Curriculum for B.Tech. in Information Technology

(Applicable from the academic session 2018-2019)

Department of Information Technology

Government College of Engineering & Ceramic Technology
(An Autonomous Institution under MAKUT)
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 1st 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.

COURSE STRUCTURE

1st SEMESTER							
Mandatory Induction Program- 3 Weeks duration							
SL. NO.	**TYPE OF COURSE**	**COURSE CODE**	**COURSE TITLE**	**HOURS PER WEEK**			**Credit**
				Lecture	**Tutorial**	**Practical**	
THEORY							
01	Basic Science course	BS(CS/IT) 101	Mathematics – I	3	0	0	3
02	Basic Science course	BS(CS/IT) 102	Physics	3	1	0	4
03	Engineering Science Course	ES(CS/IT) 101	Basic Electrical Engineering	3	1	0	4
SESSIONAL/PRACTICAL							
01	Basic Science course	BSL(CS/IT) 103	Physics Laboratory	0	0	3	1.5
02	Engineering Science Course	ESL(CS/IT) 102	Basic Electrical Engineering Laboratory	0	0	2	1
03	Engineering Science Course	ESL(CS/IT) 103	Engineering Graphics & Design	1	0	4	3
04		CLA(IT)-1	Comprehensive Laboratory Assessment	-	-	-	1
TOTAL				**10**	**2**	**9**	**17.5**

2nd SEMESTER							
SL. NO.	**TYPE OF COURSE**	**COURSE CODE**	**COURSE TITLE**	**HOURS PER WEEK**			**Credit**
				Lecture	**Tutorial**	**Practical**	
THEORY							
01	Basic Science course	BS(CS/IT) 204	Chemistry	3	0	0	3
02	Basic Science course	BS(CS/IT) 205	Mathematics – II	3	1	0	4
03	Engineering Science Course	ES(CS/IT) 204	Programming for Problem solving	3	0	0	3
04	Humanities & Social	HS(CT/IT/ CS)201	English	2	0	0	2

	Sciences including Management						
SESSIONAL/PRACTICAL							
01	Basic Science course	BSL(CS/IT) 206	Chemistry Laboratory	0	0	3	1.5
02	Engineering Science Course	ESL(CS/IT) 205	Programming for Problem solving Laboratory	0	0	4	2
03	Engineering Science Course	ESL(CS/IT) 206	Workshop /Manufacturing Practices	1	0	4	3
04	Humanities & Social Sciences including Management	HS(CT/IT/CS)202	Language Lab.	0	0	2	1
05		CLA(IT)-2	Comprehensive Laboratory Assessment	-	-	-	1
TOTAL				**12**	**1**	**13**	**20.5**

3rd SEMESTER

SL. NO.	PAPER CODE	PAPER NAME	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(IT)-3	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**15**	**1**	**12**	**28**	**23**
4th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	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 & Analysis of Algorithm	3	0	0	3	3
04	PC(CS/IT)407	Formal Language and Automata 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(IT)-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**
5th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
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 Oriented Programming	3	1	0	4	4
04	PEC(IT)501	Elective-I	3	0	0	3	3
05	MC(CS/IT)502	Constitution of India/ (Essence of Indian Traditional Knowledge)	2	0	0	2	0
SESSIONAL/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
03	CLA(IT)-5	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**14**	**3**	**9**	**26**	**20.5**
6th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	PC(CS/IT)617	Computer Networks	3	1	0	4	4
02	PC(CS/IT)618	Compiler Design	3	0	0	3	3
03	PEC(IT)602	Elective-II	3	0	0	3	3
04	OEC(IT/CS)601	Open Elective-I	3	0	0	3	3
05	HS(CS/IT)604	Industrial Management (Organizational Behavior/ Finance & Accounting	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PCL(CS/IT)619	Computer Network lab	0	0	3	3	1.5
02	PROJ(IT)601	Project 1	0	0	6	6	3
03	CLA(IT)-6	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**15**	**1**	**9**	**25**	**21.5**

7th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	PEC(IT)703	Elective-III	3	0	0	3	3
02	PEC(IT)704	Elective-IV	3	0	0	3	3
03	OEC(IT/CS)702	Open Elective II	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PROJ(IT)702	Project 2	0	0	12	12	6
02	PEC(IT)704 (A/B/C/D)L	Elective-IV Lab.	0	0	3	3	1.5
03	INDTR(IT)701	Industrial Training	0	0	0	0	1
04	CLA(IT)-7	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**11**	**0**	**15**	**24**	**18.5**

8th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRs./WEEK	CREDIT
THEORY							
01	PEC(IT)805	Elective-V	3	0	0	3	3
02	OEC(IT/CS)803	Open Elective-III	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PROJ(IT)803	Project 3	0	0	16	16	8
02	CVV(IT)802	Comprehensive Viva Voce	0	0	0	0	1
TOTAL			**6**	**0**	**16**	**22**	**15**

List of Electives (Professional and Open)

5TH SEMESTER

PEC(IT)501
A: Information Theory and Coding
B: Computer Graphics
C: Advanced Computer Architecture
D: Computational Geometry

6TH SEMESTER

PEC(IT)602
A: Software Engineering
B: Cryptography and Network Security
C: Multimedia Systems
D: Wireless Communication

OEC(IT/CS)601
A: Optimization Techniques
B: Digital Communication
C: Cyber Law and Security Policy
D: Control System

7TH SEMESTER

PEC(IT)703
A: Machine Learning
B: Distributed Systems
C: Cloud Computing
D: Real Time Operating Sys.

PEC(IT)704
A: Web Technology
B: Internetworking
C: Pattern Recognition
D: Natural Language Processing

OEC(IT/CS)702
A: VLSI Design and Algorithm
B: Digital Signal Processing
C: Management Information Sys.
D: Big Data Analytics

8TH SEMESTER

PEC(IT)805
A: E-Commerce
B: Data Mining
C: Mobile Communication
D: Internet of Things
E: Data Science

OEC(IT/CS)803
A: Image Processing
B: Software Project Management
C: Social Network Analysis
D: Quantum Computing
E: Bioinformatics

FIRST YEAR FIRST SEMESTER

1st SEMESTER							
Mandatory Induction Program- 3 Weeks duration							
SL. NO.	**TYPE OF COURSE**	**COURSE CODE**	**COURSE TITLE**	**HOURS PER WEEK**			**Credit**
				Lecture	**Tutorial**	**Practical**	
THEORY							
01	Basic Science course	BS(CS/IT) 101	Mathematics – I	3	0	0	3
02	Basic Science course	BS(CS/IT) 102	Physics	3	1	0	4
03	Engineering Science Course	ES(CS/IT) 101	Basic Electrical Engineering	3	1	0	4
SESSIONAL/PRACTICAL							
01	Basic Science course	BSL(CS/IT) 103	Physics Laboratory	0	0	3	1.5
02	Engineering Science Course	ESL(CS/IT) 102	Basic Electrical Engineering Laboratory	0	0	2	1
03	Engineering Science Course	ESL(CS/IT) 103	Engineering Graphics & Design	1	0	4	3
04		CLA(IT)-1	Comprehensive Laboratory Assessment	-	-	-	1
TOTAL				**10**	**2**	**9**	**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	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)

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 Outcome: 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	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 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 Outcome: 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 three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction	8	
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	6	

	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.		
Course Outcome: 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	
Module	**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 would be able to-			
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	**Examination 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

Module	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 Synchronous 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 would be able to-			
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	**Examination 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

Module	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 technologiesthat impact on graphical 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	2L+8P	

	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.		
9	Demonstration of a Simple Team Design Project Geometry and topology of engineered components: creation of 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).	2L+8P	

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

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

FIRST YEAR SECOND SEMESTER

2nd SEMESTER							
SL. NO.	**TYPE OF COURSE**	**COURSE CODE**	**COURSE TITLE**	**HOURS PER WEEK**			**Credit**
				Lecture	**Tutorial**	**Practical**	
THEORY							
01	Basic Science course	BS(CS/IT) 204	Chemistry	3	0	0	3
02	Basic Science course	BS(CS/IT) 205	Mathematics – II	3	1	0	4
03	Engineering Science Course	ES(CS/IT) 204	Programming for Problem solving	3	0	0	3
04	Humanities & Social Sciences including Management	HS(CT/IT/ CS)201	English	2	0	0	2
SESSIONAL/PRACTICAL							
01	Basic Science course	BSL(CS/IT) 206	Chemistry Laboratory	0	0	3	1.5
02	Engineering Science Course	ESL(CS/IT) 205	Programming for Problem solving Laboratory	0	0	4	2
03	Engineering Science Course	ESL(CS/IT) 206	Workshop /Manufacturing Practices	1	0	4	3
04	Humanities & Social Sciences including Management	HS(CT/IT/ CS)202	Language Lab.	0	0	2	1
05		CLA(IT)-2	Comprehensive Laboratory Assessment	-	-	-	1
TOTAL				**12**	**1**	**13**	**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	6	

	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 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. 2nd 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	Semester End Exam: 75 Marks (Two third weightage for final reckoning i.e., 50 marks)
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,	8	

	Storage classes, Dynamic Memory Allocation, Recursion.		
7	Pointers Introduction, Definition and Declaration of pointers, address operator, Pointer variables, Pointers with Arrays.	5	
8	Structures and Unions Introduction, Declaration and Initialization, Array of Structures, Unions.	3	
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	4	

	• Masculine & Feminine • Singular & Plural		
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 • Comprehension • English Translation — Mother tongue to English & vice versa	6	
5	Communication Skill — incorporation of presentation skill & negotiation skilll • 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 and 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	Attendance: 10
Tutorial: Nil	Preparation of Lab Report: 20
Practical: 2hrs./week	Experimental data/ Precision of work done: 30
Credit Points: 1	Presentation/ analysis of the result: 20
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	6	

	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.		
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.

SECOND YEAR FIRST SEMESTER

3rd SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	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(IT)-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: 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	End Semester Exam: 50 Marks

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.	To create 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.	Engineering Mathematics (UG level)

Module	**Content**	**Lecture Hours**	
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:

After completion 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	Narsingh Deo, 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	Raisinghania M.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,Murray Spiegel,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,Mc Graw 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	Behrooz Parhami" 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**	**Lecture Hours**	
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	10	

	connection to binary trees and stack sortable permutations ;Comparison of performance of Heap, array and insertion priority queues.		
5	**Hashing:** Chaining, probing, Universal hashing function and analysis of various hashing methods.	6	
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,	6	

	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.		
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, Nominal & Effective Interest rate. Different Interest Formulae and their application.	5	
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.	Partha Chatterjee: 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.	

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	**Identify** the 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, Srinivas Arukonda, Monu Singh, Tapasya Dinkar, 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.	Reema Thareja, Python Programming- Using Problem Solving Approach, OUP India, ISBN: 9780199480173

SECOND YEAR SECOND SEMESTER

4th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	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 & Analysis of Algorithm	3	0	0	3	3
04	PC(CS/IT)407	Formal Language and Automata 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(IT)-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: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid Term Exams: 30 Marks
Tutorial: 1 hr./week	Assignments , Quiz etc.: 20 Marks
Credit Points: 4	End Semester Exam: 50 Marks

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.	Engineering Mathematics (UG level)

Module	**Content**	**Lecture Hours**	
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,	10	

	Rings, Integral Domain and Fields. Boolean algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function.		
5	**Module 5: Graph Theory:** 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.	8	

Course Outcomes: After completion of this course, the learners will be able to –	
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**	**Lecture Hours**	
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, Dhanpat Rai 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**	**Lecture Hours**	
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	10	

	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.		
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 & Naresh Jotwani, 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.	

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	Introduction to the source code writing, compilation and execution process of C++ programme. Writing C++ Programme using I/O stream, command line arguments. Basic loop control, functions with CBV and CBR, identification of variables with scope resolution operator.	03	
2	Programme writing on classes, creation of objects, constructors and destructors,accessing members, array of objects, accessing of static members.	03	
3	Programme writing on function overloading, constructor overloading and defaultconstructor, Object passing as function arguments and returning of objects from functions.	03	
4	Programme writing on friend functions, local classes., dynamic initialization of objects.	03	
5	Programme writing on copy constructor, operator overloading - binary and unaryoperators. operator overloading using friend functions.	03	
6.	Programme writing on derived classes, implementation of single inheritance, multilevel inheritance, hierarchical inheritance with constructor calling sequence.	06	
7.	Programme writing on multiple inheritances, constructor calling in derived classes, virtual base classes.	03	
8.	Programme writing on abstract classes, pointer to objects, this pointer, pointers to derivedclass.	06	
9.	Programme writing on virtual functions and run time polymorphism.	03	
10.	Programme writing on basic Class and Function templates.	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 Bajarne Stroustrup
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**	5	

	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		
3	**Eco Systems** a) Concept of an eco system: Understanding ecosystems, Ecosystem degradation, Resource utilisation 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)	5	
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	6	

	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	**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.	Anubha Kaushik, C.P. Kaushik, Perspectives in environmental studies, New Age International (P) Ltd, Publishers
2.	Erach Bharucha, 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.	Shashi Chawla, A Textbook of Environmental Studies, Tata McGraw Hill Education Private Limited.

THIRD YEAR FIRST SEMESTER

5th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
THEORY							
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 Oriented Programming	3	1	0	4	4
04	PEC(IT)501	Elective-I	3	0	0	3	3
05	MC(CS/IT)502	Constitution of India/ (Essence of Indian Traditional Knowledge)	2	0	0	2	0
SESSIONAL/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
03	CLA(IT)-5	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**14**	**3**	**9**	**26**	**20.5**

PEC(IT)501
A: Information Theory and Coding
B: Computer Graphics
C: Advanced Computer Architecture
D: Computational Geometry

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: S**cheduling 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 - Mukesh Singhal 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: PC(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, 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.	13	
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.	Elmasri Ramez and Navathe Shamkant, "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	Implement inheritance, 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	**INFORMATION THEORY AND CODING**
Course Code: PEC(IT)501 A	**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
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, etc. : 20 Marks
	End Semester Exam: 50 Marks

Objectives :

1.	To understand basic Information Theory.
2.	To apply information theory for understanding channel performance.
3.	To learn different error detection and correction codes.

Pre-Requisites :

1.	Mathematics II [BS(CS/IT)205]
2.	Communication Engineering [ES(CS/IT)409]

Module	**Content**	**Hrs.**	**Marks**
1	**Information Theory :** Review of probability theory, Uncertainty and Information, Self and Mutual Information, Entropy, Mathematical Properties of the Entropy Function.	4	
2	**Source Coding Theorem :** Entropy and Coding, Shannon-Fano Coding, Variable-Length Codes: Unique Decoding, Instantaneous Codes, Construction of Instantaneous Codes, Prefix tree for prefix code, The Kraft Inequality, Huffman codes.	6	
3	**Channel Capacity and Coding :** Channel models, channel capacity, channel coding and information capacity theorems, The Shannon limit.	5	
4	**Error Control Coding :** Introduction, Matrix description of linear block codes, parity check matrix, Encoding and decoding of Linear Block-codes, Syndrome Decoding, Hamming Codes. Cyclic Codes, Polynomials, Method for generating Cyclic Codes, Matrix description of Cyclic codes, Golay codes.	11	
5	**BCH Codes :** Properties of BCH codes, minimal polynomials, generator polynomials, check polynomials, examples of BCH codes, Reed Solomon Code.	5	
6	**Convolutional Codes :** Introduction, Polynomial description of Convolutional Codes, Generating function, Matrix description of Convolutional Codes, Viterbi Decoding of Convolutional codes, Trellis codes.	5	

Course Outcomes:
After completion of this course students will be able to-

CO1	Define the basic notions of information and channel capacity.
CO2	Explain the properties of various error control code.
CO3	Apply information theory to explain channel performance.

CO4	Implement linear block codes and cyclic codes for error detection and correction
CO5	Design BCH & Convolution codes for the improvement of Channel performance against burst errors.
Learning Resources:	
1.	Information theory, coding and cryptography - Ranjan Bose; TMH.
2.	Introduction to Error Control Codes – S Gravano; Oxford.
3.	Coding and Information Theory – R. W. Hamming; Prentice Hall.
4.	Information and Coding Theory - G. A. Jones and J. M. Jones ; Springer – Verlag.
5.	Essentials of Error-Control Coding – Jorge C. Moreira and Patrick G Farrell; Wiley.

Name of the course	**Computer Graphics**
Course Code: PEC(CS/IT)501B	**Semester: 5th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exams: 30 Marks
Credit Points: 3	Assignment, Quiz etc. : 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)
Objective:	
1.	To understand the basic concepts of various elements of graphics systems and underlaying software.
2.	To understand different scan conversion algorithm and curve generating algorithm to generate graphics on graphics systems.
3.	To comprehend various transformation techniques and apply the same on 2D and 3D graphics.
4.	To describe various color models and lighting conditions.
5.	To understand various clipping and surface removal techniques.
Pre-Requisite:	
1.	Mathematics-I(BS(CS/IT)-101)
2.	Discrete Mathematics(BS(CS/IT)-408)

Module	Content	Hrs.	Marks
1	**Introduction to Computer Graphics & Graphics Systems** Overview of CG, definitions of CG, types of CG, storage tubes display, CRT technologies– Raster Scan Display, Computer graphics software.	4	
2	**Scan Conversion** Points & lines, Line drawing algorithms; DDA algorithm, Bresenham's line algorithm, Circle generating algorithm; Ellipse generating algorithm; scan line polygon, fill algorithm, boundary fill algorithm, flood fill algorithm.	4	
3	**2D Transformation** Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, transformations between coordinate systems; reflection shear; Transformation of points, lines, parallel lines, intersecting	6	

	lines.		
4	**Viewing** Viewing pipeline, Window to Viewport co-ordinate transformation, clipping operations, point clipping, line clipping, clipping circles, polygons & ellipse.	4	
5	**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, Viewport clipping, 3D viewing, perspectives & Depth Cueing.	6	
6	**Curves and Fractals** Curve representation, surfaces, designs, Bezier curves, B-spline curves, end conditions for periodic B-spline curves, rational B-spline curves.	4	
7	**Hidden Surfaces** Depth comparison, Z-buffer algorithm, Back face detection, BSP tree method, the Printer's algorithm, scan-line algorithm; Hidden line elimination, wire frame methods, fractal - geometry.	4	
8	**Color & Shading Models** Introduction, Modeling Light Intensities and Sources, Diffuse Reflection, Lambert's Cosine Law, Specular Reflection, Halftoning, Color Models - RGB Color, CMY Color.	4	
Learning Resources:			
1	Computer Graphics (C version) – Hearn D, Baker M P, Pearson.		
2	Computer Graphics –A programming Approach– Harrington, Steven; McGraw Hill		
3	Computer Graphics – principles and practice - Foley, Van Dam, Feiner and Huges; Pearson.		
4	Computer Graphics, Multimedia and Animation – Pakhira Malay K ; PHI Learning Pvt. Ltd.		
Course Outcomes: After completion of this course the students will be able to -			
CO1	Explain basic working principle of graphics systems and hardware.		
CO2	Develop programs to implement drawing, filling and clipping algorithms and solve transformation and clipping problems.		
CO3	Identify the curves and make use of fractal geometry.		
CO4	Examine operations on 3D graphics system and solve the problems of hidden surface removal on 3D graphic systems.		
CO5	Identify various colour, light, material and shadow models.		

Name of the course	**Advanced Computer Architecture**
Course Code: PEC(CS/IT)501C	**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: 50 Marks		
Objective:			
1.	To make students know about the Parallelism concepts in Programming		
2.	To give the students an elaborate idea about the different memory systems and buses.		
3.	To introduce the advanced processor architectures to the students.		
4.	To make the students know about the importance of multiprocessor and multicomputers.		
5.	To study about data flow computer architectures.		
Pre-Requisite:			
1.	Principles of digital electronics		
2.	Microprocessor & Microcontroller		
3.	Web Technology		
Module	**Content**	**Hrs.**	**Marks**
1	**Module 1:** Introduction to High Performance Computing Pipeline Processing : Pipeline Performance, design of arithmetic pipelines Pipeline hazards – structural hazards, data hazards, control hazards & their solutions Pipeline scheduling Theory: Greedy pipeline scheduling algorithm – Static and Dynamic Pipelining. Parallel Processing, Taxonomy of Parallel Architectures : 1) SISD, 2) SIMD, 3) MIMD, 4) MISD, Amdahl's Law and parallel speed up.	12	
2	**Module2:** RISC architecture, RISC VS CISC, VLIW architecture Vector and Array Processors, Super-scalar machines,Distributed computing architectures, Data flow architectures.	7	
3	**Module3:** Interfacing : Peripheral interfacing, Interfacing a microprocessor with memory and various I/O controllers.	5	
4	**Module4:** Advanced Memory Technology : SRAM, SDRAM, Flash memory, Dual port memory, Cache memory. Memory interleaving, virtual memory.	8	
5	**Module5:** Introduction to FPGA and Reconfigurable architecture.	4	
Learning Resources:			
1	M. R. Bhujade, "Parallel Computing", Newage International Pvt. Ltd., 1995.		
2	Stallings William, "Computer organization and architecture, designing for performance", Prentice Hall of India, 1997		
3	J. L. Hennessy and D. A. Patterson, "Computer architecture: a quantitative approach", Harcourt Asia, Singapore 1996		
4	Hwang and Briggs, ―Computer Architecture and Parallel Processing‖, TMH.		
5	Hayes, ―Computer Architecture and Organization‖, McGraw-Hill.		
6	Hwang, ―Advanced Computer Architecture‖, McGraw-Hill.		
7	Kain, ―Advanced Computer Architecture: a system Design approach‖, PHI.		
8	Flynn, ―Computer Architecture‖, New Age Computer Network		
9	Parhami – Computer Architecture, Oxford University Press		
Course Outcomes: After successful completion of this course students will be able to-			

CO1	Demonstrate concepts of parallelism in hardware/software.
CO2	Discuss memory organization and mapping techniques.
CO3	Describe architectural features of advanced processors.
CO4	Interpret performance of different pipelined processors.
CO5	Explain data flow in arithmetic algorithms
CO6	Development of software to solve computationally intensive problems.

Name of the course		**Computational Geometry**	
Course Code: PEC(IT)501D		**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	
		Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objectives :			
1.	To implement convex hull, triangulation, and closest pair algorithms		
2.	To understand and apply Voronoi diagrams		
3.	To assess various data structures associated with range queries.		
4	To apply visibility and robot motion planning algorithms.		
Pre-Requisites :			
1.	Data structure and Algorithms [PC(CS/IT)302]		
2.	Design and Analysis of Algorithm [PC(CS/IT)406]		
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction to Geometric preliminaries and Convex Hull:** Introduction, Geometric preliminaries. Convex Hulls: Convex Hull Algorithms in the Plane - Graham's Scan Algorithm, Jarvi's March, Divide and Conquer Algorithm. Line Segment Intersection (using plane sweep), Doubly linked edge list, Overlay subdivisions. Triangulations: Polygon Triangulation (Triangulating monotone polygons, Partitioning monotone polygons). Convex Partitioning.	10	
2	**Voronoi diagram: A**lgorithms, closest pair problems. Delaunay triangulations: algorithms (divide-and-conquer, flip, incremental), duality of Voronoi diagrams, properties (min-max angle).	7	
3	**Searching:** Orthogonal Search: Geometric data structures; Range search (Quad-tree, kd-tree), Improvements on range searching (Range tree, fractional cascading), Inverse Range Search (Segment tree, interval tree, priority search tree) Geometric searching: point-location, 2d linear programming with prune and search.	9	
4	**Visibility:** Algorithms for weak and strong visibility, visibility with reflections,	6	

	art-gallery problems. Arrangements: Zones (Duality, line arrangements; many-faces complexity, incremental algorithm, zone theorem), algorithms.		
5	**Robot Motion Planning:** Geometric Applications: Robot Motion Planning (Trapezoidal Maps, point robots, Translational Motion Planning), Computing the Visibility Graph.	4	
Learning Resources:			
1	M. de Berg, M. van Kreveld, M. Overmars, and O. Schwarzkopf. Computational Geometry: Algorithms and Applications. Springer-Verlag, 2nd edition, 2000.		
2	Franco P. Preparata and Michael Ian Shamos, Computational geometry: An Introduction, 1 st edition, Springer-Verlag New York.		
Course Outcomes: After successful completion of this course students will be able to-			
CO1	Implement Convex hulls, line segment, and triangulation algorithms		
CO2	Illustrate Voronoi diagrams, Delaunay triangulation, and closest pair of points.		
CO3	Identify appropriate Range Search data structures for various range queries.		
CO4	Identify appropriate Range Search data structures for various range queries.		
CO5	Devise various Robot motion planning algorithms.		

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	05	

	Remedies. Directive Principles of State Policy. Fundamental Duties.		
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, Lok Sabha, Rajya Sabha. 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,Latika Shekhar.
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- Alexandru Calcatinge, 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.		
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.		
Course Outcomes: After completion of this course the students will be able to -			
CO1	Implement java programs with data protection, method overloading, object independent class member accessing features and string handling operations.		
CO2	Demonstrate nested structuring of java classes and their name conflict resolving issues		
CO3	Implement inheritance, 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

THIRD YEAR SECOND SEMESTER

6th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
THEORY							
01	PC(CS/IT)617	Computer Networks	3	1	0	4	4
02	PC(CS/IT)618	Compiler Design	3	0	0	3	3
03	PEC(IT)602	Elective-II	3	0	0	3	3
04	OEC(IT/CS)601	Open Elective-I	3	0	0	3	3
05	HS(CS/IT)604	Industrial Management (Organizational Behavior/ Finance & Accounting	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PCL(CS/IT)619	Computer Network lab	0	0	3	3	1.5
02	PROJ(IT)601	Project 1	0	0	6	6	3
03	CLA(IT)-6	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**15**	**1**	**9**	**25**	**21.5**

PEC(IT)602
A: Software Engineering
B: Cryptography and Network Security
C: Multimedia Systems
D: Wireless Communication

OEC(IT/CS)601
A: Optimization Techniques
B: Digital Communication
C: Cyber Law and Security Policy
D: Control System

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: 3 hrs/week	Two Mid term Exam: 30 Marks
Tutorial: 1 hours/week	Assignment & Quiz: 10 Marks
Practical:	Term paper: 05 Marks
Credit Points: 4	Presentation on selected topics: 05 Marks
	End Semester Exam: 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.	

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.	4	7
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.	4	10
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.	8	20
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 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.	10	20

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.	8	17
6	**Application Layer :** Introduction to DNS, SMTP, SNMP, FTP, HTTP & WWW;	5	10
7	**Security:** Attacks, Cryptography, Firewalls, IDS & IPS, Malware, IP and transport layer security, DMZ.	3	10
8	**Modern topics:** ISDN services & ATM, DSL technology, Wireless LAN, Bluetooth, VPN.	2	6

Course Outcomes:
After completion of the course students will 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	Asses different routing models for computer network and IP addressing
CO4	Asses quality of services (Qos) in Transport layer and services using client server paradigm.
CO5	Investigate different security protocols and different encryption mechanism
CO6	solution of Real life problems for designing IP addressing of net and subnet of network cluster

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	**Software Engineering**	
Course Code: PEC(IT)602A	**Semester: 6th**	
Duration: 6 months	**Maximum Marks: 100**	
Teaching Scheme	**Examination Scheme**	
Theory: 3 hrs/week	Mid Term I Exam:	15 Marks
Credit Points: 3	Mid Term II Exam:	15 Marks
	Class performance & Attendance:	20 Marks
	End Semester Exam & Viva:	50 Marks

Objective:

1.	To understand different software process models.
2.	To analyze software testing activities.
3.	To determine software reliability and quality.
4.	To assess different tools for software project management.

Pre-Requisite:

1.	Data Structures & Algorithms -PC(CS/IT)302		
2.	Mathematics III-BS(CS/IT)307		
Module	**Content**	**Hrs.**	**Marks**
1	**Information System:** Software Engineering –Objectives, Definitions, Software development life cycle, Software Process models – Waterfall Model, Spiral model, Agile model. Software Requirements (SRS), Feasibility Analysis.	6	
2	**Software Design:** Context diagram and DFD, Physical and Logical DFDs, Data Dictionary, ER diagrams, Decision tree, decision table and Structure chart, Structured English.	4	
3	**Software Testing:** Levels of Testing, White-box and Black-box Testing, Test Case Generation, Acceptance Testing, Software Validation, Regression Testing, Mutation Analysis, Cyclomatic complexity.	10	
4	**Reliability:** Reliability concept, Software Reliability, Hazard, MTTF, MTBF, Repair and Availability.	4	
5	**Software Quality:** Quality attributes, Risk Management, McCall's quality factors, Software Quality Assurance, quality standards, Total Quality Management.	4	
6	**Software Project Management:** Software Project Planning, Project Scheduling, Software Configuration Management, Cost estimation-COCOMO, function point analysis, Halstead metric, Project management tools- WBS, Gantt chart, PERT, Critical Path Method.	8	
Course Outcome: After completion of the course students will able to -			
CO1	Select different software development process models.		
CO2	Develop the software architecture/design using design tools.		
CO3	Apply different testing and debugging techniques.		
CO4	Analyze software risks, reliability and failure.		
CO5	Determine the concept software quality.		
CO6	Implement different tools for software project management.		
Learning Resources:			
1	Software Engineering: A practitioner's approach– R.G. Pressman (TMH)		
2	Software Engineering- I. SomerVille(Pearson Education)		
3	Software Engineering- Rajib Mall (PHI)		
4	Software Engineering –Agarwal and Agarwal (PHI)		
5	Software Engineering- Pankaj Jalote (Wiley-India)		
6	Fundamentals of Software Engineering- C. Ghezzi, M. Jazayeri and D. Mandrioli(PHI)		
7	Software Engineering Fundamentals- Behforooz(OUP)		

Name of the course	**Cryptography and Network Security**
Course Code: PEC(IT)602B	**Semester: 6th**
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
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To learn the main concepts of cryptography, its services and classical encryption techniques.
2.	To understand the block ciphers concept, Festal structure and symmetric key cryptography.
3.	To study the number theory and basic principles of public key cryptosystems.
4.	To study Message Authentication Codes and Digital Signature
5.	To learn Key distribution problem, Kerberos, remote user authentication
6.	To study the concept of security association, System security and Web security.

Pre-Requisite

1.	Computer Network (PC(CS/IT)617)

Module	Content	Hrs.	Marks
1	**Introduction:** Overview, Need for Security, attacks, services and mechanism, introduction to cryptography. Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, stream and block ciphers, Cryptanalysis, Steganography.	4	
2	**Symmetric key Cryptography:** Block Cipher principle, Feistel structure, The Data Encryption Standard, Strength of DES, Triple DES, Block Cipher modes of operations, IDEA encryption and decryption, RC5 algorithm, Overview of AES.	8	
3	**Asymmetric key Cryptography:** Principles of Public key Cryptography Systems, Knapsack Cryptosystem. Euler's Totient Function, Fermat's Little Theorem, Euler's Theorem, Extended Euclidean Algorithm. RSA Cryptosystem. Elliptic curve cryptography.	8	
4	**Message Authentication and Hash Function**: Authentication requirements, authentication functions, message authentication code, Hash functions- MD5 & SHA 1(algorithm), birthday attacks. Digital Signatures and digital signature standards (DSS).	5	
5	**Key Management and Security protocols:** Key Distribution Centre, Diffie-Hellman Key Agreement, Man in the middle attack. Network Authentication Protocol: Kerberos. Certificate based Authentication-X.509. Electronic mail security: Pretty Good Privacy, S/MIME.	5	
6	**System Security:** IP Security: Framework, AH, ESP. Web Security: SSL and TLS, Secure Electronic Transaction. Firewalls: Packet filters, Application-Level Gateway, Encrypted tunnels.	6	

Learning Resources:	
1	Behrouz A. Forouzan, Cryptography and Network Security, Tata McGraw-Hill. 2010
2	William Stallings, Cryptography and Network Security, Pearson Education, 2014
3	Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, PHI, 2002
4	Johannes A. Buchmann, Introduction to Cryptography, Springer-Verlag.
5	Atul Kahate, Cryptography & Network Security, TMH.
6	B. Schneier, Applied Cryptography, Protocols, Algorithms, and Source Code in C, 2nd Edn, Wiley, 1995.
Course Outcomes: After completion of this course students will be able to-	
CO1	Explain the services of cryptography and various classical encryption techniques.
CO2	Illustrate Feistel structure and write Symmetric key cryptographic algorithms.
CO3	Explain number theory and Asymmetric key cryptographic algorithms.
CO4	Apply Cryptographic Hash Functions and verify messages using well known signature generation techniques.
CO5	Analyse Key Management, Authentication and Email Security.
CO6	Evaluate Security Association, Transport Layer and Application layer Security.

Name of the course	**Multimedia Systems**
Course Code: PEC(IT/CS) 602C	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exam: 30 Marks
Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To study the concept of multimedia
2.	To study text, audio, computer graphics as components of multimedia
3.	To study animation, image and video processing in multimedia
4.	To study lossless and lossy compression techniques
5.	To study multimedia database
Pre-Requisite:	
1.	Communication Engineering EC(CS/IT)409

Module	**Content**	**Hrs.**	**Marks**
1	**Introduction:** : Multimedia Components and Structure, Hardware and Software Specifications, Application Domains, uses of multimedia, Analog and digital media, digitization, Visual Display Systems: Cathode Ray Tube, Liquid Crystal Display, Plasma Display	3	8

2	**Text:** Types of Text, Font, ASCII Character Set, Unicode, File Formats, Text compression, Text file format	3	10
3	**Audio:** Concept of Sound, Components of audio systems, Data acquisition, Sampling and Quantization, Audio file formats, Audio tools, Audio processing software, MIDI	3	10
4	**Image**: Image acquisition and representation, Colour models (Device Dependent and Device Independent), Image Processing, File Formats	5	12
5	**Computer Graphics:** Components of graphics system, 2D and 3D modelling, Graphics file formats, Fractals	3	10
6	**Animation:** Principles of animation, Computer based animation, 3D animation, Rendering Algorithms, File format, Animation software	4	10
7	**Video:** Video Frame, Frame Rate, Composite video signal NTSC, PAL and SECAM Video Standards, Formats, Digital Video, Steps of Video Processing and Software	4	10
8	**Compression:** Lossy and Lossless Compression, Run Length encoding, Huffman Encoding, Arithmetic Encoding, Differential Pulse Code Modulation, JPEG image compression standard, MPEG video compression, H.261	4	10
9	**Synchronization**: Intramedia and Intermedia Synchronization, Jitter, Skew, Delay, Error rate, Quality of Service	4	8
10	**Image and Video Database:** Image representation, segmentation, similarity based retrieval, image retrieval by color, shape and texture; indexing- k-d trees, R-trees, quad trees; Case studies- QBIC, Virage, Video Content, querying, video segmentation, indexing	5	12

Learning Resources:

1.	Ralf Steinmetz and Klara Nahrstedt, Multimedia: Computing, Communications & Applications, Pearson Ed.
2.	Parekh Ranjan, Principles of Multimedia, Mc Graw Hill. 3. Koegel Buford, Multimedia Systems, Pearson Ed.
3.	Ralf Steinmetz and Klara Nahrstedt, Multimedia Fundamentals: Vol. 1- Media Coding and Content Processing, PHI.
4.	Nalin K. Sharda, Multimedia Information System, PHI.
5.	J. Jeffcoate , Multimedia in Practice: Technology and Application , PHI.

Course Outcomes:
After completion of this course students will be able to-

CO1	Investigate different multimedia systems, components and applications
CO2	Assess different multimedia components like text, audio, video and image.
CO3	Design animation using multimedia knowledge
CO4	Investigate colour model and conversion
CO5	Apply computer graphics for multimedia
CO6	Explore different database and their architecture used in multimedia
CO7	Design different multimedia applications

Name of the course:	**WIRELESS COMMUNICATION**
Course Code: PEC(IT)602D	**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.: Nil	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 analyze different communication technologies used in wireless communication systems.
2.	To study cellular communication systems.
3.	To study wireless local area networks
4.	To compare different modern wireless communication systems

Pre-Requisite:

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

Module	Content	Hrs.	Marks
1.	Introduction to wireless communication and wireless network, Examples & comparison of different wireless communication systems, Evolution of Mobile radio communication, Multiplexing, Modulation Techniques, Spread Spectrum modulation(FHSS, DSSS), Multiple access techniques(FDMA,TDMA,CDMA).	08	20
2.	Cellular concept and architecture: GSM Network Architecture, GSM call set up procedure, Authentication and security, Routing of a call to a mobile subscriber. CDMA based cellular network	10	30
3.	Fundamentals of Wireless Networks (WLAN) WLAN transmission Technology, WLAN system architecture, IEEE 802.11standard. Wireless Media Access Control: Wireless Issues, ALOHA, Carrier Sense Multiple Accesses with Collision Avoidance, Mobile IP and Wireless Access Protocol.	08	20
4.	Introduction to satellite communication, Satellite communication subsystems, transponder, satellite link(uplink & downlink)	04	10
5.	Recent advances in wireless communication: Wide Band (UWB) communication, Wireless Fidelity (Wi-Fi) systems; Wireless Sensor networks, Bluetooth technology, Cognitive Radio Network	06	20

Course Outcomes:

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

CO1	apply the basic concepts of communication Engineering to study different wireless communication system.
CO2	apply the basic knowledge of computer networks for analysis of mobile communication networks
CO3	explain the satellite communication network and the link parameters
CO4	explain different modulation and multiple access technologies applied to different wireless communication systems
CO5	analyze the evolution of modern communication systems and their features.

Learning Resources:	
1.	T. S. Rappaport, "Wireless Communications: Principles & Practice," Prentice-Hall.
2.	I.Saha Misra, “Wireless Communications and Networks, 3G and beyond” TMH.
3.	W.Stallings, “Wireless Communications and Networks” PHI.
4.	Satellite Communication – D.C Agarwal, Khanna Publications, 5th Ed

Name of the course	**OPTIMIZATION TECHNIQUES**
Course Code: OEC(IT/CS)601	**Semester: 6th**
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.	To understand the basic concepts of optimization and solve linear programming problems.
2.	To introduce the concept of game theory
3.	To execute Johnson’s algorithm to solve scheduling problem
4.	To understand basic concept of queuing theory
5.	To calculate project implementation time using both probabilistic and deterministic method.
6.	To solve problems using dynamic programming method and non-linear programming techniques.

Pre-Requisite:	
1.	Discrete Mathematics BS(CS/IT)408
2.	Design & Analysis of Algorithm PC(CS/IT)406

Module	**Content**	**Hrs.**	**Marks**
1	**Introduction to Optimization & Linear Programming:** Historical Development, Engineering application of Optimization, Classification of optimization problems, Introduction to linear programming, formulation of linear programming model, Graphical method for solving LPPs with 2 variables, Simplex method, Duality in Linear Programming, Transportation problem, Assignment problems.	12	
2	**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	
3	**Sequencing Models:** Johnson’s Rule and its logic, method of solution, Two machines and n jobs (no passing), Three machines and n jobs (no passing), Two jobs and m machines, n jobs and m machines.	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.	4	
5.	**PERT/CPM:** Introduction to Network analysis, definition of a project, job and events, drawing of arrow diagrams, Project management origin and use of PERT, origin and use of CPM, Application of PERT and CPM, Project Network, Diagram representation, Critical path calculation by network analysis and critical path method (CPM), Determination of floats, Construction of time chart and resource labelling.	5	
6.	**Dynamic Programming & Non-Linear Programming:** Basic Concepts, Bellman's optimality principles, Dynamic programming approach in decision making problems, Unconstrained optimization techniques, Direct search methods – Fibonacci Search Method, Golden section Search Method.	5	

Course Outcomes:
After completing of the course, student will be able to-

CO1	Solve LPP using different techniques.
CO2	Apply various method to solve game problems.
CO3	Solve different sequencing problems.
CO4	Explain basic concept of queuing theory.
CO5	Analyze project management problem using PERT and CPM.
CO6	Apply dynamic programming and non-linear programming to solve various problems.

Learning Resources:

1.	S.S. Rao, "Engineering optimization: Theory and practice", New Age International (P) Limited, ISBN : 9788122427233
2.	H. A. Taha, "Operations Research", Pearson, ISBN : 9780134444017
3.	Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency, ISBN : 9780198538646
4.	J. K. Sharma - "Operations Research", Macmillan Publishing Company, ISBN : 9781403931511
5.	NVR Naidu, G Rajendra, T Krishna Rao, "Operations Research", I K International Publishing house, New Delhi, ISBN : 9789380578941
6.	Kanti Swaroop — "Operations Research", Sultan Chand & Sons, ISBN : 9789351610236
7.	S.D.Sharma, "Operations Research" ,KedarnathRamanath& Co, ISBN : 9789380803388
8.	A.M. Natarajan, P. Balasubramani and A. Tamilarasi - "Operations Research", Pearson, ISBN : 9789332526471
9.	M. V. Durga Prasad – "Operations Research", CENGAGE Learning, ISBN : 9788131516256

Name of the course:	**Digital Signal Processing**
Course Code:OEC(IT/CS)702B	**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: 4	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:

1.	To understand the properties of different type of discrete time signals and systems
2.	To apply different mathematical tools for frequency domain analysis of discrete time signals.
3.	To design different types of digital filters and compare their performances

Pre-Requisite:

1.	Communication engineering (ES(CS/IT)409)

Module	Content	Hrs.	Marks
1	**Discrete-time signals** Concept of discrete-time signal, basic idea of sampling, sampling theorem, sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.	4	
2	**LTI Systems** Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical and analytical methods to compute convolution supported with examples and exercises, properties of convolution, stability and causality conditions	6	
3	**Z-Transform** Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, inverse Z-transform	6	
4	**Discrete Fourier Transform** Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.	9	
5	**Fast Fourier Transform** Radix-2 algorithm, decimation-in-time, decimation-in-frequency FFT algorithms.	5	
6	**Digital Filter** Basic concepts of IIR and FIR digital filters. design of Butterworth IIR filter using impulse invariant and bilinear transformation method, design of FIR filter using window method.	6	

Course Outcomes:

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

CO1	compare the characteristics of different discrete time signals and systems.
CO2	describe Z transform of discrete time sequences and its properties.
CO3	apply the concepts of sampling in frequency domain for computing DFT and IDFT of discrete time sequences.
CO4	compare the performance of different Fast Fourier Transform(FFT) techniques.
CO5	design different types of Digital Filters.

Learning Resources:	
1.	Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis&D.G.Manolakis, Pearson Ed.
2.	Digital Signal Processing, P. Rameshbabu, Scitech Publications (India)
3.	Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co
4.	Digital Signal Processing, S.Salivahanan, A.Vallabraj& C. Gnanapriya, TMH Publishing Co

Name of the course	**Cyber Law and Security Policy**
Course Code: OEC(IT/CS)601C	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hours/week	Mid Semester Exams: 30 Marks
Credit Points: 3	Assignment, Quiz, Surprise tests, Presentations, Attendance etc.: 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To provide with the basic understanding of cyberspace and Cyber Securitycyber laws and knowledge of security related to various attacks.
2.	To understand the concept of cybercrime and its types.
3.	To comprehend the basics of various attack techniques.
4.	To take preventive measures against various attacks.
5.	To provide the basic understanding of cyber laws and legal perspective of cybercrimes.
Pre-Requisite:	
1.	Computer Network

Module	**Content**	**Hrs.**	**Marks**
1	**Introduction to Cyber Security:** Defining Cyberspace, Architecture, Regulation of cyberspace, Concept of Cyber Security, Importance of cyber security and cybersecurity strategy; Perspective of cyber security policy, National Cyber Security Policy (2013). Overview of Cyber-attack, Cyberwarfare (Cyber espionage and sabotage), Cyberterrorism.	5	
2	**Cybercrime:** Cybercrime and its evolution, Cybercrime categories, Cybercrimes- targeting computer and mobiles (virus, worm, Trojan horse, backdoors), ransomware, Fraud and Financial Crimes; Cybercrime on Mobile Phones: Security challenges in mobile devices, cryptographic security for mobile devices, Attacks on Mobile phones (Mishing, Smishing, Vishing, Mobile Malicious Code)	10	
3	**Tools and Techniques Used in Cybercrime:** Planning the attack, Use of proxies and Tunnelling techniques (cover up), Fraud Techniques (Phishing, Rogue Antivirus, Click Fraud), Identity Theft, Botnets, Buffer Overflows, SQL Injection, DoS and DDoS attacks, Keylogger	10	

	and spyware; Cyberstalking, Social Engineering, Hacking(Ethical/ Hacktivism)		
4	**Cyber Strategy and Security policy:** Need and building of a cyber strategy, cyber attack and cyber defense strategies, cybersecurity strategies for business, Protecting the network: IDS/IPS, Firewall.	5	
5	**Cyber Law:** The Legal perspective of cybersecurity and cybercrime, The Indian IT Act, IT Act 2000: Challenges, Digital Signature and ITA 2000, Amendments to IT Act.	6	
Learning Resources:			
1	Godbole, Nina, and Sunit Belapure. "Cyber Security." Wiley India, New Delhi (2012).		
2	Graham, James, Ryan Olson, and Richard Howard, “Cyber security essentials”. CRC Press, 2016.		
3	Wu, Chwan-Hwa John, and J. David Irwin. “Introduction to computer networks and cybersecurity”. CRC Press, 2016.		
4	Kremling, Janine, and Amanda M. Sharp Parker. “Cyberspace, cybersecurity, and cybercrime”. SAGE Publications, 2017.		
5	Alexandrou, Alex. “Cybercrime and Information Technology: The Computer Network Infrastructure and Computer Security, Cybersecurity Laws, Internet of Things (IoT), and Mobile Devices”. CRC Press, 2021.		
Course Outcomes: After completion of the course the students will be able to-			
CO1	Explain the concepts of cyberspace, Cybersecurity and its perspectives, National policy on cybersecurity, Cyberattack, Cyberwarfare and Cyberterrorism..		
CO2	Identify various types of attacks related to cyberspace and the cybercrimes targeting computer and mobiles.		
CO3	Differentiate the tools and techniques used in cybercrime.		
CO4	Develop cyber security strategies for businesses to prevent different cyberattacks and network intrusion.		
CO5	Explain legal issues of cybercrime, Indian IT Act 2000, its amendments and the provision of digital signature in ITA2000.		

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 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 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.			
Module	**Content**	**Hrs.**	**Marks**
1.	**Human resource Management:** Introduction of Human Resource Management, recruitment and selection, performance appraisal, industrial, trade , collective bargaining.	03	
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	05	
3.	**Quality management:** concepts, dimensions for goods and services, cost of quality, statistical quality control, control , acceptance sampling, total quality management, new quality tools	05	
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	04	
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)	06	
7.	**Budget analysis:** union and State budget analysis of the concerned year, budget at a glance, annual financial statement economic survey of concerned year	04	
Course Outcomes: After completion of this course the students will be able to -			
CO1	**analyse** different management techniques and schools of Management		
CO2	**analyse** about different quality control methods and organisational behaviour		
CO3	**create** strategic management in future		
CO4	**comprehend** and analyse accounts and its related management		
CO5	**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.k JaJain, S Chand		
4.	Organisational behaviour- 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**
Theory:	Continuous Evaluation
Tutorial:	Experiment:50
Practical: 3 hrs/week	Lab copy:30
Credit Points: 1.5	Viva:20

Objective:

1.	To study the components of computer network
2.	To configure MAC, IP and subnet
3.	To implement socket programming
4.	To configure different server
5.	To implement real life application of client server paradigm

Pre-Requisite

1.	Basic knowledge of communication engineering

Module	Content	Hrs.	Marks
1	NIC Installation & Configuration (Windows/Linux)	1	5
2	Understanding IP address, subnet, MAC address, IP configuration	2	5
3	Networking cables (CAT5, UTP), Connectors (RJ45, T-connector)	1	5
4	Physical verification of existing LAN	2	5
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	50
6	Server Setup/Configuration FTP, Telnet, DNS.	6	10
7	Firewall configuration in client level	3	5
8	Mini project: Multiple user chat server implementation	6	15

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

CO1	Investigate configuration of existing LAN
CO2	Investigate and 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

Name of the course	**Project 1**
Course Code: PROJ(IT)601	**Semester: 6th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 6 hours/week	Internal Evaluation: 80 Marks
Credit Points: 3	End Semester (External) Exam: 20 Marks

Objective:	
1.	To provide with the basic understanding of computer science and knowledge of proficient different techniques.
2.	Familiar with technical documentations and research articles related to some engineering problem.
3.	Put in order a systematic literature survey on some engineering problem and existing solutions.
4.	Evaluate the scholarly articles.
Pre-Requisite:	
(As required)	
Learning Resources:	
(As required)	
Course Outcomes: After completion of this Project 1 the students will be able to -	
CO1	Analyze technical documentations and research articles related to some engineering problem.
CO2	Evaluate the scholarly articles with peer members as a team.
CO3	Organize a systematic literature survey on some engineering problem and existing solutions
CO4	Demonstrate the knowledge, skills and attitudes of a professional engineer during presentation.
CO5	Defend the arguments of research articles cited in survey report during presentations.

FOURTH YEAR FIRST SEMESTER

7th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
THEORY							
01	PEC(IT)703	Elective-III	3	0	0	3	3
02	PEC(IT)704	Elective-IV	3	0	0	3	3
03	OEC(IT/CS)702	Open Elective II	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PROJ(IT)702	Project 2	0	0	12	12	6
02	PEC(IT)704(A/B/C/D)L	Elective-IV Lab.	0	0	3	3	1.5
03	INDTR(IT)701	Industrial Training	0	0	0	0	1
04	CLA(IT)-7	Comprehensive Laboratory Assessment	0	0	0	0	1
TOTAL			**11**	**0**	**15**	**24**	**18.5**

PEC(IT)703
A: Machine Learning
B: Distributed Systems
C: Cloud Computing
D: Real Time Operating Sys.

PEC(IT)704
A: Web Technology
B: Internetworking
C: Pattern Recognition
D: Natural Language Processing

OEC(IT/CS)702
A: VLSI Design and Algorithm
B: Digital Signal Processing
C: Management Information Sys.
D: Big Data Analytics

Name of the course	**MACHINE LEARNING**
Course Code: PEC(IT)703A	**Semester: 7th**
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
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, etc. : 20 Marks
	End Semester Exam: 50 Marks

Objectives :	
1.	To understand and implement existing learning algorithms
2.	To employ probability, statistics, calculus and linear algebra in order to develop new predictive models for learning methods
3.	To select and apply an appropriate learning algorithm for problems of different kinds, including classification, regression, structure prediction and clustering.
4.	To Formulate real-world problems involving data, such that they can be solved by machine learning.
Pre-Requisites :	
1.	Mathematics I [BS(CS/IT)101], Mathematics II [BS(CS/IT)205], Mathematics III [BS(CS/IT)307].
2.	Programming knowledge in Python [PCL(CS/IT)305]

Module	**Content**	**Hrs.**	**Marks**
1	**Introduction:** Basic definitions, types of learning. Probability and Bayes learning, Framework for Developing Machine Learning Models, Prepare the Data for Machine Learning Algorithms, Data Cleaning, Handling Text and Categorical Attributes, Handling Missing Values, Exploration of Data using Visualization, Types of Machine Learning Systems.	4	10
2	**Linear Regression:** Linear regression, Multivariate regression, Decision trees, Gradient Descent Algorithm for Linear Regression Model, Multi-collinearity, Logistic Regression.	4	10
3	**Supervised Learning** : Types of classifiers, Binary Classifier, Naive Bayes Classifier, Multiclass, Multi-label and Multi-output Classifier, Decision Trees, Ensembles of Decision Trees: Random Forests, Support Vector Machines, Model Evaluation and Improvement.	6	20
4	**Dimensionality Reduction :** Dimensionality Reduction, Feature Extraction, and Manifold Learning, Principal Component Analysis (PCA), Randomized PCA, Incremental PCA, Kernel PCA, Selecting a Kernel and Tuning Hyper-parameters.	5	12
5	**Unsupervised Learning:** Different clustering algorithms, Partitive, Hierarchical and Density based clustering, Clustering for big data,Compare the Clusters Created by K-Means and Hierarchical Clustering, Anomaly Detection using Gaussian Mixtures, Assessment Metrics for Clustering Algorithms.	5	20
6.	**Reinforcement Learning :** Introduction, model free and model based RL,	4	10

	RL algorithms – Q learning, State-Action-Reward-State-Action (SARSA) etc.		
7.	**Neural Network :** Introduction, Multilayer network, Perceptron Learning, Backpropagation, Initialization, Training & Validation, Parameter Estimation - MLE, MAP, Bayesian Estimation, Introduction to Deep Neural Network, Convolution Neural Network and Recurrent Neural Network.	8	18

Course Outcomes: After completion of this course students will be able to-	
CO1	Explain the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
CO2	Explain a wide variety of learning algorithms.
CO3	Apply the underlying mathematical relationships to Machine Learning algorithms.
CO4	Analyze different learning algorithms like supervised, un-supervised and reinforcement learning.
CO5	Select algorithm (neural network) for specific application.
CO6	Design and implement various machine learning algorithms in a range of real world applications.
Learning Resources:	
1.	Tom Mitchell, Machine Learning , McGraw Hill Education.
2.	M. Mohri, A. Rostamizadeh, A. Talwalkar, Foundation of Machine Learning, MIT Press.
3.	Christopher Bishop. Pattern Recognition and Machine Learning. 2e, Springer.
4.	S. S. Shwartz and S. B. David, Understanding Machine Learning : From Theory to Algorithms, Cambridge University Press, 2014.
5.	I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, MIT Press.
6.	V.S. Devi; M.N. Murty, Pattern Recognition: An Introduction, Universities Press,Hyderabad, 2011.
7.	R. O. Duda, P. E. Hart and D. G. Stork, Pattern Classification, Wiley, 2000

Name of the course	**DISTRIBUTED SYSTEMS**
Course Code: PEC(IT)703B	**Semester: 7th**
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
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To learn the principles, architectures, algorithms and models used in distributed systems.
2.	To give an understanding of the principles and techniques behind the design of distributed systems, such as message passing, coordination, synchronization and fault tolerance.
3.	To understand the issues involved in a virtual uniprocessor system of multiple computers along with a distributed shared memory.

4.	To provide an exposure conceptually into the design and functioning of existing distributed systems		
Pre-Requisite:			
1.	Operating Systems [PC(CS/IT)511]		
2.	Computer Networks [PC(CS/IT)617]		
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction:** Introduction to DCS, DCS design goals, Design issues, Transparencies, Examples and trends in distributed system, Challenges, Architectural models.	4	
2	**Inter-process communication:** Basic Message Passing Model, Issues in IPC by message, RPC basics, The RPC Model, RPC implementation, RPC communication protocols, Lightweight RPC.	6	
3	**Distributed Coordination:** Temporal ordering of events, Lamport's logical clocks, Vector clocks, Ordering of messages, Physical clocks, Global state detection.	5	
4	**Distributed System Synchronization:** Distributed Mutual Exclusion, Election Algorithms, Deadlocks in Distributed Systems, Termination detection.	7	
5	**Distributed Shared Memory:** DSM Concepts, Architecture, Design and Implementation Issues, Algorithms for implementing DSM. Memory Coherence, Heterogeneous and other DSM systems.	4	
6	**Fault Tolerance:** Failure Models, Process Resilience, Reliable Client Server and Group Communications, Distributed Commit Protocols, Check-pointing and Recovery	5	
7	**Distributed File System:** DFS definition, Characteristics, Goals, DFS Design, DFS Implementation, File Caching and Replication in DFS.	5	
Learning Resources:			
1	Andrew S. Tanenbaum and Maarten V Steen, Distributed Systems Principles and Paradigms, PHI.		
2	Coulouris, G. et al, Distributed Systems: Concepts and Design, 3rd Edition, Addison Wesley.		
3	P. K. Sinha, Distributed Operating Systems: Concepts and Design, IEEE press.		
4	Singhal Mukesh & Shivaratri N. G., Advanced Concepts in Operating Systems, TMH		
5	**Tanenbaum, A. S. Distributed Operating Systems, Prentice Hall.**		
6	Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge University Press.		
Course Outcomes: After successful completion of this course, the learners will be able to -			
CO1	Illustrate the design goals, issues and challenges associated and the architecture of a distributed system.		
CO2	Demonstrate the knowledge of details of message passing system and RPCs of distributed environment.		
CO3	Apply important methodologies in distributed systems to support coordination and synchronization of such systems.		
CO4	Explain the architecture, design issues, implementing algorithms and coherences of Distributed Shared Memory.		
CO5	Analyze the implementation and underlying concepts of file caching and replication in distributed		

	file system.
CO6	Discern the issues related with faults in a distributed system to suggest basic measures.

Name of the course		**CLOUD COMPUTING**	
Course Code: PEC(IT)703C		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Semester Exam: 15 Marks	
Tutorial:		Assignment & Quiz: 10 Marks	
Practical:		Attendance: 05 Marks	
Credit Points:		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the concept of cloud computing.		
2.	To introduce the various levels of services that can be achieved by cloud.		
3.	To describe the security aspects in cloud.		
4.	To solve a real-world problem using cloud computing.		
5.	To appreciate the emergence of cloud as the next generation computing paradigm.		
Pre-Requisite:			
1.	Operating System		
2.	Computer Networks		
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction to Cloud Computing:** Cloud Computing (NIST Model),Properties, Characteristics & Disadvantages	3	
2	**Cloud Computing Architecture:** Cloud computing stack, Service Models, Deployment Models	5	
3	**Infrastructure as a Service (IaaS):** Introduction to IaaS, Resource Virtualization, Case study on IaaS	6	
4	**Platform as a Service (PaaS):** Introduction to PaaS, Cloud Platform and Management, Case study on PaaS.	5	
5	**Software as a Service(SaaS):** Introduction to SaaS, Web services, Web 2.0, Web OS, Case Study on SaaS	5	
6.	**Service Management in Cloud Computing:** Service Level Agreements (SLAs),Billing & Accounting,Comparing Scaling Hardware: Traditional vs. Cloud, Economics of scaling: Benefitting enormously, Managing Data	6	
7	**Cloud Security:** Infrastructure Security,Data security and Storage,Identity & Access Management,Access Control, Trust, Reputation, Risk, Authentication in cloud computing, Client access in cloud, Cloud contracting Model, Commercial and business considerations	6	
Learning Resources:			

1	Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
2	Cloud Computing: Principles and Paradigms, Editors: Rajkumar Buyya, James Broberg, Andrzej M. Goscinski, Wile, 2011
3	Cloud Computing: Principles, Systems and Applications, Editors: Nikos Antonopoulos, Lee Gillam, Springer, 2012
4	Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
5	Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley-India, 2010
6	Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill, rp2011.
Course Outcomes: After completion of this course, the learners will be able to	
1	Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
2	Compare the advantages and disadvantages of various cloud computing platforms.
3	Deploy applications over commercial cloud computing infrastructures.
4	Select the appropriate technologies and approaches for implementation and use of cloud.
5	Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
6	Identify security and privacy issues in cloud computing.

Name of the course		**REAL TIME OPERATING SYSTEM**	
Course Code: PEC(IT)703D		**Semester: 7th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hrs/week		Mid Term I Exam:	15 Marks
Credit Points: 3		Mid Term II Exam:	15 Marks
		Class performance & Attendance:	20 Marks
		End Semester Exam & Viva:	50 Marks
Objective:			
1.	To understand the structure and properties of real time operating system.		
2.	To understand resource management activities in Real time operating system.		
3.	To apply different techniques for process management and memory management in RTOS.		
4.	To implement RTOS models.		
Pre-Requisite:			
1.	Operating Systems		
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction to RTOS** Overview of Architecture of OS, Virtual Computers, Interaction of O.S. & hardware architecture, Distributed real-time systems, multiprocessor real-time	6	

	systems.		
2	**Architecture of RTOS** Defining Real time systems, designing and Developing Real-time Systems, Special Characteristics of real time systems, Hard Real Time System and Soft Real Time System, Interrupts and Exceptions, Concepts of interrupt driven activation, need for real time monitor, pseudo parallelism, meeting of deadlines & real time constraints, Real-Time Devices, Event driven activities, Timers and Real-time Facilities.	8	
3	**Resource management** Resource management in real-time systems, potential problems and their resolution, issues in building real-time systems. Resource sharing in real-time systems.	6	
4	**Process Management** Multitasking in Real-Time Systems, Real Time Scheduling concepts. Uniprocessor scheduling, Multiprocessor Scheduling, schedulable analysis, clock-driven and priority-driven scheduling Process Synchronization, Inter-task communication Networking,	6	
5	**Memory management** Memory space protection, Memory allocation schemes, deallocation, large virtual address space, memory protection.	4	
6	**Implementation model** Overview of WARD & MELLOR Methodology: Ward & Mellor Life Cycle, the essential model step, the, real time extensions of DFD Real time languages: overview of ADA/Java Extension	6	

Course Outcome:
After completion of the course students will able to-

CO1	Review different types of Operating systems, their basic structure and features.
CO2	Select the architecture of real time operating system.
CO3	Analyze the resource management in real time operating system.
CO4	Determine the process management in real time operating system.
CO5	Evaluate the memory management in real time operating system.
CO6	Develop different real time implementation models.

Learning Resources:

1	*"Real Time Systems,"*- C.M. Krishna and G. Shin, -McGraw-Hill International Edition
2	"Real Time Systems and software" -Alan C. Shaw; John Wiley & Sons Inc
3	"Real time Systems", J. W. S. Liu, Pearson
4	"Embedded and real time operating systems" ---K.C. Wang- Springer
5	"Building a real time operating system" ---Colin Walls. - Newnes publication
6	"Real time operating system books" –Jim Cooling

Name of the course	**WEB TECHNOLOGY**
Course Code: PEC(IT)704A	**Semester: 7th**

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
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To understand the web-based technologies and able to apply the appropriate one to design web-based applications.
2.	To apply different web design tools & techniques for developing web application.
3.	To understand the underlying architecture of web-based applications.
4.	To solve the common ecommerce site design and maintenance problems.

Pre-Requisite:	
1.	Object Oriented Programming [PC(CS/IT)513]
2.	Database Management System [PC(CS/IT)512]

Module	**Content**	**Hrs.**	**Marks**
1	**Module1: Introduction to Web Application** Web Client, Web server, Web Application Architecture, Web Client-Server Request-Response Paradigm, Server-side Technologies: Common Gateway Interface, JEE Overview, JEE Architecture.	3	
2	**Module2: Web Pages** Static, Dynamic and Active Web Pages, Overview of HTML, CSS and Bootstrap, Java Applets: Applet Life Cycle, Applet API, Graphics and Event Handling in Applet.	5	
3	**Module3: JavaScript** Variables, Expressions, Control Statements, Arrays, Objects, Functions, Events and Validations, Regular Expressions.	4	
4	**Module4: XML** Introduction to XML, Document Type Definition and its attributes and entities, Namespaces and Schema, XSLT.	3	
5	**Module5: JDBC** Introduction to Java database connectivity, JDBC Drivers, Establishing connection, Executing query, Result processing, Database Metadata, Working with PreparedStatemnt, Callable Statement.	3	
6	**Module6: Java Servlet** Server-side programming, Servlet API, The Servlet Architecture, The Servlet Life Cycle, GET and POST, Servlet Life Cycle methods, Processing form data, Database connectivity through servlet, ServletConfig and ServletConext, Servlet chaining.	6	
7	**Module7: Java Server Pages** Introduction to JSP, Life Cycle of a JSP Page, JSP Elements: Directives, Scripting Elements, JavaBeans, Implicit Objects and Scope.	6	

8	**Module8: Cookies and Session Management** The Contents of a Cookie, Types of Cookies, Creating Cookies using Servlet, Lifecycle of HTTP Session, Session Tracking with Servlet API, Working with a Session.	4	
9	**Module9: Enterprise Java Beans** Introduction to EJB, Enterprise Bean Architecture, Benefits of Enterprise Bean, Types of Enterprise Bean, Writing Enterprise Beans.	4	

Course Outcomes: After completion of this course the students will be able to -	
CO1	Differentiate among various types of web application development technologies.
CO2	Design the front end of any web application with the help of associated technologies.
CO3	Apply the skills related to client side validation technique and able to recognize different types of document type definition in web design.
CO4	Work with different database management system and also be able to perform different CRUD operations.
CO5	Create dynamic web pages and also be able to develop server side scripting for server side processing.
CO6	Apply user sessions in dynamic web project and also be able to design business logic.
Learning Resources:	
1	Java EE for Beginners, Sharanam Shah, SPD Publications
2	Beginning Java EE 5: From Novice to Professional, Mukhar and Zelenak, Apress
3	Professional Java Server Programming, Allamaraju, WROX Publishers
4	Java Server Programming Java EE 7 (J2EE 1.7), Kogent Learning Solutions Inc.

Name of the course	**INTERNETWORKING**
Course Code: PEC(IT)704B	**Semester: 7th**
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
	Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:	
1.	To build an understanding of the fundamental concepts of layered protocol stack, Internet administration, architecture and interconnection..
2.	To give an understanding of the general principles behind different addressing schemes, routing, network diagnostics, address translation.
3.	To cover the issues involved in different Internet related protocols and connection oriented services to support network applications and QoS.
4.	To provide an exposure on the issues of different applications, network-management and network-security.

Pre-Requisite:			
1.	Computer Networks [PC(CS/IT)617]		
Module	**Content**	**Hrs.**	**Marks**
1	**An Overview of the Internet:** Introduction, The need and scope, Accessing the Internet, Protocol Layering, OSI-ISO, Intranet and Internet, The TCP/IP Internet, Internet services, Internet Architectural model, Internet standards and administration.	3	
2	**Internetworking Concepts:** Review of Network technologies: WAN, Switching Network; ISDN and ATM services, DSL technologies, Interconnection through IP Gateways or routers.	4	
3	**Internet Addressing:** Introduction, Universal identifiers, Classful and classless IP addresses, CIDR, Multicast addressing, Special addresses, subnet and supernet addressing, Mapping internet addresses to physical addresses (ARP), IPv6.	5	
4	**Routing:** Table driven IP routing, Default Routes, The origin of Gateway routing tables, Core Routers, Distance Vector (Bellman-Ford) routing, Link State Routing, Autonomous system concept, Interior Gateway Protocol (RIP, OSPF), An Exterior Gateway Protocol: BGP, Routing with partial information, MPLS.	7	
5	**Internet Protocols:** The concept of Connectionless delivery system, The Internet Datagram, Error and control messages: ICMP; NAT. The concept of connectionless and connection oriented transport layer services: UDP datagram, TCP services and segments, TCP congestion control and QoS, SCTP.	7	
6	**Internet Security and Firewall:** IP Security: IPSec, Security Association, AH, ESP; SSL: Architecture, implementation (four protocols), Use of SSL; Introduction to Firewall, Types and configuration of firewall, squid (proxy), VPN, DMZ.	6	
7	**Internet Servers and Applications:** DNS, DHCP, FTP, SSH, HTTPS and E-Mail.	4	
Learning Resources:			
1	Internetworking with TCP / IP - Douglas E .Comer; PE.		
2	Computer Networks and Internets - Douglas E. Comer; PE.		
3	TCP/IP protocol suite - Forouzan Behrouz A; TMH.		
4	Communication Networks - Leon-Garcia-Widjaja; TMH.		
5	Computer Networks – Andrew S. Tanenbaum; PHI.		
5	Data and Computer Communication - William Stallings; PHI.		
Course Outcomes: After completion of the course students will able to-			
CO1	Analyze the fundamental issues, challenges and basic working methodologies of both intranet and the Internet.		
CO2	Apply the fundamental concepts of different addressing schemes and their translation.		
CO3	Compare the philosophy and implementation of different routing and their corresponding algorithms.		
CO4	Apply key networking protocols considering their hierarchical relationship in the context of TCP/IP framework.		

CO5	Analyze different security threats and vulnerabilities in the domain of internetworking and the required measures to mitigate the threat.
CO6	Demonstrate the working principle and the server implementation of some common applications.

Name of the course		**Pattern Recognition**	
Course Code: PEC(IT)704C		**Semester: 7th**	
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	
		Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objective:			
1.	To learn the main concepts of the design and construction and a pattern recognition system.		
2.	To understand the the major approaches in statistical and syntactic pattern recognition. The student should also have some exposure to the algorithm theoretical issues involved in pattern recognition system design such as the curse of dimensionality.		
3.	Analyze the performance of different clustering algorithm on big data set based on classification rate.		
Pre-Requisite:			
1.	The students have a working knowledge of calculus, linear algebra, and probability theory. A basic knowledge of Matlab will be useful		
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction :** The nature of statistical pattern recognition; Three learning paradigms; The sub-problems of pattern recognition; The basic structure of a pattern recognition system; Comparing classifiers.	6	
2	**Bayes Decision Theorem** : Bayes classifier; Linear and non linear discrimination functions,Optimal decisions; Minimum error rate classification; error probability.	6	
3	**Parametric approaches** Basic statistical issues; Sources of classification error; Bias and variance; Three approaches to classification: density estimation, regression and discriminant analysis; Empirical error criteria; Optimization methods; Failure of MLE.	6	
4	**Parametric Estimation** : Maximum Likelihood estimation,Gaussian mixture models ,Expectation-maximization method, Baysian estimation, Hidden markov model .	6	
5	**Nonparametric Techniques:** Parzen window method, Nearest Neighbor method.	4	
6	**Feature Selection:** Class Seperability Measures- Divergence, Scatter Matrices, dimensionality reduction, similarity measures, feature selection criteria and algorithms, principal component analysis.	8	

Course Outcomes: After completion of this course students will be able to-
CO1: Understand the various techniques and algorithms involved in pattern recognition research.
CO2: Categorize the various pattern recognition techniques into supervised and unsupervised.
CO3: Illustrate the artificial neural network based pattern recognition.
CO4: Apply pattern recognition techniques to real-world problems such as document analysis and recognition.
CO5: Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.
Learning Resources:
1.Duda, R.O., Hart, P.E., and Stork, D.G. Pattern Classification. Wiley-Interscience. 2nd Edition. 2001.
2. S.Theodoridis and K.Koutroumbas, Pattern Recognition, 4th Ed., Academic Press, 2009
3. J.T.Tou and R.C. Gonzalez:Pattern Recognition Principles,Addison-Wesley,London.
4.Marsland, S. Machine Learning: An Algorithmic Perspective. CRC Press. 2009. (Also uses Python.)
5. Bishop, C. M. Pattern Recognition and Machine Learning. Springer. 2007.
6.Theodoridis, S. and Koutroumbas, K. Pattern Recognition. EditionAcademic Press, 2008.
7.Russell, S. and Norvig, N. Artificial Intelligence: A Modern Approach. Prentice Hall Series in Artificial Intelligence. 2003.
8.Bishop, C. M. Neural Networks for Pattern Recognition. Oxford University Press. 1995.
9.Hastie, T., Tibshirani, R. and Friedman, J. The Elements of Statistical Learning. Springer. 2001.
10. Koller, D. and Friedman, N. Probabilistic Graphical Models. MIT Press. 2009.
GeneralLinks: Pattern Recognition: Pattern Recognition Course on the Web (by Richard O. Duda).

Name of the course:	**VLSI Design and Algorithm**
Course Code: PE (IT) 702D	**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.	Basic idea about MOS transistor models and fundamental idea about CMOS inverter.
2.	Able to realize the dynamic and static power dissipation of CMOS.
3.	Basic idea about Placement & Routing mechanism of CMOS VLSI circuit.
4.	Idea about Verification and Testing of CMOS circuit, Types of testing, Fundamental idea about FPGA.
5.	Basic idea about Computer aided design tools for digital systems.
6.	Combinational and Sequential Circuit design using VHDL.

Pre-Requisite:			
1.	Physics (CS/IT 102)		
2.	Computer Architecture (IT 507)		
Module	**Content**	**Hrs.**	**Marks**
1.	**Introduction to CMOS:** MOS Structure, MOS Transistor models: NMOS, PMOS and CMOS Logic, Enhancement & Depletion Transistor, Threshold Voltage, MOS device design equations, the inverter, MOS transistor switches. NMOS Inverter and Transfer Characteristics, pull up and pulldown ratios of NMOS, Alternative forms of pull up the CMOS Inverter and transfer characteristics. CMOS Inverter Delays. Combinational Logic, NAND gate, NOT Gate, Compound Gates, Multiplexers, Memory-Latches and Registers.	08	
2.	**Power Dissipation:** Static dissipation, Dynamic dissipation, short-circuit dissipation, total power dissipation.	02	
3.	**Placement & Routing:** Mincut based placement – Iterative improvement placement simulated annealing. Segmented channel routing – maze routing – routability and routing resources.	04	
4.	**Verification and Testing:** Verification: logic simulation design validation – timing verification – Testing concepts: failures – mechanisms and faults – fault coverage – ATPG methods – types of tests – FPGAs – programmability failures – design for testability.	05	
5.	**Introduction to Computer aided design tools for digital systems:** Hardware description languages, Introduction to VHDL. Design Methods: Behavioural Synthesis, RTL synthesis. Introduction to behavioral, dataflow and structural models.	15	
6.	**Applications of VHDL**: Combinational Circuit Design such as Multiplexers, Encoders, Decoders, Code Converters, Comparators, and Implementation of Boolean functions etc., Sequential Circuit Design such as Shift registers, Counters etc.	04	
Course Outcome: After completion of this course the students will be able to -			
CO1	Analize the MOS transistor models and fundamental idea about CMOS inverter.		
CO2	Compare to realize the dynamic and static power dissipation of CMOS.		
CO3	Evaluate the Placement & Routing mechanism of CMOS VLSI circuit.		
CO4	Classify the basic idea about Verification and Testing of CMOS circuit.		
CO5	Design Combinational and Sequential Circuit using VHDL.		
Learning Resources:			
1.	CMOS Digital Integrated Circuit, S.M.Kang & Y .Leblebici ; TMH.		
2.	Algorithm for VLSI Design & Automation ; N.Sherwani, Kluwer .		
3.	Principle of CMOS VLSI Design, Weste and Eshrighian ; Pearson Education.		
4.	Modern VLSI Design: system on silicon, Wayne Wolf, Addison; Wesley Longman Publisher.		
5.	“Basic VLSI Design” Douglas A. Pucknell & Kamran Eshranghian; PHI		
6.	“CMOS Circuit Design, Layout & Simulation”, R.J.Baker, H.W.Lee, D.E. Boyee, PHI		

Name of the course:	**Digital Signal Processing**
Course Code:OEC(IT/CS)702B	**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: 4	Assignment, Quiz & class attendance: 20 Marks
	End Semester Exam: 75 Marks (to be mapped into 50 marks)

Objective:

1.	To understand the properties of different type of discrete time signals and systems
2.	To apply different mathematical tools for frequency domain analysis of discrete time signals.
3.	To design different types of digital filters and compare their performances

Pre-Requisite

1.	Communication engineering (ES(CS/IT)409)

Module	Content	Hrs	Marks
1	**Discrete-time signals** Concept of discrete-time signal, basic idea of sampling, sampling theorem, sequences – periodic, energy, power, unit-sample, unit-step, unit-ramp, real & complex exponentials, arithmetic operations on sequences.	4	
2	**LTI Systems** Definition, representation, impulse response, derivation for the output sequence, concept of convolution, graphical and analytical methods to compute convolution supported with examples and exercises, properties of convolution, stability and causality conditions	6	
3	**Z-Transform** Definition, mapping between s-plane and z-plane, unit circle, convergence and ROC, properties of Z-transform, inverse Z-transform	6	
4	**Discrete Fourier Transform** Concept and relations for DFT/IDFT, Twiddle factors and their properties, computational burden on direct DFT, DFT/IDFT as linear transformations, DFT/IDFT matrices, computation of DFT/IDFT by matrix method, multiplication of DFTs, circular convolution, filtering of long data sequences – Overlap-Save and Overlap-Add methods with examples and exercises.	9	
5	**Fast Fourier Transform** Radix-2 algorithm, decimation-in-time, decimation-in-frequency FFT algorithms.	5	
6	**Digital Filter** Basic concepts of IIR and FIR digital filters. design of Butterworth IIR filter using impulse invariant and bilinear transformation method, design of FIR filter using window method.	6	

Course Outcome:

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

CO1	compare the characteristics of different discrete time signals and systems.
CO2	describe Z transform of discrete time sequences and its properties.

CO3	apply the concepts of sampling in frequency domain for computing DFT and IDFT of discrete time sequences.
CO4	compare the performance of different Fast Fourier Transform(FFT) techniques.
CO5	design different types of Digital Filters.
Learning Resources:	
1.	Digital Signal Processing – Principles, Algorithms and Applications, J.G.Proakis&D.G.Manolakis, Pearson Ed.
2.	Digital Signal Processing, P. Rameshbabu, Scitech Publications (India)
3.	Digital Signal processing – A Computer Based Approach, S.K.Mitra, TMH Publishing Co
4.	Digital Signal Processing, S.Salivahanan, A.Vallabraj& C. Gnanapriya, TMH Publishing Co

Name of the course:		**MANAGEMENT INFORMATION SYSTEM**	
Course Code: OEC(IT/CS)702C		**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.:		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 structure of Management Information Systems (MIS) and different types of Information Systems.		
2.	To learn about MIS Planning and Development and analyzing of Economic Behavior.		
3.	To understand the relationship between MIS and BPR and also have knowledge about ERP and E-enterprise System.		
4.	To learn about MIS support models and current trends in MIS along with security issues.		
Pre-Requisite:			
1.	Economics for Engineers [HS(CS/IT)303]		
2.	Industrial Management [HS (CS/IT)604]		
Module	**Content**	**Hrs.**	**Marks**
1.	**Understanding MIS and Conceptual Foundations:** Introduction to Management Information Systems, MIS Categories, Managers and Activities in IS, The Decision Making Process, System Approach to Problem Solving, The Structure of Management Information System, Kinds of Information Systems, Governance Modes in the use of IT	5	
2.	**Planning, Development and MIS Organization Structure:** MIS Planning, MIS development, MIS at Management levels, Strategic Level Planning, Operational Level Planning, Economic and Behavior Theories	5	
3.	**MIS and BPR:** Business Process Re – Engineering, Improving a process in BPR, Object Oriented methodology, BPR – Current Focus	4	

4.	**Enterprise Resource Planning and E-Enterprise System:** Basics of ERP, Enterprise Systems in Large Organizations, Organization of Business in an E-enterprise, E-business, E-commerce, E-communication, E-collaboration	6	
5.	**MIS – Support Models and Knowledge Management:** Market Research Methods, Ratio Analysis for Financial Assessment, Procedural Models, Project Planning and Control Models, Operations Research Models: Mathematical Programming Techniques, Knowledge Management	8	
6.	**Ethical Issues and Trends in MIS:** Control Issues in Management Information Systems, Security Hazards, Ethical Issues, Technical solutions for Privacy Protection, Decision Support Systems (DSS), Types of Database Users, Designing of DBMS, Artificial Intelligence (AI), Basic Network Terminologies, The Intranet and the Extranet	8	

Course Outcomes: After completion of this course the students will be able to -	
CO1	explain MIS, Structure of MIS as well as different kinds of Information Systems.
CO2	make use of the concept of MIS Planning, Development and Economic and Behavior Theories.
CO3	discuss the relation between MIS and BPR.
CO4	apply ERP, E-business, E-commerce, E-communication and E-collaboration.
CO5	design MIS- Support Models and the concept of Knowledge Management.
CO6	illustrate the Security Hazards in MIS and the applications currently trending in MIS.
Learning Resources:	
1.	Kenneth C. Laudon, Jane P. Laudon, Management Information System, Pearson Education India, ISBN: 9789332548909
2.	Ramesh Behl, James A. O'Brien, George M. Marakas, Management Information Systems, McGraw Hill Education India, ISBN: 9789353164652
3.	S. Sadagopan, Management Information Systems, PHI Learning, ISBN: 9788120348929
4.	Indrajit Chatterjee, Management Information Systems, PHI Learning, ISBN: 9788120340237
5.	Girdhar Joshi, Management Information Systems, Oxford University Press India, ISBN: 9780198080992
6.	Oz Effy, Management Information Systems, Cengage Learning Inc., ISBN: 9780619215385

Name of the course:	**BIG DATA ANALYTICS**
Course Code:	**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.:	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 Big Data and its uses		
2.	To provide an overview of Hadoop and its Ecosystem		
3.	To understand MapReduce Jobs		
4.	To learn HDFS concepts		
Pre-Requisite			
1.	Database Management System [PC(CS/IT)512]		
Module	**Content**	**Hrs.**	**Marks**
1.	**Big Data Overview and Applications** Definition and History of big data, Elements of big data, Advantages and Disadvantages of big data, Using big data in businesses	4	
2.	**Technologies for handling Big Data** Introduction to Hadoop, Functioning of Hadoop, Cloud Computing for big data	6	
3.	**Understanding Hadoop Ecosystem** HDFS, MapReduce, Hbase, Hive, Pig, Big SQL	9	
4.	**MapReduce** Anatomy of a MapReduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, MapReduce Types and Formats, MapReduce Features	8	
5.	**HDFS(Hadoop Distributed File System)** Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data Flow, Data Ingest with Flume and Sqoop and Hadoop archives, Hadoop I/O	9	
Course Outcomes: After completion of this course the students will be able to -			
CO1	explain Big Data and its business applications		
CO2	apply the technologies for handling Big Data		
CO3	classify the components of Hadoop Ecosystem		
CO4	demonstrate Jobs in Hadoop Environment		
CO5	analyze data on Distributed File System		
Learning Resources:			
1.	Seema Acharya, Subhashini Chellappan, Big Data and Analytics, Wiley India Pvt. Ltd, ISBN: 9788126579518		
2.	Tom White, Hadoop: The Definitive Guide - Storage and Analysis at Internet Scale, Shroff Publishers & Distributors Pvt Ltd, ISBN: 9789352130672		
3.	Mark Hornick, Tom Plunkett, Using R to Unlock the Value of Big Data, McGraw-Hill Education - Europe, ISBN: 9780071824385		
4.	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer-Verlag Berlin and Heidelberg GmbH & Co. KG, ISBN: 9783540430605		
5.	Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, ISBN: 9781316638491		
6.	Bill Franks, Taming The Big Data Tidal Wave, John Wiley & Sons Inc, ISBN: 9781118208786		

Name of the course	**Web Technology Lab.**
Course Code: PEC(IT)704A-L	**Semester: 7th**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Theory: 3 hrs./week	Laboratory journal book and Results: 40 marks
Credit Points: 1.5	Viva Voce conducted during semester: 40 marks
	Attendance, Overall conduct, Skills etc.: 20 marks

Objective:	
1.	To design and deploy web enabled services with the help of appropriate technologies.
2.	To maintain the modules associated with web-based applications.
3.	To solve the common ecommerce site design and maintenance problems.
Pre-Requisite:	
1.	Object Oriented Methodology [PC(CS/IT)513]
Laboratory Experiments:	
1.	Designing of web pages using HTML, CSS.
2.	Client-side scripting using java script.
3.	XML.
4.	CRUD operations using JDBC.
5.	Servlets.
6.	JSP.
7.	Session Management.
8.	Case study on designing web-application module.
9.	Demonstration on AJAX.

Course Outcomes: After completion of this course the students will be able to -	
CO1	Differentiate among various types of web application development technologies.
CO2	Design the front end of any web application with the help of associated technologies.
CO3	Apply the skills related to client side validation technique and able to recognize different types of document type definition in web design.
CO4	Work with different database management system and also be able to perform different CRUD operations.
CO5	Create dynamic web pages and also be able to develop server side scripting for server side processing.
CO6	Apply user sessions in dynamic web project and also be able to design business logic.

Learning Resources:	
1	Java EE for Beginners, Sharanam Shah, SPD Publications
2	Beginning Java EE 5: From Novice to Professional, Mukhar and Zelenak, Apress
3	Professional Java Server Programming, Allamaraju, WROX Publishers
4	Java Server Programming Java EE 7 (J2EE 1.7), Kogent Learning Solutions Inc.

Name of the course	**Internetworking Lab.**
Course Code: PEC(IT)704B-L	**Semester: 7th**
Duration: 6 months	**Maximum marks:100**
Teaching Scheme	**Examination scheme:**
Theory: 3 hrs./week	Laboratory journal book and Results: 40 marks
Credit Points: 1.5	Viva Voce conducted during semester: 40 marks
	Attendance, Overall conduct, Skills etc.: 20 marks

Objective:	
1.	To learn coding and implementation of different types client server socket programing.
2.	To implement simulation based communication.
3.	To design IP address allocation scheme and handle basic router configuration.
4.	To have exposure on some common server configuration.
Pre-Requisite:	
1.	Computer Network lab [PCL(CS/IT)619]
Laboratory Experiments:	
1.	Using TCP/IP sockets, Implementation of Echo Server and Client program in Linux using C.
2.	Programming for error detection using CRC.
3.	Implementation of data link protocols - Stop and Wait ARQ in Linux using C
4.	Initial Setup and Configuration of Graphical Network Simulator 3 (GNS3).
5.	Switch Configuration for PC to PC communication in GNS3.
6.	Router Configuration for PC to PC communication in GNS3.
7.	Configuration of DNS server/ Firewall server.
8.	Designing a scheme for IP address allocation.
Learning Resources:	
1.	UNIX Network Programming: The sockets networking API, Volume 1 of UNIX Network Programming, W. Richard Stevens , Pearson Education
Course Outcomes: After completion of this course the students will be able to -	
CO1	Implement basic concepts of client/server models and communicate using socket programming.
CO2	Implement transport layer concepts and protocols; including connection oriented and connection-less models, techniques to provide reliable data delivery.
CO3	IMplement data link layer concepts and protocols (Stop and Wait, including CRC)
CO4	Simulate basic networking environments, switching and routing.
CO5	Configure some application servers.
CO6	Determine the structure and organization of computer networks, IP addressing allocation schemes.

Name of the course	**Project 2**
Course Code: PROJ(IT)702	**Semester: 7th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**

Theory: 12 hours/week	Internal Evaluation: 80 Marks
Credit Points: 6	End Semester (External) Exam: 20 Marks
Objective:	
1.	To apply the concept related to mathematics and computer Sc.
2.	Express a sound technical knowledge to undertake problem identification and solution methodology on project topic.
3.	To demonstrate the techniques those have been used to implement the idea.
4.	Propose work solutions to intricate problems exploiting a systematic approach.
Pre-Requisite	
(As required)	
Learning Resources:	
(As required)	
Course Outcomes: After completion of this Project 2 the students will be able to -	
CO1	Demonstrate a sound technical knowledge to undertake problem identification and solution approach on project topic.
CO2	Demonstrate the ability to locate and use technical information from multiple sources.
CO3	Design engineering solutions to complex problems utilizing a systematic approach.
CO4	Perform as a team-member and to focus on getting a working project done on time.
CO5	Communicate effectively in speech and writing to make presentation and prepare technical document.

FOURTH YEAR SECOND SEMESTER

8th SEMESTER							
SL. NO.	PAPER CODE	PAPER NAME	L	T	P	CONTACT HRS./WEEK	CREDIT
THEORY							
01	PEC(IT)805	Elective-V	3	0	0	3	3
02	OEC(IT/CS)803	Open Elective-III	3	0	0	3	3
SESSIONAL/PRACTICAL							
01	PROJ(IT)803	Project 3	0	0	16	16	8
02	CVV(IT)802	Comprehensive Viva Voce	0	0	0	0	1
TOTAL			**6**	**0**	**16**	**22**	**15**

PEC(IT)805
A: E-Commerce
B: Data Mining
C: Mobile Communication
D: Internet of Things
E: Data Science

OEC(IT/CS)803
A: Image Processing
B: Software Project Management
C: Social Network Analysis
D: Quantum Computing
E: Bioinformatics

Name of the course	**E-Commerce**
Course Code: PEC(IT)805A	**Semester: 8th**
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, Quizzes, Presentations, Attendance etc. : 20 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To apply basic design tools & techniques for developing E-Commerce application.
2.	To recognize the underlying architecture of E-Commerce applications.
3.	To solve the common E-commerce site design and maintenance problems.

Pre-Requisite:

1.	Object Oriented Methodology PC(CS/IT)513
2.	Database Management System PC(CS/IT)512
3.	Web Technology PEC(IT)704A

Module	Content	Hrs.	Marks
1	**Introduction to E-Commerce** Definition, Scope of E-Commerce, Hardware requirements, Ecommerce and Trade Cycle, Electronic Markets, Internet Commerce.	4	
2	**Business to Business E-Commerce** Electronic Data Interchange (EDI): Technology, Standards (UN/EDIFACT), Communications, Implementations, Agreements, Security, EDI and Business, Inter-Organizational E-commerce.	6	
3	**Legal issues** Risks: Paper Document vs. Electronic document, Authentication of Electronic document, Laws, Legal issues for Internet Commerce: Trademarks and Domain names, Copyright, Jurisdiction issues, Service provider liability, Enforceable online contract.	5	
4	**Security Issues** Security Solutions: Symmetric and Asymmetric Cryptosystems, Digital Signature, Protocols for secure messaging, Secure Electronic Transaction (SET) Protocol, Financial transactions over internet, Internet Security.	6	
5	**Business to Consumer E-Commerce** Consumer trade transaction, Internet, Page on the Web, Elements of E-Commerce with case studies.	8	
6	**E-business** Internet bookshops, Software supplies and support, Electronic Newspapers, Internet Banking, E Auctions, Online Share Dealing, E-Diversity with Case studies.	7	

Course Outcomes:

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

CO1	Identify various types of module development technologies related to E-Commerce applications.
CO2	Select the module of any E-Commerce application with the help of associated technologies.
CO3	Organise different types of E-Commerce sites in the implementation of E-Commerce module.
CO4	Execute security and legal issues in E-Commerce.
CO5	Describe the knowledge of E-Business.
Learning Resources:	
1	E-Commerce-Strategy, Technologies & Applications by David Whitley, TMH
2	E-Commerce- The cutting edge of business by Kamlesh K. Bajaj, TMH
3	Global Electronic Commerce- Theory and Case Studies by J. Christopher Westland and Theodore H. K Clark, University Press

Name of the course	**Data Mining**
Course Code:PEC(IT)805B	**Semester: 8th**
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.	To understand the principles of Data warehousing and Data Mining.
2.	To be familiar with the Data warehouse architecture and its Implementation.
3.	To know the Architecture of a Data Mining system.
4.	To understand the various Data preprocessing Methods.
5.	To understand and apply various Classification and Clustering techniques using tools.
6.	To know the Association Rule Mining.
7.	To understand various Web Mining techniques.
Pre-Requisite	
1.	Database Management System PC(CS/IT)512
2.	Basic Statistics

Module	**Content**	**Hrs.**	**Marks**
1.	**Data Warehousing:** Define Data Warehouse, The building blocks of a Data warehouse, Warehouse Schema, Data Warehouse Architecture, Infrastructure and Metadata Management, Data Marts, ETL, OLAP, MOLAP.	4	
2.	**Introduction of Data Mining**: Basics of data mining, related concepts, Data mining techniques, The KDD processes, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization.	3	
3.	**Classification Algorithms:** Define Classification, Supervised Learning,	6	

	Classifier Accuracy, Decision Tree and Naïve Bayes Classifier.		
4.	**Clustering:** Define clustering, Types of data, Partitioning Methods (K-Means, K-Medoids), PAM, CLARA, CLARANS, Hierarchical Methods (Agglomerative, Divisive), Distance and similarity Function.	10	
5.	**Association rules:** Define Association Rule mining, Market Basket Analysis, Apriori Algorithm, FP tree Algorithm, Iceberg Queries, Advanced Association Rules (concepts only), Applications of Data Mining.	9	
6.	**Web Mining:** Web Content Mining, Web Structure Mining, Web Usage Mining	4	

Course Outcomes: After completion of this course, the student will be able to-	
CO1	Implement Data warehouse system and perform business analysis with OLAP tools.
CO2	Apply suitable pre-processing and visualization techniques for data analysis.
CO3	Identify appropriate classification and clustering techniques for data analysis.
CO4	Apply frequent pattern and association rule mining techniques for data analysis.
CO5	Explain Web mining techniques.
Learning Resources:	
1.	Jiawei Han, Micheline Kamber and Jian Pei "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2011, ISBN : 9780123814807
2.	Arun K Pujari,"Data Mining Techniques", 3rd Edition, Universities Press, ISBN : 9788173718847
3.	Pang-Ning Tan, Vipin Kumar, Michael Steinbanch, "Introduction to Data Mining", Pearson Education, ISBN : 9780321420527
4.	Alex Berson and Stephen Smith, "Data Warehousing, Data Mining and OLAP", Tata McGraw-Hill Edition, ISBN : 9780070587410
5.	K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006, ISBN :9788120328976
6.	G. K. Gupta "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006, ISBN : 9788120350021
7.	Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007, ISBN : 9789354491047

Name of the course	**Mobile Communication**
Course Code: PEC(IT)805C	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exams: 30 Marks
Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper, Presentation on selected topics: 10 Marks
	End Semester Exam: 50 Marks
Objective:	
1.	To study the concept of mobile communication and evolution of mobile network
2.	To understand cellular concepts and improvements cell capacity

3.	To study wireless network and different protocol in physical and data link layer		
4.	To be familiar with mobile IP and mobile TCP		
5.	To study mobile routing and mobile security		
Pre-Requisite			
1.	Computer Networks [PC(CS/IT)617]		
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction:** A General Overview: History of wireless communication, Multiplexing, Multiple Access basics and Different generations of Cellular Telephony: GSM, GPRS, CDMA2000, UMTs, LTE	6	17
2	**Cellular Networks:** Cellular Concept, Frequency Reuse, Channel Allocation Management, Call Setup, Location Management, Cell Handoffs; Interference: Co-channel and Adjacent Interference. System Capacity, Improving Cell Capacity and Coverage: Cell Splitting, Sectoring, Repeaters and Microcell Zone Concept.	7	19
3	**Wireless Networks:** Infrastructure and ad-hoc network, IEEE 802.11: System and Protocol Architecture, Physical and MAC Layer. Media Access Techniques – ALOHA, CSMA. Bluetooth: Architecture, Radio Layer, Baseband Layer, Link Management Protocol, L2CAP and Security. Wi-Fi and WiMax.	8	22
4	**Mobile Network Layer:** Mobile IP, IP Packet Delivery, Agent Discovery, Registration, Tunnelling and Encapsulation, Optimizations and Reverse Tunnelling, Ad-hoc network, Proactive and reactive routing	6	17
5	**Mobile Transport Layer:** Introduction, Traditional TCP: Congestion Control, Slow Start, Fast Retransmit and Implications of Mobility. Classical TCP Improvements: Indirect TCP, Snooping TCP, Mobile TCP and Fast Retransmit/fast recovery.	6	17
6	**Mobile Security:** Threats, Vulnerabilities, Attacks, Integrity, Confidentiality, malware, Policies.	3	8
Learning Resources:			
1	J. Schiller, Mobile Communications, Addison –Wesley		
2	T. S. Rapport, Wireless Communications, Principle and Practices		
3	Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, Principles of Mobile Computing, Springer		
4	W.C.Y. Lee - Mobile Cellular Communications, 2nd Edition, MC Graw Hill.		
Course Outcomes: After completion of this course students will be able to-			
CO1	Compare different mobile communication technologies and evolution of mobile network		
CO2	Illustrate different methodologies for improving cell capacity in cellular network		
CO3	Analyze different wireless communications and access techniques		
CO4	Illustrate MobileIP and different routing models for ad hoc network		
CO5	Assess different transport layer protocols in mobile communication		
CO6	Analyze threats and vulnerabilities in mobile network and relate different security policies.		

Name of the course	**Internet of Things**
Course Code: PEC(IT)805D	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Mid Term I Exam: 15 Marks
Credit Points: 3	Mid Term II Exam: 15 Marks
	Assignments, Quiz, Presentation & Attendance: 20 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To learn fundamentals, genesis, Internet principles and architectures of IoT
2.	Illustrate diverse methods of deploying smart objects and connect them to network.
3.	To understand prototyping embedded devices for sensing real world entities
4.	To gain an understanding of the role of Application protocols and Security in IoT

Pre-Requisite:

1.	Computer Networks [PC(CS/IT)617]

Module	Content	Hrs.	Marks
1	**The Internet of Things:** Overview, Evolution of IoT, Challenges and impact of IoT, Enabling IoT and Interdependence of Technologies, IoT Networking Components, IoT Addressing Strategies; Overview of the Architecture of an IP-based Internet of Things: Physical/Link Layer, IoT Connectivity Technologies: IEEE 802.15.4, Zigbee, Z-Wave, (Low-power) Wi-Fi, Bluetooth and BLE, LoRa, LoRaWAN, NBIoT.	8	
2	**IoT Network Architecture and Design:** Drivers Behind New Network Architectures, IoT Architectures: The IoT World Forum (IoTWF) Standardized Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud.	6	
3	**Prototyping Embedded Devices:** Sensors, Actuators, Micro-Electro-Mechanical Systems (MEMS) and Smart Objects, Wireless Sensor Network and its communication protocol, Machine to Machine Communication, Introduction to Arduino and Raspberry Pi.	6	
4	**IoT Communication Technologies:** Constrained nodes and networks, Low power and lossy networks, Infrastructure Protocols: IPv6, 6LoWPAN, Micro Internet Protocol; Discovery Protocol: mDNS; Data Protocols: MQTT, CoAP, AMQP; Overview of Identification protocols and Device management.	8	
5	**Interoperability:** Interoperability issues and challenges, IoT interoperability standards: EnOcean, DLNA, UPnP; Overview of Frameworks, Cloud-based Solutions, REST and The Web of Things.	4	
6	**IoT Case Studies and Future Trends:** IoT in agriculture and Healthcare, Evolution of new paradigms in IoT, Future Trends: Bigdata, AI-ML, SDN.	4	

Learning Resources:

1	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things",

	Pearson Education
2	Sudip Misra, Anandarup Mukherjee, and Arijit Roy, "Introduction to IoT". Cambridge University Press.
3	Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", Wiely,
4	Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri, "Internet of Things: Architectures, Protocols and Standards", John Wiley & Sons.
5	Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education.
Course Outcomes: After completion of this course students will be able to-	
CO1	Explain the issues, Interdependence of technologies, addressing to enable IoT and some connectivity technologies of IoT,
CO2	Analyse the architectural models, Core IoT Functional stack, Compute stack and Data Management of IoT.
CO3	Compare the deployment of smart objects and the technologies to connect them to network.
CO4	Justify the requirement of communication technologies at different layers of IoT applications
CO5	Examine the IoT framework and interoperability standards involved in it.
CO6	Analyse different Applications of IoT and the future possibilities IoT.

Name of the course		**Data Science**	
Course Code: PEC(IT)805E		**Semester: 8th**	
Duration: 6 months		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 3 hours/week		Mid Semester Exams: 30 Marks	
Tutorial: 0		Assignment , Quiz etc. : 20 Marks	
Credit Points: 3		End Semester Exam: 50 Marks	
Objective:			
1.	To provide with the basic understanding of data science and knowledge of proficient data science techniques.		
2.	To apply the concept of mathematics for data science to analyze the data set.		
3.	To demonstrate the machine learning techniques that are vital for data science.		
4.	To evaluate the data visualization based on their design.		
Pre-Requisite:			
1. IT Workshop(Python) PCL(CS/IT)305			
2. Mathematics-II(BS(CS/IT)-205)			
Module	**Content**	**Hrs.**	**Marks**
1	**Introduction to Data Science:** Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	2	
2	**Introduction to R:** Data types and variables, Data Frames, Recasting and Joining Data Frames,	4	

	Various mathematical operations, Control structures, Data visualization in R Graphics.		
3	**Linear Algebra for Data Science:** Linear equations, Distance, Hyperplanes, Halfsapces, Eigenvalues and Eigenvectors.	3	
4	**Statistical modelling:** Probability mass/density functions, Sample statistics, Hypotheses testing.	3	
5	**Optimization for Data Science:** Unconstrained multivariate optimization, Gradient Descent Learning, Constrained multivariate optimization.	4	
6	**Data Science problems and solution Framework:** Data analysis problem solving, Data collection and analysis techniques, Visualization techniques, Application development methods in data science.	5	
7	**Data visualisation:** Introduction, Types of data visualisation, Data for visualisation: Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings. Technologies for visualisation, Bokeh (Python).	5	
8	**Predictive modelling and cross validation techniques:** Liner regression and Model assessment, Model building and assessment, Multiple Liner regression, Multiple liner modelling and selection,	5	
9	**Classification and clustering:** Logistic regression, performance measures. Logistic regression implementation in R, KNN clustering, KNN clustering implementation in R, K-means clustering, KNN clustering implementation in R, PCA in high dimensions, Spectral clustering and Cheeger's inequality	5	

Learning Resources:	
1	Doing Data Science, Straight Talk from The Frontline, Cathy O'Neil and Rachel Schutt, O'Reilly.
2	Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Book Publishing.
3	Data Science for Business: What You Need to Know about Data Mining and Data: analytic Thinking, Foster Provost and Tom Fawcett.

Course Outcomes: After completion of this course the students will be able to -	
CO1	Illustrate the concepts of basic data science.
CO2	Solve data science problems using the skills of statistical and optimization methods.
CO3	Examine the data visualization based on their design.
CO4	Explain various machine learning techniques in data science.
CO5	Appraise different Classification and clustering techniques in data science.

Name of the course	**Image Processing**
Course Code: OEC(IT/CS)803A	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exam: 30 Marks

Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To study the concept of image, definitions related to image
2.	To study image enhancement techniques in spatial and time domain
3.	To study noise in image and image restoration
4.	To study segmentation and compression techniques of image
5.	To study colour image process techniques

Pre-Requisite:

1.	Knowledge of Fourier transform
2.	Knowledge of digital data

Unit	Content	Hrs	Marks
1	**Introduction:** Definition, Steps in Digital Image Processing, Components of an Image Processing System, Applications of Digital Image Processing, Neighbors of pixel, Adjacency, Connectivity, Region and Boundary, Distance Measures, Arithmetic/Logic Operations	6	15
2	**Digital image formation:** Light and the Electromagnetic Spectrum, Image Sensing and Acquisition. Image Sampling and Quantization, Image Model, Classification of Digital Images, Image File Formats	4	10
3	**Image transformation:** Need for Transform, Discrete Fourier Transform, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Karheunen-Loeve transform, Hough transform	4	14
4	**Image transformation in spatial domain:** Basic Gray Level Transformations, Histogram Processing, Convolution and Correlation, Image Smoothing through Spatial Filters, Image Sharpening through Spatial Filters	4	14
5	**Image transformation in time domain:** Image Smoothing through Frequency-Domain Filters, Image Sharpening through Frequency Domain Filters, Homomorphic Filtering	4	10
6	**Image restoration:** Types of Degradation, Types of Image Blur, Classification of Image Restoration Techniques, Image Restoration Model, Linear and Non-linear Image Restoration Techniques, Blind Deconvolution, Classification of Noise in Image, Image Denoising	4	13
7	**Image segmentation:** Classification of Image Segmentation Techniques, Edge based Segmentation, Classification of edges, Edge detection, Edge Linking, Region based approach to Segmentation, Clustering Techniques, Segmentation based on Thresholding, Watershed Transformation, Active Contour	4	12
8	**Image compression:** Spatial and Temporal Redundancy, Image Compression Models- Lossless and Lossy Compression.	4	10
9	**Colour image processing:** Colour Models, Colour Transformation, Image Segmentation based on Colour	2	5

Learning Resources:

1.	Digital Image Processing, Gonzalves and Woods, Pearson

2.	Digital Image Processing, Jahne, Springer India
3.	Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab, Solomon and Breckon, Wiley
Course Outcomes: After completion of this course students will be able to	
CO1	Asses different image enhancement techniques and application
CO2	Investigate different image segmentation algorithms
CO3	Compose different image restoration techniques for application in real time problems
CO4	Asses different colour models for enhancement, segmentation and restoration
CO5	Investigate different lossless and lossy compression
CO6	Design of real life problems and solution through image processing

Name of the course	**SOFTWARE PROJECT MANAGEMENT**		
Course Code: OEC(IT/CS)803B	**Semester: 8TH**		
Duration: 6 months	**Maximum Marks: 100**		
Teaching Scheme	**Examination Scheme**		
Theory: 3 hrs/week	Mid Term I Exam:	15 Marks	
Credit Points: 3	Mid Term II Exam:	15 Marks	
	Class performance & Attendance:	20 Marks	
	End Semester Exam & Viva:	50 Marks	
Objective:			
1.	To understand the Software Project Planning and Evaluation techniques.		
2.	To plan and manage projects at each stage of the software development life cycle.		
3.	To develop skills to manage the various phases involved in project management and people management.		
4.	To deliver successful software projects that support organization ‘s strategic goals.		
Pre-Requisite			
1.	Software Engineering – PEC(IT)602A		
Module	**Content**	**Hrs.**	**Marks**
1	**SOFTWARE PROJECT** Concept of Project, Software project, Importance of Software Project Management, Activities, Methodologies, Categorization of Software Projects, Setting objectives, Project portfolio Management, Risk evaluation, Strategic program Management, Stepwise Project Planning**.**	6	
2	**PROJECT LIFE CYCLE AND EFFORT ESTIMATION** Software process and Process Models – Choice of Process models – Rapid Application development, Agile methods – Dynamic System Development Method, Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.	8	

3	**ACTIVITY PLANNING AND RISK MANAGEMENT** Objectives of Activity planning, Project schedules, Activities, Sequencing and scheduling, Gantt chart, Network Planning models, Critical path method, PERT technique, Resource Allocation, Cost schedules. Industrial strength software: features & challenges. Risk identification, Assessment, Risk Planning, Risk Management: Proactive & Reactive risk management.	8	
4	**PROJECT MANAGEMENT AND CONTROL** Framework for Management and control, Collection of data, Visualizing progress, Cost monitoring, Earned Value Analysis, Project tracking, change control, Contract Management. Software Configuration Management- need, basic configuration, baseline of configuration. Concept of quality, quality attributes, iron triangle, TQM.	8	
5	**STAFFING IN SOFTWARE PROJECTS** Managing people, Organizational behavior, Best methods of staff selection, The Oldham – Hackman job characteristic model, Health and Safety, Ethical and Professional concerns – Working in teams, Decision making, Organizational structures, Dispersed and Virtual teams, Leadership, role of project manager.	6	

Course Outcomes: After completion of the course students will able to-	
CO1	Assess Project Management principles while developing software.
CO2	Identify the basic project management concepts, framework and the process models.
CO3	Review about software process models and software effort estimation techniques.
CO4	Estimate the risks involved in various project activities.
CO5	Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
CO6	Determine staff selection process and the issues related to people management.
Learning Resources:	
1	Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – TMH
2	Robert K. Wysocki ―Effective Software Project Management‖ – Wiley
3	Software Engineering: A Practitioner's Approach- Roger Pressman--TMH
4	Ingenieria del Software-- Ian Sommerville--Pearson
5	Walker Royce: ―Software Project Management‖- Addison-Wesley
6	Gopalaswamy Ramesh, ―Managing Global Software Projects- McGraw Hill
7	Software Engineering- Pankaj Jalote- Wiley India

Name of the course	**Social Network Analysis**
Course Code: OEC(IT/CS)803C	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs./week	Two Mid term Exam: 30 Marks

Credit Points: 3	Assignment & Quiz: 10 Marks
	Term paper: 05 Marks
	Presentation on selected topics: 05 Marks
	End Semester Exam: 50 Marks

Objective:

1.	To study the concept of online social network in graph theoretic concept
2.	To study centrality measures of online social network graph
3.	To study social network content and analyze the sentiment
4.	To study rumour detection in social media
5.	To study influence maximization and minimization in social media

Pre-Requisite

1.	Discrete mathematics BS(CS/IT)408
2.	DBMS PC(CS/IT)512

Module	Content	Hrs.	Marks
1	**Introduction:** A General Overview: online social network(OSN), online social network as graph, topology, Erdos Reyni concept of graph, concept of six degree separation, small world network, large scale network, propagation approaches through social network graph	2	6
2	**Centrality measures:** Graph centrality concept, Node degree centrality, Betweenness centrality, closeness centrality, page rank centrality, Eigen vector centrality, K-core	6	15
3	**Sentiment analysis:** Sentiment: positive, negative and neutral. NLP for analysis of sentiment, machine learning approaches for analysis of sentiment in OSN	5	15
4	**Rumour detection:** Detection of rumour in social network, content based rumour detection, generating dictionary for identifying misinformation, machine learning approaches to differentiate rumour content, interaction based rumour detection, identifying the profile generating rumour	5	15
5	**Influence maximization:** Introductory concepts. Different approaches of influence maximization. Recent trends in influence maximization, applications.	6	15
6	**Influence minimization:** Introductory concepts. Different approaches of influence minimization. Application of influence minimization for rumour content in OSN	4	12
7	**Clustering and community detection:** Community detection in online social network, clustering, clustering coefficient, modularity, transitivity, average path length	4	10
8	**Application of SNA:** Real world social network issues and solution	4	12

Learning Resources:

1.	Analyzing Social Networks Using R; Stephen P. Borgatti et al, Sage publishing, 2022
2.	Social Network Analysis with Applications, Ian McCulloh, Helen Armstrong, Anthony Johnson, Wiley, 2013

Course Outcomes:

After completion of this course students will be able to

CO1	Assess proficiency and understanding of social networks for business and professional use

CO2	Investigate different use of social network analysis and social network developer tools
CO3	Assess different centrality measures and community detection mechanisms for different applications
CO4	Compose different influence maximization/minimization problems
CO5	Investigate different content of social network and validate the sentiments and purposes
CO6	Design real life solution for online social network issues

Name of the course		**QUANTUM COMPUTING**	
Course Code: OEC(IT/CS))803D		**Semester: 8th**	
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	
		Assignment, Test based on assignments, Surprise tests, Quizzes, Presentations, Attendance etc. : 20 Marks	
		End Semester Exam: 50 Marks	
Objectives :			
1.	To develop mathematical foundation for application in Quantum Computing.		
2.	To introduce the fundamentals of quantum computing and understand the basic postulates of quantum mechanics.		
3.	To apply quantum algorithms for solving various problems**.**		
Pre-Requisites :			
1.	Mathematics I [BS(CS/IT)101], Physics [BS(CS/IT)]102		
2.	Design and Analysis of Algorithms [PC(CS/IT)406]		
Module	**Content**	**Hrs.**	**Marks**
1	**Mathematical Preliminaries:** Representation of states in linear vector space, Basis and Dimensions, Inner Product, Orthonormality, Bra-Ket Formalism, Hilbert Space, Hermitian, Unitary, Normal and Projection Operators, Tensor Product, Density Operator.	8	
2	**Introduction to Quantum Mechanics:** Classical Deterministic Systems, Probabilistic Nature of Quantum Systems, Basics of Quantum Theory, Schrodinger's Equation and Born Rule, Wave -Particle Duality, Postulates of Quantum Mechanics, Dirac Formalism, Stern-Gerlach Experiment and Measurement, Electron Spin, Superposition of States, Quantum Entanglement.	6	
3	**Quantum Circuits:** Bits and Qubits, Bloch sphere representation of a qubit, multiple qubits. Classical gates versus quantum gates, single qubit gates, multiple qubit gates, design of quantum circuits.	8	
4	**Quantum Information and Cryptography:** Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	8	
5	**Quantum Algorithms:** Introduction to quantum algorithm, quantum parallelism, Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization	8	

	algorithm, Grover Search algorithm, Simon's algorithm, Quantum Fourier Transform.		

Course Outcomes: After completion of this course students will be able to-	
CO1	Understand Hilbert Space and Operators.
CO2	Explain basic concepts of quantum mechanics as applied in Quantum computing.
CO3	Develop quantum logic gate circuits.
CO4	Differentiate the classical and quantum information processing concepts.
CO5	Implementation of simple quantum algorithms using quantum parallelism.
Learning Resources:	
1.	Quantum Computation and Quantum Information, Michael A. Nielsen and Isaac L. Chuang, Cambridge University Press 2010.
2.	Quantum computing explained, David McMahon, Wiley-interscience, John Wiley & Sons, Inc. Publication 2008.
3.	Quantum computing for computer scientists, Noson S. Yanofsky, Mirco A. Mannucci, Cambridge University Press 2008
4.	Introduction to Quantum Mechanics, 2nd Edition, David J. Griffiths, Prentice Hall New Jersey 1995.
5.	Reskill 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
6.	Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, Benenti G., Casati G. and Strini G, World Scientific.

Name of the course:	**BIOINFORMATICS**
Course Code: OEC(IT/CS)803E	**Semester: 8th**
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 provide an introduction to what bioinformatics is and why it is important
2.	To describe how bioinformatics data is stored and organized
3.	To classify different types of Biological Databases
4.	To learn how to extract sequence from a database
5.	To describe the basics of theoretical protein structure prediction
Pre-Requisite:	
1.	Programming for Problem Solving [ES(CS/IT)204]
2.	High School Biology

Module	Content	Hrs.	Marks
1.	**Definition and Scope** Definition, Scope and importance of bioinformatics, Role of internet in bioinformatics	05	
2.	**Biological Data and Management** Characteristics of biological data-types and features, Data management-organization of data, Analysis and Introduction of Biological Data Management System	07	
3.	**Biological Database** Relevance and scope of biological databases, Classification of Biological database, DNA and proteins databases-NCBI, EBI, Uniprot, Omics in biology - genomics, transcriptomics, proteomics and metabolomics	08	
4.	**Sequence Analysis** Outline of sequence, Structure and functions of DNA and Proteins, Introduction and Application to Sequence analysis, Sequence alignment- Introduction, Types- Local, Global, Pairwise Alignment, Multiple Alignment	09	
5.	**Structural Principles** Overview of macromolecular structures - DNA and proteins, Protein structure database –CATH, SCOP, PDB, Basics of theoretical protein structure prediction	07	

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

CO1	describe the scope and importance of Bioinformatics and role of internet in Bioinformatics
CO2	characterize and manage the different types of Biological data
CO3	locate and extract data from key bioinformatics databases and resources
CO4	apply the basics of sequence alignment and analysis
CO5	describe the biological macromolecular structures and structure prediction methods

Learning Resources:

1.	Dr. Zhumar Ghosh, Bibekanand Mallick, Bioinformatics, Oxford University Press India, ISBN: 9780195692303
2.	Orpita Bosu, Simminder Kaur Thukral, Bioinformatics - Databases, Tools, and Algorithms, Oxford University Press India, ISBN: 9780195676839
3.	S.C. Rastogi, Namita Mendiratta, Parag Rastogi, Bioinformatics - Concepts, Skills & Applications, CBS Publishers & Distributors, ISBN: 9788123914824
4.	Prakash S. Lohar, Bioinformatics, Mjp Publishers, ISBN: 9788180940668
5.	Jin Xiong, Essential Bioinformatics, Cambridge, ISBN: 9780521706100
6.	D. W. Mount, Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, ISBN: 978-0879697129

Name of the course	**Project 3**
Course Code: PROJ(IT)803	**Semester: 8th**
Duration: 6 months	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 16 hours/week	Internal Evaluation: 80 Marks

Credit Points: 8	End Semester (External) Exam: 20 Marks
Objective:	
1.	Design the solution with suitable techniques, resources and modern tools revealing reliability and ethical behaviour in industrial practice.
2.	To apply the concept related to mathematics and Information Technology
3.	To demonstrate the techniques those have been used to implement the idea.
4.	Discuss the experimental results
Pre-Requisite	
(As required)	
Learning Resources:	
(As required)	
Course Outcomes: After completion of this Project 3 the students will be able to -	
CO1	Design the solution with appropriate techniques, resources and contemporary tools exhibiting integrity and ethical behavior in engineering practice.
CO2	Manage project schedule, resources, and work assignments to ensure timely completion.
CO3	Perform professionally as a team member, accepting responsibility, taking initiative, and providing leadership necessary to ensure Project success.
CO4	Perform formal and informal Communication with team members to prepare presentation and technical documentation (report).
CO5	Defend the performance of the implemented project and the implication of the solution.