), slope of P-V curve in adiabatic and	6	

	isothermal process. Application of first law of thermodynamics to chemical processes: exothermic, endothermic processes, law of Lavoisier and Laplace, Hess's law of constant heat summation, Kirchoff's law. 2^{nd} law of thermodynamics: Statement, Mathematical form of 2nd law of thermodynamics (Carnot cycle). Joule Thomson and throttling processes; Joule Thomson coefficient for Ideal gas, Concept of inversion temperature. Evaluation of entropy: characteristics and expression, entropy change in irreversible cyclic process, entropy change for irreversible isothermal expansion of an ideal gas, entropy change of a mixture of gases. Work function and free energy: Definition, characteristics, physical significance, mathematical expression of ΔA and ΔG for ideal gas, Maxwell's Expression (only the derivation of 4 different forms), Gibbs Helmholtz equation. Condition of spontaneity and equilibrium reaction.		
5	Surface and Colloid Chemistry Adsorption, absorption and sorption, Physical and Chemisorption, Langmuir and Freundlich isotherm, Multilayer adsorption, BET isotherm and its application to surface area measurement, Sols (reversible and irreversible), emulsion and emulsifier, micelle, gels, application of colloids, qualitative idea of electrokinetic phenomena, Zeta potential.	3	
6	Solid state Chemistry Introduction to stoichiometric defects (Schottky & Frenkel) and non – stoichiometric defects (Metal excess and metal deficiency). Role of silicon and germanium in the field of semiconductor.	3	
7	Stereochemistry Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds	6	
8	Organic reactions and synthesis of a drug molecule Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.	6	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	describe various types of bonding and connectivity in a molecular system.
CO 2	use various tools to analyze different linkages present in a molecular system to determine exact structure of a molecule.
CO 3	estimate the energy change of a chemical reaction using thermodynamic parameters.
CO 4	apply knowledge of surface phenomena and colloidal properties of solids in assessing particulate behaviour.
CO 5	identify different imperfections in solids based on understanding of the ideal crystal structures.
CO 6	Identify three-dimensional structures of different isomeric molecules and their participation in different chemical reactions like addition, substitution, elimination reaction etc.

Learning Resources:	
1.	P. C. Rakshit, Physical Chemistry, Sarat Book House (7th Edition).
2.	S. Glasston, Text Book of Physical Chemistry, Macmillan India Limited.
3.	S. Pahari, Physical Chemistry, New Central Book Agency.
4.	R. P. Sarkar, Inorganic Chemistry (Vol-1 & II)
5.	J.D .Lee, Concise Inorganic Chemistry(5th Edition) Chapman & Hall
6	I. L. Finar,(Vol-I) Organic Chemistry, Addison Wesley Longman, Inc.
7	Physical Chemistry, Atkins, 6th Edition, Oxford Publishers.
8	Organic Chemistry,G Mark Loudon, 4th Edition, Oxford Publishers.
9	Basic Stereochemistry of Organic Molecules, Subrata Sengupta, Book syndicate Pvt. Ltd.

Name of the course		Mathematics-II	
Course Code: BS(CS/IT) 205		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Two Mid Term Exams: 30 Marks	
Tutorial: 1 hrs/week		Assignments , Quiz etc.: 20 Marks	
Credit Points: 4			
Objective:			
1.	To learn the ideas of probability and random variables, various discrete and continuous probability distributions with their properties and their applications in physical and engineering environment.		
2.	To understand the basic ideas of statistics with different characterization of a univariate and bivariate data set.		
3.	To learn statistical tools for analyzing data samples and drawing inference on a given data set.		
4.	To understand the logic and framework of the inference of hypothesis testing.		
5.	To create and interpret frequency table.		
Pre-Requisite			
1.	This course also provides an understanding of practical problem-solving techniques for the chapters covered in the course.		
Module	Content	Hours	Marks.
1	Module 1: Basic Probability: Probability spaces, conditional probability, independence, Baye's theorem, infinite sequences of Bernoulli trials ,Discrete random variables, Binomial distribution, Poisson distribution, Poisson approximation to the Binomial distribution, , sums of independent random variables; Expectation, variance of Discrete Random variables, Moments, Chebyshev's Inequality.	8	
2	Module 2 : Continuous Probability Distributions: Continuous random variables and their properties, Distribution functions and densities, Normal, Exponential and Gamma densities.	5	
3	Module 3: Bivariate Distributions: The Multinomial distribution, marginal distribution,bivariate expectation, Variance of a sum, Correlation coefficient, Independent random variables, Bivariate distributions of continuous random variable and their properties, distribution of sums and quotients, Conditional densities.	7	
4	Module 4: Basic Statistics: Frequency distribution, measures of Central tendency, central moments and raw moments, Skewness and Kurtosis, Sampling and it's distribution, population distributions, central limit theorem.	6	
5	Module 5: Applied Statistics: Correlation and regression – Rank-correlation, scatter diagram, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.	4	
6	Module 6: Statistical Hypothesis Testing: Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations. test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	calculate probabilities using conditional probability, rule of probability and Baye's theorem.		
CO 2	define discrete and continuous distribution and solve the mathematical and engineering problems using these distributions.		
CO 3	compute probabilities of bivariate distributions, correlation coefficient, regression coefficients.		
CO 4	analyze various statistical problem and compute measure of central tendency, dispersion, skewness and kutosis and fit a curve from a given data set.		
CO 5	relate Type I error and level of significance for a hypothesis test when making a decision and explain meaning of significance level in context.		

Learning Resources:	
1.	Reena Garg, Chandrika Prasad, Advanced Engineering Mathematics, Khanna Publishers. 2.
2.	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
3.	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4.	N.G. Das, Statistical Methods (Combined Volume), Tata-McGraw Hill.
5.	Banarjee,De & Sen, Mathematical Probability, U.N. Dhar & Sons.
6	A. Gupta, Groundwork of mathematical probability and statistics, Academic publishers.
7	S. Ross, A First Course in Probability, Pearson Education India
8	W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, Wiley
9	John E. Freund, Ronald E. Walpole, Mathematical Statistics, Prentice Hall.

Name of the course	PROGRAMMING FOR PROBLEM SOLVING
Course Code: ES(CS/IT)204	Semester: 2nd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: Nil	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:	
1.	To understand the various steps in Program development and basic concepts in C Programming Language.
2.	To learn how to write modular and readable C Programs in C to solve problems.
Pre-Requisite	
1.	Basic fundamental knowledge of Mathematics.
2.	Knowledge of arithmetic and logical reasoning

Module	Content	Hours	Marks.
1	Introduction to Computing Computer Systems-Hardware and Software, Different components, Computer Languages, Algorithm, Flowchart, Representation of Algorithm and Flowchart with examples.	4	
2	Introduction to C History of C, Features of C, Structure of C Program, Character Set, C Tokens-Keywords, Identifiers, Constants, Variables, Data types, Operators.	4	
3	Statements Selection statements (Decision Making)- if and switch statements with examples, Repetition statements (loops)- while, for, do-while statements with examples, Unconditional statements- break, continue, goto statements with examples.	4	
4	Arrays Declaration and Initialization, One dimensional Arrays, Two dimensional Arrays, Searching, Basic Sorting Algorithms.	4	
5	Strings Declaration and Initialization, String Input / Output functions, String manipulation functions.	4	
6	Function Designing Structured Programs, Types of Functions-User defined functions, Standard functions, Categories of functions, Parameter Passing techniques, Storage classes, Dynamic Memory Allocation, Recursion.	8	
7	Pointers Introduction, Definition and Declaration of pointers, address operator, Pointer variables, Pointers with Arrays.	5	
8	Structures and Unions	3	

	Introduction, Declaration and Initialization, Array of Structures, Unions.		
9	File Handling (Only if time is available)	2	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	Explain fundamentals of computers.		
CO 2	Use syntax and semantics of C Language to translate the algorithms into programs.		
CO 3	Implement program modules using branching and looping.		
CO 4	Organize data using arrays and structures.		
CO 5	Assemble functional program modules using functions and recursion.		
Learning Resources:			
1.	Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill		
2.	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill		
3.	Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India		

Name of the course		ENGLISH	
Course Code: HS(CT/IT/CS) 201		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 2 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 2		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	To develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking and Writing.		
2.	To revise and reinforce structure already learnt		
3.	To enable the learner to communicate effectively and appropriately in real life situations.		
Pre-Requisite			
1.	Basic English Grammar knowledge of class 12th standard		
Module	Content	Hours	Marks.
1	Vocabulary building and new words concept: • Concept of Word formation • Collection of five new words everyday (from Oxford Dictionary & English Newspapers) • Synonyms & Antonyms • Masculine & Feminine • Singular & Plural	4	
2	Basic Writing Skill — Written English • Sentence construction • Use of Phrases, idioms and clauses in sentences • Importance of proper punctuation • Techniques for writing precisely • Paragraph writing	4	
3	Avoiding mistakes & errors in English • Subject — Verb agreement • Noun — Pronoun agreement • Misplaced Modifiers • Articles • Prepositions	4	
4	Practice of Writing English — Form • Precis writing • Essay writing • Letter writing	6	

	• Comprehension • English Translation — Mother tongue to English & vice versa		
5	Communication Skill — incorporation of presentation skill & negotiation skill • Listening comprehension • Spoken English • Comprehension, intonation, accent, stress and rhythm • Conversation and dialogues • Manoeuvring sentences — replacing words • Interview — personal interview / Group Discussion • Public speaking	6	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	develop a minimum repository of English words to use for making meaningful sentences.
CO 2	write correct sentences using phrases, idioms, clauses with proper punctuation marks.
CO 3	identify the common mistakes and grammatical errors in sentence construction.
CO 4	write letters, essays, precis etc. in proper format.
CO 5	able to speak English with correct pronunciation.
CO 6	communicate effectively in public forum and in professional field
Learning Resources:	
1.	Technical Education: Raman and Sharma
2.	Effective Technical Communication: Ashraf Rizvi
3.	Effective Communication and Soft Skills: Nitin Bhatnagar & Mamta Bhatnagar

Name of the course		Chemistry Lab	
Course Code: BSL(CS/IT) 206		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: Nil		Attendance : 10	
Tutorial: Nil		Preparation of Lab Report : 30	
Practical: 3 hrs./week		Experimental data/ Precision of work done : 30	
Credit Points: 1.5		Presentation/ analysis of the result : 10	
		Viva Voce : 20	
Objective:			
1.	To develop laboratory practice and safety.		
2.	To develop laboratory skills and instrumentation.		
3.	To deepen the understanding of concepts.		
4.	To provide scientific skills and chemical knowledge.		
Pre-Requisite			
1.	Class 12th standard knowledge in Practical Chemistry		
Module	Content	Hours	Marks.
1	Qualitative analysis of an inorganic sample salt.	6	
2	Estimation of Fe(II) present in a solution permanganometrically	3	
3	Estimation of Fe(II) present in a solution dichromatometrically.	3	
4	Determination of hardness of water in ppm unit complexometrically.	6 (any two from Module 4-9)	
5	Determination of surface tension of a given liquid.		
6	Determination of viscosity of a given liquid.		
7	Determination of rate constant of a reaction.		
8	Determination of cell constant and conductance of a solution.		
9	Potentiometry: determination of redox potential and emf.		
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	analyze qualitative parameters (basic and acid radicals) of inorganic salts.handle stalagmometer and Ostwald's viscometer to determine surface tension and viscosity of liquid.		
CO 2	estimate quantities of Fe (II) permanganetometrically and dichromatometrically.		
CO 3	estimate hardness of water complexometrically.		
CO 4	handle stalagmometer and Ostwald's viscometer to determine surface tension and viscosity of liquid.		

CO 5	develop perception about safety standards to be maintained inside the laboratory.
CO 6	develop skill to work in a team.
Learning Resources:	
1.	Practical Chemistry, Prof Sachin Dutta, Bharati Book Stall
2.	Practical Chemistry , R Mukhopadhyay & P Chatterjee, Books and Allied (p) Ltd.
3.	Practical Chemistry, Pandey, Bajpai, Giri, S Chand Publication
4.	Vogel's Qualitative Inorganic Analysis, G Svehla, B Shivasankar (7th Edition), Pearson
5.	Vogel's Quantitative Chemical Analysis, J Mendham, R C Denney, J D Barnes, M Thomas, B Shivasankar (6th Edition), Pearson

Name of the course		PROGRAMMING FOR PROBLEM SOLVING LAB	
Course Code: ESL(CS/IT) 205		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: Nil		Attendance: 10	
Tutorial: Nil		Preparation of Lab Report: 30	
Practical: 4 hrs./week		Experimental data/ Precision of work done: 30	
Credit Points: 2		Presentation/ analysis of the result: 10	
Objective:			
1.	To understand the various steps in Program development.		
2.	To understand the basic concepts in C Programming Language.		
3.	To learn how to write modular and readable C Programs		
4.	To learn to write programs (using structured programming approach) in C to solve problems.		
Pre-Requisite			
1.	knowledge of Mathematics.		
2.	knowledge of arithmetic and logical operations.		
3.	knowledge of reasoning.		
Module	Content	Hours	Marks.
1	Familiarization with programming environment	2	
2	Simple computational problems using arithmetic expressions	3	
3	Problems related to Branching and logical expressions	3	
4	Iterative problems using loops e.g., sum of series	3	
5	1D Array manipulation, searching, sorting related problems	3	
6	Problems related to 2D arrays and Strings manipulation	3	
7	Problems related to Functions, call by value, call by reference and dynamic memory allocation	3	
8	Problems regarding Recursion	8	
9	Pointers related problems	3	
10	Problems on structures and Unions	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	formulate algorithms for simple problems and translate given algorithms to a working and correct program		
CO 2	identify and correct logical errors and syntax errors encountered at run time.		
CO 3	write iterative as well as recursive programs.		
CO 4	represent data in arrays, strings and structures and manipulate them through a program		
CO 5	declare pointers of different types and use them in defining self-referential structures.		
CO 6	work effectively in a team.		
Learning Resources:			
1.	E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill		
2.	Programming with C by T Jeyapoovan, Vikas Publishing House Pvt Ltd		
3.	Programming in C by J.B. Dixit, Laxmi Publications Pvt Ltd		

Name of the course		WORKSHOP/ MANUFACTURING PRACTICES	
Course Code: ESL(CS/IT) 206		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 1 hr./week		Attendance: 10	
Tutorial: Nil		Preparation of Lab Report: 20	
Practical: 4 hrs./week		Experimental data/ Precision of work done: 30	
Credit Points: 3		Presentation/ analysis of the result: 20	
Objective:			
Pre-Requisite			
Module	Content	Hours	Marks.
1	Manufacturing methods: casting, forming, machining, joining and advanced manufacturing methods	2	
2	CNC machining, Additive manufacturing	3	
3	Fitting operations & power tools	3	
4	Electrical & Electronics	3	
5	Carpentry	3	
6	Plastic moulding, glass cutting	3	
7	Metal casting	3	
8	Welding (arc welding & gas welding), brazing	8	
9	Machine shop	3	
10	Smithy	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	explain different manufacturing processes which are commonly employed in industry to fabricate components using different materials including CNC machining, additive manufacturing.		
CO 2	complete a defined job in different sections of mechanical workshop e.g., carpentry, fitting etc.		
CO 3	find out dimensional accuracies and dimensional tolerances possible with different manufacturing processes.		
CO 4	assemble different components to produce small devices.		
CO 5	make electrical wiring for household applications.		
Learning Resources:			
1.	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.		
2.	Kalpakjian S And Steven S. Schmid, "Manufacturing Engineering an Technology",4thedition, Pearson Education India Edition, 2002.		
3.	Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology — I" Pearson Education, 2008.		
4.	Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.		
5.	Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.		

Name of the course		LANGUAGE LAB	
Course Code: HSL(CT/IT/CS) 202		Semester: 2nd	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: Nil			
Tutorial: Nil			
Practical: 2hrs./week			
Credit Points: 1			
Objective:			
Pre-Requisite			
Module	Content	Hours	Marks.
1	LISTENING Listening to pre-recorded short episodes, conversations, passages, stories, news bulletin, speeches by famous personalities — Listening for general and specific information etc.	4	
2	READING: Reading aloud — by students individually — reading rhymes — proverbs — passages on various topics of interest — Newspaper reading — Reading humorous passages — Anecdotes — Stories — tricky sounds (conditioners) — Reading manuals — Reading individual sentences with articulation, pronunciation, Tones, Punctuation, pauses etc. - Reading the titles of popular books, movies and poems.	4	
3	SPEAKING: Self-introduction — introducing one self, one's family — one's friends and relatives, one's country etc. Welcome Address, Vote of thanks. Extempore speeches. Short speech on simple topics on simpler themes for about one minute. Role play — Group Discussion — Debate — Seminars — Machine Descriptions (depending upon branches) — Compering — Interviewing others by Asking Questions — Interview Techniques — Conversational Practice — Telephonic Conversation — Telephonic Interviews — How to establish conversation / dialogues — Entry Attempts/Admissions.	6	
4	WRITING: Writing Resume, preparing Curriculum Vitae, Converting newspaper headlines into sentences. Formation of Sentences — Using the table of Sentence-making and producing multiple sentences. Framing Questions for the responses given. Tips for better performance in interviews. Describing Objects. Describing Situations; Project report writing (outline): significant features of Project report writing — Organization — Presentation — Use of Impersonal Passives — Acknowledgements.	6	
5	PROFESSIONAL ETHICS & ORGANISATIONAL BEHAVIOUR: Different kinds of Ethics — Ethics in different fields — Engineering Ethics — Senses of Engineering Ethics — Moral Values — Integrity & Loyalty — Work Ethics — Respect for others and authority — Empathy — Caring and Sharing — Honesty — Courage and Commitment — Valuing Time — Cooperation & Teamwork — Safety and Risk — Right Action — Professional ideals and virtues — Individual's Ambition — Conflict Resolution — Self- Confidence — Customs and Manners — General Behaviour — Etiquettes to be followed — Professional Responsibility — Accountability — Leadership Quality — Effective Communication skills.	4	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	develop listening skill with proper comprehension.		
CO 2	read aloud fluently various topics with proper pronunciation and articulation and necessary pauses.		
CO 3	able to speak English fluently with correct pronunciation during Group Discussions, Seminar presentations, Telephonic conversations etc.		
CO 4	write Resume, prepare Curriculum Vitae and Convert newspaper headlines into sentences etc.		
CO 5	develop self-confidence and leadership quality through effective communication skills.		

3rd SEMESTER							
SL. NO.	PAPERCODE	PAPERNAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	BS(CS/IT)307	Mathematics- III	3	0	0	3	3
02	ES(CS/IT)307	Digital Electronics	3	0	0	3	3
03	PC(CS/IT)301	Computer Organization	3	1	0	4	4
04	PC(CS/IT)302	Data structure & Algorithms	3	0	0	3	3
05	HS(CS/IT)303	Economics for Engineers	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	ESL(CS/IT)308	Digital Electronics Lab	0	0	3	3	1.5
02	PCL(CS/IT)303	Computer Organization Lab	0	0	3	3	1.5
03	PCL(CS/IT)304	Data structure & Algorithms Lab	0	0	3	3	1.5
04	PCL(CS/IT)305	IT Workshop (python/matlab)	0	0	3	3	1.5
05	CLA(CS)-3	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**15**	**1**	**12**	**28**	**23**

Name of the course		Mathematics-III	
Course Code: BS(CS/IT) 307		Semester:3rd	
Duration:6months		MaximumMarks:100	
Teaching Scheme		ExaminationScheme	
Theory:3hrs/week		TwoMidTerm Exams:30Marks	
Tutorial:NIL		Assignments,Quizetc.:20Marks	
CreditPoints: 3		EndSemesterExam:50Marks	
Objective:			
1.	To learn the concept of Cauchy sequence, convergence of infinite series.		
3.	To understand gradient, divergence and curl using the calculus and multiple variable.		
4.	To understand Green, Gauss and stokes theorem using integral of a function.		
5.	To learn analytical technique for finding solution of higher order differential equation.		
5.	Tocreate mathematical models using first order differential equation.		
6.	To understand basic concept of graph theory.		
Pre-Requisite:			
1.	Mathematics –I (BS(CS/IT)101		
2.	EngineeringMathematics(UGlevel)		
Module	Content	LectureHours	
1	Module 1:Sequences and series Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions.	8	
2	Module 2:Multivariable Calculus (Differentiation) Limit, continuity and partial derivatives, Chain rule, Implicit function, Jacobian, Directional derivatives, Total derivative; Maxima, minima and saddle points; Gradient, curl and divergence and related problems.	7	
3	Module 3: Multivariable Calculus (Integration) Double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar).Theorems of Green, Gauss and Stokes (Statement only) and related problems.	8	
4	Module 4: Ordinary Differential Equation First Order Differential Equation, Exact, Linear and Bernoulli's equations, Equations of first order but not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's form, general & singular solution. Second order linear differential equations with constant coefficients, D-operator method, method of variation of parameters, Cauchy-Euler equation.	9	
5	Module 5: Graph Theory Basic Concept of graph, Walk, Path Circuit, Euler and Hamiltonian graph, diagraph. Matrix Representation: Incidence & Adjacency matrix. Tree: Basic Concept of tree, Binary tree, Spanning Tree, Kruskal and Prim's algorithm for finding the minimal spanning tree.	8	
Course Outcomes: Aftercompletion of this course, the learners will be able to-			
CO1	apply the concept of sequence and convergence of infinite series in many approximation techniques in engineering disciplines and use the tools of power series to analyze engineering problems.		
CO2	apply the knowledge for addressing the real life problems which comprises of several variables or attributes and		

	identify extremum points in different surfaces of higher dimensions.
CO3	evaluate multiple integrals and apply the techniques to different physical problems.
CO4	solve first and second order ordinary differential equations by applying different techniques and also will be able to formulate differential equations for model systems and problems of engineering sciences.
CO5	apply the basic concepts of graph theory to network analysis, data analytics and many other branches of computer science.
Learning Resources:	
1	Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
2	Michael Greenberg, Advanced Engineering Mathematics, Pearson.
3	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4	NarsinghDeo, Graph Theory with Applications to Engineering and Computer Science.
5	Derek Holton & John Clark, A First Look at Graph Theory
6	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
7	RaisinghaniaM.D, Advanced differential equation, S.Chand.
8	S.K Mapa, Real Analysis,Sarat
9	C Charles H.C. Little, Kee L. Teo, Bruce van Brunt,Real analysis via sequence and series,Springer
10	Douglas Brent West, Introduction to Graph Theory, Prentice Hall.
11	Robert wrede,MurraySpiegel,Schaum's Outline of Advanced Calculus, Third Edition,Schaum's outline
12	S.L. Ross, Differential equation,Willey.
13	Clark John, Holton Derek Allan, A First Look at Graph Theory, World Scientific.
14	E. L. Ince, Ordinary Differential Equations, Dover Publications.

Name of the course:		Digital Electronics	
Course Code: ES(CS/IT)307		Semester: 3th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 3 hrs/week		Mid Semester-1 Exam: 15 Marks	
Tutorial Contact Hrs.: 0 hrs./week		Mid Semester-2 Exam: 15 Marks	
Credit Point: 3		Assignment, Quiz & class attendance: 20 Marks	
		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To study Analog Electronic devices.		
2.	To study boolean logic and logic gates.		
3.	To compare digital and analog electronic circuits.		
Pre-Requisite:			
1.	Basic Electrical Engineering ES(CS/IT)101		
Module	Content	Lecture Hours	

1.	Basic Electronic devices: PN junction diode, Application of diodes in rectification, Half wave Full wave rectifier and Factors determining rectifier performance , Transistor,Transistor characteristics for CE, CB and CC mode, current amplification factors and their relationship, Introduction to JFET, MOSFET and CMOS.	08	
2.	Number system, Boolean algebra & logic gates: Binary numbers & Boolean algebra , Logic gates, Truth Tables and function minimization using algebraic method, Karnaugh map, , Signed binary number representation with 1's and 2's complement methods, Maxterm, Minterm, Representation in SOP and POS forms ; Realization of Boolean functions using NAND/NOR gates	10	
3.	Combinational circuits:Adder and Subtractor circuits ; Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer, Parity Generator and checker.	10	
4.	Sequential Circuits: Flip-flops - SR, JK, Master slave JK, D and T. Register, counter	08	

Course Outcomes: After completion of this course the students will be able to -	
CO1	Identify the difference between analog and digital electronic systems.
CO2	Compare the operation of semiconductor devices based on their characteristic curves.
CO3	Explain number base conversions and K-Map.
CO4	Construct various combinational logic circuits.
CO5	Design various sequential circuits.

Learning Resources:	
1.	Morries Mano, Digital Logic Design, PHI
2.	Kharate, Digital Electronics, Oxford
3.	Leach &Malvino, Digital Principles &Application,McGraw Hill
4.	D chattopadhyay&P.C.Rakshit. Electronics (Fundamentals and Applications), New Age International Publishers
5.	Malvino, Electronic Principle, McGraw Hill.
6.	Millman&Halkias, Integrated Electronics, McGraw Hill
7.	Boyelstad&Nashelsky, Electronic Devices & Circuit Theory,PHI
8.	R.P.Jain, Modern Digital Electronics, McGraw Hill

Name of the course	Computer Organization
Course Code: PC(CS/IT)301	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 1 hrs/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Assignment, Quiz, Attendance: 20 Marks

Credit Points: 4		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1	To identify different processor architectures and their performance measurement parameters.		
3	To develop the concept of instruction set of a processor.		
4	To design pipeline processor architecture.		
Pre-Requisite:			
1.			
Module	Content	Lecture Hours	
1	Introduction: History of computing, von Neumann machine, Instruction and data, fixed-point and floating point numbers, errors, IEEE standards	3	
2	Processor design: Instruction Set Architecture-Instruction format, opcode optimization; operand addressing; Instruction implementation-data movement, branch control, logical, Input/output and debugging instructions; arithmetic instruction implementation–addition and subtraction, multiplication-division, 2's complement multiplication; Booth's algorithm–theory and examples; bit-pair algorithm; high performance arithmetic	9	
3	Control unit design: Hardwired control, micro-programmed control design – micro-instruction formats, control optimization;	6	
4	Memory subsystem: Registers, Memory hierarchy, memory interfacing, virtual memory, cache memory, memory replacement techniques, address mapping, content addressable memory (CAM), memory interleaving, real life problem solution	9	
5	Peripherals: Basic properties, bus architectures, control and arbitration, interfacing of I/O devices, data transfer schemes –programmed I/O, memory mapped I/O, I/0 mapped I/O, DMA, mass storage, RAID	7	
6	Pipelining: Pipelining, data path and instructions, speed up, CPI, latency; linear / non-linear pipeline–reservation table, MAL; super-pipelined and super-scalar processors.	6	
Course Outcomes: After completion of the course the learners will be able to-			
CO1	Represent numbers in fixed-point and floating-point systems		
CO2	Visualize machine's instruction set architecture (ISA) including basic instruction fetch and execute cycles, instruction formats, control flow, and operand addressing modes		
CO3	Explain the design and functioning of a machines central processing unit (CPU), the data path components (ALU, register file) and the control unit.		
CO4	Design memory organization systems and compare in terms of efficiency		
CO5	Analyse basic input/output functioning including program controlled I/O and interrupt I/O.		
CO6	Analyze performance improvement of system using instruction and memory level parallelism		
Learning Resources:			
1	Mano, M.M., "Computer System Architecture", PHI.		
2	BehroozParhami" Computer Architecture", Oxford University Press		
3	Hayes J. P., Computer Architecture & Organisation, McGraw Hill		
4	Hamacher, Computer Organisation, McGraw Hill,		
5	N. Senthil Kumar, M. Saravanan, S. Jeevananthan, Microprocessors and Microcontrollers OUP		
6	Chaudhuri P. Pal, Computer Organisation & Design, PHI		
7	P N Basu- Computer Organization & Architecture ,Vikas Pub		

Name of the course	Data Structure and Algorithm
Course Code: PC(CS/IT)302	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Term Exam I: 15 Marks
Tutorial: NIL	Mid Term Exam II: 15 Marks
Practical: NIl	Assignment.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:

1.	To Understand basic data structures such as arrays, linked lists and trees.
2.	To Calculate the time complexities of accessing various data structures.
3.	The ability to decide based on a given problem which data structure is appropriate.

Pre-Requisite:

1.	Programming for problem solving (ES(CS/IT) 204)

Module	Content	LectureHours	
1	Introduction :Elementary Data Organizations, Data Structure Operations - insertion, deletion and traversal in arrays, asymptotic Notations, Time-Space trade off, recursion, tail recursion, Tower of Hanoi, recursion tree and master theorem method of complexity analysis, Linear Search and Binary Search Techniques and their complexity analysis, finding min max in O(3n/2) time.	10	
2	Stacks and Queues: ADT Stack and its operations; Algorithms and their complexity analysis, Applications of Stacks - Expression Conversion and evaluation – corresponding algorithms and complexity analysis; ADT queue and types of Queue-Simple Queue, Circular Queue, Operations on each type of Queue- Algorithms and their analysis.	6	
3	Linked List: Singly linked lists, Representation in memory, Algorithms of several operations -Traversing, Searching, Insertion into, Deletion from linked list; Linked List representation of Stack and Queue; Doubly linked list - operations, space and time analysis; Circular Linked Lists - all operations and complexity analysis; Floyd-Cycle finding algorithm.	6	
4	Trees: Basic Tree Terminologies, Different types of Trees - Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, binary heap, b-tree; operations on each of the trees and their algorithms with complexity analysis; Tree traversal algorithms - recursive and iterative. Catalan Number and its connection to binary trees and stack sortable permutations ;Comparison of performance of Heap, array and insertion priority queues.	10	
5	Hashing: Chaining, probing, Universal hashing function and analysis of various hashing methods.	4	

Course Outcomes:
After completion of this course, the learners will be able to-

CO1	Analyze the algorithm to determine the time and computation complexity.
CO 2	Decide based on nature of the search problem which search technique (Linear Search, Binary Search, hashing) to use when.
CO 3	Implement the Stacks, Queues and linked list data structure and apply the same to various problems
CO 4	Apply non linear data structures in searching, insertion and retrieval of data. Analyze the time complexity of

	various balanced and unbalanced trees and to apply the data structure to relevant problems.
Learning Resources:	
1	Horowitz, Sahni, Anderson-Freed:*Fundamentals of Data Structures in C* (Second Edition), Universities Press, 2008.
2	T.H. Cormen, C.E. Leiserson, R. Rivest and C. Stein: *Introduction to Algorithms*,(Second/Third Edition), PHI, 2009.
3	R. Sedgewick: *Algorithms in C*, Pearson, 2004.
4	Steven S Skiena, Algorithm design manual, 2nd Edition, Springer.
5	Steven S Skiena, Miguel A. Revilla, Programming Challenges: The Programming Contest Training Manual (Texts in Computer Science) Springer.

Name of the course		ECONOMICS FOR ENGINEERS	
Course Code: HS(CS/IT)303		Semester: 3RD	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	To understand various concepts of Economics, Accounting and Financial Management.		
2.	To familiarize with the application of the different topics covered in the syllabus.		
Pre-Requisite:			
1.	Class 12th standard knowledge of Mathematics.		
Module	Content	Lecture Hours	
1	Introduction to Economics for Engineers – Basic Introduction to Economics, Productive resources, Scarcity and the Economic problem, Efficiency and sustainability, Engineering & Economics, Scope of Economics for Engineers, Role of Engineers in Economic Decision making, Problems in Economic Decision-Making, Decision-Making Process. Engineering Cost Concepts – Fixed, Variable, Marginal & Average costs, Semi-variable and Step cost, Product and Period cost, Direct and Indirect cost, Sunk cost, Shutdown cost, Opportunity cost, Recurring and Nonrecurring costs, Anticipated and Unanticipated costs, Differential or Incremental costs, Cash cost vs. Book costs, Life-Cycle Costing; Cost estimation Techniques - Types Of Estimate, Approaches to cost estimation, Cost Estimation Models - Per Unit Model, Segmenting Model, Cost Index Model, Power-Sizing Model, Learning Curve Model, Benefits and difficulties in estimation.	6	
2	Break-even analysis- Basic concept, terminology and assumptions, Derivation of break-even point, Profit Volume (P/V) ratio, Margin of Safety, Uses and limitations of break-even analysis. Cash Flow, Interest and Equivalence: Cash Flow – Diagrams and Cash Flow Statement, Time Value of Money, Interest factor and interest rate, Economic Equivalence, Real,	5	

	Nominal & Effective Interest rate. Different Interest Formulae and their application.		
3	Capital budgeting and Project selection – Basic concept of capital budgeting, Types of projects and cash flow patterns, features of a good capital budgeting criteria; Net Present Value (NPV) Analysis, NPV criteria for revenue dominated and cost dominated models, Internal Rate of Return (IRR) Analysis, Incremental IRR, Comparison between NPV and IRR, Future Worth Analysis, Annual Worth Analysis, Evaluation of Public Projects and Benefit-Cost Ratio Analysis, Sensitivity Analysis.	9	
4	Inflation and Price Change – Definition, types, stages, causes and effects of inflation. Price Change with Index Numbers – Definition and features of Index Numbers, Construction of index numbers, Price relative, Types of Index Numbers, Tests of Index Numbers, Use of Price Indexes in Engineering Economic Analysis. Uncertainty in Future Events - Uncertainty and Risk, Types of risk, Risk vs. Return, Application of Probability to analyse risk, Using Expected Value, Variance, and Coefficient of Variation to measure return and risk; Economic Decision Trees, Simulation.	8	
5	Depreciation and Replacement Analysis - Basic aspects of depreciation, Reasons for depreciation, Obsolescence, Depreciable assets, Depreciation, depletion and amortization, Various methods of calculating depreciation; Replacement analysis – Basic aspects, reasons for replacement, Types of maintenance, Replacement Analysis Decision Map, Minimum Cost Life of a New Asset. Introduction to Accounting – Basic concepts, scope, functions and limitations of Accounting, Financial Statements - Balance Sheet and Income Statement, Financial Ratios, Uses and limitations of ratio analysis. Introduction to Financial Management - Overview and scope of Financial Management, Approaches to Financial Management, Objectives of Financial Management, Role and Functions of a Financial Manager.	8	

Course Outcomes: After completion of the course, a student would be able to:	
CO 1	Explain various concepts of Economics, Accounting and Financial Management.
CO 2	Develop cost estimates using different cost estimation techniques.
CO 3	Solve problems using break-even analysis and interest formulae.
CO 4	Utilize various analysis methods for project selection.
CO 5	Apply Depreciation, Replacement Analysis, Index numbers and price change, Financial statements, Financial ratio analysis, return and risk analysis using appropriate methods in relevant problems.

Learning Resources:	
1.	R. Panneerselvam: Engineering Economics, PHI.
2.	H.L. Bhatia & S.N. Maheswari: Economics for Engineers, Second edition, Vikas Publishing House Pvt. Ltd.
3.	Donald Newnan, Ted Eschembach, Jerome Lavelle : Engineering Economics Analysis, OUP
4.	Sullivan and Wicks: Engineering Economy, Pearson
5.	ParthaChatterjee: Economics for Engineers, Vrinda Publications.
6.	James L. Riggs, David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill .
7.	Niall M. Fraser, Elizabeth M. Jewkes: Engineering Economics Financial Decision Making for Engineers, Pearson
8.	M.Y. Khan & P.K. Jain: Financial Management Text, Problems & Cases, McGraw Hill Education.
9.	N.G. Das: Statistical Methods (combined volume), Tata McGraw-Hill.

Name of the course	Digital Electronics Lab.
Course Code: ESL(CS/IT)308	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme, Total Marks: 100
Theory: Nil	Attendance : 10
Tutorial: Nil	Preparation of Lab Report : 30
Practical: 3 hrs./week	Experimental data/ Precision of work done : 30
Credit Points: 1.5	Presentation/ analysis of the result : 10
	Viva Voce: 20

Module	Content	Hours	
1.	I-V characteristics of semiconductor diode.	03	
2.	Input and output characteristics of BJT in CE configuration	03	
3.	Output and transfer characteristics of JFET in CS configuration.	03	
4.	Logic function realization using logic gates.	03	
5.	Design and implementation of half adder and full adder	03	
6.	Design and implementation of parity generator and checker	03	
7.	Construction of simple Decoder & Multiplexer circuits.	03	
8.	Realization of RS / JK / D flip flops using logic gates.	03	

Course Outcomes: After completion of this course the students will be able to -	
CO1	Measure static and dynamic resistance of P-N junction diode from the I-V characteristics.
CO2	Identify different regions of operation of BJT and JFET from the characteristics curves.
CO3	Construct logic circuits using minimum number of logic gates.
CO4	Implement adder, parity generator and checker, decoder and multiplexer circuits using basic logic gates.
CO5	Construct different types of sequential circuits using basic logic gates.

Learning Resources:	
1	Laboratory Manual For Introductory Electronics Experiments by Maheshwari, L.K. ,Anand, M.M.S. , New Age International (P) Ltd., Publishers.

Name of the course	Computer Organization Lab
Course Code: PCL(CS/IT)303	Semester: 3rd
Duration: 6 months	Maximum marks:100
Teaching Scheme	Examination scheme:
Theory: Nil	Attendance: 10 marks
Tutorial: Nil	Preparation of Lab Report: 30 marks
Practical: 3 hrs/week	Experimental data/ Precision of work done: 30 marks
Credit Points:1.5	Presentation / analysis of the result: 30 marks

		Viva voce: 20 marks
Module	Content	
1.	Familiarization with IC chips: Multiplexer, Decoder, Priority Encoder, ROM, Comparator, Flip flop (Truth table verification and application)	
2.	Design Adder, Subtractor using basic gates, Multiplexer and decoder	
3.	Design Adder Subtractor composite unit	
4.	Design BCD adder	
5.	Design Carry look ahead adder circuit	
6.	Design ALU(Arithmetic Logic Unit)	
7.	Design of counter using Flip Flop	
8.	Synthesize sequential circuits	
9.	Execute Read and Write operation using RAM chip	
10.	Cascading of RAM IC for vertical and horizontal expansion	
Course Outcomes: After completion of the course students will able to -		
CO1	Asses different Integrated circuits	
CO2	Design combinational circuits	
CO3	Design sequential circuits	
CO4	Implement different real life applications of combinational and sequential circuits required for basic computer architecture.	
CO5	Evaluate different applications for higher order design	
Learning Resources:		
1	Mano, M.M., “Computer System Architecture”, PHI.	
2	M. Lotia, Modern IC data and substitution Manual, PHI	

Name of the course:	Data Structure & Algorithm Lab
Course Code: PCL(CS/IT)304	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory:NIL	Attendance 10
Tutorial:NIL	Preparation of Lab Report: 30
Practical:3 hrs/week	Experimental data/Precision of work done: 30
Credit Point:1.5	Presentation/ analysis of the result: 10
	Viva Voce:20

Objective:	
1.	To understand the working of basic data structures..
2.	To analyse the performance of various data structures
3.	To implement various data structures
4.	To understand the difference between linear and non-linear data structure

Pre-Requisite:			
1.	NA		
Module	Content	Hours	Marks
1	Application of array insertion, deletion and traversal operations in solving problems.	03	
2	Linear Search, Binary Search Techniques and time complexity comparison.	03	
3	Application of binary search like divide and conquer technique in various array related O (log n) problems.	03	
4	Implementation and applications of Stacks and queues using arrays.	03	
5	Implementation of Singly linked lists, Linked representation of Stack and Queue.	03	
6	Implementation of Binary Search Tree.	03	
7	Application of binary trees in solving various problems.	03	
8	Array implementation of binary heap.	03	
9	Comparison of performance of binary Heap and array as priority queues.	03	
10	Implementation of B-Tree.	03	
11	Implementation of Chaining and probing techniques of collision resolution in hashing.	03	
Course Outcomes: After completion of this course, the learners will be able to -			
CO1	Implement linear data structures.		
CO2	Analyze data sets and problems.		
CO3	Implement non-linear data structures.		
CO4	Compare various searching techniques.		
CO5	decide which data structure to implement based on the problem.		
Learning Resources:			
1.	Horowitz, Sahni, Anderson-Freed: *Fundamentals of Data Structures in C* (Second Edition), Universities Press, 2008.		
2.	T.H. Cormen, C.E. Leiserson, R. Rivest and C. Stein: *Introduction to Algorithms*,(Second/Third Edition), PHI, 2009.		
3.	R. Sedgewick: *Algorithms in C*, Pearson, 2004.		
4.	Steven S Skiena, Algorithm design manual, 2nd Edition, Springer.		

Name of the course:	IT WORKSHOP
Course Code: PCL(IT/CS)305	Semester: 3rd
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.:	Attendance : 10
Tutorial Contact Hrs.:	Preparation of Lab Report : 20
Practical: 3 hrs./week	Experimental data/ Precision of work done : 30
Credit Point: 1.5	Presentation/ analysis of the result : 20
	Viva Voce: 20

Objective:			
1.	To implement Python programs using core Python programming concepts and functions		
2.	To understand Object Oriented Python Programming techniques		
Pre-Requisite:			
1.	Basic Programming concept		
Module	Content	Hours	Marks
1.	Python Fundamentals Python Character Set, Python Tokens, Basic structure of Python Program, Variables and assignments, Multiple Assignments, Dynamic Typing, Input and Output in Python, Data Types and Operators, Control Structure, Sequence Statements, Selection Statements, range() function , Iterative Statements, Jump Statements	6	10
2.	Strings Accessing Values in Strings, Traversing a String, String Operators, Built-In String Methods	3	10
3.	Lists Creating a List, Accessing Lists, Difference between String and List, Traversing a List, List Operations	3	10
4.	Tuples Tuple vs List, Creating a Tuple, Accessing Tuples, Traversing a Tuple, Comparing Tuples, Common Tuple Operators, Packing and Unpacking Tuples, Tuples Built-In Functions, Deleting a Tuple	3	10
5.	Dictionary Creating a Dictionary, Properties of Dictionary Keys, Traversing a Dictionary, Accessing Keys or Values Separately, Nested Dictionary, Adding Elements to Dictionary, Updating Elements in a Dictionary, Deleting Element from a Dictionary, Dictionary Built-In Methods	3	10
6.	Introduction to Python Modules Math Module, Random Module, Statistics Module	3	10
7.	Functions Scope, Parameter passing, Passing strings, Default parameters, Return values, Positional parameters	3	10
8.	Object Oriented Programming(OOP) With Python Basics of OOP, Class and Objects, Inheritance, Types of Inheritance	6	10
9.	File Handling Need for data file, Types of file :Text, Binary and Comma separated value files	3	10
10.	Data Structures Stacks : Push, Pop using a list, Queues : Insert, Delete using a list	3	10
Course Outcomes: After completion of this course the students will be able to -			
CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements		
CO2	Express proficiency in the handling of strings and functions		
CO3	Identifythe commonly used operations involving file systems		
CO4	Apply object oriented programming concepts		
CO5	Determine the methods to create and manipulate Python programs by utilizing lists, tuples and dictionaries		
Learning Resources:			
1.	https://www.anaconda.com		

2.	Rakesh K. Yadav, SrinivasArukonda, Monu Singh, TapasyaDinkar, Dileep Kumar Yadav, Zero to Mastery in Python Programming, Vayu Education of India, ISBN: 9789389769364
3.	Pooja Sharma, Programming in Python, BPB Publications, ISBN: 9789386551276
4.	ReemaThareja, Python Programming- Using Problem Solving Approach, OUP India, ISBN: 9780199480173

4th SEMESTER							
SL. NO.	PAPERCODE	PAPERNAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	BS(CS/IT)408	Discrete Mathematics	3	1	0	4	4
02	ES(CS/IT)409	Communication Engineering	3	0	0	3	3
03	PC(CS/IT)406	Design&Analysisof Algorithm	3	0	0	3	3
04	PC(CS/IT)407	FormalLanguage andAutomata Theory	3	1	0	4	4
05	PC(CS/IT)408	Computer Architecture	3	1	0	4	4
SESSIONAL/PRACTICAL							
01	ESL(CS/IT)410	Communication Engineering Lab	0	0	3	3	1.5
02	PCL(CS/IT)409	Algorithm Lab	0	0	3	3	1.5
03	PCL(CS/IT)410	Programming Lab using C++	0	0	3	3	1.5
04	CLA(CS)-3	Comprehensive Laboratory Assessment	0	0	0	0	1
MANDATORY COURSE							
01	MC(CS/IT)401	Environmental Sciences	2	0	0	2	0
TOTAL			**17**	**3**	**9**	**29**	**23.5**

Name of the course		Discrete Mathematics	
Course Code: BS(CS/IT) 408		Semester:4th	
Duration:6months		Maximum Marks:100	
Teaching Scheme		ExaminationScheme	
Theory:3 hrs./week		Two Mid Term Exams:30Marks	
Tutorial:1 hr./week		Assignments, Quizetc.:20Marks	
CreditPoints: 4		End Semester Exam:50Marks	
Objective:			
1.	To learn the concept of division algorithm and integer modulo n.		
3.	To understand counting techniques and combinatorics in the context of discrete probability.		
4.	To learn recurrence relations and generating functions.		
5.	To learn a given logic sentence and can check it's validity.		
5.	To understand Algebraic structures and classify Boolean function.		
6.	To understand basic concept of graph theory, Dual and planar graph.		
Pre-Requisites:			
1.	Mathematics –I (BS(CS/IT)101,Mathematics-III(BS(CS/IT)307)		
2.	EngineeringMathematics(UGlevel)		
Module	Content	LectureHours	
1	Module 1: Theory of Numbers: Principles of Mathematical Induction, Well Ordering Principle, Divisibility theory and properties of divisibility; Fundamental theorem of Arithmetic; Euclidean Algorithm for finding G.C.D and some basic properties of G.C.D with simple examples; Congruence, Residue classes of integer modulo n (Zn) and its examples, Chinese Remainder Theorem.	8	
2	Module 2: Counting Techniques: Pigeon- hole Principle, Principles of inclusion and exclusions; Recurrence relations: Formulation & Modelling of different counting problems in terms of recurrence relations, Solution of linear recurrence relations with constant coefficients (upto second order) by (i) The iterative method (ii) Characteristic roots method (iii) Generating functions method.	7	
3	Module 3: Propositional Logic: Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency. Disjunctive and Conjunctive normal form.	7	
4	Module 4: Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Permutation Groups, Normal Subgroups, Quotient group, Homomorphism & Isomorphism (Elementary properties only). Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields. Boolean algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function.	10	
5	Module 5: Graph Theory:	8	

	Planar and Dual Graphs. Kuratowski's graphs. Homeomorphic graphs. Eulers formula (n - e + r = 2) for connected planar graph and its generalisation for disconnected graphs. Detection of planarity. Graph colouring. Chromatic numbers of simple graphs. Chromatic Numbers and its bounds, Independence and Clique Numbers, Perfect Graphs-Definition and examples, Chromatic polynomial and its determination, Applications of Graph Colouring. Simple applications of chromatic numbers. Statement of four and five colour theorems.		

CourseOutcomes: Aftercompletionofthiscourse,thelearnerswillbeableto–	
CO1	determine multiplicative inverses, integer modulo n and solve linear congruences using Euclidean algorithm.
CO2	solve different engineering problems using counting techniques and recurrence relation.
CO3	express a given logic sentence in terms of predicates, quantifiers, and logical connectives and derive the solution for a given problem using deductive logic and prove the solution based on logical inference.
CO4	classify the algebraic structure for a given mathematical problem and evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
CO5	apply the basic concepts of graph theory and find chromatic polynomial of a graph.

Learning Resources:	
1	C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill.
2	N. Chandrasekaran and M. Umaparvathi, Discrete Mathematics, PHI
3	J.K. Sharma, Discrete Mathematics, Macmillan.
4	Malik,Mordeson,Sen, Fundamentals of abstract algebra, Tata McGraw-Hill
5	Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
6	Susanna S. Epp, Discrete Mathematics with Applications,4th edition, Wadsworth Publishing Co. Inc.
7	Douglas Brent West, Introduction to Graph Theory, Prentice Hall
8	Clark John, Holton Derek Allan, A First Look at Graph Theory, World Scientific

Name of the course:	Communication Engineering
Course Code: ES(CS/IT)409	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.:	Mid Semester-2 Exam: 15 Marks
Credit Point: 3	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To study Amplitude Modulation and Frequency Modulation techniques
2.	To study pulse modulation techniques and line codes.
3.	To study different shift keying techniques
4.	To study different aspects of satellite communication

Pre-Requisite:	
1.	

Module	Content	LectureHours	
1.	Introduction to Communication Engineering, need of Modulation, Amplitude Modulation(AM): Concept of AM, Calculation of Modulation Index, total transmitted power of AM, DSB-SC modulation & SSB-SC modulation techniques, calculation of Bandwidth and Savings of power, Demodulation of AM, Superheterodyne Receiver	12	
2.	Frequency Modulation(FM): Concept of FM, Direct & Indirect Method , Bandwidth calculation of FM, Demodulation of FM. Phase Modulation(PM) : Concept of PM, generation of PM from FM.	05	
3.	Pulse & Digital Communication: Sampling Theorem, aliasing effect, natural and flat top sampling, PAM, PWM,PPM, basic concept of Pulse Code Modulation (PCM) , concept of quantization and quantization error, Companding, DPCM, Delta Modulation and Adaptive Delta Modulation, signal to quantisation noise ratio in PCM system. ASK, FSK, PSK, QPSK	12	
4.	Data Formatting: NRZ-Unipolar, NRZ-polar, NRZ-Bipolar, RZ-Bipolar, Manchester Coding,Synchronous and Asynchronous Data Transmission, Concept of Satellite Communication	07	

Course Outcomes: After completion of this course the students will be able to -	
CO1	Explain the necessity of Modulation and how to transfer information from one place to another place using Amplitude Modulation, Frequency Modulation and Phase Modulation.
CO2	Apply the concept of sampling and quantization for analog to digital signal conversion.
CO3	Compare various techniques of digital communication techniques.
CO4	Compare different line coding techniques.
CO5	Compare Satellite Communication system with terrestrial communication system.

Learning Resources:	
1.	Modern Digital and Analog Communication Systems by B.P. Lathi, Published by Oxford University Press.
2.	An Introduction to Analog and Digital Communications by Simon Haykin (Wiley India)
3.	Principles of Communication Engineering by Taub H. & Shilling D.L.- TMH
4.	Introduction to Digital and Data Communication – Michael A. Miller, Jaico Publishing House
5.	Communication Systems by A. B. Carlson, Published by McGraw-Hil
6.	Principles of Analog and Digital Communication by Jerry D Gibson, Published by MacMillan.
7.	A Text Book of Analog and Digital Communication by A Kumar, Umesh Publication
8.	Communication Systems (Analog and Digital) by Sanjay Sharma, Published by S.K.Kataria& Sons
9.	Modern Electronic Communication, Principles and Practice- Sharma &Sinha, DhanpatRai Publishing Company (p) Ltd

Name of the course		Design and Analysis of Algorithm	
Course Code: PC(CS/IT)406		Semester: 4th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: NIL		Mid Term Exam II: 15 Marks	
Practical: NIL		Assignment.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	To understand different paradigms of algorithms such as greedy, dynamic programming, divide and conquer etc..		
2.	To calculate the time complexities of algorithms.		
3.	The ability to decide based on a given problem which design paradigm and algorithm is appropriate		
Pre-Requisite:			
1.	Data Structure and Algorithm (PC(CS/IT)302)		
Module	Content	Lecture Hours	
1	Models of computation & Algorithm design frameworks: Models of computation - RAM model, Deterministic and Non-deterministic problems, Tractable and Intractable problems, Solvability, Algorithm design frameworks - Divide/Decrease and Conquer, Backtracking, Greedy, Dynamic Programming, Decision and Optimization problems; Comparison - Divide & Conquer, Greedy and Dynamic Programming.	5	
2	Sorting: Comparison based sorts - Bubble sort, insertion sort, selection sort, quick sort, merge sort, analysis and comparison. Non-comparison based sorts - Radix sort, count sort; Median order statistics; Lower bound of sorting.	8	
3	Illustrations of various design framework : Dynamic Programming - Optimal substructure and overlapping sub problems; Matrix-chain multiplication; Backtracking - 8-queens problem; Greedy Method - Knapsack problem, Job sequencing with deadlines.	7	
4	Graph Algorithms: BFS and DFS- algorithm and comparison; Single source shortest path, All pair shortest paths; Prim's and Kruskal's algorithms for finding minimum spanning tree.	6	
5	String matching problem: Naive algorithm, Knuth-Morris-Pratt (KMP) algorithm.	3	
6	Amortized Analysis: Basic concept of amortized analysis, disjoint set data structure.	4	
7	P and NP :Notion of NP Class: P, NP, NP-hard, NP-complete; reduction (concept only); Cook's theorem (statement only)	3	
Course Outcomes: After completion of this course, the learners will be able to-			
CO1	Classify algorithms as on the basis of various design paradigms.		
CO2	Analyze a problem to determine which design paradigm to use to solve the problem.		
CO3	Clearly distinguish between problems employing divide and conquer, greedy and dynamic programming.		
CO4	Solve various graph problems efficiently.		
CO5	Identify whether a problem is in P or NP		
Learning Resources:			

1	T.H.Cormen, C.E. Leiserson, R.L.Rivest and C. Stein ,"Introduction to Algorithms", PHI.
2	Ellis Horowitz, Sartaz R. Sahani, "Fundamentals of Computer Algorithms". Computer Science Press.
3	A. Aho, J. Hopcroft and J. Ullman, "The Design and Analysis of algorithms", Pearson Education.
4	D.E. Knuth: The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, Addison-Wesley.
5	G.Brassard, P.Bratley, Fundamentals of Algorithmics -, PHI.
6	S.Baase, Allen VenGelder"Computer Algorithms-Introduction to Design & Analysis"- 3rd Edition, Pearson Education

Name of the course:		Formal Language and Automata Theory	
Course Code: PC(CS/IT)407		Semester: 4th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 2 hrs/week		Mid Semester-1 Exam: 15 Marks	
Tutorial Contact Hrs.: 2 hrs/week		Mid Semester-2 Exam: 15 Marks	
Credit Point: 4		Assignment, Quiz & class attendance: 20 Marks	
		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To understand the Chomsky hierarchy of languages.		
2.	To learn about regular expressions, finite automata, regular language.		
3.	To learn about context free and context sensitive grammars and its uses.		
4.	To learn about undecidability of languages and Turing machines.		
Pre-Requisite:			
1.			
Module	Content	LectureHours	
1	Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.	02	
2	Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA), epsilon-NFA and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages (proof not required), pumping lemma for regular languages, minimization of finite automata.	10	
3	Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (NPDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs(proof not required). Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.	12	

4	Turing machines: The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.	10	
5	Undecidability: Universal Turing machine, the universal and diagonalization languages, PCP, Rice s theorem.	02	

Course Outcomes: After completion of this course, the learners will be able to-	
CO1	identify the languages and its hierarchy, Alphabet, languages, regular grammars and derivations
CO2	design finite state machines, regular grammar and expressions for regular languages
CO3	design pushdown automata and context free grammar for context-free-languages
CO4	discuss the Turing machine and study of their variants and unrestricted grammars
CO5	decide whether a language is decidable or undecidable
Learning Resources:	
1.	Harry R. Lewis and Christos H. Papadimitriou, Elements of the Theory of Computation, Pearson Education Asia.
2.	Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.
3.	Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.
4.	John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill
5.	John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Name of the course	COMPUTER ARCHITECTURE
Course Code: PC(CS/IT) 408	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term I: 15 Marks
Tutorial: 1 hrs/week	Mid Term II: 15 Marks
Credit Points: 4	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, etc. : 20 Marks
	End Semester Exam: 50 Marks

Objectives:	
1.	To identify different processor architectures and their performance measurement parameters.
2.	To apply different techniques for improving the performance of processor.
3.	To develop the concept of multiprocessor architecture.
4.	To design pipeline processor architecture.
Pre-Requisites:	
1.	Digital Electronics [ES(CS/IT)307]

2.	Computer Organization [PC(CS/IT)301]		
Module	Content	Lecture Hours	
1	Pipelining Architecture: Introduction: Review of basic computer architecture (Revisited), Quantitative techniques in computer design, measuring and reporting performance. Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques.	10	30
2	Memory Module: Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses, cache mapping techniques; Virtual memory organization.	9	20
3	Instruction-level parallelism: Basic concepts, techniques for increasing ILP, RISC Architecture, superscalar, super pipelined and VLIW processor architectures. Array and vector processors.	9	20
4	Multiprocessor architecture: taxonomy of parallel architectures; Centralized shared-memory architecture: synchronization, memory consistency, interconnection networks. Distributed shared-memory architecture, Cluster computers. Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures	10	30
Course Outcomes: After completion of this course students will be able to-			
CO1	Explain the concept of pipeline architecture, different hazards and analyze different techniques for handling pipeline hazards		
CO2	Assess the hierarchical memory technology		
CO3	Design cache and virtual memory using different mapping techniques		
CO4	Explain multiprocessor architecture and taxonomy of parallel architecture		
CO5	Analyze the concepts of distributed shared-memory architecture, cluster computers		
CO6	Explain the design of Non von Neumann architectures: data flow computers, reduction computer architectures, systolic architectures.		
Learning Resources:			
1.	Advanced Computer Architecture-Kai Hwang &NareshJotwani, McGraw Hill		
2.	Computer Architecture and Parallel Processing -Kai Hwang and A. Briggs, McGraw Hill		
3.	Computer Architecture: a quantitative approach - J. L. Hennessy and D. A. Patterson,, Harcourt Asia, Singapore.		
4.	Computer Organization and Architecture - V. Rajaraman and T. Radhakrishnan PHI Learning Pvt. Ltd.		
5.	Computer Architecture and Parallel Processing - Hwang and Briggs, TMH.		
6.	Computer Architecture and Organization - Hayes, McGraw-Hill.		

Name of the course	Communication Engineering Lab.
Course Code: ESL(CS/IT)410	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme, Total Marks: 100
Theory: Nil	Attendance : 10
Tutorial: Nil	Preparation of Lab Report : 30
Practical: 3 hrs./week	Experimental data/ Precision of work done : 30

Credit Points: 1.5		Presentation/ analysis of the result : 10	
		Viva Voce: 20	
Module	Content	Hours	Marks
1.	Amplitude Modulation and Demodulation	03	
2.	Frequency modulation and Demodulation.	03	
3.	Generation and Detection of PAM	03	
4.	Generation and detection of PWM & PPM	06	
5.	Generation and detection of ASK	03	
6.	Generation and detection of FSK	03	
7.	Time Division Multiplexing &Demultiplexing	03	
Course Outcomes: After completion of this course the students will be able to -			
CO1	Compare the Amplitude modulated(AM) and Frequency modulated (FM) signals.		
CO2	Measure the modulation index of amplitude modulated and frequency modulated signals.		
CO3	Compare PAM, PWM and PPM signal.		
CO4	Compare ASK and FSK signals with AM and FM signals.		
CO5	Identify the multiplexed signals at the output of TDM system and the corresponding demultiplexed signals at the receiver end.		
Learning Resources:			
1	Octave online https://octave-online.net/the open-source alternative for simulation of the above experiments		

Name of the course:		Algorithm Lab	
Course Code: PCL(CS/IT)409		Semester: 4th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory:NIL		Attendance 10	
Tutorial:NIL		Preparation of Lab Report: 30	
Practical:3 hrs/week		Experimental data/Precision of work done: 30	
Credit Point:1.5		Presentation/ analysis of the result: 10	
		Viva Voce:20	
Objective:			
1.	To understand the working of Fundamental algorithms such as sorting.		
2.	To analyse the performance of algorithms based on the underlying data structures		
3.	To implement various graph algorithms		
4.	To decide which algorithms to employ based on nature of problem.		
Pre-Requisite:			
1.	NA		
Module	Content	Hours	Marks

1	Comparison of performance of various sorting algorithms.	03	
2	Implementation of median order statistics in O(n) time	03	
3	Performance comparison of problem solving using dynamic programming and recursion.	03	
4	Solving 8 queens problem using backtracking and brute force method with comparison of performance	03	
5	Solving of Knapsack and job sequencing using greedy approach	03	
6	Implementation of BFS and DFS both recursive and non-recursive version and their performance comparison	03	
7	Implementation of Prim's algorithm and performance comparison based on different data structures used	03	
8	Implementation of Dijsktra's algorithm and performance comparison based on different data structures used	03	
9	Implementation of Bellman Ford algorithm and all pair shortest path algorithm	03	
10	Implementation of KMP algorithm	03	
Course Outcomes: After completion of this course, the learners will be able to-			
CO1	Compare performance of various sorting algorithm.		
CO2	Decide which design paradigm to use for a particular problem		
CO3	Implement various graph algorithms		
CO4	Apply graph algorithms to real life problems		
CO5	Implement string matching algorithms.		
Learning Resources:			
1.	T.H. Cormen, C.E. Leiserson, R. Rivest and C. Stein: *Introduction to Algorithms*,(Second/Third Edition), PHI, 2009.		
2.	R. Sedgewick: *Algorithms in C*, Pearson, 2004.		
3.	Steven S Skiena, Algorithm design manual, 2nd Edition, Springer.		

Name of the course:	Programming Lab Using C++
Course Code: PCL(CS/IT)410	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: Nil	Attendance: 10 marks
Tutorial Contact Hrs.: Nil	Preparation of Lab Report: 30 marks
Practical: 3 hrs/week	Experimental data/ precision of work: 30 marks
Credit Point:1.5	Presentation / analysis of the result: 30 marks
	Viva voce: 20 marks
Objective:	
1.	To learn the syntax and semantics of the C++ programming language
2.	To learn how to write inline functions for efficiency and performance.
3.	To learn how to implement copy constructors and class member functions

4.	To learn how to design C++ classes for code reuse		
5.	To understand how C++ improves C with object-oriented features		
Pre-Requisite:			
1.	C programming lab		
2.	Data structure Lab		
Module	Content	Hours	Marks
1	IntroductiontothesourcecodewritingcompilationandexecutionprocessofC++programme.Writing C++Programmeusing I/Ostream, commandlinearguments.Basic loop control,functionswithCBVandCBR,identificationofvariableswithscoperesolutionoperator.	03	
2	Programmewritingon classes,creationofobjects,constructorsanddestructors,accessingmembers,arrayofobjects,accessingofstaticmembers.	03	
3	Programmewritingonfunctionoverloading,constructoroverloadinganddefaultconstructor,Objectpassingasfunctionargumentsandreturningof objectsfromfunctions.	03	
4	Programmewritingonfriendfunctions,localclasses.,dynamicinitializationofobjects.	03	
5	Programmewritingoncopy constructor,operatoroverloading-binaryandunaryoperators.operatoroverloadingusingfriendfunctions.	03	
6.	Programmewritingonderivedclasses,implementationofsingleinheritance,multilevelinheritance,hierarchicalinheritancewithconstructorcalling sequence.	06	
7.	Programmewritingonmultipleinheritances,constructorcallingin derivedclasses,virtualbase classes.	03	
8.	Programmewritingonabstractclasses,pointertoobjects,thispointer,pointerstoderivedclass.	06	
9.	Programmewritingonvirtualfunctionsandruntimepolymorphism.	03	
10.	ProgrammewritingonbasicClassandFunctiontemplates.	03	
Course Outcomes: After completion of this course the students will be able to -			
CO1	Define the concept of object oriented programming.		
CO2	Implement the concepts of loop, functions, array & pointers in C++.		
CO3	Analyze the concept of classes/objects, constructor and destructor.		
CO4	Apply the concept of inheritance in programming.		
CO5	Apply the concept of encapsulation in programming.		
CO6	Implement the concept of polymorphism in programming.		
Learning Resources:			
1.	The C++ Programming Language (4th edition) by BajarneStroustrup		
2.	C++ Primer 5th Edition		
3.	A Tour of C++ (C++ in –Depth Series) 1st Edition		
4.	The Design and Evolution of C++.		

Name of the course		ENVIRONMENTAL SCIENCES	
Course Code: MC(CS/IT)401		Semester: 4th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 2 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment.: 20 Marks	
Credit Points: Nil		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	To provide knowledge as to why the study of environment is of great importance		
2.	To learn about problems of various types of pollution (anthropogenic and natural), loss of forest, degradation of land, waste disposal, global warming, depletion of ozone layer and loss of biodiversity i.e. degradation of Mother Earth made by the humans.		
3	To know about "Sustainable development", i.e. meeting human goals along with sustaining the ability of natural systems to provide resources and services for mankind to survive.		
4	To get idea about disaster management to deal with environmental hazards in the events of natural and anthropogenic calamities.		
5	To learn various environmental protection Acts, Environmental Impact Assessment (EIA), which is mandatory for setting up new industries		
Pre-Requisite:			
1.	Class 12 standard knowledge of physics, chemistry, biology, mathematics		
Module	Content	Lecture Hours	
1	The Multidisciplinary nature of environmental studies :Definition, scope and importance, Need for public awareness.	2	
2	The Natural Resources a) Natural resources and associated problems Forestresources: Use and over-exploitation, deforestation, mining, dams and their effects on forests and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems. Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources. Food Resources: World food problems, changes caused by agriculture and over grazing, effects of modern agriculture, fertilizers- pesticides problems, water logging, salinity. Energy Resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land Resources: Land as a resource, land degradation, man induced landslides, soil erosion, and desertification. b) Role of individual in conservation of natural resources. c) Equitable use of resources for sustainable life styles	5	
3	Eco Systems a) Concept of an eco system: Understanding ecosystems, Ecosystem degradation, Resource utilisation	5	

	b) Structure and function of an eco system. c) Producers, consumers, decomposers. d) Energy flow in the eco systems: Water cycle, Carbon cycle, Oxygen cycle, Nitrogen cycle, Energy cycle, Integration of cycles in nature e) Ecological succession. f) Food chains, food webs and ecological pyramids. g) Introduction, types, characteristic features, structure and function of (1) Forest ecosystem (ii) Grass land ecosystem (iii) Desert ecosystem (iv) Aquatic eco systems (ponds, streams, lakes, rivers, oceans, estuaries)		
4	Biodiversity and its Conservation (a) Introduction, Definition: genetic diversity, species diversity and ecosystem diversity. (b) Biogeographically classification of India. (c) Value of biodiversity: consumptive, productive, social, ethical (d) Biodiversity at global, national and local level. (e) India as a mega diversity nation. (f) Hot-spots of biodiversity. (g) Threats to biodiversity: habitats loss, poaching of wild life, man wildlife conflicts. (h) Endangered and endemic species of India. (i) Conservation of biodiversity: in-situ and ex-situ conservation of biodiversity.	5	
5	Environmental Pollution (a) Definition, (b) Causes, effects and control measures of: (1) Air pollution, (2) water pollution, (3) Soil pollution, (4) Marine pollution, (5) Noise pollution, (6) Thermal pollution, (7) Nuclear hazards (c) Solid waste Management: Causes, effects and control measures of urban and industrial wastes. (d) Role of an individual in prevention of pollution. (e) Disaster management: Floods, earth quake, cyclone and landslides, industrial safety.	6	
6	Social issues and the Environment (a) Urban problems related to energy (b) Water conservation, rain water harvesting, water shed management (c) Resettlement and rehabilitation of people; its problems and concerns, (d) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust (e) Wasteland reclamation (f) Consumerism and waste products (g) Environment protection Act (h) Air (prevention and control of pollution) Act (i) Water (prevention and control of pollution) Act (j) Wildlife protection act (k) Forest conservation act (l) Issues involved in enforcement of environmental legislations(m) Public awareness	4	
Course outcomes: After completion of the course the learners will be able to-			
CO 1	apply the knowledge regarding how human beings should make a sustainable living using the Earth's finite resources.		
CO 2	use scientific methods judiciously in preventing causes which damage natural ecosystems.		

CO 3	use the knowledge in protecting endangered and endemic species and conserving biodiversity.
CO 4	use the knowledge in preventing/minimising various types of pollution, their causes and effects.
CO 5	apply their knowledge of disaster management in case of natural and anthropogenic calamities.
CO 6	apply their knowledge of various environment protection acts, "Environment Impact Assessment" (EIA) as and when required in setting up of new industries as well as expansion of industries in which they will be employed
Learning Resources:	
1.	AnubhaKaushik, C.P. Kaushik, Perspectives in environmental studies, New Age International (P) Ltd, Publishers
2.	ErachBharucha, Textbook for Environmental Studies, University Grants Commission
3.	D. D. Mishra, Fundamental concepts in Environmental Studies, S Chand & Co Ltd
4.	Anil Kumar De, Arnab Kumar De, Environment and Ecololgy, New age international (P) Limited, Publishers
5.	Environmental Chemistry by Anil Kumar De, Wiley Eastern Limited
6.	Linda D. Williams, Environmental Science demystified, McGRAW-HILL
7.	ShashiChawla, A Textbook of Environmental Studies, Tata McGraw Hill Education Private Limited.

THEORY							
5th SEM							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	PC(CS/IT)511	Operating Systems	3	1	0	4	4
02	PC(CS/IT)512	Database Management System	3	1	0	4	4
03	PC(CS/IT)513	Object OrientedProgramming	3	1	0	4	4
04	PEC(CS)501	Elective-I A: Advanced Algorithms B: Soft Computing C: Embedded Systems	3	0	0	3	3
05	MC(CS/IT)502	Constitution of India/ Essence of Indian Traditional Knowledge	2	0	0	2	0 (non-credit according to AICTE)
PRACTICAL							
01	PCL(CS/IT)514	Operating System Lab	0	0	3	3	1.5
02	PCL(CS/IT)515	Database Management System Lab	0	0	3	3	1.5
03	PCL(CS/IT)516	Programming Lab using Java	0	0	3	3	1.5
		SESSIONAL					
01	CLA(CS)-5	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	14	3	9	26	20.5

Name of the course		OPERATING SYSTEMS	
Course Code: PC(CS/IT)511		Semester: 5th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Term I Exam:	15 Marks
Tutorial: 1 hr/week		Mid Term II Exam:	15 Marks
Credit Points: 4		Class performance & Attendance:	20 Marks
		End Semester Exam & Viva:	50 Marks
Objective:			
1.	To understand and analyze operating system structures and services.		
2.	To understand and determine process management in Operating System.		
3.	To understand and determine memory management and file management in Operating System.		
4.	To analyze and assess disk management, I/O management and protection & security in Operating System.		
Pre-Requisite			
1.	Data Structures & Algorithms -PC(CS/IT)302		

2.	Computer Architecture – PC(CS/IT)408		
Module	Content	Hrs.	Marks
1	Introduction of O.S: Concept of OS. Operating system services, dual-mode operation, Evaluation of O.S, Different types of O.S: batch, multi-programmed, timesharing, real-time, distributed, network. Introduction of Process: Concept of process, Process life cycle, Resource utilization, Operations on processes, IPC.	4	
2	System Structure: Computer system operation, Operating system structure, kernel: microkernel, monolithic kernel, system calls. Threads: Overview, Benefits of threads, User and kernel threads, multithreading models.	4	
3	CPU Scheduling: Scheduling criteria, Preemptive& non-preemptive scheduling, Scheduling algorithms (FCFS, SJF/SRTF, RR, Priority), MLQ scheduling, Multi-processor scheduling. Process Synchronization: Race condition, Critical Section problem, Semaphore, Mutex, Monitor. Deadlocks: Deadlock criteria, Methods for handling deadlocks, Resource allocation graph, Banker's algorithm, Recovery from deadlock.	10	
4	Memory Management: Background, Logical vs. physical address, Address binding, Swapping, Contiguous memory allocation, Fragmentation, Segmentation, Paging. Virtual Memory: Concept, Demand paging, Page replacement, Page replacement algorithms (FCFS, LRU, Optimal). File Systems: File attributes, File system structure, File access methods, File allocation methods (contiguous, linked, indexed).	8	
5	Disk Management: Disk structure, Disk formatting, Boot block, Bad blocks, Disk scheduling algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK).	3	
6	I/O Management: I/O hardware, Polling, Interrupts, DMA, Application I/O interface, Kernel I/O subsystem, Spooling and device reservation. Protection & Security: Goals of protection, Security problem, Authentication, Program threats, System threats	7	

Course Outcomes: After completion of the course students will able to -	
CO1	Analyze different types of operating system.
CO2	Select different types of kernel in operating system.
CO3	Apply different mechanism to handle process management.
CO4	Determine different memory management, file management mechanism to provide better performance to users.
CO5	Evaluate different disk management policies.
CO6	Implement different techniques for protection and security.

Learning Resources:	
1	Operating System concepts- A. Silberschatz, Greg Gagne, and Peter Baer Galvin- Wiley India
2	Operating Systems: Internals and Design Principles-William Stallings-Pearson
3	Operating Systems Concepts & design - Milan Milenkovic, TMH
4	Tanenbaum A.S. and Woodhull "Operating System Design & Implementation", Pearson
5	Advanced Concepts in operating Systems - MukeshSinghal and Niranjan G. Shivaratri, TMH
6	Operating System. - Dhamdhere: - TMH
7	An Introduction to Operating Systems- Dietel H. N- Addison Wesley.

Name of the course	Database Management System
Course Code: PEC(CS/IT)512	Semester: 5th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term I: 15 Marks
Credit Points: 3	Mid Term II: 15 Marks
	Assignments, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc.: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:

1.	Understand the basic concepts and the applications of database systems.
2.	To learn the fundamentals of data models and to represent a database system using ER diagrams.
3.	To study SQL and relational database design.
4.	To understand the fundamental concepts of transaction processing, concurrency control techniques and recovery procedures.
5.	To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.

Pre-Requisite:

1.	Data structure & Algorithms PC(CS/IT)302
2.	Discrete Mathematics BS(CS/IT)408

Module	Content	Hrs.	Marks
1	Introduction: Concept of File system & Database system & their differences, Data abstraction & Data independence in DBMS, Instances & Schemas, Data models, Database languages (Data definition & Data manipulation languages).	2	
2	Entity Relationship Model: Basic concepts, Types of attributes, Relationship sets, Mapping cardinalities & Participation constraints, Types of Keys., Entity-Relationship diagram (E-R diagram), Strong & Weak entity sets, Specialization & Generalization & Aggregation in ER model.	3	
3	Relational Model and SQL: Fundamental operations in Relational Algebra, Extended Relational Algebra operations, Concept of View, Relational Calculus, Characteristic of SQL, Types of SQL commands (DDL, DML, DCL, TCL), SQL operators & their procedures, Queries, Sub-queries & nested queries, Aggregate Functions, Operations on Modification of databases (Insertion, Updation, Deletion).	8	
4	Integrity Constraints and Normalization: Concept of Foreign Key, Definition of integrity constraints, Types of integrity constraints (Domain Constraints, Entity Integrity Constraint, Referential Integrity Constraints, Key Constraints), Functional Dependency, Closure of functional dependency, Armstrong's Axioms, Canonical Cover, Lossless join decomposition & Dependency preservation, Full & Partial & Transitive dependency, Prime & Non-prime attribute, Need of Normalization, 1NF, 2NF, 3NF, BCNF.	7	
5	Transaction Management: Overview of Database transaction concepts, ACID properties, Transaction state,	13	

	Concurrent executions, Conflicts in Transaction, Serializability, Conflict & View Serializability, Test for serializability (Precedence Graph), Recoverability, Recoverable, Cascade less & Strict schedules, Shared lock & Exclusive lock, Two phase locking protocol, Deadlock handling, Deadlock prevention, Deadlock detection, Deadlock recovery, Causes of transaction failure, Storage structure, Log-based recovery, Write Ahead Logging (WAL) protocol, Checkpoints, Shadow paging.		
6	Storage: Single level & Multi level indexing, Structure of B & B^+ tree, File organization in B^+ tree, Hashing techniques.	3	

Course Outcomes: After completing the course, the student will be able to-	
CO1	Explain the concept of Database system.
CO2	Design ER-models to represent simple database application scenarios.
CO3	Implement Relational algebra and SQL queries on database.
CO4	Apply integrity constraints and normalization to improve database design.
CO5	Solve concurrency problems in database transactions.
CO6	Explain basic database storage structures and access techniques.
Learning Resources:	
1.	Henry F. Korth and Silberschatz Abraham, "Database System Concepts", McGraw Hill, ISBN: 9780072283631
2.	ElmasriRamez and NavatheShamkant, "Fundamentals of Database Systems", Pearson Education India, ISBN: 9788131716250
3.	Ramakrishnan and Gehrke, "Database Management Systems", McGraw-Hill, ISBN: 9780071231510
4.	Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle",4th edition, BPB Publications ISBN: 9788176569644
5.	C.J. Date, "An Introduction to Database Systems" ,7th edition, Pearson,ISBN:9780321197849

Name of the course	Object Oriented Programming
Course Code: PC(CS/IT)513	Semester: 5st
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3	Mid Semester Exams: 30 Marks
Tutorial: 1	Assignment, Quiz etc.: 20 Marks
Credit Points: 4	End Semester Exam: 75 Marks (to be mapped into 50 marks)
Objective:	
1.	To construct models for object-oriented software development
2.	To inspect different run time exception cases in a java programme
3.	To comprehend and write java programmes with abstraction, code reusability and data security features
4.	To plan concurrent processing scenarios with java multithread programming.
Pre-Requisite:	
1.	Programming for problem solving(ES(CS/IT)204)

Module	Content	Hrs.	Marks
1	Introduction to Object Oriented Programming Concepts Object Oriented Programming language concepts & features, Comparison between Object Oriented Programming language and conventional programming languages, Object Oriented Modelling concepts.	2	
2	Introductory Concept of Java Programming Advantages of Java, Data types & variables, Loops, Arrays, Operators, Control statements, constants, methods, Compile time Polymorphism: Method Overloading, Keyboard input operations. Classes & Objects-Defining Classes and Creation of objects, Access specifiers, Instance variables and Static variables, Constructors, Constructor overloading, Static blocks, Array of objects, Use of this keyword, Passing objects as parameter to a method & returning objects from a method, Nested classes & Inner classes concept of string object with length(), equals() and charAt() method of string object, Command Line Arguments, garbage collection.	10	
3	Inheritance and Polymorphism in Java Concept of Inheritance, Super classes & Subclasses, Object Modelling in Java: Generalization and Specialization, Constructor calling mechanism in inheritance, Use of super keyword, Runtime Polymorphism: Method Overriding. Use of static keyword in java. Abstract classes & Interfaces-Concept of Abstract classes & Interfaces and their properties, use of final keyword, Dynamic binding in abstract classes and interfaces, Inheritance of interfaces, Nested Abstract classes & Nested Interfaces. Packages in Java- Creation of packages, Importing packages, Member access rules in the aspect of packages.	10	
4	Exception handling in Java Basic concept of exception handling in Java, Different types of exception classes, Concept of try and catch block, Concept of nested try block and multiple catch blocks, throw and throws clause, Concept of finally block, Creation of user defined exception classes.	5	
5	Multithreading in Java Basic concept of multithreading, Concept of main thread and child thread, Thread life cycle, Creation of multiple threads, Thread priorities, Thread synchronization, Inter thread communication, Deadlocks, Suspending & Resuming threads.	6	
6	Applet Programming in Java Basics of applet programming, Applet life cycle, Differences between application & applet programming, Parameter passing through applets, I/O operations in applets.	3	

Learning Resources:	
1	Core Java Volume I — Fundamentals (9th Edition) by Cay S Horstmann and Gary Cornell
2	Rambaugh, James Michael, Blaha, Object Oriented Modelling and Design, Prentice Hall, India
3	Java: A Beginner's Guide by Herbert Schildt, Oracle Press.
4	Head First Java by Kathy Sierra and Bert Bates
5	Deitel and Deitel- "Java How to Program", Pearson Education.

Course Outcomes: After completion of this course the students will be able to -	
CO1	Identify Object oriented programming features associated with object oriented modelling concepts related to object-oriented software development.
CO2	Apply various abstraction and code reusability features of java for more efficient and secure coding along with dynamic resolving of polymorphic behaviours of the entity in combination with java modular programming
CO3	Implementinheritance,run time polymorphism and abstraction features of java in combination with java

	modular programming
CO4	Examine different run time or compile time exceptional cases that may occur in a java program.
CO5	Organize different parallel processing scenarios with java multithread programming and make use of them in web applications through java applet programming

Name of the course:		Advanced Algorithms	
Course Code: PEC(CS) 501 A		Semester: 5th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 3 hrs/week		Mid Semester-1 Exam: 15 Marks	
Tutorial Contact Hrs.: 0 hrs./week		Mid Semester-2 Exam: 15 Marks	
Credit Point: 3		Assignment, Quiz & class attendance: 20 Marks	
		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To understand the concept of randomized algorithms		
2.	To implement number theory algorithms		
3.	To able to use computational geormetry in real life practical problems.		
4.	To understand the concept of approximate algorithms		
Pre-Requisite:			
1.	Algorithm (PC(CS/IT)406		
Module	Content	Hrs.	Marks
1	Probabilistic Analysis and Randomized algorithms The hiring Problem, Indicator random variables, Randomized algorithms.	06	
2	Polynomials and FFT Representing Polynomials, DFT and FFT, Efficient FFT implementation.	06	
3	Number Theoretic Algorithms Modular arithmetic, Solving Modular Linear Equations, The Chinese Remainder Theorem, primality Testing, Integer Factorization.	10	
4	Computational Geometry Line Segment properties, determining whether any pair of segments intersect, Convex hull, Finding the closest pair of points.	06	
5	Approximate Algorithms Performance ratios for approximation algorithms, The vertex cover problem, The Travelling Salesman Problem, The set covering Problem, Randomization and linear programming.	08	
Course Outcomes: After completion of the course students will able to -			
CO1	Analyze Randomized algorithms for a given problem.		
CO2	Efficiently implement FFT, primality testing and integer Factorization.		
CO3	Solve Modular Arithmetic Problems.		
CO4	Apply computational geometry algorithms to real life problems		
CO5	Design approximate algorithms for problems.		
Learning Resources:			

1.	"Introduction to Algorithms, 3rd edition", T.H.Cormen, C.E. Leiserson, R.L.Rivest and C. Stein , PHI
2.	Randomized •algorithms, Rajeev Motwani, PrabhakarRaghavan, Cambridge University Press
3.	Computational Geometry Algorithms and Applications, Third Edition, Mark de Berg , Otfried Cheong
4.	Approximation Algorithms, Vazirani, Vijay V, 2003, Springer.

Name of the course:		Soft Computing	
Course Code: PEC(CS) 501 B		Semester: 5th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 3 hrs/week		Mid Semester-1 Exam: 15 Marks	
Tutorial Contact Hrs.: 0 hrs./week		Mid Semester-2 Exam: 15 Marks	
Credit Point: 3		Assignment, Quiz & class attendance: 20 Marks	
		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To understand basic soft computing techniques		
2.	To learn how to use soft computing technique for a particular problem		
3.	To implement hybrid soft computing techniques		
Pre-Requisite:			
1.	Discrete Mathematics BS(CS/IT)408		
2.	Design and Analysis of Algorithm PC(CS/IT)406		
Module	Content	Hrs.	Marks
1	Introduction to Soft Computing: Concept of computing systems, "Soft" computing versus "Hard" computing, Characteristics of Soft computing, some applications of Soft computing techniques.	02	
2	Artificial Neural Network: Introduction to Artificial Neural Networks, Perceptron, Neural Networks Learning Rules, Activation Functions, Derivation of generalized delta learning rule (back propagation) for Multilayer perceptron. Kohonen Self- Organizing Feature Maps.	12	
3	Fuzzy Logic: Fuzzy Sets, Basic Definitions and Terminology, membership function Set-theoretic operation. Fuzzy union, intersection and complement, various T-norm and T-conorm operators, Fuzzy Relations. Fuzzy Logic, Approximate Reasoning, Compositional Rule of Inference.	5	
4	Evolutionary Algorithms: Genetic Algorithms: Simple GA, Encoding Techniques, Crossover, mutation, inversion and deletion, genetic algorithms in search and optimization. Ant Colony Optimization(ACO). Particle Swarm Optimization(PSO).	10	
5	Hybrid Systems: Hybrid Systems, GA based Fuzzy Systems and Neural Networks Training, Any other applications of soft computing.	07	

Course Outcomes: After completion of the course students will able to -	
CO1	Understand the concept of soft and hard computing
CO2	Compare the relation between real brains and simple artificial neural network models
CO3	Explain fuzzy sets and represent these sets by membership functions
CO4	Analyze Evolutionary Algorithms for single and multiple objective optimization problem
CO5	Design GA based Fuzzy Systems and other hybrid approaches of soft computing techniques for problem solving
Learning Resources:	
1.	S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI
2.	"Neuro-Fuzzy and Soft computing", Jang, Sun, Mizutani, PHI
3.	Neural Networks: A Classroom Approach,1/e by Kumar Satish, TMH
4.	Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg, Pearson/PHI
5.	"Fuzzy logic with engineering applications", Timothy J. Ross, John Wiley and Sons.
6.	"Fuzzy Sets and Fuzzy Logic:Theory and Applications", George J. Klir and Bo Yuan,Prentice Hall
7.	"Neural Networks: A Comprehensive Foundation (2nd Edition)", Simon Haykin, Prentice Hall.
8.	"A beginners approach to Soft Computing", Samir Roy &UditChakraborty, Pearson

Name of the course:	Embedded Systems
Course Code: PEC(CS) 501 C	Semester: 5th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 0 hrs./week	Mid Semester-2 Exam: 15 Marks
Credit Point: 3	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To understand embedded system technologies
2.	To use embedded systems in real life problems
Pre-Requisite:	
1.	Computer Organization PC(CS/IT)301
2.	Computer Architecture PC(CS/IT) 408

Module	Content	Hrs.	Marks
1	Introduction Introduction to Embedded System, features of Embedded System, application of Embedded System.	03	

	Module4:Arduino UNO R3[12L] Overview and features of Arduino UNO R3.Mapping of AVR ATMega8 pins and Arduino UNO R3 pins.Analog pins, Digital Pins and Power Supply of Arduino UNO R3.Programming of Arduino UNO R3.Interfacing of sensors with Arduino UNO R3.Usage of the common instructions pinMode(), analogRead(), analogWrite(), digitalRead(), digitalWrite(), Serial.begin(), Serial.print() , delay(), etc.		
2	8051 Microcontroller Overview of 8051 family and various versions of 8051 Microcontroller. Block Diagram of 8051 Microcontroller, Memory Organization: bit addressable register, byte addressable register, general purpose register and special function register (SFR). Assembly Language Programming for Arithmetic and Logic operations, Assembly Language Programming using the instructions JUMP, LOOP, CALL etc. Description of Timers and Ports of 8051 Microcontroller.	10	
3	AVRAtmega8 Introduction to AVR Microcontroller.Description of AVR ATmega8 Microcontroller.Assembly Language Programming for Arithmetic and Logic operations using AVR ATmega8 Microcontroller.Assembly Language Programming for Input-Output Port for AVR ATmega8 Microcontroller.Interfacing of sensors with AVR ATmega8 Microcontroller.Data uploading toAVR ATMega8 Microcontroller.	11	
4	Arduino UNO R3 Overview and features of Arduino UNO R3.Mapping of AVR ATMega8 pins and Arduino UNO R3 pins.Analog pins, Digital Pins and Power Supply of Arduino UNO R3.Programming of Arduino UNO R3.Interfacing of sensors with Arduino UNO R3.Usage of the common instructions pinMode(), analogRead(), analogWrite(), digitalRead(), digitalWrite(), Serial.begin(), Serial.print() , delay(), etc.	12	

Course Outcomes: After completion of the course students will able to -	
CO1	Identify the features of Embedded System and their necessity.
CO2	Gather knowledge on Assembly Language Programming of Microcontroller.
CO3	Program AVR Microcontroller using low level as well as high level language.
CO4	Design of various experiments, analysis and interpretation of results on Arduino Platform.

Learning Resources:	
1.	The 8051 Microcontroller and Embedded Systems Using Assembly and C by M.A. Mazidi, J. G. Mazidi an R. D. McKinlay, published by Pearson.
2.	The 8051 Microcontroller by Kenneth J. Ayala, published by Cenage Learning.
3.	AVR Microcontroller and Embedded Systems: Using Assembly and C by M. A. Mazidi , published by Pearson.
4.	Make: Getting Started with Arduino by Massimo Banzi and Michael Shiloh (Available at Amazon).
5.	Make: AVR Programming by Elliot Williams, SHROFF PUBLISHERS &DISTRIBUTERS PVT.LTD.
6.	Internet of Things with Arduino-Cookbook by Marco Schwartz published by Packt[www.packtpub.cpm].
7.	Getting Started with Arduino [www.it-ebooks.info]
8.	Arduino Software [www.arduino.cc]
9.	AVR Microcontroller Book[www.finebook.ir]
10.	AVR Studio Software [www.microchip.com]

Name of the course:		Constitution of Indian	
Course Code: MC(CS/IT)502		Semester: 5th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 1 hrs/week		Mid Semester-1 Exam: 15 Marks	
Tutorial Contact Hrs.: 1 hrs./week		Mid Semester-2 Exam: 15 Marks	
Credit Point:		Assignment, Quiz & class attendance: 20 Marks	
		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To understand the structure of the Indian Constitution.		
2.	To learn about the Nature-Specialty and Proposal Of Indian Constitution.		
3.	To Describe the Centre- State relationship and the role of government administration.		
4.	To gain knowledge about the Indian Jurisdiction and conceptualization of social reforms that lead to revolution in India.		
Pre-Requisite:			
1.	Constitution of India(MC(CS/IT)502[PC (CS/IT)-513])		
Module	Content	Hrs.	Marks
1	Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble.	05	
2	Fundamental Rights & Duties: Fundamental Rights, Right On: Equality, Freedom, Against Exploitation, Freedom of Religion, Cultural and Educational Rights, Constitutional Remedies. Directive Principles of State Policy. Fundamental Duties.	05	
3	Structure of the Indian Union and its administration: Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministerrs, Cabinet and Central Secretariat, LokSabha, RajyaSabha. State government and its administration: Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions.	08	
4	Jurisdiction: Supreme court: Organization of supreme court, procedure, jurisdiction and power of the supreme court. High court: Organization of high court, procedure, jurisdiction and power of high court. Subordinate courts: constitutional provision, structure and jurisdiction. National legal services authority, gram nyayalays. Public interest litigation (PIL): meaning of PIL, features ,scope , principle , guidelines for admitting PIL.	06	
5	Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	05	
Course Outcomes: After completion of the course students will able to -			
CO1	explain about different features of Indian constitution.		
CO2	identify the power and functioning of Union, state and local self-government.		

CO3	explain about jurisdiction and function of Indian Judiciary.
CO4	applying the authority to redress a problem in the profession and in the society.
CO5	using the basics of PIL and guideline for admission of PIL along with the functioning of local administration starting from block to municipal Corporation.
CO6	demonstrate the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
Learning Resources:	
1.	Indian polity, M, Laxmikanth, MC Graw Hill education, 5th Edition.
2.	Indian Constitution,M P Jain,8th Edition.
3.	Indian Constitution and Administration,LatikaShekhar.
4.	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5.	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015. municipal Corporation.

Name of the course	Operating System Lab
Course Code:	Semester: 5th
Duration: 6 months	Maximum marks:100
Teaching Scheme	Examination scheme:
Theory: Nil	Attendance: 10 marks
Tutorial: Nil	Preparation of Lab Report: 30 marks
Practical: 3 hrs/week	Experimental data/ Precision of work done: 30 marks
Credit Points:1.5	Presentation / analysis of the result: 30 marks
	Viva voce: 20 marks

Module	Content
1.	Familiarization of Linux Commands.
2.	Shell in UNIX. Different types of Shell in UNIX. Creating a bash shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, commands).
3.	Implementation of CPU scheduling algorithms.
4.	Implementation of classical problems in process synchronization.
5.	Implementation of deadlock handling techniques.
6.	Implementation of memory management techniques.
7.	Operations on Processes, signals, Pipes and system calls.

Course Outcomes: After completion of the course students will able to -	
CO1	Review commands in UNIX.
CO2	Write programs using shell scripts.
CO3	Implement different process management mechanisms.
CO4	Implement different memory management techniques.
CO5	Evaluate different system management mechanisms.

Learning Resources:	
1	Linux Command Line and Shell Scripting Bible- Christine Bresnahan and Richard BLUM- Wiley India
2	Linux Administration: The Linux Operating System and Command Line Guide- Jason Cannon- CreateSpace Independent Publishing Platform
3	Mastering Linux Administration- AlexandruCalcatinge, Julian Balog-- Packt

Name of the course	DATABASE MANAGEMENT SYSTEM LAB
Course Code: PCL(CS/IT)515	Semester: 5th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme, Total Marks: 100
Theory: Nil	Attendance : 10
Tutorial: Nil	Preparation of Lab Report : 30
Practical: 3 hrs./week	Experimental data/ Precision of work done : 30
Credit Points: 1.5	Presentation/ analysis of the result : 10
	Viva Voce: 20

Objective:	
1.	Describe the basics of SQL
2.	Construct queries using SQL
3.	Demonstrate the use of constraints
4.	Implement PL/SQL Concepts and Constructs

Pre-Requisite	
1.	Programming for Problem Solving Laboratory ESL(CS/IT)205
2.	Discrete Mathematics BS(CS/IT)408

Module	Content	Hrs.	Marks
1.	Structured Query Language: Creating a Database, Creating a Table, Specifying Relational Data Types, Specifying Constraints, Creating Indexes	03	
2.	Table and Record Handling: INSERT statement, INSERT INTO SELECT statement, DELETE, UPDATE, TRUNCATE statements, DROP, ALTER statements	06	
3.	Retrieving Data from a Database: The SELECT statement, Using the WHERE clause, Using Logical Operators in the WHERE clause, Using IN, BETWEEN, LIKE, ORDER BY, GROUP BY and HAVING Clause, Using Aggregate Functions, Combining Tables using JOINS, Sub queries	09	
4.	Database Management: Creating Views, Creating Column Aliases, Creating Database Users, Using GRANT and REVOKE	06	
5.	PL/SQL Concepts and Constructs: Introduction Of PL/SQL, Structure of basic PL/SQL Structure, Conditional statements, Basic loops, Cursors in Oracle PL/SQL	06	

Course Outcome: After completion of this course the students will be able to -	
CO1	Construct Databases and Tables
CO2	Manipulate Tables and Records
CO3	Compose queries to retrieve data from a Database

CO4	Facilitate the management of a Database
CO5	Implement conditional statements, basic loops and cursors in PL/SQL
Learning Resources:	
1	Ivan Bayross, SQL, PL/SQL the Programming Language of Oracle, BPB Publications, ISBN: 9788176569644
2	Abraham Silberschatz, Henry F. Korth, S. Sudarshan, Database System Concepts, McGraw-Hill, ISBN: 9789332901384

Name of the course		Programming Lab Using Java	
Course Code: PCL(CS/IT)516		Semester: 5st	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Assignments and Quiz: 100 Marks	
Credit Points: 1.5			
Objective:			
1.	To construct models for object-oriented software development		
2.	To handle different run time exception cases in a java programme		
3.	To write java programmes with abstraction, code reusability and data security features		
4.	To plan concurrent processing scenarios with java multithread programming.		
Pre-Requisite:			
1.			
Module	Content	Hrs.	Marks
1	Programming with java classes involving data members having various access protection, class methods, constructors, overloading features, this and final keyword, static block, static variables and methods.		
2	Use of array of objects, passing of object in method and returning of object form method, use of string handling functions– length (), equals (), charAt(), keyboard input operations, command line arguments.		
3	Program implementation for nested/inner classes, name conflict resolving for inner and outer classes.		
4	Program implementation for abstract class, interface, inheriting multiple interfaces in a single class, extending multiple interfaces within a single interface, combined inheritance of both abstract class and interface. Use of dynamic method dispatch for abstract class and interface implementation.		
5	Implementation of nested abstract class and interface combinations. Resolving name conflict scenarios for the combined inheritance of abstract class and interface.		
6	Designing program modules with creation and accessing of packages.		
7	Handling exception with try, catch and finally. Adoption of throw, throws and user defined exception.		
8	Program writing for creation of multiple threads, thread synchronization, inter thread communication.		
9	Applet program execution with I/O operation, use of repaint () method.		
Course Outcomes:			

After completion of this course the students will be able to -	
CO1	Implementjava programs with data protection, method overloading, object independent class member accessing features and string handling operations.
CO2	Demonstratenested structuring of java classes and their name conflict resolving issues
CO3	Implementinheritance,run time polymorphism and abstraction features of java in combination with java modular programming
CO4	Solve different run time and user inducted exception cases in the java program
CO5	Organize parallel processing scenarios with java multithread programming and incorporate them in web applications through java applet programming
Learning Resources:	
1	Core Java Volume I — Fundamentals (9th Edition) by Cay S Horstmann and Gary Cornell
2	Harvey Deitel and Paul Deitel, Java How to Program, Early Objects, Global Edition, Pearson Education, ISBN-13: 9781292223902
3	Java: A Beginner's Guide by Herbert Schildt, Oracle Press.
4	Head First Java by Kathy Sierra and Bert Bates
5	Deitel and Deitel- "Java How to Program", Pearson Education.

6th SEM							
THEORY							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	PC(CS/IT)617	Computer Network	3	1	0	4	4
02	PC(CS)618	Compiler Design	3	0	0	3	3
03	PEC(CS)602	Elective-II A. Real Time System B. Information and Coding Theory C. Software Engineering D. AI in Bioinformatics E. Digital Signal Processing F. Cyber Security	3	0	0	3	3
04.	PEC(CS)603	Elective-III A. Machine Learning B. Operation Research C. Cryptography D. Advance Architecture E. Cloud Computing F. Ad-Hoc Sensor Network	3	0	0	3	3
05	HS(CS/IT)604	Industrial Management	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PCL(CS/IT)619	Computer Network lab	0	0	3	3	1.5
02	PROJ(CS)601	Project 1	0	0	6	6	3
03	CLA(CS)-6	Comprehensive Laboratory Assessment	0	0	0	0	1
		TOTAL	15	1	9	25	21.5

Name of the course:	Computer Network
Course Code: PC(CS/IT) 617	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 1 hrs./week	Mid Semester-2 Exam: 15 Marks
Credit Point: 4	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:			
1.	To study the concept of computer network and protocol suite		
2.	To study Physical and data link layer and related hardware and protocol		
3.	To study network layer, routing protocols, IP addressing		
4.	To study transport layer, TCP and socket		
5.	To study Application layer and network security		
Pre-Requisite			
1.	Communication engineering (ES(CS/IT)409)		
Module	Content	Hrs	Marks
1.	Introduction: Overview of Data Communication and Networking; Layered Network Architecture; Mode of communication, topology, Data and Signal; Transmission Media: Guided, Unguided, categories of network (LAN, MAN, WAN); Internet: brief history, Protocols and standards; Reference models: OSI reference model, TCP/IP reference model, their comparative study.	04	
2.	Physical Layer: Transmission Media: Guided, Unguided; switching: time division & space division switch, TDM bus, Banyan switch; MODEM, Repeater and hub, Multiplexing: TDM, FDM, SDM, WDM.	04	
3.	Data link Layer: Medium Access sub layer: MAC address and LLC; Error Control: Types of errors, framing (character and bit stuffing), error detection & correction; Flow control: Protocols: Stop & wait ARQ, Go-Back- N ARQ, Selective repeat ARQ, HDLC; Point to Point Protocol, LCP, NCP, Token Ring; Access mechanism: Reservation, Polling, Random access: Pure ALOHA, Slotted ALOHA, CSMA, CSMA/CD, CSMA/CA, TDMA, FDMA, CDMA, Traditional Ethernet, fast Ethernet.	08	
4.	Network layer: Internetworking & devices: Bridges, Switches, Router, Gateway; Addressing: IP addressing (IPV4, IPv6), masking, Classful and Classless Addressing, Subnetting, NAT; Routing : Intra and Inter	10	

	Domain Routing, Unicast, Multicast Broadcast routing. static vs. dynamic routing, Unicast Routing Protocols: RIP, OSPF, BGP; Other Protocols: ARP and RARP, IP, ICMP, IPV6; Mapping between IP and MAC address: ARP & RARP Switching Communication Networks: Circuit switching; Packet switching; Routing in packet switched networks; X.25; Frame Relay; ATM, SONET.		
5.	Transport layer : Process to Process delivery; UDP; TCP, Features, Segment, Three-Way Handshaking, socket and port addressing, Flow Control, Error Control, Congestion Control: Open Loop, Closed Loop, choke packets; Quality of service: techniques to improve QoS: Leaky bucket algorithm, Token bucket algorithm.	08	
6.	Application Layer : Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW	05	
7.	Security: Attacks, Cryptography, Firewalls, IDS & IPS, Malware, IP and transport layer security, DMZ.	03	
8.	Modern topics: ISDN services & ATM, DSL technology, Wireless LAN, Bluetooth, VPN.	02	
Course Outcome: After completion of this course the students will be able to -			
CO1	investigate two protocol suits and different topologies, transmission media of computer network		
CO2	investigate different random and controlled access mechanism , flow and error control		
CO3	assess different routing models for computer network and IP addressing		
CO4	assess quality of services (Qos) in Transport layer		
CO5	investigate different security protocols and encryption mechanism		
CO6	design of real life problems and solution for IP addressing and DMZ		
Learning Resources:			
1.	B. A. Forouzan – "Data Communications and Networking (3rd Ed.) " – TMH		
2.	A. S. Tanenbaum – "Computer Networks (4th Ed.)" – Pearson Education/PHI		
3.	W. Stallings – "Data and Computer Communications (5th Ed.)" – PHI/ Pearson Education		
4.	Black, Data & Computer Communication, PHI		
5.	Kurose and Rose – "Computer networking -A top down approach featuring the internet" – Pearson Education		

Name of the course		Compiler Design	
Course Code: PC(CS)618		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To learn concepts of language translation and phases of compiler design		
2.	To describe the common forms of parsers		
3.	To acquire knowledge of parser by parsing LL parser and LR parser		
4.	To demonstrate intermediate code using technique of syntax directed translation		
5.	To illustrate the various optimization techniques for designing various optimizing compilers		
Pre-Requisite			
1.	Formal Language and Automata Theory PC(CS/IT)407		
Module	Content	Hours	Marks.
1	Introduction to Compiling [2L] Compilers, Analysis-synthesis model, phases of the compiler, Cousins of the compiler, Basicconcepts of NFA, DFA. Lexical Analysis [4L] The role of the lexical analyzer, Tokens, Patterns, Lexemes, Specifications of a token,Recognition of tokens, lexical analyzer generator (Lex).	6	
2	Syntax Analysis [7L] The role of a parser, Top down Parsing, Predictive parsing (LL), Bottom up parsing, Operatorprecedence parsing, LR parsers (SLR, LALR,CLR), Parser generators (YACC). Syntax directed translation [4L] Syntax directed definitions, Construction of syntax trees, Bottom-up evaluation of S attributeddefinitions, L attributed definitions.	11	
3	Type checking [3L] Type systems, Specification of a simple type checker. Run time environments [6L] Activation trees, Control stack, scope of declaration, Binding of names, Activation records,Storage allocation strategies, Parameter passing (call by	9	

	value, call by reference, copy restore,call by name), Symbol tables.		
4	Intermediate code generation [4L] Graphical representation, Three-address code, Implementation of three address statements(Quadruples, Triples, Indirect triples). Code optimization [4L] Basic blocks & flow graphs, Transformation of basic blocks, DAG representation of basicblocks, the principle sources of optimization, Loops in flow graph, Peephole optimization. Code generations [2L] Issues in the design of code generator, Register allocation & assignment.	10	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	describe the basic concepts and application of Compiler Design
CO 2	design Symbol Table, Lexical Analyser, Intermediate Code Generation, Parser (Top Down and Bottom Up Design) using basic knowledge of Data Structure, Grammar and Programming Language.
CO 3	explain various Code optimization Techniques and Error Recovery mechanisms.
CO 4	design and Implement a Parser.
CO 5	design syntax directed translation schemes for a given context free grammar.
CO 6	apply the optimization techniques to intermediate code to have a better code for code generation
Learning Resources:	
1.	Alfred Aho, Ravi Sethi, Jeffrey D Ullman.- Compilers Principles, Techniques, and Tools, 2nd Edition, Pearson Education, New Delhi, 2006
2.	A.I.Holub -Compiler Design in C, Prentice Hall of India, New Delhi, 1995
3.	J.P. Tremblay - The Theory and Practical of Compiler Writing, McGraw Hill, Singapore, 1993.
4.	K.C. Louden- Compiler Construction: Principles and Practice, Thomson Learning, New Delhi, 2005.
5.	Chattopadhyay , S- Compiler Design (PHI)

Name of the course	Real Time System
Course Code: PEC(CS)602A	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs./week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs./week	Assignment, quiz, Attendance: 20Marks
Credit Points: 3	End Semester Exam:75 Marks (to be mapped into 50 marks)

Objective:	
1.	To understand the concept of real-time system
2.	To determine Real-time scheduling and schedulability analysis
3.	To observe the advantages of using a RTS using examples
Pre-Requisite	
1.	Operating Systems [PC(CS/IT)511]

Unit	Content	Hrs	Marks
1	Introduction: Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Dead-lines, 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, Precedence Constraints.	6	
2	Real Time Scheduling: Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline-First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.	10	
3	Resources Sharing: Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority- Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Module	8	

	Resources, Controlling Concurrent Accesses to Data Objects.		
4	Multiprocessors and distributed systems: Multiprocessor priority ceiling protocol, End-to-end scheduling.	6	
5	Real Time Operating Systems: Basic operating-system functions, Commercial Real Time Operating System.	6	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	explainthe concept of modelling of Real-Time systems.
CO 2	analyze the characteristics of a real-time system.
CO 3	evaluate the characteristics of a real-time system in context of real time scheduling.
CO 4	classify various resource sharing mechanisms and their related protocols.
CO 5	apply the basics of RTOS in interpretation of real time systems.
Learning Resources:	
1.	Real Time Systems – Jane W. S. Liu, Pearson Education Publication
2.	Real Time Systems – Mall Rajib, Pearson Education.
3.	Real-Time Systems: Scheduling, Analysis, and Verification – Albert M. K. Cheng, Wiley.

Name of the course	Information & Coding Theory
Course Code: PEC(CS)602B	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 0 hrs./week	Mid Semester-2 Exam: 15 Marks
Practical Contact Hrs.: 0 hts./week	Assignment, Quiz & class attendance: 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	To compute the information content within a transmitted message in the aspect of codification
2.	To evaluate the effectiveness of different encoding strategies in the aspect of message transmission
3.	To study different memoryless error control coding schemes applicable for the block codes
4.	To explain memory based decoding concepts and multiple error correction facilities
Pre-Requisite	
1.	Computer Network [PC(CS/IT)617]
2.	Communication Engineering ES(CS/IT)409

Unit	Content	Hrs	Marks
1	MODULE-1: INFORMATION & CODING THEORY Uncertainty and Information, Self and Mutual Information, conditional self-information, Average Mutual Information and Entropy, Information measures for continuous random variables, source coding theorem.	6	
2	MODULE-2: CODING SCHEMES Fixed and variable length coding, prefix code, study of static and dynamic dictionary based encoding schemes- Shannon-Fano Coding, Huffman encoding, Run length encoding, idea of Lempel-Ziv encoding.	6	
3	MODULE-3: ERROR CONTROL CODING Idea of channel transmission, objective of good error control coding scheme, hamming weight and hamming distance, concept of block code, Linear Block-code, Galois Field, Matrix description of linear block codes with generator matrix, equivalent codes, systematic form of generator matrix, concept of parity check matrix, error syndrome, error detection and corrections with parity check matrix, error correction using nearest neighbour decoding concept of linear block code.	10	
4	MODULE-4: CYCLIC CODING Idea of cyclic codes, polynomial representation of cyclic codes, cyclic shift in terms of polynomials, monic polynomials, addition and multiplication of polynomials, division algorithm for polynomials, ring of polynomials, generator polynomial, systematic and non-systematic encoding of cyclic codes, error detection and correction for cyclic codes, concept of prime polynomial, factorization or reducibility aspect of polynomials related to cyclic codes, method for generating cyclic codes.	10	
5	MODULE-5: BCH CODES Introduction to BCH codes, primitive elements, primitive polynomials, minimal polynomials, concept of conjugates, generator polynomial for error correcting BCH code	2	
6.	MODULE-6: CONVOLUTION CODES	2	

	Basic idea, parameters, designing of convolution codes, convolution encoder states and trees.		
Course Outcome: After completion of this course the students will be able to			
CO1	find the actual information content within a codified transmitted message based on the probability of symbol occurrences		
CO2	discuss the concepts of various encoding schemes focused on redundancy of symbol occurrences		
CO3	identify linear block code and its propagated error which is to be tracked during the decoding phase		
CO4	inspect cyclic code and its propagated error which is to be tracked during the decoding phase		
CO5	explain the working procedure of memory based efficient decoding concepts and multiple error correction facilities		
Learning Resources:			
1	Ranjan Bose, Information theory, coding and cryptography, Second Edition, McGraw Hill Education		
2	Salvatore Gravano, Introduction to Error Control Codes, South Asia Edition, Oxford.		
3	K.S. Shivaprakasha and MurlidharKulkarni, Kindle Edition, Information Theory and Coding, Kindle Edition, Wiley		
4	ArijitSaha, Nilotpal Manna, SurajitMandal, Information Theory, Coding and Cryptography, Kindle Edition, Pearson		

Name of the course		Software Engineering	
Course Code: PEC(CS)602C		Semester:6th	
Duration:6months		Maximum Marks:100	
Teaching Scheme		Examination Scheme	
Theory:3hrs/week		Mid Semester1 Exam:15Marks	
Tutorial:0hrs/week		Mid Semester2Exam:15Marks	
Practical:0hrs/week		Other Assessment tools (Assignment,Quizetc.):20Marks	
Credit Points: 3		End Semester Exam:75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To learn the different models for the development of a software product		
2.	To explore the designing, coding and testing to develop software product		
3.	To asses quality of software product to sustain in the market		
Pre-Requisite			
1.	Programming for problem solving ES(CS/IT) 204		
2.	Object Oriented Programming PC(CS/IT)513		
Module	Content	Hours	Marks.
1	Software Development Process Models: Waterfall, Spiral, Prototyping, RAD, Evolutionary,Software Requirement and Feasibility Analysis, Cost- Benefit Analysis, etc.	5	
2	Software Design: Context Diagram, DFD, Data Dictionary, ER diagram, Decision Tree, Decision Table, Structured Chart, Structured English, Top-Down and Bottom-Up design, Modular Programming, Module Relationship- Coupling, Cohesion, Functional vs. Object- Oriented approach etc.	8	
3	Software Testing: Different types of Testing,Test case specification, Verification vs. Validation etc.	6	
4	Software Quality: Quality Attributes,Total Quality Management,Software Quality Assurance and Quality Control, Reliability, MTTF, MTBF, Reliability Models etc.	6	
5	Coding & Documentation: Structured Programming, OO Programming, UML, Information Hiding, Reuse, Software Metrics, Cyclomatic complexity, System Documentation etc.	5	
6	SoftwareProjectManagement: Software Project Management concepts, Software Project Management Plan, Tools for project plan – WBS, PERT, GANTT, ProjectScheduling &Monitoring,Staffing, Cost Estimation, COCOMO,SoftwareConfiguration Management, Software Reengineering Process model; Casestudyonsoftwaredevelopment process etc.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	differentiatedifferenttypesofmodels for software development.		
CO 2	evaluatedifferentdesign approaches for development of software product		
CO 3	applyvarioustesting techniques in software product		

CO 4	assessthe quality of software product
CO 5	estimate the cost ofsoftware product
CO 6	evaluatethe activity of software project management with CASE study
Learning Resources:	
1.	Software Engineering: A practitioner's approach– Pressman (TMH)
2.	Software Engineering: PankajJalote (Wiley-India)
3.	Software Engineering: Rajib Mall (PHI)
4.	Software Engineering: Agarwal and Agarwal, (PHI)
5.	Software Engineering: Sommerville, Pearson
6.	Fundamentals of Software Engineering – C. Ghezzi, M. Jazayeri, D. Mandrioli
7.	Software Engineering Martin L. Shooman,– TMH

Name of the course	AI in Bioinformatics
Course Code: 602D	Semester: 6TH
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: Nil	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:	
1.	To Apply AI in Bioinformatics.
2.	To learn different machine learning techniques to understand various biological processes.
3.	To develop the ability to deal with different biological data in machine learning algorithms.
Pre-Requisite	
1.	NA

Module	Content	Hours	Marks.
1	Introduction Cell and organisms; Prokaryotes, Eukaryotes; Cellular molecules; Basic cellular functions; Cell division; Biomolecules – nucleic acids, proteins; Genetic expression – genes, genomes, and genetic code, RNA, genetic regulation, Central Dogma; Metabolic pathways, Genetic mechanism of Evolution; Source of biological knowledge – model organisms; Experimental methods – Imaging, Gel Electrophoresis, Cloning, Hybridization and Immunological Staining, Gene Mapping and Sequencing, Crystallography and NMR, Computational Biology.	6	
2	Computation Linguistic of Biological Sequences Basic of Formal Language Theory; Computational language and Pattern Recognition; Developmental Grammars; Gene Grammars; Structural linguistics of Nucleic acids;	3	
3	RNA secondary structure prediction Primary and Secondary structure of RNA; Mathematical Models – Structure and Free Energy; The Tinoco-Uhlenbeck Theory; Serial Algorithms; 2˚RNA as a Search Problem; Optimal Algorithms and Exhaustive Search, Approximation and Heuristic Algorithms, Local Search, Monte Carlo Methods, Simulated Annealing, Dynamic Programming, MFT Network Search, Future work.	4	
4	Predicting Protein structural features Brief introduction to Artificial neural network; Protein structure and sequence database; Protein structures – primary, secondary, and tertiary; Secondary structure prediction using neural network – alpha-helix prediction, beta-turn prediction, coil prediction; Prediction of amino acid residues on the Protein surface; Tertiary Structure Prediction with Neural Network;	4	
5	Integrating AI with Sequence Analysis Comparing Primary Sequences to each other; Comparing Primary Sequences to patterns; ARIADNE; ARIADNE Protein Representation; ARIADNE Pattern Language; ARIADNE Pattern Matching Algorithm; ARIEL; ARIEL Protein and pattern representations; Pattern Matching in parallel hardware; ARIEL Pattern Induction Mechanisms; Pattern-Induced Multiple Alignment (PIMA); Application of PIMA; Pattern Library SEARCH (PLSEARCH) Significance, Validity, and Pattern Quality.	4	
6	Learn about Protein Structure Selecting Data; Knowledge Goals; Problem Transformation; Characterizing the Desired Knowledge; Knowledge Acquisition Strategy; Selecting Relevant Data; Reducing the Size of the Problem Space; Choosing and Applying an Induction Method; Evaluating the	4	

	Outcome of Learning.		
7	Identification of Qualitatively Feasible Metabolic Pathways Thermodynamic Feasibility; Synthesis of Pathways – Stoichiometric Constraints; Description of the Algorithm – Reaction-Processing Phase, Metabolite-Processing Phase, Pathway-Marking Phase, Correctness, Completeness, Computational Complexity Issues; A Case Study: Lysine Pathways.	3	
8	Knowledge-Based Simulation of DNA Metabolism DNA Metabolism; Representation of Objects; Representation of Interactions and Behaviors; Inference; Explanation; Prediction of Enzyme Action; Envisionment of Metabolic Pathways.	4	
9	AI Approach to the Interpretation of the NMR Spectra of Proteins Nature of Proteins; Protein Structure; Protein NMR; Two-Dimensional NMR; Protein Structure Prediction; Assignment of Spin Systems; Connecting the Spin Systems; Secondary Structure Prediction; 3D Structure Determination; Computational Aspects of NMR; AI Applications & NMR; Computational Aids for Protein NMR; Protein NMR Assistant (PNA); Blackboard Architecture; PNA Blackboard; PNA Knowledge Sources; Control.	4	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	Learn the basics of collecting, analysing, and modeling bioinformatics data using AI.
CO 2	Map different biological problems in computation domain.
CO 3	Understand various biological datasets.
CO 4	Design a machine learning framework to C different biological problems.
CO 5	Developthe understanding of different cases of AI-based bioinformatics research, including genome sequencing, protein function prediction, and gene expression examination.

Learning Resources:	
1.	Machine Learning in Bioinformatics by Yan-Qing Zhang, Jagath C. Rajapakse
2.	Bioinformatics: The Machine Learning Approach by Pierre Baldi&SarenBrunak
3.	Introduction to Machine Learning and Bioinformatics by SushmitaMitra, et al.
4.	Artificial Intelligence and Molecular Biology by Lawrence Hunter
5.	Artificial Intelligence in Bioinformatics by Hari Om Sharan

Name of the Course	Digital Signal Processing
Course Code: PEC(CS)602E	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: Nil	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (to be mapped into 50 marks)

Objective:

1.	To understand the features of Signals.
2.	To gather knowledge on Fourier Series and Fourier Transform Properties.
3.	To design Discrete Fourier Transform and Fast Fourier Transform Circuits.
4.	To simulate circuits of Finite Impulse Response Filters.

Pre-Requisite:

1.	Communication Engineering [ES(CS/IT) 409]

Module	Content	Hours	Marks.
1	Representation of Signals and Systems: Deterministic and Non- deterministic Signal, Periodic and Aperiodic Signal, Unit-step Function and Unit Impulse Function. Causal and Non-causal System, Recursive and Non-recursive System. Convolution Theorem, High Pass and Low Pass Filter, 3dB Frequency.	6	
2	Fourier Series and Fourier Transform: Fourier Series and its explanation, conditions for existence of Fourier Series, exponential form of Fourier Series. Fourier Transform and Inverse Fourier Transform.	6	
3	Discrete Fourier Transform and First Fourier Transform: Discrete Fourier Transform (DFT), Twiddle Factor, Periodicity and Symmetry Property of Twiddle Factor. Computation of addition and multiplication operations of DFT. Fast Fourier Transform (FFT), Decimation in Time FFT & Decimation in Frequency FFT, Butterfly operation. Computation of addition and multiplication operations of FFT.	10	
4	Finite Impulse Response and Infinite Impulse Response Filter: Basic concepts of FIR Filter, Calculation of Filter Coefficients, Impulse Response Sequence. Rectangular Window, Hamming Window and Hanning Window Function. Calculation and determination of the Order of FIR Filter. Basic concepts of IIR Filter. Transfer Function of IIR Filter. Advantages and disadvantages of FIR Filter and IIR Filter.	8	
5	DSP Processor and Programming: Block Diagram of TMS320C54x Processor and brief explanation including Accumulator, Memory and MAC Unit. Basic Instruction Sets and simple Assembly Language Programming using TMS320C54x. FIR Filter design and implementation using TMS320C54x	6	

Course Outcomes

After completion of the course, a student would be able to:

CO 1	explain the features of different types of signals.
CO 2	explain the properties of Fourier Series and Fourier Transform.
CO 3	calculate Addition and Multiplication operations of Discrete Fourier Transform and Fast Fourier Transform.
CO 4	design Finite Impulse Response Filter with various Window Methods.
CO 5	simulate Digital Filters.

Learning Resources:

1.	Digital Signal Processing by S. Salivahanan, A. Vallavaraj and C. Gnanapriya, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2.	Signal Processing and Linear Systems by B. P. Lathi, Oxford University Press, New Delhi.
3.	Digital Signal Processing: A Computer Based Approach by S.K. Mitra, Tata McGraw-Hill Publishing Company Limited, New Delhi.
4.	Digital Signal Processing: Principles, Algorithms, and Applications by J.G. Proakis and D.G. Manolakis, Pearson Education, India.
5.	Theory and Application of Digital Signal Processing by L.R. Rabiner and B. Gold, Prentice Hall of India

	Private Limited, New Delhi.
6.	Digital Signal Processing: System Analysis and Design by P.S.R Diniz, E.A.B da Silva and S.L. Netto, Cambridge University Press, Delhi.
7.	https://www.ti.com/microcontrollers-mcus-processors/processors/digital-signal-processors/overview.html

Name of the course	Cyber Security
Course Code: PEC(CS)602F	Semester: 6th
Duration: 6 month	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial: NIL	Mid Semester-2 Exam: 15 Marks
Practical: NIL	Assignment, Quiz & class attendance: 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:	
1.	To know about Classification of Cyber Security.
2.	To identify the key features and approaches of Cyber Crime and Security.
3.	To analyze the key features and approaches of Cyber Crime and Security
4.	To examine human and intellectual issues and jurisdictional challenges critically.

Pre-Requisite	
1.	Computer Network PC(CS/IT) 617
2.	Operating System PC(CS/IT)511

Unit	Content	Hrs	Marks
1	Introduction of Cybercrime: Cybercrime definition and origins of the word, Cybercrime and information security,Different types of Cyber Crime and data frauds,A global Perspective on cybercrimes.	3	
2	Cyber Offenses:How Criminals plan them, Categories of Cyber Crimes, How Criminal Plans the Attack: Active Attacks, Passive Attacks, Cyberstalking.	4	
3	Cybercrime on Mobile & Wireless devices: Proliferation of Mobile and Wireless devices, Trends in Mobility, Credit card Frauds in Mobile and wireless devices, Authentication Service Security, Attacks on Mobile/Cellphones,Security Implications for Organizations, Organization Security polices and Measures in Mobile Computing Era.	7	
4	Tools and Methods used in Cybercrime: Proxy servers, password checking,Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow ,Attacks on Wireless Networks,	8	
5	Phishing and Identity theft: Methods of Phishing, Phishing Techniques, Types of Phishing Scams,Identity theft, Types and Techniques of identity thefts.	6	
6	Security Policy: Intrusion detection system(IDS), Digital signatures and the Indian ITA act, Cybercrime and punishment, Indian laws and IT act, Public key certificate.	8	

Course Outcome: After completion of the course the students will be able to-	
CO1	describe Cyber-crime vulnerabilities and exploitations of the Internet
CO2	implement different methods to prevent cyber-criminal activities.
CO3	distinguish between various types of cybercrimes with respect to the motivations and methods of operation of offenders.
CO4	identify the law with regards to the investigation and prosecution of cyber criminals.
CO5	apply appropriate law enforcement strategies to both prevent and control cyber-crime.

Learning Resources:	
1	Cyber Security : Understanding Cyber Crimes , Computer Forensics and Legal Perspectives By Nina Godbole, SunitBelapur , Wiley

2	Nina Godbole, SunitBelapure, Cyber Security, Wiley India, New Delhi.
3	The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
4	The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
5	Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai

Name of the course		Machine Learning	
Course Code: PEC(CS)603A		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	Develop an appreciation for what is involved in Learning models from data		
2.	Understand a wide variety of learning algorithms		
3.	Understand how to evaluate models generated from data		
4.	Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models		
Pre-Requisite			
1.	Mathematics I BS(CS/IT) 101		
2.	Mathematics II BS(CS/IT) 205		
Module	Content	Hours	Marks.
1	Introduction: Introduction to Analytics and Machine Learning, Framework for Developing Machine,Learning Models, Prepare the Data for Machine Learning Algorithms,Data Cleaning,Handling Textand Categorical Attributes, Handling Missing Values, Exploration of Datausing Visualization,Types of Machine Learning Systems	5	
2	Linear Regression: Linear regression, Gradient Descent Algorithm for Linear Regression Model,Polynomialmodel, Regularization, Multi-Collinearity, Logistic Regression	7	
3	Classification: Training a Binary Classifier, Measuring Performance, Using Linear Regression forClassification, Using Logistic Regression, Multiclass Classifier, Multi-label Classification,Multi-output Classification	8	
4	Some Supervised Machine Learning Algorithms: k-Nearest Neighbors (KNN), Naive Bayes Classifiers, Decision Trees, Ensembles ofDecision Trees: Random Forests, Kernelized Support Vector Machines, Model Evaluationand Improvement	7	
5	Dimensionality Reduction: Dimensionality Reduction, Feature Extraction, and Manifold Learning, Principal ComponentAnalysis (PCA),Randomized PCA, Incremental PCA, Kernel PCA, Selecting a Kernel andTuning Hyper-parameters, Other Dimensionality Reduction Techniques	7	
6	Unsupervised Learning: Clustering: K-Means, Image Segmentation using clustering,Creating Product Segments UsingClustering,Finding Optimal Number of Clusters Using Elbow Curve Method, Normalizingthe Features,Hierarchical Clustering, Compare the Clusters Created by K-Means andHierarchical Clustering,Anomaly Detection using Gaussian Mixtures, Assessment Metricsfor Clustering Algorithms.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	describe the concepts of Machine Learning.		
CO 2	implementalgorithms of Machine Learning.		

CO 3	develop Machine Learningmodels.
CO 4	apply Machine LearningModels to classification and recognition problems.
CO 5	design variousMachine Learning algorithms for real-world applications for model optimization.
Learning Resources:	
1.	Christopher Bishop. Pattern Recognition and Machine Learning. 2e
2.	Machine Learning by Tom Mitchell, McGraw Hill Education
3.	Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
4.	R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.

Name of the course		Operation Research	
Course Code: PEC(CS)603B		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0hrs./week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs./week		Other Assessment tools (Assignment, quiz, Attendance): 20Marks	
Credit Points: 3		End Semester Exam: 75Marks(to be mapped into 50 marks)	
Objective:			
1.	To classify and formulate real-life problem for modelling, solving and applying for decision making.		
2.	To study the formulation and various methods of solutions for linear programming, transportation, assignment, CPM and PERT problems.		
3.	To solve problems using dynamic programming method.		
Pre-Requisite			
1.	Mathematics I BS(CS/IT) 101		
2.	Mathematics II BS(CS/IT) 205		
Module	Content	Hrs	Marks
1.	Linear Programming Problems (LPP):Basic LPP and Applications; Various Components of LP Problem Formulation. Solution of Linear Programming Problems:Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution,Degenerate and Non-degenerate Solution, Convex set and explanation with examples. Solution of LPP by Simplex Method; Big-M Method; Duality Theory. Transportation Problems and Assignment Problems.	17	
2.	Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).	5	
3.	Game Theory: Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point;Graphical Method; Principle of Dominance.	5	
4.	Queuing Theory: Introduction;Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure (Poisson Queue). Poisson Queue Models: (M/M/1): (∞/ FIFO) and (M/M/1: N / FIFO) and problems.	5	
5.	Dynamic Programming:Basic Concepts, Bellman's optimality principles, Dynamic programming approach in decision making problems, optimal subdivision problem.	4	
Course Outcome: After completion of this course the students will be able to:			
CO1	apply various techniques to solve linear programming problems.		
CO2	implement different network flow algorithms and cost analysis techniques.		
CO3	solve Game Theory problems.		
CO4	explainQueuing Theory.		

CO5	design dynamic programming solutions to different problem.
Learning Resources:	
1.	H. A. Taha, "Operations Research", Pearson
2.	P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House
3.	Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency
4.	Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA
5.	KantiSwaroop — "Operations Research", Sultan Chand & Sons
6.	Rathindra P. Sen—"Operations Research: Algorithms and Applications", PHI
7.	R. Panneerselvam - "Operations Research", PHI
8.	A.M. Natarajan, P. Balasubramani and A. Tamilarasi - "Operations Research", Pearson
9.	M. V. Durga Prasad – "Operations Research", CENGAGE Learning 6. J. K. Sharma- "Operations Research", Macmillan Publishing Company

Name of the course		Cryptography	
Course Code: PEC(CS)603C		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 3 hrs/week		Mid Semester-1 Exam: 15 Marks	
Tutorial Contact Hrs.: 0 hrs./week		Mid Semester-2 Exam: 15 Marks	
Practical Contact Hrs.: 0 hts./week		Assignment, Quiz & class attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To explain the need of information security in the aspects of various attacks and forgery issues		
2.	To discuss various cryptographic techniques related to the codification of plain text message		
3.	To construct suitable data encryption algorithm for secret transmission of confidential data		
4.	To justify the effectiveness of client-server authentication protocol in the aspect of client user identification		
5.	To explain the idea of some network security services		
Pre-Requisite			
1.	Computer Network [PC(CS/IT)617]		
Module	Content	Hrs	Marks
1	MODULE-1: IDEA OF INFORMATION SECURITY Need for information security, principles of information Security- authentication, confidentiality, integrity, non-repudiation, access control, availability, types of attacks- application-level and network-level attacks, passive & active attacks, malicious software based attacks-virus, worms, trojanhoarse, some specific attacks- packet sniffing, packet spoofing, DNS spoofing.	6	
2	MODULE-2: CRYPTOGRAPHIC CONCEPTS & TECHNIQUES Idea of cryptographic system- plaintext & cipher text, cryptanalysis, plain text codification with substitution technique- caser cipher, mono-alphabetic cipher, homophonic substitution cipher, polygram substitution cipher, polyalphabetic substitution cipher, plain text codification with transposition technique- rail fence technique, columnar transposition technique, vernam cipher, concept of symmetric & asymmetric key cryptography, key distribution, key ranges & key sizes	10	
3	MODULE-3: DIFFERENT ENCRYPTION ALGORITHMS Symmetric key encryption algorithm types- stream cipher and block cipher, confusion and diffusion, symmetric key encryption algorithm modes- Electronic Code Book, Cipher Block Chaining, Cipher Feedback, Output Feedback, some standard symmetric key encryption algorithm- DES, variations of DES- double DES, triple DES, asymmetric key encryption algorithm- RSA, elliptic curve cryptography, concept of digital signature and message digest, combining symmetric & asymmetric key encryption for secure data transmission.	12	
4	MODULE-4: USER OWNERSHIP VALIDATIONS Authentication basics, password-based authentication, random challenge based authentication, authentication token- challenge/response based and time based token, certificate based authentication, basic idea of steganography & watermarking, domain & types of watermarking.	6	
5	MODULE-5: SECURITY SERVICES Concept of firewall and their types- application gateway, packet filtering, limitation of firewall, basic idea of mail security protocol	2	
Course Outcome: After completion of this course the students will be able to -			

CO1	explain the need of information security in the aspects of various attacks and forgery cases
CO2	compare the effectiveness of different cryptographic techniques for generation of cipher text message
CO3	design secure data encryption algorithm for secret transmission of confidential data
CO4	justify the effectiveness ofuser validation scheme through client-server authentication protocols
CO5	discuss document ownership validations and different network security services
Learning Resources:	
1	William Stallings, Cryptography and Network Security Principles and Practices, 5th Edition, Prentice Hall
2	C. Kaufman, R. Perlman and M. Speciner, Network Security: Private communication, 2nd Edition, Pearson Education
3	AtulKahate, Cryptography & Network Security, 3rd Edition, McGraw Hill Education (India) Private Limited
4	MerikeKaeo, Designing Network Security, 2nd Edition, Pearson Books

Name of the course		Advanced Architecture	
Course Code: PEC(CS) 603D		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Assignment, Quiz, Attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To identify different processor architectures and their performance measurement parameters.		
2.	To apply different techniques for improving the performance of processor.		
3.	To develop the concept of multiprocessor architecture.		
4.	To design pipeline processor architecture.		
Pre-Requisite			
1.	Computer Architecture PC(CS/IT)408		
2.	Computer Organization PC(CS/IT)301		
Module	Content	Hours	Marks.
1	The evolution of modern Computer systems – from DEC PDP-11, IBM 360/370 family, CDC Cyber 6600, Intel X86 architecture, Performance measurement parameters – MIPS, MFLOPS, SPEC ratings, CPI etc. Introduction to high performance Computing – Overview, Flynn's classifications – SISD, SIMD, MISD, MIMD, Examples from Vector & Array Processors, Performance comparison of algorithms for Scalar, Vector and Array Processors, Fundamentals of UMA, NUMA, NORMA architectures, Performance measurement for parallel architectures – Flynn's measure, Feng's measure	10	
2	Pipelined processor design, Pipeline performance measurement parameters – speedup factor, efficiency, throughput of a linear pipeline, comparing performance of a N stage pipeline with a N processor architecture, Pipeline design principles, Examples of Arithmetic pipelines, Floating point Adders, Multipliers, Dividers etc., Classifications of Unifunction, Multifunction & Dynamic pipelines, Scheduling in a pipelines with feedback , Pipeline hazards and their solutions	10	
3	RISC architecture, characteristics of RISC instruction set & RISC pipeline, its comparisons with CISC, necessity of using optimizing compilers with RISC architecture, Examples from POWER PC and SPARC architectures, Superpipelining (MIPS architecture), Superscalar architecture , Diversified pipelines and out of order execution, VLIW architecture	10	
4.	Memory hierarchy – Techniques for improving Cache memory performance parameters,(reduce cache miss rate, reduce hit time, reduce miss penalty), Main memory performance enhancement – interleaved memory, improvement of memory bandwidth, use of TLB for performance enhancement.	6	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	explain the concepts of parallel computing and hardware technology		
CO 2	explain multiprocessor architecture and taxonomy of parallel architecture		
CO 3	design the hierarchical memory structure and ~~design~~ cache		
CO 4	analyze RISC and CISC architecture		
CO 5	design pipeline processor		

Learning Resources:	
1.	Advanced computer architecture: Parallelism, Scalability, Programmability - Kai Hwang and NareshJotwani (McGraw Hill)
2.	Computer Architecture: A Quantitative Approach – Patterson & Hennessy (Elsevier)
3.	Computer Architecture & Parallel Processing – Hwang &Briggs(TMH)
4.	Computer organization and architecture, designing for performance – Stallings (PHI)
5.	Advanced Computer Architecture – Hwang (TMH) 5. Structured Computer Organization – Tanenbaum (PHI)
6.	Computer Architecture & Organization – J P Hayes (McGraw Hill)

Name of the course		Cloud Computing	
Course Code: PEC(CS)603E		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Assignment, Quiz, Attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To identify the technical foundations of cloud systems architectures.		
2.	To analyze the problems and solutions to cloud application problems.		
3.	To apply principles of best practice and technical challenges in cloud application design		
4.	To understand the key security and compliance challenges of cloud computing		
Pre-Requisite			
1.	Database Management System PC(CS/IT)512		
2.	Computer Networks PC(CS/IT)617		
Module	Content	Hours	Marks.
1	Definition of Cloud Computing and its Basics: Defining a Cloud, Cloud Types – NIST model, Cloud Cube, model, Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing, A brief introduction on Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications, Connecting to the Cloud by Clients	6	
2	Use of Platforms in Cloud Computing : Concepts of Abstraction and Virtualization technologies Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network	6	
3	Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance, Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks	8	
4.	Cloud Infrastructure: Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle).	6	
5	Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)	5	
6	Concepts of Services and Applications :	5	

	Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs, Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs		

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	apply fundamental concepts in cloud infrastructures to tradeoffs in power, efficiency and cost.
CO 2	analyze storage virtualization in cloud computing system model.
CO 3	implement the principles of Parallel and Distributed Computing in server side
CO 4	develop different types of Virtualization technologies and Service Oriented Architecture systems
CO 5	elucidate the concepts of NIST Cloud Computing architecture and its design challenges
CO 6	analyze Resource provisioning and Security governance in clouds
Learning Resources:	
1.	Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,2013
2.	Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, McGraw Hill
3.	Cloud computing: A practical approach, Anthony T. Velte, Tata Mcgraw-Hill
4.	Cloud Computing, Miller, Pearson
5.	Building applications in cloud: Concept, Patterns and Projects, Moyer, Pearson
6.	Cloud Computing – Second Edition by Dr. Kumar Saurabh, Wiley India

Name of the Course		Ad Hoc and Sensor Networks	
Course Code: PEC(CS)603F		Semester: 6th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	To understand the features of Ad Hoc and Sensor Networks.		
2.	To learn the techniques of Wireless Sensor Networks.		
3.	To design Transceiver System for Ad Hoc and Sensor Networks.		
4.	To apply IEEE Standards for the implementation of Ad Hoc and Sensor Networks.		
Pre-Requisite			
1.	Communication Engineering [ES(CS/IT) 409]		
Module	Content	Hrs	Marks
1	Basics of Ad Hoc Networks and Sensors: Features of Ad Hoc Networks, classification of Ad Hoc Networks, routing in Ad Hoc Networks, Destination Sequence Distance Vector (DSDV) routing protocol and Ad Hoc On-demand Distance Vector (AODV) routing protocol, Hybrid routing protocols, format of a Routing Request Packet. Principles of Sensors and Actuators, different types of Optical Sensors, Magnetic Sensors, Ultrasonic Sensors, Biological and Chemical Sensors, Motion Sensors etc.	8	
2	Sensor Networks and Spectrum of Electromagnetic Waves: Characteristics of Wireless Sensor Networks (WSN), Sensor Nodes, Protocol Stack of Sensor Networks. Frequency Spectrum of Radio Waves, Microwaves, Infrared Rays, Visible Lights and UV rays. Calculation of Energy from their Wavelengths.	6	
3	Uses of Communication Technology for Ad Hoc Networks: Wi-Fi Technology (IEEE 802.11): Wi-Fi based Ad Hoc Networks, Communication distance and data rate, Wi-Fi Direct (P2P) Communication. Bluetooth Technology (IEEE 802.15.1): Bluetooth Classic, Bluetooth Low Energy, Bluetooth Low Energy Channels and Advertising Intervals.	12	

	ZigBee Technology (IEEE 802.15.4): Features of ZigBee Technology, Frequency Band, Data Rates, Communication Distance. IEEE 802.15.4e Standards, Hopping Systems: Frequency Hopping, Channel Hopping, Time Slot, Frame Slot.		
4	Transceiver Architecture: Structure of Transceiver for Sensor Networks. Key components of Sensor Network System. Useful Frequency Bands for Sensor Networks. Receiver Sensitivity and calculation of Sensitivity Level.	6	
5	Power Management and Challenges: Design of Low Power Wireless System, Power Management of Wireless Sensor Networks, various Power Modes: Active Mode, Modern Sleep Mode, Light Sleep Mode, Deep Sleep Mode. Challenges in designing of Ad Hoc Networks.	4	

Course Outcomes	
After completion of the course, a student would be able to:	
CO 1	explain the features of Ad Hoc Networks.
CO 2	describe Protocol Stacks of Wireless Sensor Networks.
CO 3	analyze Ad Hoc Networks using Wireless Communication Technologies.
CO 4	design Ad Hoc and Sensor Network System.
CO 5	implement Ad Hoc Networks deploying Sensor Nodes at various locations.
Learning Resources:	
1.	Wireless Ad Hoc and Sensor Networks: Protocols, Performance, and Control by J. Sarangapani, CRC Press, New York.
2.	Wireless Ad Hoc and Sensor Networks: Management, Performance, and Applications by Jing (Selena) He, S. Ji, Y. Pan and Y. Li, CRC Press, Boca Raton (Florida).
3.	Wireless Ad Hoc and Sensor Networks: Theory and Applications by Xiang-Yang Li, Cambridge University Press, England.
4.	Ad Hoc Wireless Networks: Architectures and Protocols by C. S. Ram Murthy and B. S. Manoj, Pearson Education, Inc. New Jersey.
5.	Wireless Sensor and Actuator Networks: Technologies, Analysis and Design by R. Verdone, D. Dardari, G. Mazzini and A. Conti, Elsevier Academic Press, London.
6.	Deploying Wireless Sensor Networks: Theory and Practice by M. R. Senouci and A. Mellouk, ISTE Press Ltd., London.

Name of the Course	Industrial Management
Course Code: HS(CS/IT)604	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs./week	Mid Term Exam I: 15 Marks
Tutorial: Nil	Mid Term Exam II: 15 Marks
Practical: Nil	Assignment & Quiz etc.: 20 Marks
Credit Points: 3	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

Objective:			
1.	To understand what is industrial Management		
2.	To understand different corporate structures and management techniques.		
3.	To understand quality management and financial management.		
4.	To understand the union and State budget		
Pre-Requisite			
1.	NIL		
Module	Content	Hrs	Marks
1	Human resource Management: Introduction of Human Resource Management, recruitment and selection, performance appraisal, industrial ,	3	

	trade , collective bargaining.		
2	Organisational behaviour: Different schools of Management thought: scientific management, administrative theory, theory of bureaucracy, human relations theory . Motivation: different theories, Communication: purpose, process, barriers to effective communication, guidelines to make communication effective, Perception: process, important factors influencing perception, shortcuts for judging people, Halo effect, stereotyping projection	5	
3	Quality management: concepts, dimensions for goods and services, cost of quality, statistical quality control, control , acceptance sampling, total quality management, new quality tools	4	
4	Marketing management: basic concepts of marketing, difference between selling and marketing, elements of marketing mix, brief idea about marketing environment, simple marketing strategies, SWOT analysis	4	
5	Introduction to accounting: basic accounting concepts, important definitions, uses, limitations, advantages, types of accounting, financial statements, introduction to general accounting, different types of vouchers, double entry, bookkeeping, different types of transaction related to financial accounting	10	
6	Financial control: posting of ledgers and preparation of trial balance, preparation of balance sheet and profit and loss accounts, controlling other departments by financial accounting (a practical approach)	6	
7	Budget analysis: union and State budget analysis of the concerned year, budget at a glance, annual financial statement economic survey of concerned year	4	

Course Outcomes	
After completion of the course, a student would be able to:	
CO 1	explain the features of Human Resource Management.
CO 2	analyse about different quality control methods and organisationalbehaviour
CO 3	create strategic management in future
CO 4	comprehend and analyse accounts and its related management .
CO 5	analyse union and State Government budgets
Learning Resources:	
1.	Industrial Management volume 1 LC, Jhamb, EPH
2.	Industrial relations trade unions and labour legislation- Sinha Pearson education Asia
3.	Financial Management and accounting- P.kJaJain, S Chand
4.	Organisationalbehaviour- SP Robbins, Prentice Hall
5.	Production and operations management Joseph Monks, TMH

Name of the course	Computer Network Lab
Course Code:PCL(CS/IT)619	Semester: 6th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme, Total Marks: 100
Theory: Nil	Attendance : 10
Tutorial: Nil	Preparation of Lab Report : 30
Practical: 3 hrs./week	Experimental data/ Precision of work done : 30
Credit Points: 1.5	Presentation/ analysis of the result : 10
	Viva Voce: 20

Module	Content	Hrs	Marks
1.	NIC Installation & Configuration (Windows/Linux)	01	
2.	Understanding IP address, subnet, MAC address, IP configuration	02	
3.	Networking cables (CAT5, UTP), Connectors (RJ45, T-connector)	01	
4.	Physical verification of existing LAN	02	
5.	5.TCP/UDP Socket Programming i) UDP time client server program ii) UDP echo client server program iii) TCP time client server program iv) TCP echo client server program v) TCP chat client server program Vi) Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check)	18	
6.	Server Setup/Configuration FTP, Telnet, DNS.	06	
7.	Firewall configuration in client level	03	
8.	Mini project: Multiple user chat server implementation	06	

Course Outcome: After completion of this course the students will be able to -	
CO1	Investigate configuration of existing LAN
CO2	Configure different components of computer network
CO3	Implement client server model using socket programming
CO4	Implement different server configuration
CO5	Configure firewall
CO6	Design of real life problems and solution for multiple client chat server

Learning Resources:	
1	TCP/IP Sockets in Java, Practical Guide For Programmers Second Edition Kenneth L. Calvert and Michael J. Donahoo, The Morgan Kaufmann Practical Guides Series
2	TCP/IP Sockets in C, Practical Guide For Programmers Second Edition Kenneth L. Calvert and Michael J. Donahoo, The Morgan Kaufmann

THEORY							
7th SEM							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
01	OEC(CS/IT)701	Open Elective I A. History of Science and Engineering B. Organizational Behavior	3	0	0	3	3
02	OEC(CS/IT)702	Open Elective II A. Economic Policies in India B. Soft Skills and Interpersonal Communication	3	0	0	3	3
03	OEC(CS/IT)703	Open Elective III A. Programming and Application of Advanced Microprocessors B. Control System C. Mobile Computing	3	0	0	3	3
04	PEC(CS)704	Elective-IV A. Web & Internet B. Artificial Intelligence C. Introduction to Deep Learning D. Digital Image processing E. Big Data Analytics	3	0	0	3	3
05	PEC(CS)705	Elective-V A. Internet of Things B. Distributed Database C. Computer Graphics D. Introduction to Quantum Computing E. Data Mining	3	0	0	3	3
PRACTICAL							
01	PROJ(CS)702	Project 2	0	0	15	15	7.5
		SESSIONAL					
01	INDTR(CS)1	Industrial Training Evaluation	0	0	0	0	1
		TOTAL	15	0	15	30	23.5

Name of the course	History of Science and Engineering		
Course Code: OEC(CS/IT)701A	Semester: 7th		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme	Examination Scheme		
Theory:3 hrs/week	Mid Semester 1 Exam:15 Marks		
Tutorial:0 hrs/week	Mid Semester 2 Exam:15 Marks		
Practical:0 hrs/week	Other Assessment tools (Assignment, Quiz etc.):20 Marks		
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)		
Objective:			
1.	To learn the development stages of ancient Science and Engineering		
2.	To explore the inventions of Agricultural, Technological and Medical Sciences		
3.	To judge the contributions of eminent Scientists of India		
Pre-Requisite:			
1.	NIL	Hrs	Marks
Unit	Content	Hrs	
1	Development of Ancient Science and Engineering : Stone Age (3.4 million BCE to 2000 BCE): Stone and bone tools, control of fire and cooking, boats, fishing tackle, stone and mud dwellings etc. Copper and Bronze Age (3300 BCE to 1200 BCE): Metal pots and pans, pottery wheel, pulley, metal tools and weapons etc. Iron Age (1500 BCE to 200 BCE): Block and tackle system, Pump, Lathe, Iron tools, Iron axe, development of weapons etc.	8	
2	Development of Medieval Science and Engineering : Middle Age (500 CE to 1500 CE): Waterwheel, windmill, cannon, mechanical clock, wheeled plow, compass, ships, optics, anatomy, Human dissection anatomy, books on optics, books on anatomy etc.	8	
3	Renaissance and Science and Engineering in Industrial Age Renaissance Period (c.1300 to c.1700): Mining, metallurgy, development of telescope, microscope, thermometer, barometer, printing press, firearms, nautical compass, sawmills etc. Industrial Age (c.1700 to c.1920): Steam engine, electricity, automobile, radio, airplane, mechanical television, telephone, rocket etc.	8	
4	Modern Science and Engineering: Information Age (c. 1920 to Present day): Vacuum tube, transistor, integrated circuits, microprocessor, computer, internet, mobile phones, wireless technology, Nuclear power and space technology, GPS etc.	6	
5	Eminent Ayurvedacharya& Scientist of India and their contributions: Sushruta (800 BCE- 700 BCE): Invention and Development of Surgical Procedures Charaka(Approx 200 BCE – 200CE): Contribution to Medicine Aryabhata (476 CE- 550 CE): Trigonometry, Algebra and Astronomy Brahmagupta (c.598 – 668 CE): Arithmetic Manipulation Rules for zero and Negative Numbers Bhaskara II (1114 - 1185): Some Principles of Differential Calculus and concept of Infinity Jagadish Chandra Bose (1858 – 1937): Investigation of Radio & Microwaves and Plant Science Prafulla Chandra Ray (1861- 1944): Eminent Chemist. Established Bengal Chemical & Pharmaceutical Ltd Srinivasa Ramanujan (1887-1920): Great Mathematician, Number Theory was among his specialities. C V Raman (1888 – 1970): Noble Prize in Physics in the field of Light Scattering Meghnad Saha (1893-1956): Astrophysicist and developed Saha Ionization Equation Satyendra Nath Bose (1894 – 1974): Best known for his work on Quantum Mechanics	6	

Course Outcomes:	
CO1	Identify the technological developments of the Stone Age, Bronze Age and Iron Age.
CO2	Interpret the advancement of Science and Medicine of the Medieval Age.
CO3	Differentiate the developments of Science and Engineering in the Renaissance and Industrial Age.
CO4	Estimate the progress of Modern Science and Engineering in the Information Age.
CO5	Review the activity of eminent Ayurvedacharya& Scientists.

Learning Resources:	
1.	A History of Science, Jackson Tom published by Worth Press Limited.
2.	An Introduction to the History of Science, Walter Libby published by Newman Press
3.	Science and Technology in World History: An Introduction, James E. McClellan, Harold Dorn published by JHU Press.
4.	The History of Science and Technology: A Browser Guide …… by B. H. Bunch, A. Hellemans, Published by Houghton Miffin (USA)
5.	History of Science and Technology in India by B. B. Satpathy [available at www.amazon.in]
6.	https://en.wikipedia.org/wiki/History_of_science
7.	https://en.wikipedia.org/wiki/History_of_technology
8.	https://en.wikipedia.org/wiki/Science
9.	https://en.wikipedia.org/wiki/Science_education
10.	https://en.wikipedia.org/wiki/Timeline_of_historic_inventions#Modern_era

Name of the Course	Organizational Behaviour
Course Code: OEC(CS/IT)701B	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester I Exam: 15 marks
Tutorial: 0 hrs/week	Mid Semester II Exam: 15 marks
Practical: 0 hrs/week	Assignment, Quiz, Attendance: 20 marks
Credit Points: 3	End Semester Exam: 50 marks (75 converted to 50)

Objectives:	
1.	To understand the human interactions of the organization.
2.	To find what is driving it and influence it for getting better result in attaining business goals.
Prerequisites:	
1.	Basic knowledge of motivation, learning, perception and personality.

Unit	Content	Hrs	Marks
1.	Behavioural concept: Nature & concept of O.B. – Relationship with other fields – learning – nature significance process of learning.	03	
2.	Individual Behaviour: Personality self-awareness – personality measurement.	03	
3.	Perception: perceptual process model – perceptual errors in organizational settings – improving perception – Attitude – job satisfaction – organisational commitment – Attribution theory – attribution errors – Ethics & Values.	08	
4.	Theory of motivation: Hierarchy of needs – goal setting theory – content and process theory of motivation – money as a motivator – team motivation.	08	
5.	Group Behaviour: stages of group formation – 5 stages model – group structure – task – decision making in group – team building and development – conflict and negotiation – leadership approach & development.	08	

6.	Organizing and Organization: Organization Structure & design – organizational culture – change – development – at the end students will be able to	06	

Course Outcomes:	
CO1	Identify different forms of organization and features and explain their relevance in a particular business context.
CO2	Define what an organization is, can define how organization evolve can act out what makes them effective.
CO3	To assess their behaviour with that others in organizational settings.
CO4	To appraise their ability to manage lead and work.
CO5	To detect, assess, analyse human behavioural problems.
CO6	To develop ethical thinking, they will be able to negotiate, lead, manage.

Learning Resources:	
1.	Organizational Behaviour by S. Shajahan
2.	New Age International Publishers
3.	Organizational Behaviour Publisher – University of Minnesota
4.	A Text book of O.B. by Dr. C. S.
5.	GuptaOB by Dr. Mittal & Agarwal

Name of the course	Economic policies in India
Course Code: OEC(CS/IT)702A	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs./week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 0 hrs./week	Mid Semester-2 Exam: 15 Marks
Practical Contact Hrs.: 0 hrs./week	Assignment & class attendance: 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (to be converted into 50 marks)

Objective:	
1.	To understand the changing nature of economic policy in India.
2.	To discuss the different sector-specific policies.
3.	To explain the implications of sectoral policies.

Pre-Requisite	
1.	NA

Unit	Content	Hrs	Marks
1	Changing nature of Economic Policy in India: Indian economy at independence. Economic Planning in India – Objectives, development strategy and assessment.	8	

	Economic reforms and liberalization.		
2	Policies in Agriculture: Importance of agriculture in Indian economy. An overview of policies for agriculture and rural development. Green Revolution – features, phases and impact. Land Reforms. Food security and food policy. Agricultural price policy.	8	
3	Policies in Industry: Industrial policy prior to 1991.Industrial Licensing Policy. New Industrial Policy 1991.Public sector in the Indian economy. Evolution of disinvestment programme and privatization policy. Small scale industries.	8	
4	Policies in Financial Sector: The banking sector in the pre-reform period. Banking sector reforms. Indian capital market – pre and post reform phase.	6	
5	India's Fiscal Policy: Objectives of fiscal policy in India. Fiscal imbalance and deficit financing. The fiscal imbalance and the new fiscal approach. The tax reforms since 1991.Federal finance in India.	6	

Course Outcome:	
After completion of this course the students will be able to :	
CO1	Explain the Changing nature of Economic Policy in India.
CO2	Analyze the different policies in Agriculture.
CO3	Examine the role of different industrial policies in India's industrial development.
CO4	Outline the policy reforms in the financial sector.
CO5	Discuss the different aspects of fiscal policy.
Learning Resources:	
1	Ruddar Dutt & KPM Sundaram: Indian Economy, S. Chand & Company Ltd.
2	Mishra and Puri: Indian Economy, Himalaya Publishing House.
3	Uma Kapila (ed.): Indian Economy since independence, Academic Foundation.
4	Uma Kapila: Understanding the problems of Indian economy, Academic Foundation.
5	Uma Kapila: Indian Economy issues in development & planning and sectoral aspects, Academic Foundation.
6	Economic Survey, Government of India- various issues.
7	Finance Commission Report, Ministry of Finance, various issues.

Name of the course		Soft Skill and interpersonal communication	
Course Code: OEC(CS/IT)702B		Semester: 7th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hr/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Assignment ,Quiz, Attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objectives:			
1.	To handle interpersonal relations.		
2.	To communicate effectively.		
3.	To take appropriate decision.		
4.	To gain professional development		
Prerequisites:			
1.	To know at least basic grammar in English language		
Unit	Content	Hrs	Marks
1.	Introduction: Difference between soft and hard skill, communication the most important soft skill, types, process, barriers.	2	
2.	Verbal Communicationoral: listening, reading, speaking.	2	
3.	Verbal Communication Written: paragraph, letter, essay, precie, comprehension.	2	
4.	Communication As A Source Of Career Building: Job application letter with resume./cv, group discussion, presentation, mock interview.	10	
5.	Business Communication: Memo, agenda, minutes of meeting, notice, Email.	10	
6.	Soft Skill: Time management, goal setting, problem solving, decision making, leadership style, intra &interpersonal skill, swot analysis	10	
Course Outcomes:			
CO1	Define what communication is .		
CO2	Build strong professional vocabulary by reading writing listening and speaking.		
CO3	Express themselves properly to others.		
CO4	Organize Their thought processes,ideas, arguments through group discussion, presentation, interview.		
CO5	Negotiate with people.		
Learning Resources:			
1.	Organizational Behaviour by S. Shajahan		
2.	New Age International Publishers		
3.	Organizational Behaviour Publisher – University of Minnesota		
4.	A Text book of O.B. by Dr. C. S.		
5.	GuptaOB by Dr. Mittal & Agarwal		

Name of the course		Programming and Application of Advanced Microprocessors
Course Code: OEC(CS/IT)703A		Semester: 7th
Duration: 6 months		Maximum Marks: 100
Teaching Scheme		Examination Scheme
Theory: 3 hrs/week		Mid Term Exam I: 15 Marks
Tutorial: NIL		Mid Term Exam II: 15 Marks
Practical: NIL		Assignment & Quiz etc.: 20 Marks
Credit Points: 3		Semester End Exam: 75 Marks (to be mapped into 50 marks)
Objective:		
1.	To understand the features of 8086 and Pentium family of Microprocessors.	
2.	To learn Assembly Language Programming of advanced Microprocessors.	

3.	To design interface circuits and their connection with Microprocessors.		
4.	To implement Microprocessor based systems		
Pre-Requisite			
1.	Digital Electronics [ES(CS/IT) 307]		
Module	Content	Hrs	Marks
1	Introduction to 8086 Microprocessor: 8086 Microprocessor: Block diagram, Execution Unit, Bus Interface Unit, General Purpose Registers, Flag Registers, Memory Segmentation, Logical Memory and Physical Memory, Addressing Modes.	8	
2	x86 and Pentium family of Microprocessors: Simple Block Diagram, Address Bus, Data Bus, other Buses, Control Registers, General Purpose Registers, Cache Memory, Upward compatibility of features and privileges.	8	
3	Instruction Sets and Assembly Language Programming: Basic Instruction Sets, Assembler Directives and Assembly Language Programming, Machine Cycle and instruction Cycle, Minimum Mode and Maximum Mode.	8	
4	Controller and Peripheral Devices Working principles of DMA Controller, Interrupts and its application. Programmable Peripheral Interface, Working principles of LCD, Interface with LCD, Interface with Stepper Motors. Interface with Ports.	6	
5	BIOS and DEBUG: BIOS Function Calls, DEBUG in DOS and Windows Environment. Various DEBUG Commands, Memory access using DEBUG Command, Advanced Assembly Language Program with DEBUG. Disassemble and generation of HEX Codes using DEBUG.	6	
Course Outcomes			
After completion of the course, a student will be able to:			
CO 1	explain the characteristics of 16 bit Microprocessor.		
CO 2	determine the features of upward compatible Microprocessors.		
CO 3	execute Assembly Language Program.		
CO 4	simulate programs using DEBUG.		
CO 5	design circuits based on Microprocessors.		
Learning Resources:			
1.	Advanced Microprocessors and Peripherals by K.M. Bhurchandi and A. K. Ray, McGraw Hill Education (India) Private Limited.		
2.	An Introduction to the Intel Family of Microprocessors by James L. Antonakos, Pearson Education Asia.		
3.	The x86 PC: Assembly Language, Design and Interfacing by M.A. Mazidi, J. G. Mazidi and D. Causy, Pearson Publication.		
4.	The x86 Microprocessors: Architecture, Programming and Interfacing (8086 to Pentium) by Lyla B. Das, Pearson Publication.		
5.	Fundamentals of Microprocessors and Microcomputers by B. Ram, Dhanpat Rai Publications, New Delhi.		
6.	Microprocessors and Interfacing: Programming and Hardware by Douglas V. Hall, Tata McGraw-Hill Publishing Company Limited, New Delhi.		

Name of the course		Control System	
Course Code: OEC(CS/IT)703B		Semester: 7th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Internal Assessment (50 Marks) a) Mid Semester Exam I: 15 Marks b) Mid Semester Exam II: 15 Marks c) Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 75 Marks (to be mapped into 50 marks)	
Objective:			
1.	To classify different systems and the related parameters.		
2.	To apply different mathematical tools & techniques for analyzing different practical systems.		
3.	To develop the concept of stability of a system and compute stability parameters.		
4.	To design different controller parameters for stabilizing specific systems		
Pre-Requisite			
1.	Basic Electrical Engineering (ES (CS/IT) 101)		
2.	Mathematics (BS (CS/IT) 101, BS (CS/IT) 205, BS(CS/IT)307)		
Module	Content	Hrs	Marks
1	Introduction to Control System: Introduction to control system, objectives and areas of applications, Open loop system and closed loop system, Feedback control and Automatic control: concepts and examples, Concept and examples of linear and nonlinear systems, sensitivity, robustness, accuracy	03	
2	Concept of transfer function: mathematical modeling of physical systems: Transfer function of real life systems, properties and applications, Basic concepts of poles and zeroes of a transfer function, Mathematical modeling: electrical analogy of spring–mass-dashpot system, Block diagram representation of physical systems and analysis of block diagram, Different techniques for block diagram reduction, Development of signal flow graph, Mason's gain formula	07	
3	Control system components: Potentiometer, Synchros, Resolvers, Position encoders, Tacho-generators, Actuators, Basic concept of position control, speed control, temperature control, liquid level control, pressure control.	03	
4	Time domain analysis: Impulse, step and ramp function, Step response of first and second order system, Time domain analysis of a standard second order closed loop system, Understanding of Steady state error, undamped natural frequency, damping, overshoot, rise time and settling time and their applications, Stability assessment using locations of poles and zeroes, Stability analysis using Routh-Hurwitz criteria	07	
5	Stability Analysis and control: Stability analysis using Root locus techniques from transfer function, Idea of semi-log graph, Bode plots and stability analysis using Bode plots from transfer function, Measurement of phase margin and gain margin, Development of polar plots from transfer function, Measure of relative stability using Nyquist criteria, PI, PD and PID control	11	
6	Introduction to State variable Analysis: State variables and state space model, Diagonalization, Solution of state equations, Computation of stability, controllability and observability from state model	05	
Course Outcome: After completion of this course the students will be able to			
CO1	Develop transfer function of different systems using mathematical analysis, block diagram reduction, Mason's gain formula etc.		
CO2	Explain the operation of different components of control system and physical control systems		
CO3	Examine the system performance using different parameters of time domain response		
CO4	Determine stability of a system using Root locus techniques, Bode plots and Nyquist criteria using transfer function of		

	a system
CO5	Measure controllability and observability of a system from its state space model
Learning Resources:	
1.	Modern Control Engineering, K. Ogata, 5th Edition, Pearson Education India
2.	Control System Engineering, I. J. Nagrath & M. Gopal. 6th Edition, New Age International Publication
3.	Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 10th Edition, McGraw Hill India
4.	Automatic Control Systems (with Matlab Programs), S. Hasan Saeed, Kataria, S. K., & Sons
5.	Modern Control Engineering, D. Roy Choudhury, PHI Learning
6.	Control Systems, A. Anand Kumar, 2nd Edition, PHI Learning
7.	Linear Control Systems with MATLAB Applications, B. S. Manke, Khanna Publishers

Name of the course:	Mobile Computing
Course Code: OEC(CS/IT)703C	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester Exam 1: 15 Marks
Tutorial Contact Hrs.: NA	Mid Semester Exam 2: 15 Marks
Credit Point: 3	Assignment, Quiz, Attendance: 20 Marks
	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:

1.	To make the student understand the concept of mobile computing paradigm, its novel applications and limitations.
2.	To understand the typical mobile networking infrastructure through a popular GSM protocol.
3.	To understand the issues and solutions of various layers of mobile networks, namely MAC layer, Network Layer & Transport Layer.
4.	To understand the database issues in mobile environments & data delivery models.

Pre-Requisite

1.	Communication Engineering (ES-CS/IT-409)
2.	Computer Networks (PC(CS/IT) 617)

Module	Content	Hrs	Marks
1.	Fundamentals of Mobile Computing: - Introduction to Mobile Computing (MC), Current Wireless Systems, Cordless Phones, Cellular concept, Satellite Communication, Wireless LANs, GSM Systems Overview, Architecture, Location tracking and call setup, GPRS Network Nodes, Radio interface, Protocols, Localization and calling, Handover, channel structure, location management, HLR-VLR, Overview of Paging Systems.	07	
2.	Wireless communication and Mobile IP: Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA. IEEE 802.11, TCP over wireless, data broadcasting, Mobile IP, protocol stack.	05	
3.	Mobile Network Layer: Mobile IP (Goals, assumptions, entities and terminology, IP packet delivery, agent advertisement and discovery, registration, tunnelling and encapsulation, optimizations), Dynamic Host Configuration Protocol (DHCP).	07	
4.	Mobile Transport Layer: Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP, Fast retransmit/fast recovery, Transmission /time-out freezing, Selective retransmission, Transaction oriented TCP. Transport Layer Security. Session Protocol.	05	

5.	Data management Issues: Hoarding techniques, caching invalidation mechanisms, client server computing with adaptation, power-aware, context-aware computing, transactional models, query processing, recovery, 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.	07	
6.	Application Issues of Dynamic DNS File System: Synchronization Protocol, Wireless Application Protocol-WAP. Mobile Agents computing, Mobile networking security, Mobile Operating Systems: Blue tooth, Overview of Mobile Ad hoc Networks (MANETs)	05	

Course Outcome:

After completion of this course the students will be able to -

CO1	Extrapolate the basic elements and applications of mobile computing.
CO2	Think and develop new mobile application.
CO3	Debate on any new technical issue related to this new paradigm and come up with a solution.
CO4	Develop new ad hoc network applications and/or algorithms/protocols.
CO5	Explain & develop any existing or new protocol related to mobile environment

Learning Resources:

1.	Jochen Schiller, “Mobile Communications”, Second Edition Pearson, 2003
2.	Raj Kamal, “Mobile Computing”, Second Edition Oxford ,2000
3.	Tomasz Imielinski , Henry F. Korth, “Mobile Computing”, 1996, Kluwer Academic Publication.
4.	Dharma PrakashAgarwal and Qing AnZeng, “Introduction to Wireless and Mobile Systems”, Third Edition Cengage Learning.

Name of the course		Web & Internet	
Course Code: PEC(CS)704A		Semester: 7th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0hrs./week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs./week		Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 mark)	
Objective:			
1.	To explain web application development procedures		
2.	To understand the concept of JAVA SCRIPTS, HTML& XML.		
3.	To impart servlet technology for writing business logic		
4.	To familiarize various concepts of application development using JSP		
5	To facilitate students to connect to databases using JDBC		
Pre-Requisite			
1.	JAVA [PC(CS/IT)513]		
2.	Database Management System [PC(CS/IT)512]		
3	Computer Networks [PC(CS/IT)617]		
Unit	Content	Hrs	Marks
1	Introduction: Concept of client & server side web applications, Web Architectures, Enterprise architecture styles: Single 2-tier, 3-tier, n-tier, comparison of J2EE and .NET framework, concepts of URL, HTTP, Message format of HTTP-Request and response message, Persistent & Non Persistent connections in HTTP, Web Caching, HTTP Proxies.	5	
2	HTML Basics–HTML elements, attributes and tags, comments, title, paragraphs, line breaks, changing font size, style, making text bold, underlined , italicized, Table with Row and Column Header, CSS & its advantages, different style information-inline, internal/embedded and external,css cascading rules. Java Script - statements, comments, placing functions, variables, literals-String, Number, Boolean, looping- for, while, do-while, conditional statements, arrays, objects.	11	
3	Servlet- Introduction, servlet architecture, life cycle of servlet, Generic Servlet and HTTP servlet, parameter passing to servlets, retrieving parameters, session management-.cookies, hidden form field,URLrewriting,HttpSession Java Server Pages(Jsp)- Introduction, life cycle of JSP,comparision JSP & SERVLET, JSP components- directives, declarations, expressions, scriptlets, variables and methods, scope of JSP objects, concepts of beans-useBean, setProperty, getProperty. .	12	
4	Java Database Connectivity (Jdbc)-Introduction to data streams, JDBC architecture, JDBC Driver types- Type1, Type2, Type3 and Type4, making connections with the database for accessing records from JSP & servlet.	4	
5	Xtensible Mark Up Language –XML-Need for XML, HTML and XML, XML syntax and tags, elements and attributes, comments, Role of XML DTD and Schema, need for XML parser.	4	

Course outcomes			
After completion of the course, a student would be able to:			
CO 1	Explain web application & their types		
CO 2	Design web application using JavaScript and HTML		
CO 3	Create appropriate Server-side applications		
CO 4	Apply JDBC and ODBC technologies to create database connectivity.		
CO 5	Identify the engineering structural design of XML and parse tree.		
Learning Resources:			
1.	Web Design Technology (Theory And Technique On The Cutting Edge)-D.P. Nagpal, S.Chand Publication		
2.	Learn Object Orinted Programming Using Java: An Uml Based- Dr. N.B. Venkateswarlu&Dr. E.V. Prasad-S.Chand Publication.		
3.	Web Technologies-Uttam K. Roy, Oxford University Press, Higher Education.		
4.	Web Technologies: Tcp/Ip To Internet Application Architectures-Achyut S. Godbole, Achyut S Godbole, AtulKahate-Tata Macgraw-Hill Publication		
5.	Web Technology & Design - Xavier C., New Age Publication.		
6.	Java Server Programming, J2EE edition. (VOL I and VOL II); WROX publishers.		

Name of the course:	Artificial Intelligence
Course Code: PEC(CS)704B	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester-1 Exam: 15 Marks
Tutorial Contact Hrs.: 1 hrs./week	Mid Semester-2 Exam: 15 Marks
Credit Point: 3	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:	
1.	The main purpose of this course is to provide the most fundamental knowledge to the students so that they can understand what the AI is.
2.	Apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and design of information systems.
3.	Analyze the structures and algorithms of a selection of techniques related to searching, reasoning, machine learning, and language processing.
Pre-Requisite	

1.	Strong knowledge of Mathematics. (BS (CS/IT) 101, BS (CS/IT) 205, BS(CS/IT)307).		
2.	Good command over programming languages. (PCL(CS/IT)305, PCL(CS/IT)516).		
3.	Design & Analysis of Algorithm PC(CS/IT)406.		
Module	Content	Hrs	Marks
1.	Introduction of AI and Agents : Overview of Artificial intelligence- Problems of AI, AI technique, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents.	5	
2.	Problem Solving: Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	3	
3.	Search techniques: Problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, genetic algorithms; constraint satisfaction problems, Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning.	11	
4.	Knowledge & reasoning and Representing knowledge using rules: Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation, The First Order Predicate Logic, Semantic Nets, Frames and Scripts Formalisms, Resolution in Predicate Logic, Unification, Strategies for Resolution by Refutation, Procedural verses declarative knowledge, logic programming, forward verses backward reasoning, matching, control knowledge.	6	
5.	Planning and Learning: Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques, preliminary ideas of distributed and real time planning, Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning.	5	
6.	Natural Language processing and Expert Systems: Introduction, Syntactic processing, semantic analysis, discourse & pragmatic processing, Representing and using domain knowledge, expert system shells, knowledge acquisition.	6	
Course Outcome: After completion of this course the students will be able to -			
CO1	To understand the basic issues of knowledge representation, blind and heuristic search as well as other topics such as minimax, resolution, etc. that play an important role in AI programs.		
CO2	To inspect of both the achievements of AI and the theory underlying those achievements.		
CO3	To apply the basic principles, models, and algorithms of AI to recognize, model, and solve problems in the analysis and		

	design of information systems.
CO4	To assess AI language including an ability to write simple to intermediate programs.
CO5	To develop the knowledge of the more advanced topics of AI such as learning, natural language processing, agents and robotics, expert systems, and planning.
Learning Resources:	
1.	E. Charniak, et.al., Introduction to Artificial Intelligence, PEARSON Education. P. H. Winston, Artificial Intelligence, PEARSON
2.	Education. E. Rich and K. Knight, Artificial Intelligence, PEARSON Education. R. Honavar and E. Uhr, Artificial Intelligence and
3.	The Handbook of Artificial Intelligence, Vol.1,2 and 3, Kaufman Inc.,1982. B. K. P. Horn, Robot Vision, MIT Press, 1985. J.
4.	Carbonell, Machine Learning paradigms and Methods, MIT Press, 1990. Journals- Artificial Intelligence, AI Magazine, IEEE 6. Expert, Machine Learning, Computer Vision Image Processing and Graphics, IEEE Transactions on Neural Networks.
5.	Logic & Prolog Programming, Saroj Kaushik, New Age International

Name of the course		Introduction to Deep Learning	
Course Code: PEC(CS)704C		Semester: 7th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs./week		Mid Term Exam I: 15 Marks	
Tutorial: Nil		Mid Term Exam II: 15 Marks	
Practical: Nil		Assignment & Quiz etc.: 20 Marks	
Credit Points: 3		Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)	
Objective:			
1.	Understand the concepts of TensorFlow, Keras, its main functions, operations and execution.		
2.	Implement deep learning algorithms, understand neural networks and traverse the layers of data abstraction which will empower the student to understand data more precisely.		
3.	Build deep learning models in TensorFlow and interpret the results.		
4.	Learn topics such as convolutional neural networks, recurrent neural networks, LSTM, GRU, training deep networks and high-level interfaces.		
5.	Understand the Autoencoders, GAN and Reinforcement learning concepts.		
Pre-Requisite			
1.	Mathematics I BS(CS/IT) 101		
2.	Mathematics II BS(CS/IT) 205		
3.	Machine Learning PEC(CS)603A		
Module	Content	Hours	Marks.
1	Introduction to TensorFlowand Keras, Artificial Neural Networks (ANNs), Perceptron, Multi-Layer Perceptron (MLP), Back propagation, Training an MLP with TensorFlow/keras, Fine-Tuning Hyper-parameters, Hidden Layers, Neurons	10	

	per Hidden Layer, Activation Functions.		
2	Training Deep Neural Networks, Vanishing Gradients Problems, Batch Normalization, Reutilizing Pretrained Layers, Optimizers: AdaGrad, RMSProp, Adam Optimization, Escaping Over-fitting by means of Regularization.	6	
3	Convolutional Neural Networks (CNNs), Convolutional Layers, Filters, Pooling strategies, CNN Architectures.	6	
4	Recurrent Neural Networks (RNNs), Recurrent Neurons, Basic RNNs in TensorFlow, Training RNNs, Deep RNNs, LSTM, GRU.	5	
5	Autoencodersand Generative Adversarial Networks (GAN)	4	
6	Reinforcement Learning, Introduction to OpenAI Gym, Markov Decision Processes, Q-Learning, and Deep Q-Learning.	5	

Course Outcomes	
After completion of the course, a student would be able to:	
CO 1	describe the concepts of TensorFlow, Keras, its main functions, operations and execution.
CO 2	implement algorithms of deep learning algorithms, understand neural networks.
CO 3	developmodels of convolutional neural networks (CNN), recurrent neural networks (RNN), LSTM, GRU, training deep networks and high-level interfaces.
CO 4	applyDeep Learning Models to realise the conceptsof Autoencoders and GAN.
CO 5	designDeep Learning algorithms for Reinforcement learning.
Learning Resources:	
1.	Christopher Bishop. Pattern Recognition and Machine Learning. 2e
2.	Machine Learning by Tom Mitchell, McGraw Hill Education
3.	Devi V.S.; Murty, M.N. (2011) Pattern Recognition: An Introduction, Universities Press, Hyderabad.
4.	R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000.
5.	Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016

Name of the course:	Digital Image Processing
Course Code: PEC(CS)704D	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory Contact Hrs.: 3 hrs/week	Mid Semester Exam 1: 15 Marks
Tutorial Contact Hrs.: NA	Mid Semester Exam 2: 15 Marks
Credit Point: 3	Assignment, Quiz, Attendance: 20 Marks
	End Semester Exam: 50 Marks (75 marks converted to 50)

Objective:

1.	To understand an Image fundamentals and basic analytical methods to be used in image processing.
2.	To build various Image enhancement and various restoration techniques
3.	To develop various Image segmentation methods, Wavelet basedandmorphological ImageProcessing
4.	To explain different colour image models and processingmethodology

Pre-Requisite

1.	Communication Engineering ES(CS/IT)409
2.	Mathematics (BS (CS/IT) 101, BS (CS/IT) 205, BS(CS/IT)307)

Module	Content	Hrs	Marks
1.	Fundamentals of Image processing and Image Transforms: - Basic steps of Image processing system sampling and quantization of an Image – Basic relationship between pixels Image Transforms: 2 – D Discrete Fourier Transform, Discrete Cosine Transform (DCT)	07	
2.	Image Enhancement: - Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering – Frequency Domain: Introduction to Fourier Transform – Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.	10	
3.	Image Restoration: - Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering	05	
4.	Image Segmentation: - Segmentation concepts, point, line and Edge detection, Global Processing (Hough Transform), Thresholding Techniques, Region based segmentation, Morphological processing- erosion and dilation.	08	
5.	Colour Image Processing: - Colour Fundamentals, Colour Model, Conversion of one color model to another, Pseudo color image processing, Full colour image processing	06	

Course Outcome: After completion of this course the students will be able to -	
CO1	Extrapolate the basic elements and applications of image processing
CO2	Identify image sampling and quantization requirements and implications
CO3	Design and implement two-dimensional spatial and frequency filters for image enhancement
CO4	Model and Demonstrate the image restoration problem in both time and frequency domains
CO5	Develop & Illustrate the image segmentation and also the morphological image processing.
CO6	Identify, Manipulate and Apply their knowledge by analysing image processing problems including colour images while recognizing and employing (or proposing) effective solutions
Learning Resources:	
1.	Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2010.
2.	Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image ProcessingUsing MATLAB”, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
3.	Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.
4.	S. Jayaraman, S. Esakkirajan And T.Veerakumar , “Digital Image Processing” 3Ed, TataMcGraw - Hill Education Pvt. Ltd, 2010.
5.	Willliam K Pratt, “Digital Image Processing”, John Willey, 2002.

Name of the course	Big Data Analytics
Course Code:PEC(CS)704E	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs./week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs./week	Assignment, quiz, Attendance: 10Marks
Credit Points: 3	End Semester Exam: 75 Marks

Objective:			
1.	To study the basic technologies that forms the foundations of Big Data		
2.	Provide an overview of Apache Hadoop, HDFS Concepts and Interfacing with HDFS		
3.	To understand the specialized aspects of big data including big data application, and big data analytics.		
4.	To study different types Case studies on the current research and applications of the Hadoop and big data in industry		
Pre-Requisite			
1.	DBMS and e knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment		
Unit	Content	Hrs	Marks

1	Introduction To Big Data And Hadoop Introduction to Big Data, why big data, convergence of key trends, unstructured data, Data Storage and Analysis, Characteristics of Big Data, Industry examples of big data Types of Digital Data, Introduction to Big Data,Challenges in Big Data Analytics, IBM Big Data Strategy, Introduction to InfosphereBigInsights and Big Sheets	7	
2	HDFS(Hadoop Distributed File System) Introduction to Hadoop, History of Hadoop, Apache Hadoop, Analyzing, Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, Hadoop Echo SystemThe Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures.	9	
3	Map Reduce Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.	5	
4	Hadoop Eco System Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions. Hbase:HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL : Introduction	10	
5	Data Analytics with R Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering. Big Data Analytics with BigR.	5	

Course Outcome	
After the completion of the course, a student will be able to:	
CO1	Identify Big Data and its Business Implications.
CO2	List the components of Hadoop and Hadoop Eco-System
CO3	Manage Job Execution in Hadoop Environment
CO4	Develop Big Data Solutions using Hadoop Eco System
CO5	Analyze InfosphereBigInsights Big Data Recommendations.
CO6	Apply Machine Learning Techniques using R.

Learning Resources	
1	V.K. Jain, Big Data and Hadoop, Khanna Publishing House, New Delhi(2017).
2	V.K. Jain, Data Analysis, Khanna Publishing House, New Delhi(2019).
3	Tom White “Hadoop: The Definitive Guide” Third Edit on, O’reily Media, 2012.
4	Seema Acharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015.
5	Eric Sammer, "Hadoop Operations", O'Reilley,2012.
6	Michael Berthold, David J. Hand, "Intelligent Data Analysis”, Springer, 2007.
7	Jay Liebowitz, “Big Data and Business Analytics” Auerbach Publications, CRC press (2013)
8	Tom Plunkett, Mark Hornick, “Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop”, McGraw-Hill/Osborne Media (2013), Oracle press.
9	Glen J. Myat, “Making Sense of Data”, John Wiley & Sons, 2007
10	Pete Warden, “Big Data Glossary”, O’Reily, 2011.
11	Michael Mineli, Michele Chambers, AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
12	ArvindSathi, “BigDataAnalytics: Disruptive Technologies for Changing the Game”, MC Press, 2012

Name of the course	Internet of Things
Course Code: PEC(CS)705A	Semester: 7th
Duration: 6 month	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs/week	Mid Semester 2 Exam: 15 Marks
Practical: 0hrs/week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 mark)

Objective:	
1.	To understand the application areas of IOT .
2.	To realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
3.	To understand building blocks of Internet of Things and characteristics.

Pre-Requisite			
1.	Computer Networks [PC(CS/IT)617]		
Unit	Content	Hrs	Marks
1	Introduction: What is IoT,Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Physical design of IoT, Logical design of IoT, A simplified IoT Architecture.	7	
2	Major components of IoT: IoT enabling Technologies, Sources of IoT, M2M Communication, M2M Architecture, Difference between M2M and IoT,Data and Analytics for IoT,An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology.	8	
3	Smart Objects: The “Things” in IoT: Sensors,Actuators, and Smart Objects, Sensor Networks, Connecting Smart objects,Working Principles of sensors,Selection of Sensors for Practical Applications,Introduction of Different Types of Sensors such as Capacitive, Resistive, Surface Acoustic Wave for Temperature, Pressure, Humidity, Toxic Gas etc.	7	
4	IoT Physical Devices-Arduino Uno: Introduction to Arduino, Different versions of Arduino, Features and applications of Arduino, Basic concept of integration of Sensors and Actuators with Arduino.	8	
5	Recent trends in smart sensor for day to day life: Evolving sensors and their architecture. Real world applications for IoT: Industrial IoT, Connected Vehicles, Smart Grid, Agriculture,Healthcare, Smart Cities and Smart Homes.	6	

Course outcomes	
After completion of the course, a student would be able to:	
CO 1	Explain general concepts of Internet of Things (IoT).
CO 2	Construct various M2M and IoT architectures.
CO 3	Analyze the deployment of smart objects and the technologies to connect them to network..
CO 4	Evaluate design issues in IoT applications according the need for data analytics and security.
CO 5	Develop different sensor technologies for sensing real world entities.
Learning Resources:	
1.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome

	Henry,"IoTFundamentals:Networking Technologies, Protocols, and Use Cases for the Internet of Things".
2.	Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017 .
3.	Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L., Smart Sensors at the IoT Frontier, Springer International Publishing.
4.	Jeeva Jose, Internet of Things, Khanna Publishing House
5.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547)
6.	Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill

Name of the course		Distributed Database	
Course Code: PEC(CS)705B		Semester: 7th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory Contact Hrs.: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
TutorialContact Hrs.: 0 hrs./week		Mid Semester 2 Exam: 15 Marks	
PracticalContact Hrs.: 0 hts./week		Other Assessment tools (Assignment, Quiz etc.): 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To explain the basic principles of distributed database systems and its architectures		
2.	To evaluate the efficiency of distributed database design and the distributed query processing plans		
3.	To handle different concurrency control anomalies and maintain the reliability of distributed transactions		
Pre-Requisite			
1.	Database Management System [PC(CS/IT)512]		
2.	Computer Network [PC(CS/IT)617]		
Unit	Content	Hrs	Marks
1	Introduction: Concept of distributed data processing, basic idea of distributed database systems, homogenous, heterogenous and federated database, distributed database storge- fragmentation, replication and allocation, global schema and local schema, key advantages of distributed database- layers distribution transparency- fragmentation and replication transparency, reliability through distributed transactions, improved performance, complications of distributed database systems, reference architecture for distributed DBMS- client/server, peer-to-peer, and multidatabase systems, global directory issues in distributed DBMS.	8	
2	Distributed Database Design: Design issues for distributed database, design alternatives for distributed database- non replicated and non-fragmented, fully replicated, partially replicated, top down approach of distributed database design, reasons for data fragmentation, primary and derived horizontal fragmentation, vertical fragmentation mixed or hybrid fragmentation, correctness rules of fragmentation, data fragment allocation and its associated issues, bottom-up approach of distributed database design, view management-views in centralized and distributed database.	8	
3	Distributed Query Processing And Optimization: Basic concept, Query processing issues in distributed database, objectives of distributed query processing, different layers or phases of distributed query processing- query decomposition, data localization, global query optimization, distributed query execution, concept of distributed query optimization and its associated factors, distributed query optimization process and plans- operation, data and hybrid shipping, query trading, semi join based algorithms.	6	
4	Distributed Transaction Management And Concurrency Control : Concept of distributed transaction, goals of distributed transaction, distributed transaction processing issues, distributed concurrency control, concurrency control anomalies, distributed concurrency control algorithms- centralized 2PL, distributed 2PL, time stamp-based concurrency control algorithms- basic time stamp ordering, conservative time stamp ordering, mulit-version time stamp ordering.	6	
5	Reliability and Availability Aspects of Distributed Database Systems: Concept of reliability and its main problem areas for distributed database systems, types of failures- transaction failures, site Failure, media failure, communication failure, mean time between failures/mean time to repair, idea of local recovery manager, distributed reliability protocols- centralized 2PC, distributed 2PC, termination protocol for 2PC-coordinator and participant timeout, non-blocking commit protocol, network partitioning- checkpointing and cold restarts, voting based protocol.	8	
Course Outcome: After completion of this course the students will be able to -			
CO1: Explain the overall concept of distributed database systems and its different associated components			
CO2: Choose suitable design strategies for the distributed database systems in the aspects of data storage and views			
CO3: Analyze different query processing plans applicable for the distributed database systems			
CO4: Compare different types of concurrency control mechanisms related to distributed database transaction management systems			
CO5: Classify different types of failures as well as recovery techniques related to distributed database transaction systems			
Learning resources:			
1. Stefano Ceri, Guiseppe Pelagatti, “Distributed Databases: Principles and Systems”, McGraw Hill Education, Indian Edition, 2017.			

2. M. Tamer Ozsu, Patrick Valduriez, “Principles of Distributed Database Systems”, Springer, Third edition, 2011.
3. Saeed K. Rahimi, Frank S. Haug, “Distributed Database Management Systems: A Practical Approach”, Wiley-IEEE Computer Society, Aug, 2010, Print ISBN:9780470407455, Online ISBN:9780470602379, DOI:10.1002/9780470602379
4. Chhanda Ray, “Distributed Database Systems”, Pearson Education India, 1st Edition, Kindle Edition, 2009, ISBN-9788131727188, 8131727181.
5. Sachin Deshpande, “Distributed Databases”, Dreamtech Press, Kindle Edition, 2014, ISBN 13: 9789351197201

Name of the course		Computer Graphics	
Course Code: PEC(CS)705C		Semester: 7th	
Duration: 6 months		Maximum Marks: 100	
Teaching Scheme		Examination Scheme	
Theory: 3 hrs/week		Mid Semester 1 Exam: 15 Marks	
Tutorial: 0 hrs/week		Mid Semester 2 Exam: 15 Marks	
Practical: 0 hrs/week		Assignment, Quiz, Attendance: 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks (75 marks converted to 50)	
Objective:			
1.	To explain the need of computer graphics to prepare presentation and enhance information transfer.		
2.	To apply different techniques for preparing different picture.		
3.	To develop the concept of different shape drawing technique.		
Pre-Requisite			
1.	Mathematics I BS(CS/IT) 101		
2.	Mathematics II BS(CS/IT) 205		
Module	Content	Hours	Marks
1	Introduction to computer graphics & graphics systems : Overview of computer graphics, representing pictures, preparing, presenting & interacting with pictures for presentations; Visualization & image processing; RGB color model, direct coding, lookup table; storage tube graphics display, Raster scan display, 3D viewing devices, Plotters, printers, digitizers, Light pens etc.; Active & Passive graphics devices; Computer graphics software.	7	
2	Scan conversion: Points & lines, Line drawing algorithms; DDA algorithm, Bresenham’s line algorithm, Circle generation algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	7	

3	2D transformation & viewing: Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline, Window to view port co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.	10	
4.	3D transformation & viewing: 3D transformations: translation, rotation, scaling & other transformations. Rotation about an arbitrary axis in space, reflection through an arbitrary plane; general parallel projection transformation; clipping, view port clipping, 3D viewing.	8	
5	Curves: Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.	4	
Course outcomes			
After completion of the course, a student would be able to:			
CO 1	Understand the technique to represent and prepared picture.		
CO 2	Explain translation and rotation technique of point and line.		
CO 3	Design line, circle and ellipse drawing technique.		
CO 4	Understand clipping technique.		
CO 5	Design carve drawing algorithm		
Learning Resources:			
1.	Hearn, Baker – "Computer Graphics (C version 2nd Ed.)" – Pearson education		
2.	Z. Xiang, R. Plastock – " Schaum's outlines Computer Graphics (2nd Ed.)" – TMH		
3.	D. F. Rogers, J. A. Adams – "Mathematical Elements for Computer Graphics (2nd Ed.)" – TMH		
4.	Sanyal, Prajapati – " Computer Graphics and Multimedia" Pragati Prakashan		

Name of the course	Introduction to quantum computing
Course Code: PEC(CS)705D	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0 hr/week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs/week	Other Assessment tools (Assignment, Quiz etc.): 20 Marks
Credit Points: 3	End Semester Exam: 50 Marks (75 marks converted to 50)

Objectives:			
1.	To understand basic postulates of Quantum Mechanics & quantum state decomposition		
2.	To assess various quantum information processing techniques and concepts		
3.	To apply quantum algorithms to solve various simple problems.		
Prerequisites:			
1.	Design and Analysis of Algorithms PC(CS/IT)406		
Unit	Content	Hrs	Marks
1.	Introduction to Hilbert space: Linear space, Scalar product, Hilbert space, Self adjoint operator, Projection operator, Unitary operator.	3	
2.	Introduction to Quantum mechanics: Postulates of quantum mechanics, Uncertainty principle, Complementary principle, Unitary Dynamics, Detail study of two-level system. Multipartite quantum system, Quantum entanglement	3	
3.	Quantum state decomposition: Schmidt decomposition, Non-unique decomposition of mixed state, Hugston-Jozsa-Wooters theorem, No-Cloning Theorem, Distinguishing non-orthogonal quantum states, general quantum operations, Kraus representation theorem, various Quantum gates.	6	
4.	Quantum information processing: Quantum teleportation, Quantum dense coding, Remote state preparation, Quantum key distribution (Bennett-Brassard{1984} Protocol)	12	
5.	Quantum computing: Basic idea of quantum parallelism, Qubits, Some basic quantum algorithm, Deutschs algorithm, Deutsch-Jozsa algorithm, Simon's algorithm, Grover's search algorithm, Quantum Fourier Transform and Shor's factoring algorithm.	12	
Course Outcomes:			
CO1	Define Hilbert space and operators.		
CO2	Explain basic concepts of quantum mechanics		
CO3	Analyze Quantum state decomposition		
CO4	Assess fundamental quantum information processing concepts		
CO5	Design quantum algorithms to solve some simple problems		
Learning Resources:			
1.	Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang,		
2.	Presskil Lecture notes http://www.theory.caltech.edu/~preskill/ph229/.Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly& S.M. Durbin, The Mc Graw Hill		
3.	Organizational Behaviour Publisher – University of Minnesota		
4.	An Introduction to Quantum. Computing, Phillip Kaye,. Raymond La amme, and Michele Mosca. Oxford U. Press, New York, 2007.		
5.	Quantum Computer Science, N. David Mermin, Cambridge University Press 2007.		

Name of the course	Data Mining
Course Code:PEC(CS)705E	Semester: 7th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory: 3 hrs/week	Mid Semester 1 Exam: 15 Marks
Tutorial: 0hrs./week	Mid Semester 2 Exam: 15 Marks
Practical: 0 hrs./week	Assignment, quiz, Attendance: 10Marks
Credit Points: 3	End Semester Exam: 75 Marks

Objective:			
1.	It focuses on fundamental data mining concepts and techniques for discovering interesting from data in various applications		
2.	To extract knowledge from data repository for data analysis, frequent pattern, classification and prediction		
3.	To emphasize the techniques for developing effective, efficient, and scalable data mining tools		
4.	To learn new, advanced techniques for emerging applications (e.g. social network analysis, stream data mining)		
Pre-Requisite			
1.	DBMS , algorithms and basic knowledge of statistics and probability theory		
Unit	Content	Hrs	Marks
1	Introduction Data Mining Concept, Origin, Process, Applications, Techniques, Challenges	3	
2	Data Preprocessing Data types, Quality, Descriptive data summarization – central tendency and dispersion measure, Data cleaning, Data integration & transform, Data reduction	6	
3	Association Rule Mining Market-basket analysis basics, Naïve algorithm, Apriority algorithm, Direct Hashing and Pruning (DHP), Software for Association Rule Mining, Classification and Prediction: Decision Tree, Classification by decision tree induction, Bayesian classification, Rule-based classification, Prediction – Linear and Nonlinear Regression, Classification software.	6	
4	Cluster Analysis Types of data in cluster analysis, Partitioning methods, Hierarchical methods, Density-based methods, Quality & Validity of clustering methods Cluster analysis software	7	
5	Web Data Mining Web content mining, Web usage mining, Web structure mining, Hubs and Authorities, HITS algorithm, Web mining software, Text Mining, Support Vector Machine	7	
6	Data Mining Application & Information Privacy Applications and trends in data mining such as Web, finance, telecommunication, biology and medicine, science and engineering retail industry etc. Social impacts of data mining, information privacy and data security, IT Act overview	7	
Course Outcome			
After the completion of the course, a student will be able to:			
CO1	Understand warehousing architectures and tools for systematically organizing large database and use their data to make strategic decisions.		
CO2	Understand KDD(knowledge discovery from data) process for finding interesting pattern from warehouse		
CO3	Characterize the kinds of patterns that can be discovered by association rule mining.		
CO4	Discover interesting patterns from large amounts of data to analyze for predictions and classification.		
CO5	Develop a data mining application for data analysis using various tools		
Learning Resources			
1	Data Mining: Introductory and Advanced Topics, 1e by DUNHAM		
2	Data Mining - Concepts and Techniques 3rd Edition (English, Paperback, Jiawei Han, MichelineKamber, Jain Pei)		
3	Introduction To Data Mining And Analytics by Kris Jamsa, Jones & Bartlett		
4	Introduction to Data Mining 2e by PANG-NING TAN MICHAEL STEINBACH ANUJ KARPATNE VIPIN KUMAR		
5	Data Warehousing in the Real World: A Practical Guide for Building Decision Support Systems, 1e by ANAHORY		
6	Data Mining For Dummies by Meta S. Brown		
7	Data Mining and Data Warehousing: Principles and Practical TechniquesbyParteek Bhatia		
8	Introduction to Data Mining Paperback by Pang-Ning Tan, Michael Steinbach, Vipin Kumar		
9	Data Warehousing: Fundamentals for IT Professionals, 2ed Paperback by PaulrajPonniah		

B.Tech, CSE, 8th Sem Course Structure

8th SEM							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
PRACTICAL							
01	PROJ(CS)803	Project 3	0	0	16	16	08
		SESSIONAL					
01	CVV(CS)	Comprehensive Viva Voce	0	0	0	0	2
		TOTAL	0	0	16	16	10