Bharatiya Vidya Bhavan's
Sardar Patel Institute of Technology
(Autonomous Institute Affiliated to University of Mumbai)
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058
Department of Computer Engineering

B. Tech. (Computer Engineering) Syllabus (Semester I-VIII)

2021 Iteration (w.e.f. 2021-22)

Nomenclature of the Courses

BSC	Basic Science Course	**PC**	Program Core
BSE	Basic Science Elective	**PE**	Program Elective
ESC	Engineering Science Course	**MLC**	Mandatory Learning Course
ESE	Engineering Science Elective	**SCOPE**	Skill Certification for Outcome based Professional Education
SBC	Skill Based Course	**OE**	Open Elective
ABL	Activity Based Learning	**HSSE**	Humanities and Social Science Elective
ABL-SEVA	Social Empowerment Through Various Activities	**ABL-SATVA**	Self- Accomplishment Through Various Activities

Abbreviations

L	Lecture Hour	O	Other Work (Self Study)
T	Tutorial Hour	E	Total Engagement in Hours
P	Laboratory Hour	C	Credit Assigned

Engagement and Credit Scheme

Sem I									
No.	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA101	Engineering Calculus	3	1	0	8	12	4
2	BSC	AS102	Engineering Chemistry	2	0	2	3	07	3
3	BSC	AS103	Biology for Engineers	2	0	0	3	05	2
4	ESC	AS105	Engineering Mechanics	2	0	2	4	08	3
5	ESC	CS101	Problem solving using Imperative Programming	2	0	4	6	12	4
6	ESC	EC101	Digital Systems and Microprocessors	3	0	2	5	10	4
7	SBC	AS107	Communication Skills	1	0	2	2	05	2
TOTAL				**15**	**1**	**10**	**29**	**55**	**22**

Sem II									
No.	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	BSC	MA102	Differential Equations and Complex Analysis	3	1	0	8	12	4
2	BSC	AS101	Engineering Physics	2	1	2	5	10	4
3	ESC	AS104	Engineering Graphics	1	0	2	2	05	2
4	ESC	ET101	Basic Electrical Engineering	3	0	2	6	11	4
5	ESC	CS102	Problem Solving using OOP	2	0	4	6	12	4
6	SBC	AS106	Skill Shop	0	0	2	0	02	1
7	ABL	SV1X/ST1X	SEVA-I or SATVA-I	0	0	0	2	02	1
TOTAL				**11**	**2**	**12**	**26**	**51**	**20**

Semester-I

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Engineering Calculus	3	1	0	8	12	3	1	0	4
		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
MA101		Theory	100		100		200		400	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	
Course Objective: To develop mathematical skills for solving engineering problems.	
Course Outcomes (CO):*At the End of the course students will be able to:-*	
MA101.1	Differentiate a function partially.
MA101.2	Find extreme values of a given function.
MA101.3	Find the nth order derivative of a given function.
MA101.4	Expand a given function as a power series.
MA101.5	Calculate the value of integrals in one variable using different techniques and solve multiple integrals in various coordinate systems.
MA101.6	Calculate Area using double integration.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA101.1	3											
MA101.2	3	1										
MA101.3	2											
MA101.4	2											
MA101.5	3											
MA101.6	2	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
MA101.1						
MA101.2						
MA101.3						
MA101.4						
MA101.5						
MA101.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	Understand ✓	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Partial Differentiation**	1,2,3	**10**
	1.1	Partial derivatives of first and higher order. Partial derivatives of composite functions.		4
	1.2	Euler's theorem for homogeneous functions with two and three independent variables, deductions from Euler's theorem.		3
	1.3	Application of partial derivatives: i) Local Maxima and Minima of functions of two variables. ii) Lagrange's Method of undetermined multipliers.		3
2	**Title**	**Successive Differentiation and Series**	1,2,3	**10**
	2.1	Successive Differentiation: Proofs of nth derivatives of standard functions. Use of De Moivre's theorem and partial fractions to calculate nth derivatives of given functions.		3
	2.2	Leibnitz's Theorem on nth derivative of product of two functions		2
	2.3	Infinite series: 1) Maclaurian's series (without proof) and derivation of series of some standard functions using Maclaurin series. Expansion of functions in powers of x by using i) Standard series method, ii) Method of differentiation and integration. 2) Taylor's series and applications.		5
3	**Title**	**Integral Calculus (one variable)**	1,2,3	**8**
	3.1	Gamma functions: properties of gamma functions and integrals reducible to gamma functions.		2
	3.2	Beta functions: properties, relation between Beta and Gamma functions, integrals reducible to Beta functions, Duplication formula.		4
	3.3	Differentiation under Integral sign: differentiating integrals with constant limits of integration for one parameter.		2
4	**Title**	**Integral Calculus (multi variable)**	1,2,3	**14**
	4.1	Tracing of curves. Sketching standard solids (Spheres, Ellipsoids, Cylinders, Cones, Tetrahedrons, planes)		2
	4.2	Double Integration: definition and evaluation. Evaluate by changing the order of integration and by changing to polar form.		7
	4.3	Application of double integral to finding area of given regions.		2
	4.4	Triple integration: definition and evaluation (Cartesian and cylindrical coordinates).		3
5	**Self Study**	1.1 Partial differentiation of implicit functions. 2.3 Series by method of Substitution 3.2 Proof of Duplication Formula 3.3 Differentiation under Integral sign using two parameters and variable limits 4.1 Finding lengths of curves in Cartesian and polar form	1,2,3	**08**
			Total	**42***

***Total of 42 hours does not include self study hours.**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Higher Engineering Mathematics	Forty Fourth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Engineering Mathematics	Twenty Eighth	H.K Das	S. Chand	2014
2	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
3	Advanced Engineering Mathematics	Fourth	Jain and Iyengar	Narosa Publications	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BS	Engineering Chemistry	2	0	2	3	7	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS102		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pte-requisite Course Codes, if any.	HSC level Chemistry
Course Objective: To provide necessary background of Chemistry suited for relevant areas of engineering	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS102.1	Relate thermodynamic principles and laws to crucial applications like heat engines (Understanding)
AS102.2	Summarize properties and applications of different materials like polymers, ceramics, alloys , nanomaterials, conductors and insulators (Understanding)
AS102.3	Identify methods for corrosion control based on knowledge of different types of corrosion and factors affecting rate of corrosion (Application)
AS102.4	Compare different sources of energy like conventional fossil fuels, alternative fuels, batteries and fuel cells with respect to availability, working principles, constitution, efficiency of performance and environmental impact (Understanding)
AS102.5	Apply knowledge of electro-chemistry and green chemistry in the interest of public health and environment (Application)
AS102.6	Make use of analytical techniques (complexometric and iodometric titrations) and instruments (pHmeter, conductometer and Orsats's Apparatus) for various purposes like hardness parameters of water, composition of alloys etc.
AS102.7	Estimate key properties of lubricants like flash point, viscosity and acid value
AS102.8	Estimate molecular weight of polymer

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS102.1	1											
AS102.2	1											
AS102.3	2											
AS102.4	2						1					
AS102.5	1						2					
AS102.6				1								
AS102.7				1								
AS102.8				1								

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS102.1						
AS102.2						
AS102.3						
AS102.4						
AS102.5						
AS102.6						
AS102.7						
AS102.8						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Thermodynamics**		4
	1.1	Introduction, Terminology, Concepts of Internal Energy and Thermodynamic equilibrium, Zeroth and First Law of Thermodynamics, Implications and Limitations of First law	1,3	
	1.2	Concept of Enthalpy, Joule Thomson Effect, Carnot's Cycle, Carnot's theorem and related numericals, Second Law of Thermodynamics	1,3	
	1.3	Applications of thermodynamic principles to the working of refrigerator and air conditioner	1,3	
2	Title	**Polymers**		3
	2.1	Introduction, Effect of heat on polymers : Glass transition temperature and melting with significance;	1,2,3	
	2.2	Conducting polymers, Liquid crystal polymers, Engineering Polymers	1,2,3	
3	Title	**Corrosion**		5
	3.1	Introduction, Dry corrosion (i) Due to oxygen (ii) Due to other gases	1,2	
	3.2	Electrochemical corrosion and mechanism, Galvanic, differential aeration corrosion, Significance of galvanic series for corrosion phenomenon	1,2	
	3.3	Factors affecting rate of corrosion (i) Position in galvanic series, (ii) relative areas of anode and cathode, (iii) conductance of medium	1,2	
	3.4	Methods to decrease the rate of corrosion : Material selection, Proper designing, Cathodic protection- i) Sacrificial anodic protection ii) Impressed current method, Metallic coatings, Cathodic and anodic coatings (Galvanization and Tinning: principle and application only)	1,2	

4	**Title**	**Energy Sciences**		5
	4.1	Definition and classification of fuels, Calorific value : Definition, Gross or Higher calorific value & Net or lower calorific value, Dulong's formula & numerical for calculations of Gross and Net calorific values.	1,2	
	4.2	Knocking, Octane number, Cetane number, Antiknock agents, unleaded petrol	1,2	
	4.3	Combustion- Calculations for requirement of only oxygen and air (by weight and by volume only) for given solid & gaseous fuels.	1,2	
	4.4	Disadvantages of fossil fuels, Alternative (Green) Fuels : Power alcohol , Biomass, Biogas, Bio diesel, Natural Gas and CNG (Description, Utility, advantages and disadvantages)	1,2	
5	**Title**	**Batteries and Battery Technology**		4
	5.1	Introduction, Important terms, Nickel-Hydrogen(metal hydride), Rechargeable Lithium ion batteries	1,2	
	5.2	Reserve Batteries, Fuel cells, characteristics, description, construction and working of Hydrogen-oxygen fuel cells, Types of fuel cells (in brief)	1,2	
	5.3	Electrochemical sensors : Working principle, construction and applications	1,2	
6	**Title**	**Green Chemistry**		
	6.1	12 principles of green chemistry with examples, numericals on Atom Economy, Green Solvents (Water, Supercritical Fluids),	1,2	3
7	**Title**	**Engineering Materials**		
	7.1	Eutectic mixtures and soft solders, Advanced Ceramic materials and cermets : magnetic, electronic and electrical applications Carbon nanomaterials : Fullerenes and Carbon nanotubes, Structure, Properties and applications	1,2,3	4
	7.2	Insulators, Semiconductors and Superconductors : Thermal and electrical insulating materials and important engineering applications, Stoichiometric, defect and controlled valency semiconductors.	1,2,3	
	7.3	Superconductors, perovskite structure and 1:2:3 compound YBa2Cu3O7-y, properties and applications	1,2,3	
8	**Self Study**	1. Supramolecular polymers and their applications 2. Anodic Protection as a corrosion control strategy 3. Current research and advances in fuel cells 4. Commercial applications of superconducting materials 5. Tops down vs bottoms up approach to nanotechnology and applications of nanoparticles other than carbon		4*
			Total (* Not Included)	**28**

Laboratory Component

Sr. No.	Title of the Experiment
1	Determination of total, temporary and permanent hardness of water sample
2	Removal of hardness using ion exchange column
3	Molecular weight determination of polymers by Oswald's Viscometer
4	To determine flash point of a lubricating oil
5	Determination of Viscosity of oil by Redwood Viscometer
6	Estimation of acid value of lubricant
7	Determination of amount of strong acid present in a solution using a conductometer
8	Determination of strength of acid using a pH meter
9	Estimation of Copper in brass by Iodometric Titration
10	Analysis of Flue gas for its composition (by Orsat's Apparatus)
11	Estimation of Iron in plain Carbon steel
12	Determination of COD of wastewater sample

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Engineering Chemistry	Eleventh	P.C.Jain & M.Jain	Dhanpat Rai & Co. (Pvt) Ltd.	2014
2	A Textbook of Engineering Chemistry	Twelfth	S.S.Dara & S.S.Umare	S. Chand & Co.	2014
3	A Textbook of Engineering Chemistry	Third	S Chawla	Dhanpat Rai & Co. (Pvt) Ltd.	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Physical Chemistry	Eleventh	Peter Atkins	Oxford University Press	2017

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Biology for Engineers	2	0	0	3	5	2	0	0	2
		Examination Scheme								
AS103		Component	ISE		MSE		ESE		Total	
		Theory	50		50		100		200	
		Laboratory	-		--		-		-	

Pre-requisite Course Codes, if any.	HSC level Biology
Course Objective: To provide engineering perspective towards the biological principles and systems	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS103.1	understand basic biological principles and organizational structure of living systems at molecular level.
AS103.2	comprehend basic biological principles and organizational structure of living systems at cellular level
AS103.3	know Energy transformation and information processing in biological systems
AS103.4	appreciate biological process with engineering perspective
AS103.5	identify significance of Gene, Blood and Skin in human health system.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS103.1	3											
AS103.2	3											
AS103.3	2											
AS103.4	2	1										
AS103.5	2	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS103.1						
AS103.2						
AS103.3						
AS103.4						
AS103.5						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✔	Understand ✔	Apply ✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Bio-molecules and bio-polymers:** Structure and Function	1,3	4
	1.1	Organic and inorganic molecules, Unique Properties of water		
	1.2	Carbohydrates, Lipids, Amino Acids and proteins, Nucleic Acids (DNA and RNA)		
2	Title	**Levels of organization of life**	1,3	4
	2.1	Cell as a basic unit of life, prokaryotic and eukaryotic cells, microbes, plant and animal cells; Cell organelles – structure and function; Cell membrane.		
	2.2	**Levels of organization:** cells, tissues, organs, systems & organism		
3	Title	**Energy transformations**	1,3	5
	3.1	**Energy transformations in Chloroplast:** Photosynthesis (photochemical & biochemical phase) and ATP generation, Aerobic and anaerobic systems		
	3.2	**Energy transformations in Mitochondria:** Cellular respiration (glycolysis and Kreb cycle) and ATP generation		
4	Title	**Transport and Defense mechanisms**	1,3	5
	4.1	**Transport Phenomena in Biological Systems:** Membrane channels and ion channels; Fluid flow and mass transfer (nutrients & ions); In plants: Xylem and Phloem; In animals: Blood and Lymph Transport of gases: Oxygen and Carbon dioxide Heat Transport - Body temperature regulation.		
	4.2	**Defense mechanisms:** In plants: Herbivory, secondary metabolites In animals: Innate and Adaptive immune systems		
5	Title	**Engineering perspectives of biological sciences:**	1,3	
	5.1	Biology and engineering crosstalk – At cell level: Hybridoma technology At tissue level: Plant Tissue Culture, Animal Tissue Culture;		6
	5.2	Tissue Engineering: Principles, methods and applications Introduction to Biomimetics and Bio-mimicry, nano-biotechnology		
6	Title	**Role of Gene, Blood and Skin in human health system.**	2,4	4
	6.1	Introduction to Genetic Engineering. Blood Type, Complete Blood Count Test and Abnormalities.		
	6.2	Structure of Skin, Functions of Skin. Engineering methods for identification of Skin diseases.		
7	Self Study	Introduction to Biosensors, transducers, amplifiers; Introduction to medical imaging and different medical Imaging modalities; Review of Signals and system; Electro Physiological Signal Analysis.		4*
			Total (* Not included)	**28**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Molecular Cell Biology	Fourth	Lodish H, Berk A, Zipursky SL	W. H. Freeman	2000
2	Textbook of Anatomy and Physiology for Nurses and allied Health Sciences	First	Indu Khurana & Arushi	CBS Publsihers & Distributors Pvt Ltd	2019

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Lehninger Principles of Biochemistry	Fourth	Nelson, D. L., & Cox, M. M.	Freeman	2004
2	Introduction to Biomedical Engineering.	Third	Joseph D. Bronzino, John Enderle	Academic Press	2012

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Engineering Mechanics	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS105		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To provide knowledge of force analysis methods required in engineering applications and solutions. Also, to develop analytical and computational ability.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS105.1	Draw free body diagram and determine reactive forces using conditions of equilibrium and Lami's theorem
AS105.2	Determine coefficient of friction for various contact surfaces
AS105.3	Analyze the three-dimensional system of space forces.
AS105.4	Analyze the kinematics of particle and obtain the various parameters of motion.
AS105.5	Determine Instantaneous centre of rotation (ICR).
AS105.6	Design and conduct an experiment to demonstrate principles of statics and dynamics

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS105.1	3	3										
AS105.2	3	3										
AS105.3	3	3										
AS105.4	3	3										
AS105.5	3	3										
AS105.6	3	3										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
AS105.1	3					
AS105.2	3					
AS105.3	3					
AS105.4	3					
AS105.5	3					
AS105.6	3					

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	A Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Unit1	**Equilibrium of forces**		8
	1.1	Equilibrant force, conditions of equilibrium for concurrent forces, parallel forces and general force system, equilibrium of connected bodies, Lami's theorem.	1,3	
	1.2	Types of supports, types of loads, Beams, Determination of reactions at supports for various types of loads on beams	3	
2	Unit2	**Friction**		4
	2.1	Introduction to Laws of friction, Cone of friction, Equilibrium of bodies on inclined plane, Application to problems involving wedges, ladders.	1,2	
3	Unit3	**Forces in space**		5
	3.1	Rectangular Components of Forces in Space, Resultant of Space forces, Moment of a Force about a point, axis and line. Equilibrium of a particle in space.	1	
4	Unit4	**Kinematics of Particle**		8
	4.1	Motion along straight and curved path, Rectangular component of velocity and acceleration, Tangential & Normal component of acceleration, Motion curves (a-t, v-t, s-t curves), Projectile motion.	2,3	
5	Unit5	**Kinematics of Rigid Bodies**		3
	5.1	Instantaneous center of rotation for the velocity of bodies in plane motion, (up to 2 linkage mechanism)	3	
6	Self Study	1. Applications of resultant of forces, concept of couple and moments, 2. Centroid and center of gravity, analysis of trusses. 3. Kinetics of rigid body, work energy principle. 4. Principle of Law of Conservation of momentum, Impact and collision.	1,2,3	6*
			Total (*Not included)	28

Laboratory Component

Sr. No.	Title of the Experiment
1	Draw the force polygon and determine the equilibrant force for concurrent coplanar force system.
2	Use the conditions of equilibrium for parallel force system and determine the support reactions.
3	Apply the principle of moment for equilibrium of levers.
4	Determine the coefficient of friction for glass slab and a metal plate on an inclined plane.
5	Determine the axial forces using Lami's theorem for Jib crane apparatus.
6	Use the conditions of equilibrium for non-concurrent non-parallel force system and draw the force polygon.
7	Measure the acceleration due to gravity with the help of simple pendulum apparatus.
8	Determine the range of projectile and the time of flight for the projectile motion.
9	Verify the law of conservation of momentum and determine the coefficient of restitution for collision
10	(Plot the motion of projectile using air-cushion table apparatus.) A small project based on Engineering Mechanics concept.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Vector Mechanics for Engineers statics and dynamics	Nineth	Beer and Johnston	McGraw Hill	2010
2	Engineering Mechanics	Fifth	Bhavikatti S and Rajsekharappa	New Age International	2009
3	Engineering Mechanics Statics and Dynamics	Fourteenth	A K Tayal	Umesh Publication, Delhi	2012

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Engineering Mechanic: Statics and Dynamics,	Fifth	E.W. Nelson, C.L. Best, W.G. McLean,	McGraw Hill	1998
2	Singer's Engineering Mechanics Statics and Dynamics	Third	Vijaya Kumar Reddy. K. and Suresh Kumar. J	BS Publication	2012

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Problem Solving using Imperative Programming	2	0	4	6	12	2	0	2	4
		Examination Scheme								
CS101		Component	ISE		MSE		ESE		Total	
		Theory	-		-		-		-	
		Laboratory	300		--		100		400	

Pre-requisite Course Codes, if any.	
Course Objective: To develop problem solving skills using imperative programming.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS101.1	Explain the problem solving aspects using various programming paradigms.
CS101.2	Solve real world problems using imperative programming approach.
CS101.3	Solve problems using control structures for real world problems.
CS101.4	Solve problems using Arrays and Text processing.
CS101.5	Develop modular code for a given problem.
CS101.6	Solve real world problems using Structures and Unions

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS101.1	1											
CS101.2	2	2										
CS101.3	2	2										
CS101.4	2	2										
CS101.5	2	2										
CS101.6	2	2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS101.1	1		1				
CS101.2	1		1			1	
CS101.3	1		1			1	
CS101.4	1		1			1	
CS101.5	1		1			1	
CS101.6	1		1			1	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Problem Solving and Programming Paradigms**		
	1.1	What is a Problem, Problem Solving Aspect, Top Down Design, Implementation of Algorithms, Characteristics of a good algorithm, what is a computer program, real life examples of programming, Computer based applications of programming, Steps followed in Program Development, Characteristics of good Program	3,4	2
	1.2	Overview of Programming Paradigms - Declarative and Imperative, Problem solving using Algorithm and Flowcharts,	3,4	2
2	**Title**	**Basic Elements of Computer Programming and Control flow**		
	2.1	Variables, keywords, Data types, Operators**:** Arithmetic, Relational and Logical, Assignment, Unary, Conditional, Bitwise, Expression, Statements.	1,2	1
	2.2	Branching Structures: if statement, if-else statement, multi-way decision, switch statement, continue statement, break statement Iterative Structures: while, do-while, for, nested loops	1,2	3
	2.3	Problem solving using Control Structures for real world problems	1,2,4	2
3	**Title**	**Problem Solving using Array Techniques**		
	3.1	Introduction to Arrays: Declaration, Definition, accessing array elements, one-dimensional array, two-dimensional array, array of characters, Strings	1,2	2
	3.2	Classical Problem Solving using Arrays like Array Order Reversal, Array Counting or Histogramming, Finding the maximum number in a set.	1,2,4	2
	3.3	Text Processing problems like finding length, keyword search, finding anagrams	1,2,4	2
4	**Title**	**Problem Solving using Modular Approach**		
	4.1	Defining a Function, accessing a Function, Function Prototype, Passing Arguments to a Function, call by value, pointers and call by reference, Recursion	1,2	4
	4.2	Problem solving using Functions and Recursive applications	1,2,4	3
5	**Title**	**Structures and Unions**		
	5.1	Structures and Union: Declaration, Initialization, structure within structure, Array of Structure, Operation on structures, Concept of Union, Difference between structure and union,	1,2	3
	5.2	Real world problems using Structures and Unions	1,2,4	2
6	**Self Study**	File handling**:** Types of File, File operation- Opening, Closing, Creating, Reading, Processing File, Command line arguments, Dynamic Memory Allocation	1,2,4	**4***
			Total (* not counted in total hours)	**28**

Laboratory Component (Minimum 10 Laboratory experiments are expected)
Note: All problems should be implemented using C language.

Sr. No.	Title of the Experiment
1	Use the formatted input/output statements, operators and expressions of C language
2	Apply various control structures to solve given problems.
3	Apply the concept of functions to incorporate modularity.
4	Demonstrate the use of one-dimensional arrays to solve a given problem.
5	Demonstrate the use of two-dimensional arrays to solve a given problem.
6	Apply the concept of recursion to solve a given problem.
7	Implement various text processing problems.
8	Apply the concepts of structures/union to solve a given problem.
9	Demonstrate the use of pointers to solve a given problem.
10	Implement various operations on files to solve a given problem.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Programming with C	Fourth	Byron Gottfried	McGraw Hill (Schaum's outline series)	2018
2	The C programming Language	Second	Kernighan , Ritchie	Pearson	2015
3	Foundations of Programming Languages	Second	Kent D. Lee	Springer	2017
4	How to Solve it by Computer	First	R.G. Dromey	Prentice Hall India	1998

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Let Us C	Sixteenth	Yashavant Kanetkar	BPB	2017
2	Programming Language Concepts	Third	Carlo Ghezi, Mehdi Jazayeri	John Wiley & Sons	2008
3	Computer Programming in C	Second	V. Rajaraman & Neeharika Adabala	PHI Learning, Eastern Economy Edition,	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Digital Systems and Microprocessor	3	0	2	5	10	3	0	1	4
		Examination Scheme								
EC101		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To prepare students to perform the analysis and design of various digital electronic circuits and introduce them to the concept of microprocessors	
Course Outcomes (CO):*At the End of the course students will be able to*	
EC101.1	Explain various logic gates, SOP, POS forms and their minimization with k- map for given combinational circuits.
EC101.2	Construct combinational circuits using given MSI devices.
EC101.3	Apply the knowledge of flip-flops and MSI to design sequential circuits
EC101.4	Compare the logic families based on their characteristics
EC101.5	Comprehend the architectural features of 8085 with basic assembly language programming

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
EC101.1												
EC101.2												
EC101.3												
EC101.4												
EC101.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
EC101.1							
EC101.2							
EC101.3							
EC101.4							
EC101.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Combinational Circuits**		**11**
	1.1	**Logic Gates:** Basic gates, Universal gates, Sum of products and products of sum, minimization with Karnaugh Map (up to four variables), Quine Mc'Clusky method and realization.	1,4	
	1.2	**Combinational Circuits using basic gates as well as MSI devices:** Half adder, Full adder, Half Subtractor, Full Subtractor, Multiplexer, Demultiplexer, Decoder, Comparator	1,4	
2	**Title**	**Sequential Circuits**		**11**
	2.1	**Sequential Logic:** Latches and Flip-Flops. Conversions of Flip-Flops.	1,4	
	2.2	**Counters:** Asynchronous Counters, Synchronous Counters, UpDown Counters, Mod Counters, Ring and Twisted Ring Counters , Shift Registers, Universal Shift Register	1,4	
	2.3	MSI counters (IC 7490, IC 74160, IC 74163, IC 74169), MSI Shift registers (IC 74194) and their applications	2,5	
3	**Title**	**Clocked Synchronous Machines**		**05**
	3.1	Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques.	2,5	
4	**Title**	**Logic Families**		**05**
	4.1	Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in), transfer characteristics of TTL NAND.	1,4	
5	**Title**	**Introduction to Microprocessors**		**10**
	5.1	Evolution of computers and Microprocessors	3	
	5.2	Essential components of a conventional Central Processing Unit (CPU)	3	
	5.3	Architecture of 8-bit microprocessor 8085	3	
	5.4	Basic instruction set with its addressing modes and concepts of Instruction cycle, Machine cycle and T states. Elementary programming in assembly language.	3	
	5.5	Elements of I/O data transfer with the concept of interrupts	3	
6	**Self Study**	Concepts of PROM, PAL and PLA. Timing Considerations and Meta-stability in Flip-Flops. Clocked synchronous state machine design. Interfacing CMOS to TTL and TTL to CMOS. Concepts of peripherals and memory with its interfacing with 8085 microprocessor		**5***
			Total (*Not included)	**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	To implement the combinational logic for given function using basic gates/MSI ICs. a. To study and verify the truth table of logic gates b. To study the universal NAND and NOR gate c. To study the working of half adder, full adder, half subtractor, Full subtractor along with truth table
2	To implement TTL and CMOS logic family a. To study TTL NAND gate (BJT implementation). b. To study CMOS NAND gate c. To study interfacing of the TTL /CMOS
3	To implement 4-bit, 5-bit and 8 bit comparator using given MSI
4	To design implement gate level multiplexers and MSI multiplexers
5	To design and implement gate level and MSI circuits of flip-flops
6	To design counters a. To design a MOD4 synchronous up/down counter b. To study IC 7490 – Asynchronous Decade Counter
7	To synchronous counters, synchronous counters and shift register using given MSI. a. To study IC 74160 as Synchronous Decade Counter and Mod 6 counter b. To study IC 74163 as Synchronous MOD 16 Counter and Mod 10 counter c. To verify the truth table of IC 74194 as Universal Shift Register and implement Ring and Twisted Ring Counter.
8	To perform basic arithmetic operations through assembly language program in 8085
9	To simulate COPY and PASTE operation through 8085 assembly program
10	To write a program to add N elements stored in an array of 8 bit numbers (8085)

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Modern Digital Electronics	Fourth	R. P. Jain	Tata McGraw Hill	2009
2	Digital Design Principles And Practices	Third	John F. Wakerly	Pearson Education	2001
3	Microprocessor Architecture, Programming, and Applications with the 8085	Sixth	Ramesh S. Gaonkar	Penram International	2013

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Digital Design	Forth	Morris Mano	Pearson Education	2008
2	Fundamentals of digital logic design with VHDL	Second	Stephen Brown and ZvonkoVranesic	McGraw Hill	2006

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Communication Skills	1	0	2	2	5	1	0	1	2
		Examination Scheme								
AS107		Component	ISE		MSE		ESE			Total
		Theory	--		50**		--			50
		Laboratory	150*		--		--			150

** MSE will be evaluated on the basis of written test based on module 1 and 2.
** ISE will be evaluated on the basis of marks scored in practicals, out of 150.

Pre-requisite Course Codes, if any.	
Course Objective: To apply the principles of communication in personal and professional environment.	
Course Outcomes (CO):*At the end of the course students will be able to*	
AS107.1	Apply the principles of business writing for professional documents.
AS107.2	Develop advance vocabulary and grammar for spoken and written communication.
AS107.3	Design the draft a formal speech.
AS107.4	Analyze received information by using active listening and reading skills.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS107.1										2		
AS107.2										2		
AS107.3										2		
AS107.4										2		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS107.1							
AS107.2							
AS107.3							
AS107.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	L Hrs	P Hrs
1	Title	**Vocabulary Building & Grammar**		2	4
	1.1	Concept of word formation, the root words from foreign languages and their use in English	7,1		
	1.2	Common errors in writing, confused pair of words, redundancies, clichés	6, 2		
2	Title	**Writing Skills**		7	14
	2.1	Principles of Business Writing: 7Cs of communication, sentence structures, Organizing paragraph in direct and indirect style; Summarization	4		
	2.2	Practices in Writing: E-mail Etiquettes, e-mail for business purposes	3		
	2.3	Critical Reading: understanding the concept of critical reading and applying to analyze a given text.	5		
3	Title	**Oral Skills**		5	10
	3.1	Listening Comprehension (audio): Pronunciation, intonation, Stress and Rhythm	5		
	3.2	Speaking Practices: 1. Common everyday situation: Conversation and dialogues (group activity, ice-breaking session) 2. Public Speaking: Extempore, formal speech	3		
4	Self Study	1. Basic Rules Of Grammar 2. GRE Vocabulary 3. Reading a book(fiction/non-fiction) and preparing a review on it		6*	
			Total (*Not included)	**42 hrs**	

List of activities (Graded, Non-graded)

Sr. No.	Title of the assignments	Marks
1	Skit based on a given situation	-
2	ISE 1 – Summary Writing	10
3	ISE 2 – Extempore	10
4	ISE 3 – Grammar	20
5	ISE 4 – Vocabulary	20
6	Reviewing a book (fiction/ non-fiction)	10
7	ISE 5 – Email Writing (Inquiry)	20
8	ISE 6 – Email Writing (Complaint)	20
9	ISE 6 – Speech	20
10	ISE 7 – Critical Reading	20
	Total	**150**

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Communication Skills	2013	Shirley Mathews	Technical Publication, Pune	2013
2	English Vocabulary in Use	1999	Michael McCarthy, Felicity O'Dell	Cambridge University Press, India	1999

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Oxford Practice Grammar	1999	John Eastwood	Oxford, India	1999
2	Communication Skills	2011	Meenakshi Raman, Sangeeta Sharma	Oxford, India	2011
3	Communication Skills	2010	Dr. Meera Bharwani	Synergy Knowledgeware, India	2010
4	English Grammar for Today	2005	Geoffrey Leech	Palgrave, UK	2005
5	Word Power Made Easy	1978	Norman Lewis	Anchor Books, New York	1978

Semester-II

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Differential Equations and Complex Analysis	3	1	0	8	12	3	1	0	4
		Examination Scheme								
MA102		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		400	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	MA101
Course Objective: To develop mathematical skills for solving engineering problems.	
Course Outcomes (CO):*At the End of the course students will be able to:-*	
MA102.1	Solve differential equations of first order.
MA102.2	Solve differential equations of higher order using operators.
MA102.3	Solve differential equations in electrical engineering problems.
MA102.4	Find powers, roots & logarithm of a complex number and to separate the function of a complex number into real and imaginary.
MA102.5	Check whether a given function is analytic and construct analytic functions.
MA102.6	Compute integrals of complex valued functions.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA102.1	3											
MA102.2	3											
MA102.3	1	1										
MA102.4	3											
MA102.5	2											
MA102.6	2	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MA102.1							
MA102.2							
MA102.3							
MA102.4							
MA102.5							
MA102.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	Understand ✓	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Linear Differential Equations of first order**	1,2,3	11
	1.1	Exact Differential Equations, Integrating Factors, equations reducible to exact form.		3
	1.2	Linear differential equations (Definition), equations reducible to linear form, Bernoulli's equation		2
	1.3	Simple application of differential equation of first and second order to electrical engineering problems.		2
	1.4	Numerical solution of ordinary differential equations of first order and first degree using (a)Taylor's series method (b)Euler's method (c) Modified Euler method (d) Runge-Kutta fourth order formula.		4
2	**Title**	**Linear Differential Equations of higher order**	1,2,3	**11**
	2.1	Linear Differential Equation with constant coefficient-complementary function, particular integrals of differential equation of the type f(D)y = X where X is e^{ax}, sin(ax+b), cos(ax+b), x^m, e^{ax}V, xV, where V is a function of x.		7
	2.2	Cauchy's homogeneous linear differential equation and Method of variation of parameters for second order.		2
	2.3	System of Differential Equations.		2
3	**Title**	**Complex Numbers**	1,2,3	**12**
	3.1	**Revision:** Complex Numbers as ordered pairs, Argand's diagram, Cartesian, Polar and Exponential form of Complex Numbers.		1
	3.2	De Moivre's Theorem and its application to determine powers of complex numbers. Roots of complex numbers by De Moivre's Theorem.		3
	3.3	Expansion of $\sin n\theta$ and $\cos n\theta$ in terms of powers of $\sin\theta$ and $\cos\theta$. Expansion of $sin^n\theta$ and $cos^n\theta$ in terms of sines and cosines of multiples of θ.		2
	3.4	Hyperbolic Functions: relation between circular and hyperbolic functions, Inverse hyperbolic functions. Separation into real and imaginary parts of complex functions.		4
	3.5	Logarithm of a complex number.		2
4	**Title**	**Analytic functions and Complex Integrals**	1,2,3	**8**
	4.1	Analytic functions, Cauchy Reimann equations in cartesian and polar form, construction of analytic functions using Milne-Thompson's method, Harmonic functions, poles of f(z).		4
	4.2	Line Integral, Cauchy's Integral theorem for simply connected regions, Cauchy's Integral formula (for poles lying inside or outside the curve).		4

5	**Self Study**	1.3 To form D.E. for given L-C-E-R circuit 1.4 Picard's method 2.1 Method of undetermined coefficients to solve differential equations. 2.2 Legendre's differential equation, Method of variation of parameters for third order differential equations. 3.2 Complex examples using De Moivre's Theorem. 4.1 Construction of analytic function f(z) =u+iv when u+v or u-v is given. Orthogonal trajectories		**08**
			Total	**42***

***Total of 42 hours does not include self study hours.**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Higher Engineering Mathematics	Forty Fourth	Dr.B.S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Advanced Engineering Mathematics	Twenty Eighth	H.K Das	S.Chand	2014
2.	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
3.	Advanced Engineering Mathematics	Fourth	Jain and Iyengar	Narosa Publications	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
BSC	Engineering Physics	2	1	2	5	10	2	1	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
AS101		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	HSC level physics
	Course Objective: To provide the knowledge and methodology necessary for solving problems in the field of engineering
Course Outcomes (CO):*At the End of the course students will be able to*	
AS101.1	Illustrate the knowledge of basic concepts of semiconductor physics, lasers and quantum mechanics.
AS101.2	Solve the problems by applying the basics concepts of physics.
AS101.3	Use the Schrodinger equation to realize the concept of discreteness and quantum tunneling.
AS101.4	Explain the working of various LASERs and its practical applications.
AS101.5	To develop experimental skills and the practical abilities.
AS101.6	To develop an ability of understanding of concepts and principles of physics.
AS101.7	To comprehend importance of precision, accuracy of the experimental data.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS101.1	1											
AS101.2		1										
AS101.3		1										
AS101.4	1											
AS101.5				1								
AS101.6				1								
AS101.7												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS101.1							
AS101.2							
AS101.3							
AS101.4							
AS101.5							
AS101.6							
AS101.7							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Quantum Mechanics**		**09**
	1.1	de-Broglie hypothesis; experimental verification of de Broglie hypothesis; wave packet, group velocity and phase velocity; Wave function, Physical interpretation of wave function; Heisenberg's uncertainty principle; Electron diffraction experiment; Applications of uncertainty principle	1,2,3	
	1.2	Schrodinger's time dependent wave equation, time independent wave equation; Application of time-independent Schrodinger equation - Particle trapped in one dimensional box and Potential barrier (Tunnelling), Harmonic oscillator (qualitative)	1,2,3	
2	**Title**	**Physics of Semiconductors and Semiconductor devices**		**13**
	2.1	Conduction in metals and semiconductors; Fermi-Dirac distribution function and Fermi level in a conductor, insulator and semiconductor	5	
	2.2	Intrinsic and extrinsic semiconductors; intrinsic conductivity and extrinsic conductivity; Law of mass action, charge neutrality condition; intrinsic carrier concentration, electron and hole concentration; Extrinsic carrier concentration as a function of temperature; Effect of impurity concentration and temperature on the Fermi Level; Hall Effect and its applications. Drift and Diffusion current density	5	
	2.3	Formation of a P-N junction, depletion region and barrier potential; Energy band structure of P-N Junction (unbiased, forward-bias, reverse-bias); concept of carrier current densities in p-n junction in equilibrium, forward bias and reverse bias; Breakdown mechanism - Zener effect and avalanche	5,6	
	1.4	P-N junction devices: LED, Zener diode, photoconductors, photovoltaic solar cells and Bipolar Junction Transistors	5,6	
3	**Title**	**LASERS**		**06**
	3.1	Processes - Absorption of light, spontaneous emission, stimulated emission; Einstein's equations, Population inversion; metastable states; pumping and pumping schemes; optical resonance cavity	3,4	
	3.2	Ruby and Helium Neon laser, semiconductor laser; Applications of laser in industry, medicine and holography. (construction & reconstruction of holograms)	3,4	
4	**Self Study**	Interference of light in thin films having uniform thickness, Newton's rings, Applications of interference in anti-reflecting and highly reflecting thin films. Diffraction of light, Diffraction due to single slit, double slit and diffraction grating.		**05***
			Total (*Not included)	**28**

Laboratory Component

Sr. No.	Title of the Experiment*
1	Determination of energy band gap of a semiconductor
2	Study of I-V characteristics of a Zener diode
3	Determination of the type of semiconductor sample, concentration of charge carriers and its mobility using Hall Effect
4	Determination of Planck's constant using photo vacuum tube
5	Measurement of ultrasonic velocity in liquid medium using ultrasonic interferometer
6	Determination of radius of curvature using Newton's Rings
7	Determination of thickness of a thin foil or wire using the interference pattern of a wedge-shaped film
8	Determination of wavelengths of a mercury source and resolving power of a plane diffraction grating
9	Study of single slit diffraction
10	Determination of grating element of a diffraction grating using a laser source
11	Determination of the numerical aperture of an optical fibre
12	Uses of a Cathode-Ray Oscilloscope

*Students will perform any 10 of the above experiments

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	A Textbook of Engineering Physics	Eleventh	Dr. M.N. Avadhanulu & Dr. P. G. Kshirsagar	S. Chand	2018
2	Engineering Physics	First	D. K. Bhttacharya & Poonam Tandon	Oxford University Press	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Concepts of Modern Physics	Sixth	Arthur Beiser	McGraw Hill Education	2009
2	Modern Physics	Third	Serway, Moses and Moyer	Thomson Learning	2005
3	Fundamentals of Physics	Tenth	Halliday and Resnick	Wiley	2013
4	Solid State Physics	Eighth	S. O. Pillai	New Age International Publishers	2018
5	Solid State Electronic Devices	Seventh	Ben G. Streetman and Sanjay Kumar Banerjee	Pearson Education	2016
6	Lasers: Fundamentals and Applications	Second	Ghatak and Thyagarajan	Springer	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Engineering Graphics	1	0	2	2	5	1	0	2	2
		Examination Scheme								
AS104		Component	ISE		MSE		ESE		Total	
		Theory	20		20		60		100	
		Laboratory	60		--		40		100	

Pre-requisite Course Codes, if any.	Fundamentals up to 12th science
Course Objective: To develop technical drawing and visualization skills using instrumental drawing and soft tool, required for design and modeling, in Engineering Applications and Solutions.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CO1	Construct basic engineering curves.
CO2	Draw projections of points and lines.
CO3	Draw projections of regular solids inclined to both the reference planes.
CO4	Read the 3-dimensional view and draw the orthographic projections.
CO5	Read the 3-dimensional view and draw the sectional orthographic projections.
CO6	Read the orthographic projections and draw isometric view.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										3
CO2	3	3										3
CO3	3	3										3
CO4	3	3										3
CO5	3	3										3
CO6	3	3										3

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply √	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Unit1**	**Introduction to Engineering Drawing**	1,2	**4**
	1.1	Introduction to Drawing Instruments, Types of Lines, Dimensioning Systems and Scaling as per IS conventions. First angle method of projection only		
	1.2	Basic construction of Cycloid and Involutes.		
2	**Unit2**	**Projections of Points and Lines**	1	**4**
	2.1	Projection of points in all four quadrants		
	2.2	Projection of lines parallel to one principal reference plane.		
	2.3	Lines inclined to both the Reference Planes (Excluding Traces of lines).		
3	**Unit3**	**Projections of solids** (Regular solids like Prism, Pyramid, Cylinder, Tetrahedron, Hexahedron and Cone only)	1,2	**7**
	3.1	Projection of solid resting on plane (Single step projection)		
	3.2	Projection of solid such that base inclined to one reference plane (Two step projection)		
	3.3	Projection of solid such that base inclined to both reference planes (Three step projection/problem) (Exclude Spheres, Composite, Hollow solids and frustum of solids)		
4	**Unit4**	**Orthographic Projections**	1,2	**Lab Sessions**
	4.1	Orthographic views of a simple machine part as per the first angle method of projection recommended by I.S.		
	4.2	Full Sectional views of the Simple Machine parts.		
5	**Unit5**	**Isometric Projections and views**	2	**Lab Sessions**
	5.1	Isometric views (Natural scale only)		
6	**Self Study**	1.2 Construction of Engineering curves like ellipse, parabola, hyperbola, helix, other types of cycloid etc. by using different method of construction. 2.1 Projection of lines with traces, application-based problems on Projection of lines 3.1 Projections of cut solids with different cutting planes. 4.1 Solve more practice examples of orthographic views. Draw different views of a machine part/any object using third angle method of projection. (Axonometric view, oblique view, perspective etc.) 4.2 Half sectional orthographic views. 5.1 Development of surfaces of frustum of solid, and retaining part of the solid after cutting plane, reverse development of solid.	1,2,3	**6***
Total (*Not included)				**15**

Laboratory Component (Minimum 5 sheets are expected)

Sr. No	No of Sessions	Engineering AutoCAD Laboratory
1	**2**	Introduction to Auto-CAD: -Basic Draw and Modify Commands. Knowledge of setting up layers, Dimensioning, Hatching, plotting, and Printing. **Auto-Cad Practice sheet-1**
2	**1**	**Auto-Cad Practice sheet-2**
3	**2**	**Introduction to Orthographic projections sheet-3**
4	**2**	**Orthographic projections sheet-4**
5	**2**	**Introduction to Sectional Orthographic projections sheet-5**
6	**2**	**Sectional Orthographic projections sheet-6**
7	**2**	**Introduction to Isometric Projection/View: -** Isometric View of blocks with plain and cylindrical surfaces is using plain/natural scale only. (Exclude Spherical surfaces). **Isometric Projection/View sheet-7**
8	**2**	**Isometric Projection/View sheet-8**
Total	**15**	

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Engineering Drawing	53rd	N D Bhatt	Charotar	2016
2	Engineering Drawing	3rd	Dhananjay A Jolhe	Tata McGraw Hill	2011

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	AutoCAD 2017	--	Sham Tickoo	DreamTech Press, Delhi	2017
2	Engineering Drawing and Graphics	Fifth	K Venugopal	New Age International	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Basic Electrical Engineering	3	0	2	6	11	3	0	1	4
		Examination Scheme								
ET101		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	Basic concepts of electric charge, current, voltage and Power
Course Objective: To impart a basic knowledge of electrical quantities, Circuits and components.	
Course Outcomes (CO):*At the End of the course students will be able to*	
ET101.1	Compute various electrical quantities of given dc circuit using circuit simplification techniques and various network theorems.
ET101.2	To expose the students to different terms and concepts in AC Circuits at fundamental frequency and to expose them to basics of effects of harmonics in the waveforms
ET101.3	To study the working principles of electrical machines and their applications
ET101.4	To expose the students the fundamental concepts in Controllable Switch and Modulation based Power Conversion
ET101.5	To study Electrical Parameters of the Batteries and their selection and design criteria for a specific application

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ET101.1												
ET101.2												
ET101.3												
ET101.4												
ET101.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
ET101.1							
ET101.2							
ET101.3							
ET101.4							
ET101.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**DC Circuits**	1,2	10
	1.1	Electrical circuit elements (R, L and C), Voltage and current sources, Equivalent resistance of circuits, Simplification using delta-star and star-delta transformation.		
	1.2	Kirchoff's current and voltage laws, Analysis of simple circuits with dc excitation. Mesh analysis, Superposition, Thevenin, Norton and Maximum Power Transfer Theorems		
	1.3	Time-domain analysis of first-order DC Transients in RL and RC circuits.		
2	Title	**AC Circuits**	1,2	12
	2.1	Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Harmonics, Total Harmonic Distortion, Power supplied by Harmonic voltages and currents, Power factor in case of non-sinusoidal waveforms.		
	2.2	AC Analysis of series and parallel RLC Circuits with Resonance, Concept of Bandwidth and Q-factor,		
	2.3.	Three-phase balanced circuits, voltage and current relations in star and delta connections.		
3	Title	**Electromagnetic and Electro-Mechanical Energy Converters**	1,2	10
	3.1	Magnetically Coupled Coils, Self and Mutual Inductance and Dot Convention		
	3.1	Single Phase Transformer: Principle of Operation, Equivalent Circuits		
	3.2	Single Phase Transformer: Efficiency and Regulation		
	3.3	Introduction to Three-phase Transformers and Applications		
	3.4	Fundamental Principles of Rotating Machines, Characteristics of Induction motor and DC motor		
4	Title	**Electric Power Converters**	1,2	05
	4.1	Fundamental Principles of Buck, Boost and buck-boost DC-DC converters and their Transfer Characteristics, Duty Ratio Control		
	4.2	Single-phase voltage source inverters and PWM		
5	Title	**Batteries: Electrical Characteristics and Applications**		05
	5.1	Introduction to type of Batteries, Generalized Battery parameters such as SoC, DoD, Energy and Power Densities, Battery C-rating, etc. Comparison of Batteries, Charging and Discharging Characteristic		
	5.2	Selection and Sizing of Battery Packs for Specific Applications		
6	Self Study	Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Elementary calculations for energy consumption and power factor improvement.		6*
			Total (*Not Included)	42

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
01	Introduction to Electrical Measuring instruments, Lamp Loads, Inductor Loads and Capacitor Bank
02	Verification of Star-Delta and Delta-star Transformation with Kirchhoff's Laws
03	Verification of Thevenin's Norton's and Maximum Power Transfer Theorem
04	Verification of DC Transient equations in RL and RC Circuits
05	Experimental study of single-phase AC circuit with R-L and R-C Load with Measurement of Power and Power factor
06	Experimental study of R-L-C series Resonance. To plot resonance curve, To compute Bandwidth and Q-factor
07	Experiment on Magnetic Circuit Fundamentals
08	Loading of a transformer: measurement of primary and secondary voltages and currents, and power. To compute efficiency and regulation.
09	Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
10	Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
11	Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform.
12	Demonstration of V/F control of Induction motor
13	Experimental study of charge and Discharge characteristics of a Lead-acid Battery
14	Introduction to L.T. Switch gear

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Basic Electrical Engineering	Third	D.P. Kothari and I. J.	Tata McGraw Hill	2010
2	Electrical Technology	Twenty Third	B.L.Theraja	S. Chand Publications	2003

Reference Books

Sr. No.	Title	Edition	Author	Publisher	Year
1	Basic Electrical Engineering	Second	D.C. Kulshreshtha	McGraw Hill	2019
2	Fundamentals of Electrical Engineering	Second	L.S. Bobrow	Oxford University Press	2011
3	Electrical and Electronics Technology	Third	E. Hughes	Pearson	2010
4	Electrical Engineering Fundamentals	Second	V.D. Toro	Prentice Hall India	1989
5	Elements of Power Electronics	Second	P. T. Krein	Oxford University Press	2015
6	Power Electronics: Converters, Application and Design	Second	Ned Mohan, T.M Undelands and W P Robbins	John Wiley and Sons. Inc.	1995
7	Electric Machinery	Sixth	A. E. Fitzgerald, C. Kingsley and S. D. Umans	McGraw-Hill	2003

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(ESC)	Problem Solving using OOP	2	0	4	3	7	2	0	4	4
		Examination Scheme								
CS102		Component	ISE		MSE		ESE		Total	
		Theory	--		--		--		--	
		Laboratory	300		--		100		400	

Pre-requisite Course Codes, if any.	Problem Solving using Imperative Programming
Course Objective: To learn problem solving using Object-Oriented programming paradigm	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS102.1	Apply concepts of object oriented programming using classes and objects
CS102.2	Apply Inheritance for a given scenario
CS102.3	Apply polymorphism for solving a given problem
CS102.4	Apply abstraction and exception handling to create efficient program.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS102.1	2	2	2									
CS102.2	2	2	2									
CS102.3	2	2	2									
CS102.4	2	2	2									

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS102.1	2						
CS102.2	2						
CS102.3	2						
CS102.4	2						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory (This course content delivery will be in C++/Java. Course Contents to be taken care accordingly)

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Introduction and Encapsulation**		8
	1.1	Introduction to Object Oriented Programming, Procedural verses Object Oriented Programming, Principles, Benefits and applications of Object Oriented Programming.	1,2	
	1.2	Encapsulation: Problem solving with Objects and Classes		
	1.3	static data member and methods, constructors and their types. Types of functions and keywords, Strings, Arrays		
2		**Inheritance**		6
	2.1	Concept of Inheritance, parent class, derived class, base class and derived class constructor	1,2	
	2.2	Types of inheritance: single, multiple, multilevel, hierarchical, hybrid		
	2.3	Aggregation and Composition		
3		**Polymorphism**		6
	3.1	Static Polymorphism: Method overloading and Constructor overloading	1,2	
	3.2	Dynamic Polymorphism: Method overriding		
	3.3	Data conversion		
4		**Abstraction**		2
	4.1	Abstraction: abstract class	1,2	
5		**Exception Handling**		6
	5.1	try, throw, and catch exceptions	1,2	
	5.2	Function exception declaration		
6	Self Study	File Handling, $ STL, $pointers, $virtual functions @Multithreading, @Packages, @interface	1,2	5*
Total				28+5*

$ only for C++
@ only for Java

**** Language used: C++ for Etrx and Extc Branch**
**** Language used: C++/Java for IT and CE Branch**

Laboratory Component

Sr. No.	Title of the Experiment
1	Program on Encapsulation: Write a program to demonstrate classes and objects
2	Program on Encapsulation: Write a program to demonstrate constructor
3	Program on Polymorphism: Implement a Program to demonstrate method overloading,
4	Program on Polymorphism: Implement a Program to demonstrate constructor overloading
5	Program on Polymorphism: Implement a Program to demonstrate method overriding
6	Program on Inheritance: Implement a Program to demonstrate single, multilevel Inheritance
7	Program on Inheritance: Implement a Program to demonstrate multiple Inheritance
8	Program on Abstraction: Implement a Program to demonstrate Abstraction using abstract class
9	Program on Abstraction: Implement a Program to demonstrate multithreading/ STL
10	Program to demonstrate File Handling

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Object Oriented Programming with C++	Sixth	E Balagurusamy	Tata McGraw Hill	2017
2	Oriented Programming in Turbo C++	Fourth	Robert Lafore	Galgotia	2001
3	Java -The Complete Reference	Tenth	Herbert Schildt	Tata McGraw-Hill	2017
4	Java Programming From the Ground Up	First	Ralph Bravaco,Shai Simoson	Tata McGraw-Hill	2009

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The Compete Reference C++	Fourth	Herbert Schlitz	Tata McGraw Hill	2017
2	An introduction to Programming and Object Oriented Design using Java	Third	Jaime Nino, Frederick A. Hosch	Wiley Student Edition	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Skill Shop	0	0	2	0	02	0	0	1	1
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
AS106		Theory		--		--		--		--
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	
Course Objective: To equip the students with the fundamental skills involved in the creation of simulated and physical design.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS106.1	Operate basic electronic equipment and instruments.
AS106.2	Make PCB designs in simulations.
AS106.3	Assemble, disassemble and troubleshoot computer hardware and network peripherals.
AS106.4	Fabricate basic jobs in traditional trades.
AS106.5	Design a 3D model and translate it to a 3D printed component.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS106.1												
AS106.2												
AS106.3												
AS106.4												
AS106.5												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS106.1							
AS106.2							
AS106.3							
AS106.4							
AS106.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Lab Component

Trade No.	Unit No.	Topics	Ref.	Hrs.
1	Unit 1	**Electronic Components**	5	4
	1.1	**Introduction to Electronic Components** Exposure to usual electronic equipment/instruments such as Multi-meter, Oscilloscope, Function generator, IC tester and Power supply, Information about their front panels, Demonstrations on their working, Hands-on for measurement of component values and DC voltage using multi-meter, AC mains voltage/1 KHz Square wave/any small signal from function generator on Oscilloscope, Testing of sample digital ICs using IC tester. **OR** **Repairing of gadgets and appliances:** Elementary skills of repairing juicer, mixer, grinder, etc.		
2	Unit 2	**PCB Laboratory Exercises**	6	4
	2.1	Layout drawing, Positive and negative film making, PCB etching and drilling, Tinning and soldering technique.		
3	Unit 3	**Hardware and Networking**	7, 8	4
	3.1	Dismantling of a Personal Computer (PC), Identification of Components of a PC such as power supply, motherboard, processor, hard disk, memory (RAM, ROM), CMOS battery, CD drive, monitor, keyboard, mouse, printer, scanner, pen drives, disk drives etc.		
	3.2	Assembling of PC, Installation of Operating System and Device drivers, Boot-up sequence. Installation of application software (at least one).		
	3.3	Basic troubleshooting and maintenance.		
	3.4	Identification of network components: LAN card, wireless card, switch, hub, router, different types of network cables (straight cables, crossover cables, rollover cables) Basic networking and crimping.		
4	Unit 4	**Traditional Trades***	1, 2	4
		Carpentry Use and setting of hard tools like hacksaws, jack planes, chisels and gauges for construction of various joints, wood turning and modern wood turning methods. One carpentry job involving a joint and report on demonstration of a job involving wood turning required for successful completion of module. OR **Electrical board wiring** House wiring, staircase wiring, and wiring diagram for fluorescent tube light, Godown wiring and three phase wiring for electrical motors. OR **Sheet Metal Practice** Introduction to primary technology processes involving bending, punching and drawing various sheet metal joints, development of joints. Utility job in sheet metal required for successful completion of module.		

5	**Unit 5**	**3D Modeling and Printing**	3, 4	**4**
	5.1	Modeling approaches for ideation and creation. Developing a CAD file (.iges/.step/.dwg) of a 3D model and export it as an .stl file for the purpose of 3D printing. Importing the 3D .stl file to generate a .gcode file for 3D printing through slicing, using open source software.		
	5.2	Introduction to 3D printing: methodologies, best practices, material and model variation. Live printing sessions of generated .gcode files in real time with optimal parameters and troubleshooting.		
			Total	**20**

*** Students can opt for any one of the three trades from Unit 4.**

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Workshop Manual	Sixth	Venkat Reddy	BS Publication	2008
2	Wiring Simplified: Based on 2017 National Electrical Code	Forty Fifth	Frederic P Hartwell, Herbert P. Richter, W.C. Schwan	Park Publishing	2017

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Autocad 2017	First	ShyamTikoo	Dreamtech Press	2016
2	Ultimaker 2+ reference manual	-	-	Ultimaker	2017
3	Encyclopedia of Electronic Components	First	Charles Platt	O Reilly	2012
4	Printed Circuit Boards	First	Khandpur R.S.	Tata McGraw Hill	2005
5	Troubleshooting Your PC For Dummies	Second	Gookin Dan	For Dummies	2005
6	Networking For Dummies	Eighth	Lowe Doug	For Dummies	2007

Sem III									
No.	Type	Code	Course	L	T	P	O	E	C
1	BSC	MA203	Probability and Statistics	3	0	0	5	08	3
1	BSC*	MA202	Foundation of Mathematics-I*	2	1	0	6	09	3
2	PC	CS201	Discrete Structures and Graph Theory	3	0	0	4	07	3
3	PC	CS202	Data Structures	3	0	2	5	10	4
4	PC	CS203	Computer Architecture and Organization	3	0	2	4	09	4
5	PC	CS204	Database Management Systems	3	0	2	5	10	4
6	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	03	1
7	HSSE	HSEX1	HSS-I	2	0	0	3	05	2
			TOTAL	**17**	**0**	**6**	**29**	**52**	21

**Only for Lateral Entry Students*

Sem IV									
No.	Type	Code	Course	L	T	P	O	E	C
1	BSC	MA201	Linear Algebra	2	0	2	5	09	3
1	BSC*	MA204	Foundation of Mathematics-II	2	1	0	6	09	3
2	PC	CS205	Design and Analysis of Algorithms	3	0	2	5	10	4
3	PC	CS206	Operating Systems	3	0	2	5	10	4
4	PC	CS207	Computer Communications and Networks	3	0	2	5	10	4
5	SBC	CS208	Mini Project-I	0	0	0	4	04	2
6	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	01	1
7	HSSE	HSEX2	HSS-II	2	0	0	3	05	2
8	SBC	AS201	Professional Communication Skills	1	0	2	2	05	2
9	S/M	SCX1/MNX1	SCOPE-I/Minor-I						3
			TOTAL	**14**	**0**	**10**	**32**	**56**	22

**Only for Lateral Entry Students*

Second Summer for HSC students									
No.	Type	Code	Course	L	T	P	O	E	C
1	MLC	AS202	Constitution of India				06	06	NC

Second Summer (For Lateral Entry Students)									
No.	Type	Code	Course	L	T	P	O	E	C
1	BSC	MA201	Linear Algebra	2	0	2	5	09	3
1	BSC	MA203	Probability and Statistics	3	0	0	5	08	3
2	MLC	AS202	Constitution of India				06	06	NC

Semester-III

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Discrete Structures and Graph Theory	3	0	0	4	7	3	0	0	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS201		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	
Course Objective: To teach students how to think logically and mathematically. It provides the mathematical foundation that is used in most areas of computer science.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS201.1	Solve problems using set theory, logic and its various proof techniques.
CS201.2	Apply the concepts of relations, functions, lattices and recurrence relations to solve problems
CS201.3	Apply the concepts of graph, trees and their various types with their traversing techniques to solve problems.
CS201.4	Apply the basics of coding theory and cryptography to solve real world problems.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS201.1	3											
CS201.2	3	2										
CS201.3	3											
CS201.4	3	2	2									2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS201.1			2				
CS201.2			2				
CS201.3			2				
CS201.4			2				

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Set Theory, Logic and Proofs**	**1, 2**	
	1.1	Finite and infinite set, Union, Intersection, Disjoint, and Difference of two sets. Power Set, Partition of Sets, Ordered Sets, De Morgan's Laws, Principle of Inclusion Exclusion		**2**
	1.2	Predicates, Propositions, Conditional Propositions, Logical Connectivity, Proposition calculus, Universal and Existential Quantifiers, First order logic, Equivalence, Normal Forms, Introduction to proofs, Mathematical Induction, Strong Induction, Well-ordering principle, Logical inference		**6**
2	**Title**	**Relations, Functions and Lattices**	**1, 2**	
	2.1	Product Sets and Partitions, Paths in relations and Diagraphs, Properties of Relations, Closure of Relation, Equivalence Relations, Operations on Relations, Warshall's Algorithm, Partially Ordered Sets, External Elements of Partially Ordered Sets, Hasse Diagram		**8**
	2.2	Composition of Functions, Invertible Functions, Recursive Functions, Hashing, Pigeon hole Principle, Extended PHP		**3**
	2.3	Lattice, Sub lattice, Isomorphic Lattices, Properties of Lattice, Special Types of Lattices		**4**
	2.4	Recurrence Relations – Introduction, Linear Recurrence Relations with constant coefficients, Homogeneous solutions, Particular Solutions, Total Solutions, Solution by the method of Generating functions, solving Recurrence Relations		**5**
3	**Title**	**Graph Theory**	**1, 2**	**4**
	3.1	Concepts and terminologies, Graphs as Model (Konigsberg Bridge Problem)		
	3.2	Matrices, Isomorphism, Bipartite Graphs, Directed Graphs		
	3.3	Minimal Spanning Trees-Prim's Algorithm and Kruskal's Algorithm		
4	**Title**	**Graph connectivity**	**1, 2**	**6**
	4.1	Cycles – Transport Networks, Max Flows, Matching Problems, Maximum Bipartite Matching, Perfect Matching		
	4.2	Euler Paths- Circuits, Hamiltonian Paths- Circuits		
	4.3	Coloring Graphs, Chromatic Polynomial, Planer Graphs		
5	**Title**	**Coding Theory**	**1, 2**	**4**
	5.1	Hamming Code, Minimum Distance		
	5.2	Number Theory, Modular Arithmetic and applications to cryptography; Diffie-Hellman Algorithm		
6	**Self-Study**	Algebraic Structures - Semi group, Monoids, Groups, Cyclic groups, Abelian groups, Normal Subgroups	**1, 2**	**5***
			Total (*Not included)	**42**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Discrete Mathematics and it's applications	Seventh	Kenneth H. Rosen	Tata McGraw-Hill	2013
2	Discrete Mathematical Structures	Sixth	Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman	Pearson Education	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Elements of Discrete Mathematics	Fourth	C. L. Liu	Tata McGraw-Hill	2012
2	Introduction to graph Theory	Second	Douglas B. West	Pearson Education	2015
3	Discrete Mathematical Structures with Applications to Computer Science	First	Jean-Paul, Tremblay R. Manohar	Tata McGraw-Hill	1987

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Foundations of Mathematics-I	2	1	0	0	3	2	1	0	3
		Examination Scheme								
MA202		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	-
Course Objective: To develop basic foundation of mathematical skills.	
Course Outcomes (CO):*At the End of the course students will be able to:-*	
MA202.1	Differentiate a function of one variable and partially differentiate a function of more than one variable.
MA202.2	Apply the concept of partial differentiation to find extreme values of a given function.
MA202.3	Find nth order derivative of a given function.
MA202.4	Expand a given function as a power series.
MA202.5	Perform operations on matrices and find inverses and determinants of them.
MA202.6	Perform vector operations and compute dot products and cross products between them.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA202.1	2											
MA202.2	2											
MA202.3	2											
MA202.4	1											
MA202.5	1											
MA202.6	1											

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
MA202.1						
MA202.2						
MA202.3						
MA202.4						
MA202.5						
MA202.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✔	**Understand** ✔	**Apply** ✔	**Analyze**	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Differential Calculus**	1,2	**18**
	1.1	Partial fractions. Derivatives of standard functions, product and quotient rule for differentiation.		04
	1.2	Partial derivatives of first and higher order, composite differentiation		03
	1.3	Application of partial derivatives: Local Maxima and Minima of functions of two variables.		02
	1.4	Successive Differentiation: Proofs of nth derivatives of standard functions. Use of partial fractions to calculate nth derivatives of given functions. Leibnitz theorem for nth derivative of product of two functions.		05
	1.5	Infinite series: expansion of functions in powers of x using maclaurin series. Taylor's series.		04
2	**Title**	**Matrices**	1,2	**07**
	2.1	Addition and scalar multiplication of matrices. Matrix multiplication, types of matrices.		03
	2.2	Elementary row transformations, finding inverses using matrices, determinants and its properties		04
3	**Title**	**Vectors**	1,2	**03**
	3.1	Vector definition, addition, scalar multiplication, dot product of two vectors, angle between two vectors, cross product.		03
			Total	**28**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Higher Engineering Mathematics	Forty Forth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
2	Advanced Engineering Mathematics	Twenty Eighth	H.K.Dass	S. Chand Publications	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Probability and Statistics	3	0	0	5	8	3	0	0	3
		Examination Scheme								
MA203		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	-
Course Objective: To give an exposure to the students the basic concepts of Probability and Statistical methods and their application.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
MA203.1	Familiarize with basic probability axioms, rules and their applicability.
MA203.2	Identify the characteristics of various discrete and continuous distributions.
MA203.3	Find unbiased and efficient estimates using estimation theory.
MA203.4	Test the hypothesis for means and variances using't'& F; chi-square distribution tests.
MA203.5	Find Correlation and Regression and fit different types of curves.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA203.1	2											
MA203.2		2										
MA203.3		2										
MA203.4		2										
MA203.5		2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MA203.1	2						
MA203.2	2						
MA203.3	2						
MA203.4	2						
MA203.5	2						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Probability and Random Variables**	**1, 2**	**12**
	1.1	Classical, relative frequency and axiomatic definitions of probability, addition rule and multiplication rule. Conditional Probability, Bayes' theorem and independence.		04
	1.2	Discrete, continuous and mixed random variables, probability mass function(PMF), Probability Density Function(PDF) and cumulative distribution function(CDF). Joint Distributions: Joint, marginal and conditional distribution.		04
	1.3	Mathematical expectation, moments, moments generating function, Chebyshev's inequality.		04
2	**Title**	**Probability Distributions**	**1, 2**	**12**
	2.1	Standard discrete distributions: Bernoulli, Binomial, Poisson and Geometric distributions, Probability density function, Cumulative distribution function, Expectation and Variance,		06
	2.2	Standard continuous distributions – Uniform, Normal, Exponential, Joint distribution and Joint density functions		06
3	**Title**	**Test of Hypothesis and Significance**	**1, 2**	**12**
	3.1	Statistical hypothesis, Null and Alternate hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of Significance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value.		03
	3.2	Special tests of significance for Large samples and Small samples (F, chi- square, z, t- test), ANOVA.		09
4	**Title**	**Correlation and Regression**	**1, 2**	**06**
	4.1	Correlation, Rank correlation, Regression Analysis, Linear and Non-linear Regression, Multiple regressions, Curve fitting by method of least squares, fitting of straight lines, Polynomials, Exponential curves.		
5	**Self Study**	1. Applicability of Bayes theorem 2. Proofs for mean & variance for all distribution: included in module 2 3. Examples to test goodness of fit using Chi-square		01* 02* 02*
			Total	**42**

*** Not included in Total 42 hrs.**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Probability and Statistics for Engineers and Scientists	Fourth	Sheldon M. Ross	Academic Foundation	2011
2	Probability and Statistics for Engineers and Scientists	Eighth	E. Walpole, R. H. Mayers, S. L. Mayers and K. Ye	Pearson Education	2007

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Probability and Statistics in Engineering	Fifth	Douglas C. Montgomery	Wiley India	2012
2	Probability & Statistics	Third	Spiegel, M. R., Schiller, J. and Srinivasan, R. A.	Tata McGraw Hill	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Data Structures	3	0	2	5	10	3	0	1	4
CS202		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	1. Problem solving using imperative programming
Course Objective: To introduce the fundamentals and abstract concepts of Data Structures for Problem Solving.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS202.1	Apply various operations of linear and non-linear data structures to given problems.
CS202.2	Apply the concepts of Trees and Graphs to a given problem.
CS202.3	Apply various operations of heap data structures.
CS202.4	Apply the concepts of hashing on a given problem

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS202.1	3		3						3	3	3	
CS202.2	3		3						3	3	3	
CS202.3	3		3						3	3	3	
CS202.4	3		3						3	3	3	

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS202.1			1			1	
CS202.2			1			1	
CS202.3			1			1	
CS202.4			1			1	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Data Structures**		
	1.1	Concept of Linear and Non linear Data Structures	1,2	**1**
	1.2	Stack: Stack as ADT, operations on stack,, Applications of Stacks	1,2	**4**
	1.3	Queue: Queue as ADT, Operations on Queue,, Applications of Queue , Types of Queue-Circular and Priority Queue	1,2	**4**
	1.4	Linked List: Linked List as ADT, Operations on Singly Linked List. Types of linked list- Linear and circular linked lists, Doubly Linked List, Circular Linked List and its operations, Generalized Linked List (GLL) concept , Applications of linked List and Generalized Linked List (GLL).	1,2	**6**
2	**Title**	**Trees**		
	2.1	Trees as ADT, General tree v/s Binary Tree Terminology, Traversal of Binary Tree, Operations on Binary tree, Binary Search Tree and its operations, Expression Tree	1,2	**5**
	2.2	AVL Trees- Properties of AVL trees, Rotations, Insertion, and Deletion	1,2	**4**
	2.3	Introduction to B tree- Insertion , Deletion.	1,2	**3**
3	**Title**	**Graphs**		
	3.1	Graph as ADT, Introduction To Graph, Representation of Graph- Adjacency Matrix, Adjacency List, Graph Traversal Technique	1,2	**3**
4	**Title**	**Heap Structure**		
	4.1	Heap as ADT, Introduction to Heap Structures, Min Heap, Max Heap, Construction of Heap	1,2	**3**
	4.2	Fibonacci heaps- Structure of Fibonacci heaps, Mergeable-heap, operations, Decreasing a key and deleting a node	1,2	**5**
5	**Title**	**Hashing**		
	5.1	Introduction to Hash Table, Hash functions, Collision Resolution Technique.	1,2	**4**
6	**Self Study**	**Optimal Binary Search Tree and Red-Black Trees**	**1,2**	**5***
			Total	**42**

Laboratory Component, if any (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Implement a given problem statement using Stack.
2	Implement a given problem statement using Queue
3	Implement a given problem statement using Linked List.
4	Implement a given problem statement using Doubly Linked List.
5	Implement a given problem statement using Binary Trees.
6	Implement insertion of node in AVL tree.
7	Implementation of expression tree
8	Implement Operations of Heap Structures.
9	Implement hash functions with different collision resolution techniques.
10	Apply Graph Traversal Technique on a given problem statement to solve the problem

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Algorithms	Third	Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	2009
2	Fundamentals of Computer Algorithms	Second	Horowitz E, Sahni S and S.Rajasekaran	Galgotia Publications	2010

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Classic Data Structures	Second	Samanta Debasis	PHI	2009
2	Data Structures With C	First	Seymour Lipschutz	Schaum's Outline Series	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Computer Architecture and Organization	3	0	2	4	9	3	0	1	4
CS203		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Digital Circuits & Systems, Any Programming Language
Course Objective: Imparting concepts of each component of computer architecture thoroughly with practical aspects including memory systems and I/O communications with interfacing	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS203.1	Explain basic computer structure and compare computer architecture models
CS203.2	Design algorithms to solve ALU operations and memory mapping techniques
CS203.3	Comprehend processor architecture with various design methods of CPU with comparative analysis
CS203.4	Illustrate memory systems with design and analysis of mapping techniques for cache and virtual memory
CS203.5	Analyze different parallel processing and pipelining concepts with pipelining hazards
CS203.6	Comprehend different types of I/O buses , compare and contrast different types of data transfer methods and arbitration techniques

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS203.1	3											
CS203.2		3			3			3		3		
CS203.3	3	2										
CS203.4		2	1									
CS203.5		2	1									
CS203.6	3											

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS203.1							
CS203.2							
CS203.3							
CS203.4							
CS203.5							
CS203.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Overview of Computer Architecture and Organization**		5
	1.1	Introduction of Computer Organization and Architecture, Basic organization of computer and block level description of the functional units, Evolution of x86 Computers, Von Neumann model, Harvard Model, Embedded system	1	
	1.2	Performance Issues: Designing for performance, Amdahl's Law, Multi-core, GPGPU	1	
2	Title	**Data Representation and Arithmetic Algorithms**		6
	2.1	Number representation: Floating-point representation, Floating point arithmetic, IEEE 754 floating point number representation	2,3	
	2.2	Integer Data computation: Addition, Subtraction. Multiplication: Signed multiplication, Booth's algorithm.	2,3	
	2.3	Division of integers: Restoring and non-restoring division	2,3	
3	Title	**Processor Organization and Control Unit**		9
	3.1	CPU Architecture, Register Organization Instruction formats, basic instruction cycle. Instruction interpretation and sequencing, Case Study of 8086 architecture and Register Organization	1,2,4	
	3.2	Control Unit: Soft wired (Micro-programmed) and hardwired control unit design methods. Microinstruction sequencing and execution. Micro operations	2,4	
	3.3	RISC and CISC: Introduction to RISC and CISC architectures and design issues.	2,4	
4	Title	**Memory Organization**		11
	4.1	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics.	1,2	
	4.2	Cache memory: Concept, architecture (L1, L2, L3), mapping techniques. Cache Coherency, Interleaved and Associative memory.	1,2	
	4.3	Virtual Memory: Concept, Segmentation and Paging, Page replacement policies	1,2,4	
5	Title	**I/O Organization and Introduction to Parallel Processing**		11
	5.1	Buses: Types of Buses, Bus Arbitration, BUS standards	2	
	5.2	I/O Interface, I/O channels, I/O modules and IO processor, Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA.	1,2	
	5,3	Introduction to parallel processing concepts, Flynn's classifications, pipeline processing, Pipeline stages, Pipeline Hazards	1,2,4	
6	Self Study	Comparative Study of microprocessors and micro architectures with respect to their important features. 8086 instructions and assembler directives with addressing modes with memory interfacing techniques. Cache memory protocol and virtual memory concepts in Pentium processors. Vector and Array Processors with VLIW architecture.	Ref. 2,5,6	6*
			Total (* Not included)	**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Implement various Arithmetic Operations through Assembly Language Programming for microprocessor 8086 (MASM)
2	Simulate the operation of COPY and PASTE in 8086 (MASM)
3	Implement various String Operations in 8086 through the utilities provided by DOS interrupts (MASM)
4	Generation of alphabetic arrangement of a given string in 8086 (MASM)
5	Design password application (generation and detection) in 8086 (MASM/C)
6	Design of Carry Look Ahead Adder
7	Implement Booth's Multiplication Algorithm
8	Implement Division Algorithm (Non-Restoring and Restoring)
9	Implement Mapping techniques of Cache memory
10	Implement Page Replacement Policies

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Organization	Fifth	Carl Hamacher, Zvonko Vranesic, Safwat Zaky	Tata Mc Graw-Hill	2002
2	Computer Organization and Architecture: Designing for Performance	Eighth	William Stallings	Pearson	2010
3	Computer System Architecture	Third	M, Morris Mano	Pearson	2007
4	Computer Architecture & Organization	Third	John P. Hayes	McGraw-Hill	1998

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Structured Computer Organization	Sixth	Andrew S. Tanenbaum	Pearson	2013
2	Microprocessor and Interfacing: Programming & Hardware	Third	Douglas V Hall	Tata-Mc Graw Hill	2012
3	Computer Architecture and Organization: Design Principles and Applications	Second	B. Govindarajulu	McGraw Hill	2017
4	Programmer's reference Manual for IBM Personal Computers	First	Steven Armburst	McGraw Hill	1986
5	Pentium Processor System Architecture	Second	Don Anderson, Tom Shanley, MindShare Inc, MindShare, Inc	Addison-Wesley Professional	1995
6	Modern Processor Design: Fundamentals of Superscalar Processors	Second	John Paul Shen , Mikko H. Lipasti	Waveland Press Inc.	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Database Management systems	3	0	2	5	10	3	0	1	4
		Examination Scheme								
CS204		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	-
Course Objective: To efficiently and effectively Design, develop, maintain and retrieve the Information from DBMS.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS204.1	Demonstrate understanding of given system to construct a database model.
CS204.2	Apply various Relational and SQL commands on the populated database.
CS204.3	Examine the functional dependencies to make a normalized database system.
CS204.4	Examine transaction processing techniques on a database.
CS204.5	Illustrate query processing and optimization method on a database.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS204.1	1	2	2	2	2	1		1	2			2
CS204.2	2	2	2		2							
CS204.3	1	2	2		2							
CS204.4	1	2			2							
CS204.5	2	2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS204.1						3	
CS204.2							
CS204.3							
CS204.4							
CS204.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✔	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction: Database Concepts and ER Modeling**	1,2	**09**
	1.1	Introduction to basic concept of Database, Characteristics of databases, File system V/s Database system, Users of Database system, Database Administrator, Data Independence, Codd's Rule, DBMS system architecture.		
	1.2	Introduction to ER model, Benefits of Data Modeling, Types of data Models, Phases of Database Modeling, The Entity-Relationship (ER) Model, Extended Entity-Relationship (EER) Model		
2	**Title**	**Relational Algebra and SQL**	1,2	**16**
	2.1	Introduction, Mapping the ER and EER Model to the Relational Model, Relational Algebra: Overview, Basic Operators, Extended Operators		
	2.2	Overview of SQL, Data Definition Commands, Data Manipulation commands, Data Control commands, Set operations, aggregate function, null values, Views in SQL, Subquery, Trigger, stored procedure		
3	**Title**	**Normalization**	1,2	**06**
	3.1	Design guidelines for relational schema, Functional dependencies		
	3.2	Normal Forms- 1NF, 2 NF, 3NF, BCNF and 4NF,5NF		
4	**Title**	**Transaction Processing and Recovery**	1,2	**07**
	4.1	Transaction concept, Transaction states, ACID properties, Implementation of atomicity and durability, Concurrent Executions, Serializability, Recoverability, Lock-based, Timestamp-based, Validation-based protocols.		
	4.2	Shadow paging, Deadlock handling.		
5	**Title**	**Introduction to Query Processing and Query Optimization**	1,2	**04**
	5.1	Basics of Query Processing, Measures of Query Cost		
	5.2	Query Optimization: Equivalence Rules, Pictorial representations		
6	**Self Study**	1. Relational Calculus-Information retrieval 2. NO SQL-Data type, Database creation, Basic command for creation, updating and querying the database, Mongo dB	1,2	**5***
			Total (*Not included)	**42**

Laboratory Component:
Assign a case study for group of 2/3 students and each group will perform following experiments on the case study.

Sr. No.	Title of the Experiment
1	Formulate a case study and create an E-R Diagram. Mapping of E-R model to Relational Model.
2	To create a database and populate using SQL commands (With constraints) ● Data Definition Language- Create, Alter, Drop, Rename, Truncate ● Data Manipulation Language- Insert, Update, Delete, Select ● Constraints-Not Null, Unique Key, Primary Key, Foreign Key, Check, Dropping a Constraint.
3	To perform DCL, TCL commands ● Data Control Language: Grant, Revoke, Roles ● Transaction Control Language: Commit, Rollback, Save point
4	To perform Date, Time, Arithmetic and Set operation on database.
5	To perform Aggregate function and Group by- Having clause on database
6	To perform Join operations on database. ● Equijoins, Non-Equijoins, Self Joins, Outer Join, cross Join
7	To retrieve a data using Subquery.
8	To Create a different view of database.
9	To examine integrity of database using Triggers.
10	To improve performance of system using stored procedure.

Textbooks

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Database System Concepts	Seventh	Korth, Slberchatz, Sudarshan	McGraw – Hill	2019
2	Fundamentals of Database Systems	Sixth	Elmasri and Navathe	PEARSON Education	2011

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Database Management Systems	Third	Raghu Ramkrishnan and Johannes Gehrke	TMH	2003
2	Database Management Systems	First	G. K. Gupta	McGraw – Hill.	2018
3	SQL, PL/SQL programming language of ORACLE	Forth	Ivan Bayross	BPB	2010

Semester-IV

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Linear Algebra	2	0	2	5	9	2	0	1	3
		Examination Scheme								
MA201		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Engineering Calculus/Foundation of Mathematics-I and Differential Equations and Complex Analysis/Foundation of Mathematics-II
Course Objective: To develop mathematical skills for solving engineering problems.	
Course Outcomes (CO):*At the End of the course students will be able to:*	
MA201.1	Solve a homogeneous and non-homogeneous system of linear equations using rank of a matrix.
MA201.2	Solve system of linear equations by Numerical Methods.
MA201.3	Solve equations in real life problems and to encode and decode messages using the concept of matrices.
MA201.4	Identify whether given structures are vector spaces and subspaces and construct a basis for them.
MA201.5	Show if a given matrix is diagonalisable or not.
MA201.6	Apply concepts of eigenvalues and eigenvectors to calculate functions of a square matrix, google page rank vector and solve systems of differential equations using diagonalisation of matrices.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA201.1	3											
MA201.2	3											
MA201.3	3	1										
MA201.4	3											
MA201.5	3											
MA201.6	3	1										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
MA201.1							
MA201.2							
MA201.3							
MA201.4							
MA201.5							
MA201.6							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember✔	**Understand✔**	**Apply✔**	**Analyze**	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Basics of matrices**	**3,5**	**03**
	1.1	Revision of basic matrices and types of matrices.		01
	1.2	Row echelon form, Reduced Row Echelon form, Rank of a matrix.		02
2	**Title**	**Linear equations & its solutions**	**1,2,3,5**	**07**
	2.1	Consistency and solution of simultaneous linear homogeneous and non-homogeneous equations.		02
	2.2	Application of solving systems of equations in traffic control.		01
	2.3	Solution of system of linear algebraic equations, by (1) Gauss Elimination Method (2) Gauss Jordan method (3) Gauss Jacobi Iteration method (4) Gauss Seidel Method. (5) LU Decomposition -Crout's method		04
3	**Title**	**Vector spaces (over field of real numbers)**	**1,2,5**	**08**
	3.1	Vector space, subspace, span, linear dependence and independence of vectors, basis, dimension, orthogonal projection & gram-Schmidt process. Null space, row space, column space, Rank-Nullity theorem (only statement). Least square method.		08
4	**Title**	**Encoding & decoding using Matrices.**	**4**	**02**
	4.1	Application of matrices to Coding and Decoding		02
5	**Title**	**Eigenvalues and Eigenvectors**	**1,2,3,5**	**08**
	5.1	Eigenvalues, Eigenvectors and its properties. Cayley Hamilton theorem and its applications. Diagonalisation of matrices. Derogatory and Non-derogatory matrices.		04
	5.2	Application to find google page rank. Functions of a square matrix. Solving system of differential equations using diagonalisation.		04
6	**Self Study**	1.2 Normal form. 2.2 Forming equations using KVL for circuits and solving them using matrices. 3.1 Singular Value Decomposition. 5.1 Additional properties with proofs of eigenvalues and eigenvectors.	**1,2,3,5**	**05**
			Total	**28***

***Total of 28 hours does not include the self-study hours.**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Introduction to Scilab (getting started) and its benefits to use as a mathematics tool.
2	Basic commands of Scilab and vectors & matrix operations.
3	Conditional branching and iterations using Scilab.
4	Solution of linear equations using row-echelon and inverse of a matrix.
5	Solutions of linear equations using Gauss Elimination method.
6	Solutions of linear equations using Gauss Jordan method.
7	Solutions of linear equations using Gauss-Jacobi method.
8	Solutions of linear equations using Gauss-Seidel method.
9	Solutions of linear equations using Crout's method.
10	To find Eigenvalues and Eigenvectors using Scilab

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Linear Algebra and its applications	Fourth	Gilbert Strang	Cengage	2014
2	Higher Engineering Mathematics	Forty Fourth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Linear Algebra and its applications	Third	David. C. Lay	Pearson Education	2006
2	Elementary Linear Algebra Application Version	Sixth	H Anton and Crorres	John Wiley and Sons	2010
3	Advanced Engineering Mathematics	Twenty Eighth	H.K Das	S.Chand	2014
4	Hill Ciphers	First	Jonaki B Ghosh	At Right Angles	2015
5	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(BSC)	Foundations of Mathematics-II	2	1	0	0	3	2	1	0	3
		Examination Scheme								
MA204		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	--		--		--		--	

Pre-requisite Course Codes, if any.	Foundations of Mathematics-I
Course Objective: To develop basic foundation of mathematical skills.	
Course Outcomes (CO):*At the End of the course students will be able to: -*	
MA204.1	Integrate a function of one variable using various techniques
MA204.2	Sketch basic curves and solve double and triple integrals.
MA204.3	Solve basic problems using properties of complex numbers.
MA204.4	Solve differential equations of first order.
MA204.5	Apply the techniques of solving first order differential equations to electrical engineering problems.
MA204.6	Solve differential equations of higher order

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
MA204.1	1											
MA204.2	1											
MA204.3	1											
MA204.4	2											
MA204.5	1	1										
MA204.6	2											

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2
MA204.1						
MA204.2						
MA204.3						
MA204.4						
MA204.5						
MA204.6						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember✔	**Understand✔**	**Apply✔**	**Analyze**	**Evaluate**	**Create**

Theory Component

Module No.	Unit No.	Topics	Ref	Hrs.
1	**Title**	**Integral Calculus**	1,2	**13**
	1.1	Formulae for integral of standard functions, integration by parts, integration by method of substitution.		04
	1.2	Gamma functions, Beta functions. Differentiation under Integral sign with constant limits and one parameter.		04
	1.3	Standard curves (lines, circles, parabolas, ellipses). Concept of double integration. Evaluation of double and triple integrals.		05
2	**Title**	**Complex Numbers**	1,2	**03**
	2.1	Operations on complex numbers, polar form of a complex number, properties of a complex number.		03
3	**Title**	**Differential Equations**	1,2	**12**
	3.1	Exact differential equations. Linear differential equations of the first order and equations reducible to linear.		04
	3.2	Solving differential equations of first order in electrical networks.		01
	3.3	Linear differential equations with constant coefficients: complementary function and particular integral.		07
Total				**28**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Higher Engineering Mathematics	Forty Fourth	Dr. B. S. Grewal	Khanna Publications	2020

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Engineering Mathematics	Tenth	Erwin Kreysizg	John Wiley & Sons	2011
2	Advanced Engineering Mathematics	Twenty Eighth	H.K.Dass	S.Chand	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Design and Analysis of Algorithms	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS205		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Advanced Data Structures
Course Objective: 1. To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice. 2. To make students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a classification of algorithms.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS205.1	Analyze time and space complexity of an algorithm.
CS205.2	Apply divide and conquer strategy to solve problems.
CS205.3	Apply the concept of dynamic programming and greedy approach to solve problems.
CS205.4	Apply the idea of backtracking, branch and bound strategy to solve problems.
CS205.5	Apply various string matching algorithms.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS205.1	3	2						1		1		1
CS205.2	3	2	2	1				1	1	1		1
CS205.3	3	2	2	1				1	1	1		1
CS205.4	3	2	2	1				1	1	1		1
CS205.5	3	2	2					1	1	1		1

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS205.1							
CS205.2	1		1			1	
CS205.3	1		1			1	
CS205.4	1		1			1	
CS205.5	1		1			1	

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to Analysis of algorithm**		12
	1.1	Role of Algorithms in Computing, Performance analysis-space and time complexity, Growth of Functions: Asymptotic Notation, Standard Notation and Common Functions, Analysis of sorting algorithms Such as Selection sort and insertion sort.	1,2	
	1.2	Divide and Conquer Approach – General Method, Analysis of Merge Sort, Analysis of Quick sort, Analysis of Binary search, Finding the maximum and minimum, Strassen's matrix multiplication.	1,2	
	1.3	Recurrences: The substitution method, Recursion tree method, Master method and Proof.	1	
2	Title	**Dynamic Programming and Amortized Analysis**		12
	2.1	Dynamic Programming: Assembly-line scheduling, Matrix Chain Multiplication, Longest common subsequence.	1	
	2.2	Amortized analysis- Aggregate analysis, accounting and Potential Method, Dynamic Table.	1	
3	Title	**Greedy Approach**		5
	3.1	Greedy Approach: Basic strategy, application to job sequencing with deadlines problem, single source shortest path-Dijkstra's algorithm.	1,2	
	3.2	Knapsack problem, Minimum cost spanning trees-Kruskal and prim's algorithm.	1,2	
4	Title	**Backtracking and Branch-and-bound**		5
	4.1	Backtracking: General method, 8 queen problem (N-queen problem), Sum of subsets, Graph coloring.	2	
	4.2	Branch and Bound: 0/1 knapsack problem, Travelling salesman problem, 15 puzzle problem.	2	
5	Title	**Approximation and String Matching algorithms**		8
	5.1	**Approximation algorithms:** The vertex-cover problem, The traveling-salesman problem, The set covering problem	1	
	5.2	**String Matching algorithms:** The naïve string matching Algorithms, The Rabin Karp algorithm, String matching with finite automata, The Knuth-Morris-Pratt algorithm	1	
6	Self Study	**NP-complete problems:** Basic concepts, Non-deterministic Algorithms, NP-hard and NP-complete, Cook's Theorem, NP-Hard graph and scheduling Problems. NP-completeness and reducibility, decision and optimization problems, polynomial reduction	1,2	5*
Total				**42**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Experiment on finding the running time of an algorithm.
2	Experiment based on divide and conquers approach.
3	Experiment on Recurrence relation.
4	Experiment using dynamic programming approach
5	Experiment based on greedy approach
6	Experiment based on graph Algorithms
7	Experiment using Backtracking strategy
8	Experiment using branch and bound strategy
9	Experiment based on Approximation Algorithms
10	Experiment on string matching algorithms.

Text Book(s):

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Algorithms	Third	Thomas H. Cormen, Charles E. Leiserson, Ronald L Rivest, Clifford Stein	MIT Press	2009
2	Fundamentals of Computer Algorithms	Second	Horowitz E, Sahni S and S. Rajasekaran	Galgotia Publications	2010

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The Design and analysis of algorithms	First	Alfred V. Aho**,** John E. Hopcroft and Jeffrey D. Ullman	Pearson Education India	2006

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Operating Systems	3	0	2	5	10	3	0	1	4
		Examination Scheme								
CS206		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	Computer Architecture and Organization
Course Objective: To understand structure of OS, process synchronization ,memory management and file system.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS206.1	Comprehend the primitive concepts of Operating System services and System Programming functionality.
CS206.2	Articulate process scheduling algorithms in effective execution of processes.
CS206.3	Acquaint with efficient process synchronization techniques in effective execution of programs.
CS206.4	Analyze virtual memory management algorithms in effective allocation of main memory usage.
CS206.5	Evaluates various algorithms of File Storage & I/O management for performance and quality criterion.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS206.1	1											1
CS206.2	2	2	2	2					2			2
CS206.3	2	2	2	2					2			2
CS206.4	2	2	2	2					2			2
CS206.5	2	2	2	2					2			2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS206.1							
CS206.2							
CS206.3						2	
CS206.4							
CS206.5							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to System Software and Operating Systems**		8
	1.1	**System Software** – Introduction, Goal, Systems Programs and Systems Programming, Views of Systems Software. **Linkers and Loader** – Relocation and Linking Concepts, Design of Linker, Self-Relocating Programs, Linking of Overlay Structured Programs, Dynamic Linking, Loaders.	1	
	1.2	**Operating Systems** – Introduction, Structure and Principles of Operations of Operating Systems, Classes of Operating Systems, Batch Processing Systems, Multi programming Systems, Time Sharing Systems, Real Time Operating Systems.	1	
2	Title	**Process Management**		8
	2.1	**Processes and Threads** – Process Concept, Process Scheduling, Operations on Processes, Multi core Programming, Multi threading Models, Thread Libraries, Implicit Threading, Threading Issues, Operating-System Examples	2	
	2.2	**UNIX Process and Threads –** Process Abstraction, Process Creation using fork and exec, invoking new process, process termination, awaiting process termination, User and Kernel Threads.	3	
3	Title	**Process Coordination**		12
	3.1	**Process Synchronization** - Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples	2	
	3.2	**CPU Scheduling** - Scheduling Criteria, Scheduling Algorithms, Real-Time CPU Scheduling, Operating-System Examples. **Deadlock** - Characterization, Methods for Handling Deadlocks, Detection, Prevention, Avoidance, Recovery methods for Deadlock.	2	
	3.3	**UNIX IPC –** Universal IPC Facilities, System V IPC, Message, Ports, Message Passing, Port Operations.	3	
4	Title	**Memory management**		6
	4.1	**Memory Management Strategies** - Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of the Page Table.	2	
	4.2	**Virtual Memory Management** - Demand Paging, Allocation of Frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory, Operating-System Examples.	2	

5	**Title**	**File Management**		**8**
	5.1	**Storage Management** - Disk Structure, Disk Scheduling, Disk Management	2	
	5.2	**File-System Implementation** - File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management	2	
	5.3	**UNIX Internal File Representation** - Inodes, Structure of Regular File, Directories, Path Name to Inode Conversion, Super Block, Inode Assignment, Allocation of Disk blocks, Other File Types.	4	
6	**Self Study**	1) Explore Features, characteristics and CPU scheduling of Real-Time Operating System along an example 2) Explore the requirements of Kernel, CPU Scheduling, Disk Scheduling for Multimedia Systems 3) Explore all UNIX System Calls for File System.	2,4	**5***
			Total (*Not included)	**42**

List of Experiments for Operating System Laboratory

Sr. No.	Title of the Experiment
1	Installation of Linux OS on Virtual Machine.
2	Write a program for creating a static/dynamic link library for complex number operations and then test this library through linuxld linker.
3	Write a program which creates exactly 16 copies of itself by calling fork() only twice within a loop. The program should also print a tree of the pids.
4	Write a program to simulate the following non-preemptive CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin d) Priority
5	The program r.c initializes *n* number of semaphores. It first assign count equal -1, which is then used by process p and q. This count is protected by semaphore. It also allocates shared memory of size 40 ints. It waits for process p and q to enter all n1 and n2 elements through different terminals. This program r.c sorts shared data in ascending order. It waits to finish p and q. At end, The program r.c detaches and deletes *n* semaphores and print the sorted list.
6	Write a multithreaded program for preventing race conditions and deadlock avoidance for the banker's algorithm as follows. Several customers' request and release resources from the bank. The banker will grant a request only if it leaves the system in a safe state. A request that leaves the system in an unsafe state will be denied.
7	Write a program which acts as a chat application between two users on the same computer using shared memory.

8	Assume that a system has a 32-bit virtual address with a 4-KB page size. Write a C program that is passed a virtual address (in decimal) on the command line and have it output the page number and offset for the given address. As an example, your program would run as follows: ./a.out 19986 Your program would output: The address 19986 contains: page number = 4 offset = 3602 Writing this program will require using the appropriate data type to store 32 bits. We encourage you to use unsigned data types as well.
9	Write a program to simulate disk scheduling algorithms a) FCFS b) SCAN c) C-SCAN
10	Write a program to prevent destructive update of files by locking as follows: Suppose the inode contains a new permission setting such that it allows only one process at a time to open the file for writing, but many processes can open the file for reading.

Note – Implement all programs in C language under Linux OS environment

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	System Programming	First	D M Dhamdhere	Tata McGraw-Hill Education	2011
2	Operating System Concepts	Ninth	Abraham Silberschatz, Peter B Galvin, Greg Gagne	Wiley	2012
3	UNIX Internals: The New Frontiers	First	UreshVahalia	Prentice Hall	1995
4	Design of the UNIX Operating Systems	First	Maurice J. Bach	Prentice-Hall	1990

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Operating Systems: Internals and Design Principles	Eighth	William Stallings	Pearson	2014
2	Modern Operating Systems	Fourth	Andrew S. Tanenbaum, Herbert Bos	Pearson	2014

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Computer Communications and Networks	3	0	2	5	10	3	0	1	4
CS207		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: Understand the state-of-the-art in network protocols, architectures and applications.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS207.1	Describe the fundamental concepts of Data Communication.
CS207.2	Distinguish the different layers of the OSI model and TCP/IP.
CS207.3	Identify the different types of protocols and their functions within a network.
CS207.4	Apply the knowledge of sub netting, routing mechanisms and Software Defined Networking.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS207.1	2	1						1	1			2
CS207.2	2	2						1	1			2
CS207.3	2	2						1	1			2
CS207.4	2	2						1	1			2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS207.1	3						
CS207.2	3						
CS207.3	3						
CS207.4	3						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply✔	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Computer Communication and The Internet**	1,2	**10**
	1.1	Internet: A Nut and Bolts Description, A Services Description, Protocol. The Network Edge: Access Network, The Network Core: Packet Switching, Circuit Switching, A Network of Networks	1,2	
	1.2	Delay, Loss, Throughput in Packet Switched Networks: Overview of Delay in Packet Switched Networks, Queuing Delay and Packet Loss, End to End Delay, Throughput in Computer Networks.	1,2	
	1.3	Protocol Layers and their Service Models: Layered Architecture and their Encapsulation.	1,2	
	1.4	Data and Signals: Analog and Digital, Periodic analog signals, Digital signals, Transmission impairment.	2	
	1.5	Digital Transmission: Digital-to-Digital conversion, Analog-to-Digital conversion. Transmission modes, Analog Transmission: Digital-to-Analog conversion, Analog-to-Analog conversion.	2	
2	**Title**	**Application Layer**	1,2	**6**
	2.1	Principles of Network Applications: Network Applications Architecture, Processes Communicating, Transport Services Available to Applications, Transport Services Provided by the Internet, Application Layer Protocols.	1,2	
	2.2	The Web and HTTP: Overview of HTTP, Non Persistent and Persistent Connections, HTTP Message Format, User Server Interaction: Cookies, Web Catching, The Conditional Get.	1,2	
	2.3	File Transfer Ftp: Ftp Commands and Replies. FTP, SMTP, Mail Access Protocol (IMAP, POP), DNS	1,2	
3	**Title**	**Transport Layer**	1,2	**8**
	3.1	Introduction and Transport-Layer Services: Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet	1,2	
	3.2	Multiplexing and Demultiplexing	1,2	
	3.3	Connection less Transport - UDP: UDP Segment Structure, UDP Checksum	1,2	
	3.4	Principles of Reliable Data Transfer: Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N (GBN), Selective Repeat (SR),	1,2	
	3.5	Connection-Oriented Transport - TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management	1,2	
	3.6	Principles of Congestion Control: The Causes and the Costs of Congestion, Approaches to Congestion Control.	1,2	

4	**Title**	**The Network Layer**	1,2	**10**
	4.1	Introduction: Forwarding and Routing, Network Service Models.	1,2	
	4.2	Virtual Circuit and Datagram Networks: Virtual-Circuit Networks, Datagram Networks, Origins of VC and Datagram Networks.	1,2	
	4.3	Router: Input Processing, Switching, Output Processing, Queuing, The Routing Control Plane.	1,2	
	4.4	The Internet Protocol (IP): Forwarding and Addressing in the Internet, Datagram Format, IPv4 Addressing, Internet Control Message Protocol (ICMP), IPv6	1,2	
	4.5	Routing Algorithms: The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing	1,2	
	4.6	Software Defined Networking: Introduction and Overview	R3	
5	**Title**	**The Link Layer: Links, Access Networks, and LANs**	1,2	**8**
	5.1	Introduction to the Link Layer: The Services Provided by the Link Layer, Implementation of the Link Layer	1,2	
	5.2	Error-Detection and Correction Techniques: Parity Checks, Check summing Methods, Cyclic Redundancy Check (CRC)	1,2	
	5.3	Multiple Access Links and Protocols: Channel Partitioning Protocols, Random Access Protocols, Taking-Turns Protocols.	1,2	
6*	**Title**	**Self Study Topic**	1,2	**5***
	6.1	Transmission Media: Guided media, Unguided media: Wireless	1,2	
	6.2	ARP and RARP usage	1,2	
	6.3	Multicast routing and Broadcast routing	1,2	
	6.4	Routing in the Internet: Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter-AS Routing: BGP	1,2	
	6.5	Network Function Virtualization	R3	
Total				**42**

***This module hrs. not included in Total 42 hrs**

Laboratory Component (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Use and interpret basic Networking Utilities
2	Describe various Network Topology and Networking Hardware
3	Experiment with Packet Tracers/Analyzers
4	Implement Web server and DHCP server for given scenario
5	Implement TELNET and FTP server for given scenario
6	Implement SMTP server for given scenario
7	Implement DNS server for given scenario
8	Develop client-server model using Socket Programming for given scenario
9	Illustrate basic Mininet operations for Software Defined Networking
10	Implement in Mininet to control switch manually

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Networking: Top Down Approach	Sixth	James Kurose and Kieth Ross	Pearson	2013
2	Data Communication and Networking	Second	Behrouz Forouzan	McGraw Hill	2000

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Networks	Fifth	Andrew Tanenbaum	Pearson	2013
2	Computer Networks	Third	Larry L. Peterson and Bruce Davie	Morgon Huffman	2003
3	SDN and NFV Simplified	First	Jim Doherty	Addison Wesley	2016

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Professional Communication Skills	1	0	2	2	5	1	0	1	2
AS201		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	--		--		--			--
		Laboratory	200		--		--			200

Pre-requisite Course Codes, if any.	
Course Objective: To demonstrate the desired spoken and written communication skills required in early professional life, with focus on job placements.	
Course Outcomes (CO):*At the End of the course students will be able to*	
AS201.1	Demonstrate the spoken and written skills for job placements.
AS201.2	Draft professional documents.
AS201.3	Design written communication for social media.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
AS201.1										2		
AS201.2										2		
AS201.3										2		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
AS201.1							
AS201.2							
AS201.3							

BLOOM'S Levels Targeted (Pl. appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	L Hrs.	P Hrs
1	**Title**	**Placement Skills**		6	12
	1.1	Resume Writing & Cover Letter			
	1.2	Group Discussion			
	1.3	Case Studies/Pitching a startup			
	1.4	Team Building Skills/Work			
	1.5	Interview Skills			
2	**Title**	**Corporate Communication**		6	12
	2.1	Presentation Skills			
	2.2	Meeting: Notice, Agenda, Minutes			
	2.3	Proposal Writing			
	2.4	Report Writing: Informative, Analytical report			
3	**Title**	**Research Writing**		2	4
	3.1	Sourcing information through digital media			
	3.2	Written communication using social media: Blog			
4	**Self Study**	Research Paper, News Analysis			**6***
			Total	**42 hrs**	

***Not included in the total**

List of ISEs

Sr. No.	Title of the Experiment
1	Resume
2	Cover Letter
3	GD
4	Mock Interview
5	Presentation
6	Blog Writing
7	Team Building Activity
8	Minutes of the Meeting/Notice & Agenda
9	Proposal Writing
10	Report Writing

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Interpersonal Skills at Work	2002	John Hayes	McGraw Hill Education	2002
2	Campus Placement: A Comprehensive Guide	2016	Ankur Malhotra	McGraw Hill Education	2016

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	If I Understood You, Would I Have This Look on My Face? My Adventures in the Art and Science of Relating and Communicating	FIRST	Alan Alda	Random House	2017
2	Handbook for Writing Proposals	SECOND	Robert J. Hamper, Sue Baugh	McGraw Hill Education	2010
3	Effective Communication Skills for Scientific and Technical Professionals	2000	Harry Chambers	Paperback Basic Books	2000
4	The Art Of Writing Together	2008	William Issac	Crown Business	2008
5	Communication Skills	2011	Meenakshi Raman, Sangeeta Sharma	Oxford, India	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned				
		L	T	P	O	E	L	T	P	O	Total
(SBC)	Mini Project-I	0	0	0	4	4	0	0	0	2	2
		Examination Scheme									
CS208		Component			ISE		MSE		ESE		Total
		Theory			--		--		--		--
		Laboratory			100		--		100		200

Pre-requisite Course Codes, if any.	
Course Objective: To develop the skills of Planning and Designing the working model for solving the real world Problem.	
Course Outcomes (CO):*At the End of the course students will be able to*	
CS208.1	Discover potential research areas for addressing societal issues
CS208.2	Conduct a survey of basic and contemporary literature in the preferred field of study.
CS208.3	Formulate and propose a plan for creating a solution for the research plan identified.
CS208.4	Exercise the team building, communication and management for design and implementation of projects.
CS208.5	Compare and contrast the several existing solutions for research challenge
CS208.6	Report and present the findings of the study conducted in the preferred domain.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS208.1	2	2				2		3	3	3		2
CS208.2	2	2				2		3	3	3		2
CS208.3	2	3					2	3	3	3		2
CS208.4	2		3	1	2			3	3	3	3	2
CS208.5	2	2		2				3	3	3		2
CS208.6	2	2						3	3	3		2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS208.1	2	2	2			2	
CS208.2	2	2	2			2	
CS208.3	2	2	2			2	
CS208.4	2	2	2			2	
CS208.5	2	2	2			2	
CS208.6	2	2	2			2	

BLOOM'S Levels Targeted (Pl. appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✔

Mini-project is an opportunity to make a difference in the experience of education in its own way. It is an attempt of scientific study of the problem in surrounding in order to guide, correct and evaluate the actions and decisions about it. It is based on a small project correlating scientific knowledge and day to day experience which encourages development of scientific attitude to solve real life problems among students.

The Objectives of Action Research are:

- ✓ To make students sensitive towards societal issues
- ✓ To learn scientific principles from day-to-day experiences
- ✓ To develop psycho-technological skills through observation, classification, statement of hypothesis etc.
- ✓ Development of communication, organizational skills and maturity through discussion, presentation etc.
- ✓ To develop ability to correlate science, technology and society
- ✓ To apply engineering knowledge and propose innovative, sustainable solutions to the real-life challenges
- ✓ **Steps for Implementation (ISE: 2 Phases) and ESE**
- ✓ Keen observation of the surrounding/society
- ✓ Identification of the problem
- ✓ Analysis of the problem
- ✓ Collection of relevant information by formulating research questions
- ✓ Suggesting plan of action
- ✓ Conducting experiments
- ✓ To draw conclusion
- ✓ To find the possible solution to rectify the problem
- ✓ To execute experiments and remedial measures wherever possible Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them. Students must ensure that problem to be solved in manageable in one semester.

Criteria of a good project:

- ✓ Appropriate idea, clear understanding, and proper presentation of the concept
- ✓ Quality of work
- ✓ Project plan and its execution
- ✓ Credibility of the work
- ✓ Probable impact of the work on the attitude of students and society
- ✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation
- ✓ Utility and innovation of the remedial measures
- ✓ Desirability, Feasibility and Viability in real life

The H/W and S/W resources required to complete the Mini-Project-I may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- Learning additional skills
- Development of ability to define and design the problem and lead to its accomplishment with proper planning
- Learn the behavioral discipline by working in a team. The team may be maximum three (03) students.

Evaluation:

Project report should contain project title, student details, certificate and acknowledgements. Other sections of the report shall be decided by the department based on projects. But it must have introduction, necessity of project, objectives, hypothesis, plan, observations, analysis of results, conclusion and references along with other sections related to technology. The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. The ESE marks will be based on final demonstration of the project and viva based on it and report/poster/technical paper of the project in the standard format provided by the Department.

Semester-V

Sem V									
No.	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	CS301	Theory of Computation	3	0	0	6	9	3
2	PC	CS302	Software Engineering	3	0	2	5	10	4
3	PC	CS303	Artificial Intelligence and Machine Learning	3	0	2	5	10	4
4	PC	CS304	Distributed Computing	3	0	2	5	10	4
5	SBC	CS305	Cloud and Internet Technology Lab	1	0	2	5	08	2
6	HSSE	HSEX3	HSS-III	2	0	0	3	05	2
7	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	3	1
8	S/M	SCX2/MNX2	SCOPE-II/Minor-II						3
TOTAL				**15**	**0**	**8**	**29**	**52**	**20**

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Theory of Computation	3	0	0	6	9	3	0	0	3
		Examination Scheme								
CS301		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	--		--		--			--

Pre-requisite Course Codes, if any.	CS201: Discrete Structures and Graph Theory
Course Objective: To give an overview of the theoretical foundations of computer science from the perspective of formal languages which provides the mathematical foundation of formal models of computation, and fundamentals of formal grammars and languages that is used in most areas of computer science.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
CS301.1	Design finite automaton for a regular expressions and languages.
CS301.2	Apply the properties of regular languages.
CS301.3	Construct the grammar for a language and convert it into normal forms.
CS301.4	Design and Evaluate Pushdown Automata and Turing Machine for a language.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS301.1	3	3	2	-	1	-	-	-	1	1	-	-
CS301.2	3	2	-	-	-	-	-	-	1	1	-	-
CS301.3	2	3	-	-	1	-	-	-	1	1	-	-
CS301.4	2	2	2	-	1	-	-	-	1	1	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS301.1	-	-	-	-	-	-	-
CS301.2	-	-	-	-	-	-	-
CS301.3	-	-	-	-	-	-	-
CS301.4	-	-	-	-	-	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

xxx

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Sets, Relations and Languages**	1,5	**3**
	1.1	Relations and functions		
	1.2	Alphabets and languages		
	1.3	Types of proof		
2	**Title**	**Finite Automata**	1,3,5	**7**
	2.1	Regular languages and regular expressions		
	2.2	Finite Automata, Nondeterministic Finite Automata, Nondeterministic Finite Automata with ϵ-transitions		
	2.3	Kleene's theorem		
	2.4	NFA to DFA Conversion		
	2.5	Finite Automata with output (Moore and Mealy Machine)		
3	**Title**	**Regular Languages**	1,4	**6**
	3.1	The pumping lemma for regular languages, Applications of the pumping lemma		
	3.2	Closure properties for regular languages		
	3.3	Equivalence and minimization of automata: Testing equivalence of states, Minimization of DFA's		
4	**Title**	**Context-Free Grammars and Languages**	1,5	**5**
	4.1	Context free grammars: Definition of context free grammars, Derivations using a grammar, The language of a grammar, Sentential forms		
	4.2	Parse trees: Constructing parse trees, From inferences to trees, From trees to derivations, From derivations to recursive inferences		
	4.3	Ambiguity in grammars and languages: Ambiguous grammars, Removing ambiguity from grammars		
5	**Title**	**Pushdown Automata**	1,2	**6**
	5.1	Definition of the pushdown automaton: The formal definition of pushdown automata, A graphical notation for PDA's, Instantaneous descriptions of a PDA		
	5.2	The languages of a PDA: Acceptance by final state, Acceptance by empty stack, From empty stack to final state, From final state to empty stack		
	5.3	Equivalence of PDA's and CFG's: From grammars to pushdown automata, From PDA's to Grammar		
	5.4	Deterministic pushdown automata: Definition of a deterministic PDA, Regular languages and deterministic PDA's, DPDA's and context free languages		
6	**Title**	**Properties of Context-Free Languages**	1,2,3	**5**
	6.1	Eliminating useless symbols, Computing the generating and reachable symbols, Chomsky normal form, Greibach normal form		
	6.2	The Pumping lemma for context free languages: Applications of the pumping lemma for CFL's		

7	**Title**	**Introduction to Turing Machines**	1,2,	**6**
	7.1	Turing machines: Formal definition of a Turing machine, Examples of Turing machines		
	7.2	Halting Problem, Post Correspondence Problem (PCP)		
	7.3	Variants of Turing machines: Multitape Turing Machines		
	7.4	Church-Turing hypothesis		
8	**Title**	**Recursively Enumerable Languages**	3	**4**
	8.1	Recursively Enumerable and recursive		
	8.2	Enumerating a language		
	8.3	Context sensitive languages and the Chomsky hierarchy		
	Self Study	**Tractable and Intractable Problems:** Tractable and Possibly Intractable Problems: P and NP, Polynomial-Time Reductions and NP-Completeness, Cook's Theorem	3	**5***
Total (* Not included)				**42**

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Automata Theory, Languages, and Computation	Third	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman	Pearson	2008
2	Introduction to the Theory of computation	Third	Michael Sipser	Cengage	2013

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Languages and the Theory of Computation	Fourth	John C. Martin	McGraw-Hill	2010
2	Elements of the Theory of Computation	Second	Harry R. Lewis, Christos H. Papadimitriou	Pearson	2015
3	Automata and Computability	--	Dexter C. Kozen	Springer	1997

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Software Engineering	3	0	2	5	10	3	0	1	4
CS302		Examination Scheme								
		Component		ISE		MSE		ESE		Total
		Theory		50		50		100		200
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	CS102: Object-oriented programming language CS204: Database Management Systems
Course Objective: To understand the best practices in software engineering and gain knowledge to analyze, design, implement and test software project.	
Course Outcomes (CO): ***At the end of the course students will be able to***	
CS302.1	Analyze software requirements.
CS302.2	Apply UML models for a project.
CS302.3	Evaluate system architecture and develop detailed task schedule from the overall estimates and planning.
CS302.4	Illustrate different coding principles with unit test process.
CS302.5	Understand the need for DevOps.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS302.1	-	3	-	-	-	-	-	-	2	2	-	-
CS302.2	-	2	-	-	2	-	-	-	2	2	-	-
CS302.3	-	3	2	1	2	-	-	-	2	2	2	-
CS302.4	-	-	3	-	2	-	-	-	2	-	-	-
CS302.4	-	1	1	-	-	-	-	-	-	-	-	1

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS302.1	3	-	-	-	-	-	-
CS302.2	3	2	-	-	-	-	-
CS302.3	3	2	-	-	2	-	-
CS302.4	3	-	-	-	2	-	-
CS302.5	1	2	1	-	-		1

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate ✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction**		
	1.1	Software Development Challenges, Software Scope, The Human Side of Software Development	T1,T2	
	1.2	Software Methodologies and Related Process Models with applications, Traditional Life Cycle Models, Waterfall, Incremental, Iterative models, Agile Software Engineering Process Models, SCRUM, Extreme Programming	T1,T2	**06**
2	**Title**	**Requirements Management and Project Planning**		
	2.1	Requirements Development Methodology, Specifying Requirements, Eliciting Accurate Requirements, Documenting Business Requirements, SRS, Defining User Requirements, Validating Requirements, Achieving Requirements Traceability, Managing Changing Requirements, Agile Requirements Engineering	T1,T2	**10**
	2.2	Scheduling, Work Breakdown Structure, Gantt Chart, Pert Chart, Critical Path, Earned Value Analysis, Schedule and Cost slippage, Estimation, Decomposition techniques, Empirical estimation models, Software Risk Management: Risk Identification, Risk Projection, Risk Refinement, RMMM Plan	T1,T2	
3	**Title**	**Software Analysis**		**08**
	3.1	Difference between Structured and Object-Oriented analysis, Structured Analysis, Data Flow Diagrams	R2,R3	
	3.2	Object Oriented Analysis, Uses Case, Class diagram, Interaction diagrams, Activity diagram, State Chart diagram, Component and Deployment diagram	R2,R3	
4	**Title**	**Software Design and Development**		**08**
	4.1	Software Architecture, Architectural and Pattern-Based Design, Model Driven Architectures	T1,T2	
	4.2	Software Development, Component Infrastructures, Refactoring, Test Driven Development (TDD)	T1,T2	
	4.3	DevOps, Continuous Integration, Continuous Deployment, System Provisioning and Configuration Management	R1	
	4.4	Software Change Management, Change Control, Version Control	T1,T2	
5	**Title**	**Software Quality and Testing**		**10**
	5.1	Software Quality Concepts, Quality Assurance, Quality Control, Formal Technical Reviews	T1,T2	
	5.2	Software Metrics, Product Metrics – McCall's Quality Factor, Metrics for Analysis Model and Design Model, Project Metrics, Process Metrics, Metrics for Source Code	T1,T2	
	5.3	Software Testing, Unit Testing, Integration Testing, System Testing	T1,T2	
6	**Title**	**Advance Topic in software Engineering**		**5***
	Self Study	• Design Pattern		
Total (* Not included)				**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Gather requirements and write a project proposal for case study. Prepare SRS document. (Use IEEE template)
2	Design UML diagram -Use Case, Class diagram
3	Design UML diagram -Interaction diagrams
4	Design Data flow diagram (level 0 and1) for the case study.
5	Create work breakdown structure and schedule the activities
6	Develop Risk Mitigation, Monitoring and Management Plan for the case study.
7	Create versions of software using version control tool.
8	Implement any one Module from chosen case study.
9	Prepare test cases and perform Unit Testing (test scenario, test cases, test data)
10	Study on continuous Integration using DevOp

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Software Engineering: A Practitioner's Approach	Ninth Edition	Roger S. Pressman and Bruce Maxim	McGraw-Hill	2019
2	Fundamentals of Software Engineering	Fifth Edition	Rajib Mall	PHI Learning	2018

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations	--	Gene Kin, Patrick Debois, John Willis, Jez Humble and John Allspaw	IT Revolution Press	2016
2	UML for Java Programmers	--	Robert C. Martin	Pearson	2006
3	UML Distilled: A Brief Guide to the Standard Object Modeling Language	Third Edition	Martin Fowler	Addition Wesley	2003

Course(Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Artificial Intelligence and Machine Learning	3	0	2	5	10	3	0	1	4
CS303		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	CS202/IT202: Data Structures, MA203: Probability and Statistics
Course Objective: This course covers the fundamental concepts of Artificial Intelligence and machine learning.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS303.1	Understand AI building blocks presented in intelligent agents
CS303.2	Solve the problems using suitable searching methods.
CS303.3	Solve the problems using suitable reasoning and knowledge representation methods.
CS303.4	Apply suitable machine learning technique for a given problem
CS303.5	Design an intelligent system using different AIML techniques for real life problems.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS303.1	2	3	-	-	2	-	-	-	-	-	2	-
CS303.2	2	3	2	2	-	-	-	-	-	-	2	-
CS303.3	2	3	2	2	-	-	-	-	-	1	2	-
CS303.4	2	3	-	-	2	-	-	-	-	2	2	-
CS303.5	2	3	2	2	2	-	-	-	-	2	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS303.1	-	-	-	-	-	-	-
CS303.2	-	-	-	-	-	-	-
CS303.3	-	-	-	-	-	-	-
CS303.4	CS1	CS:1	CS:1	-	-	-	-
CS303.5	CS2	CS: 2	CS: 2	-	-	CS: 2	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate ✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to Artificial Intelligence**	1	04
	1.1	Definition of AI, History and Future of AI, Problem solving Approach to Typical AI problem.		
	1.2	**Intelligent Agents and Environment** What is an Intelligent Systems, Types of Agents, structure of agent.		
	1.3	Environments and Its Properties, PEAS Representation for an Agent		
2	Title	**Problem solving by Searching**	1	10
	2.1	Searching: characteristics and issues in design of search programs		
	2.2	**Uninformed search techniques:** State Space Search, Depth First Iterative Deepening		
	2.3	**Informed Search methods:** Heuristic Search, Hill Climbing.		
	2.4	**Adversarial Search:** Game playing, Min-Max Search, Alpha-Beta Pruning		
3	Title	**Knowledge Representation and Reasoning**		08
	3.1	Reasoning: Representing and Reasoning with Uncertain Knowledge		
	3.2	Knowledge representation: A Knowledge-Based Agent, The Wumpus World.		
	3.3	Propositional Logic, First-order predicate logic, Forward and Backward Chaining		
4	Title	**Introduction to Machine Learning**		12
	4.1	Introduction: What is Machine Learning, History and overview of machine learning,	2,3	
	4.2	Types of Machine Learning – Supervised, Unsupervised Semi-Supervised Learning and Reinforcement Learning, Design a Learning System, The curse of dimensionality		
	4.3	Evaluating a hypothesis: Model selection, training/validation/testing procedures, diagnosing bias versus variance and vice versa, regularization and bias/variance, learning curves	2,3	
5	Title	**Linear Models for Regression**		8
	5.1	Two Simple Approaches to Prediction: Least Squares and Nearest Neighbors	4	
	5.2	Linear Regression, Multivariate Regression, Subset Selection, Shrinkage Methods		
6	Self Study	**Linear model for Classification**: Logistic Regression, Linear Discriminant Analysis, Perceptron, Support Vector Machines, PCA	3,4	5*
Total(* Not included)				**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Implement an Intelligent agent.
2	Implement a given problem using the searching technique.
3	Implement a given problem using knowledge representation and reasoning rules
4	To design and implement an intelligent system, incorporating the matching algorithm and the rule language. 1. It should provide a fact base updating function. 2. It should provide a function that checks the rules' LHS and return which rules were matched. 3. It should support firing RHS according to matches. Using SWISH Prolog or Java or Python or any other open-source tool
5	Implement supervised learning algorithms.
6	Implement unsupervised learning algorithms.
7	Implement the regression model
8	Minor project covering the concepts of AIML on the real life problem statements.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Artificial Intelligence: A Modern Approach	Third Edition	Stuart Russell and Peter Norvig	Prentice-Hall	2009
2	Machine Learning A Probabilistic Perspective	First Edition	Kevin P. Murphy	Massachusetts Institute of Technology	2012
3	Machine Learning,	First Edition	Tom.M.Mitchell	McGraw Hill International Edition	1997
4	The Elements of Statistical Learning	Second Edition	Trevor Hastie Robert Tibshirani Jerome Friedman	Springer	2009

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Artificial Intelligence: Making a System Intelligent	First Edition	Nilakshi Jain	Wiley Publication	2019
2	Pattern Recognition and Machine Learning	First Edition	C. M. Bishop	Springer	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Distributed Computing	3	0	2	5	10	3	0	1	4
		Examination Scheme								
CS304		Component	ISE		MSE		ESE		Total	
		Theory	75		75		150		300	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	CS206:Operating Systems CS207:Computer Networks and Communications
Course Objective: To familiarize students with the fundamental concepts, techniques and design of Distributed Systems and use of distributed computing applications domains.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS304.1	Understand the principles and desired properties of distributed systems.
CS304.2	Apply the various communication techniques for distributed communication.
CS304.3	Apply the concepts of process, naming, consistency, replication and faults tolerance in distributed environment.
CS304.4	Apply the algorithms such as clock synchronization, election, and mutual exclusion in distributed applications.
CS304.5	Identify the challenges in developing distributed applications.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS304.1	2	1	-	-	-	-	-	-	-	-	-	2
CS304.2	2	2	2	1	-	-	-	2	2	1	-	2
CS304.3	2	2	2	1	-	-	-	2	2	1	-	2
CS304.4	2	2	2	1	-	-	-	2	2	1	-	2
CS304.5	2	2	2	1	-	-	-	1	2	1	-	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
CS304.1	1	1	1	-	
CS304.2	1	1	1	-	1
CS304.3	1	1	1	-	1
CS304.4	1	1	1	-	1
CS304.5	1	1	1	-	1

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Distributed Systems**		
	1.1	Definition, Type, Goals, Distributed Computing Models, Issues in Distributed Systems.	1,2	**08**
	1.2	Hardware Concepts, Software Concepts, The Client-Server Model, Positioning Middleware, Models of Middleware, Services offered by Middleware, models of Distributed Algorithms and some fundamental problems.	1,2	
2	**Title**	**Communication In Distributed Systems**		**12**
	2.1	Introduction to Message Passing, Desirable Features of a Good Message-Passing System, Issues in IPC by Message Passing, Synchronization, Buffering, Multi-datagram Messages, Group Communication.	1,2	
	2.2	Remote Procedure Call (RPC): Basic RPC Operations, Parameter Passing, Extended RPC Models. Remote Object Invocation: Distributed Objects, Binding a Client to an Object, Static Vs Dynamic RMI Message Oriented Communication: Persistence and synchronicity in communication, Message Oriented Transient and Persistent Communications	1,2	
3	**Title**	**Process in Distributed Systems**		**6**
	3.1	Introduction to Threads, Threads in Distributed Systems, Clients, Server	1,2	
	3.2	Code Migration: Approaches to Code Migration, Models, Migration and Local Resources, Migration in Heterogeneous Systems	1,2	
4	**Title**	**Synchronization in Distributed Systems**		**10**
	4.1	Clock Synchronization: Physical Clocks, Global Positioning System, Clock Synchronization Algorithms; Logical Clocks: Lamport's Logical Clocks, Vector Clocks	1,2	
	4.2	Election Algorithms: Bully and Ring; Mutual Exclusion: Centralized Algorithm, Decentralized Algorithm, Distributed Algorithm, Token Ring Algorithm, Comparison of Algorithms; Load Balancing: Goals, Types, Strategies.	1,2	
5	**Title**	**Consistency and Replication**		**6**
	5.1	Reasons for Replication, Object Replication, Replication as Scaling Technique Data Replication in Distributed Systems, Goals, Types, Schemes,	1	
	5.2	Data-Centric Consistency Models, Client Centric Consistency Models Continuous Consistency, Consistent Ordering of Operations	1	
6	**Self Study**	Naming Entities, Locating Mobile Entities, Distribution Protocols, Consistency Protocols, Faults Tolerance: Process Resilience, Distributed Commit, Recovery	1,2	**8***
Total (* Not included)				**42**

Laboratory Component

Sr. No	Title of the Experiments
1	Implementation of Client server Communication using socket.
2	Implementation of Client Server Communication using RPC.
3	Implementation of RMI.
4	Implementation of multi-threading in distributed systems
5	Implementation of Clock Synchronization (logical/physical).
6	Implementation of Election algorithm.
7	Implementation of Mutual Exclusion algorithm.
8	Implement small application using data replication.
9	Implementation of Client Server based program to check data consistency.
10	Implement Load Balancing Algorithms.

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Distributed Systems–Principles and Paradigms.	First Edition	Andrew S. Tanenbaum, Maarten Van Steen	PHI	2004
2	Distributed Operating Systems Concepts and Design	Second Edition	P. K. Sinha	PHI	2010

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Distributed Systems – Concept and Design	Fourth Edition	George Coulouris, Jean Dollimore, Tim Kindberg, & Gordon Blair	Pearson	2010
2	Distributed VOD Systems	First Edition	Sudhir D. & Bandu B.M	Research India Publication	2011

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
SBC	Cloud and Internet Technology Lab	1	0	2			1	0	1	2
CS305		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	--		--		--			--
		Laboratory	100		--		100			200

Pre-requisite Course Codes, if any.	CS208
Course Objective: :	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS305.1	Develop a sophisticated web UX
CS305.2	Create,integrate and test REST based web services
CS305.3	Design secured web application/ web services
CS305.4	Demonstrate behavior of web crawlers and testing of web application

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS305.1					3							
CS305.2					3							
CS305.3					3							
CS305.4					3							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS305.1							
CS305.2							
CS305.3							
CS305.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Designing UI**		**2**
	1.1	Fundamentals of UX Design, Defining UX Solutions, Design Communication and Visualizing Ideas	1	
2		**Web content management system**		**1**
	2.1	Introduction to Web CMS, different types of Web CMS	2	
3		**Web services**		**2**
	3.1	Introduction to web service, REST architecture	3	
4		**Web mashups**		**1**
	4.1	Introduction to web mashups, server side mashups, client side mashups	2	
5		**Secured Web application**		**2**
	5.1	Introduction to Web Tokens, Auth2.0, OAuth, Access token	2	
6		**Integration of web services**		**2**
	6.1	Introduction to Mule ESB, Introduction to Anypoint studio, Integrating Web Services using Any point studio	4	
7		**Web crawlers**		**2**
	7.1	Introduction to web crawler, role of crawler in the internet, concept of page ranking	3	
8		**Docker**		**2**
	8.1	Architecture, Container, Host, Configuration, Merging ports, building	2	
Total				**14**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Create a website using web CMS (Node Js/Angular Js/React Js/Flask/Django/Wordpress/Joomla etc.)
2	Design UX for a given problem definition by using open source UX tools
3	Create a Restful webservice to demonstrate different HTTP methods
4	Testing of restful web service using Postman/ARC
5	Create a web mashup of web services using open source framework
6	Design secured Web application using web token
7	Integration of web services using open source integration tools like Mulesoft
8	Demonstrate the behavior of Web Crawlers/ spiders (use XPATH,CSS PATH),extract information and store it in the database.
9	Create and use a Docker container interactively.Create a Dockerfile, which allows you to declaratively define your containers. Run detached containers and understand port forwarding
10	Use docker-compose to run a multi-container web application

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Sketching the User experiences	2nd edition	Bill Buxton	Diane Cerra	2010
2	Rich Internet Application AJAX and Beyond	3rd edition	Dana Moore, Raymond Budd, Edward Benson	WROX Publisher	2017
3	Web Technology	2nd Edition	Srinivasan	Pearson	2014
4	API Recipes with Mulesoft(r) Anypoint Platform	1st Edition	WHISHWORKS Editorial Board	White falcon	2017

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	https://nodejs.org				
2	https://angularjs.org/				
3	https://reactjs.org/				
4	Internet Technology And Web Design	1st edition	R. K. JAIN	Khanna Book Publishing Company	2015
5	Understanding the Internet: A Clear Guide to Internet Technologies	1st edition	Keith Sutherland	A Butterworth-Heinemann Title	2016
6	RESTful Web APIs: Services for a Changing World	3rd edition	Leonard Richardson, Mike Amundsen, Sam Ruby	O'REILLY	2013

Semester-VI

Sem VI (Cat 1- For Students who have NOT preferred semester long internship)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	OE	OEXXX	Open Elective-I	2	0	2	4	8	3
2	PC	CS306	System Programming and Compiler Construction	3	0	2	5	10	4
3	PC	CS307	Fundamental of Signal and Image Processing	3	0	2	5	10	4
4	PE	CS3X1	PE-I	2	0	2	4	8	3
5	PE	CS3X2	PE-II	2	0	2	4	8	3
6	SBC	CS308	Main Project Stage-I	0	0	0	8	08	3
7	ABL	SVXX/STXX	SEVA II or III /SATVA II or III	0	0	0	3	3	1
8	S/M	SCX3/MNX3	SCOPE-III/Minor-III						3
TOTAL				**6**		**4**	**18**	**28**	**21**

Sem VI (Cat 2-For Students who have preferred semester long internship)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PE*	CS3X1	PE-I	2	0	2	4	8	3
2	PE*	CS3X2	PE-II	2	0	2	4	8	3
4	SBC	CS310/ CS309	Research Internship	0	0	0	40	40	15
5	S/M*	SCXX/MNXX	SCOPE-III/Minor-III						3
		*To be completed online mode or allied courses from MOOCs							**21**

Table 2 - PROGRAM ELECTIVES

Semester	**Sem-VI**		**Sem-VII**		**Sem-VIII**	
Program Elective/Thread	**Program Elective-I**	**Program Elective-II**	**Program Elective- III**	**Program Elective- IV**	**Program Elective- V**	**Program Elective- VI**
Artificial Intelligence and Machine Learning	1T11: Soft Computing	1T12: Machine Learning	1T13: Deep Learning	1T14: Artificial Intelligence for Industrial Application	1T11,1T12, 1T21,1T22, 1T31, 1T32, 1X,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y	1T11,1T12, 1T21,1T22, 1T31, 1T32, 1X,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y
Data Science	1T21: Natural Language Processing	1T22: Big Data Analytics and Visualization	1T23: Foundation of Data Science	1T24: Data Driven Internet of Things		
Network and Security	1T31: Ethical Hacking	1T32: Information and System Security	1T33: Cloud Architecture	1T34: Digital Forensics and Cyber Security		
GENERAL	1T11,1T12, 1T21,1T22, 1T31, 1T32, **1X**,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y	1T11,1T12, 1T21,1T22, 1T31, 1T32, **1X**,1Y, 2T11,2T12, 2T21,2T22 2T31,2T32 2X, 2Y	1T13,1T14, 1T23,1T24 1T33, 1T34 **1P**,1Q, 2T13,2T14, 2T23,2T24 2T33,2T34 2P, 2Q	1T13,1T14, 1T23,1T24 1T33, 1T34 **1P**,1Q, 2T13,2T14, 2T23,2T24 2T33,2T34 2P, 2Q		

In this case the Computer Engineering Department has to offer 1T11,1T12,1T21,1T22, 1X,1Y, 1T13,1T23,1T14,1T24, 1T31, 1T32, 1T33, 1T34, 1P,1Q i.e. 16 Courses to take care of 6 Elective Baskets, where,

1X: Human Machine Interaction
1Y: Computer Vision
1P: Robotics and Automation
1Q: Blockchain Technology

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	System Programming and Compiler Construction	3	0	2	5	10	3	0	1	4
CS306		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	75		75		150			300
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS201: Discrete Structures and Graph Theory CS301: Theory of Computation
Course Objective: To explore the principles, algorithms, and data structures involved in the design and construction of various System Programs and Compilers.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS306.1	Understand fundamentals of language processing activities and its relationships among all phases of the language processor.
CS306.2	Separate the lexical, syntax and semantic analysis into meaningful phases for a compiler
CS306.3	Apply different techniques of intermediate code and machine code optimization to solve problem.
CS306.4	Analyze the role of memory management as pertaining to run time storage management for compiler.
CS306.5	Understand design and working /concepts of various systems software like assemblers, macro processor, loaders and linkers to increase readability and productivity.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS306.1												1
CS306.2	2	1	2		2			2				1
CS306.3	2		2					2				1
CS306.4		2	2					2				1
CS306.5								2				1

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS306.1			1				
CS306.2			2				
CS306.3			2				
CS306.4			2				
CS306.5			1				

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember✓	Understand✓	Apply✓	Analyze✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Language Processor**		04
	1.1	**Introduction to Language Processor:** Language Processing activities, fundamentals of Language Processing.	1,2	
	1.2	**Lexical Analysis**: Role of Lexical Analyzer (Scanner), Input buffering, Specification and recognition of tokens, Lexical analyzer generator- LEX, Optimization of DFA-Based Pattern Matchers.	1	
2	Title	**Syntax and Semantic Analysis**		8
	2.1	**Syntax Analysis:** Role of Syntax Analyzer (Parser), Top-down parsing- Recursive descent and predictive parsers (LL), Bottom-Up parsing - Operator precedence parsing, LR,SLR and LALR parsers, Parser Generator-YACC	1	
	2.2	**Semantic Analysis (Syntax Directed Translation):**Syntax directed definitions, Evaluation order for SDDs , Applications of Syntax Directed Translation, Syntax Directed Translation Schemes	1	
3	Title	**ICG and Code Generation**		09
	3.1	**Intermediate Code Generation:**Variants of Syntax Trees, Three-Address code, Types and Declarations, Translations of Expressions, Type Checking, Control flow, Backpatching, Switch-statements.	1	
	3.2	**Code Generation:**Issues in the design of Code Generator , Target language and Addresses, Basic Blocks and Flow graphs, Optimization of Basic Blocks, Simple Code Generator: Register and Address Descriptors, Code Generation Algorithm, Design of Functions	1	
4	Title	**Code Optimization and RTE**		09
	4.1	**Code Optimization:**Principal sources of Optimization, Peephole Optimization, Register Allocation and Assignment, Instruction Selection by Tree Rewriting, Optimal Code Generation for Expressions, Loops in Flow Graphs,	1	
	4.2	**Run Time Environment:**Storage Organization, Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management, Garbage Collection	1	
5	Title	**Assembler , Macro-processor , Loaders and Linkers**		12
	5.1	**Assembler:** Elements of Assembly Language Programming, Simple Assembly Scheme, Pass structure of Assemblers, Design of Two-pass Assemblers and one-pass assemblers	2	
	5.2	**Macros and Macro Processors:** Macro definition and calls, Macro expansion, nested macro calls, Macro Facilities, Design of Macro Processor	2	
	5.3	**Loaders and Linkers:** Basic Loader functions , Machine Dependent loader features , Machine-Independent loader Features , loader Design Options, Implementation Example	2	
6	Self Study	**Instruction-Level Parallelism:** Processor Architectures, Code-Scheduling Constraints, Basic-Block Scheduling	1	05
Total				**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Design Lexical analyser for different programming languages*and implement using **lex** tool.
2	Write a program to implement optimization of DFA-Based Pattern Matchers.
3	Design syntax analyser for various grammars and implement using different parsing techniques* (Top-down and Bottom-up).
4	Design SDD and SDT for different grammars* and implement using **YACC**/BISON utility.
5	Write a program to generate three address code for different types of programming* language constructs
6	Write a program to find Basic blocks and generate flow graph for the given three address code.
7	Write a program to implement Code generation algorithm.
8	Write a program to create optimize code using different code optimization techniques*
9	Design a two-pass assembler.
10	Design a two pass Macro processor
11	Implementation of various loader/linker schemes

* Instructor should provide distinct programming languages/parsing techniques/optimization techniques/grammars for different batches.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Compilers, Principles, Techniques and Tools	Second	Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman	Pearson Education	2013
2	System Software An Introduction to Systems Programing	Third	Leland L. Beck	Addison Wesley	1997

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Compiler Design and Implementation	First	Steven Muchnik	Morgan Kaufmann Publishers	1997
2	Engineering a Compiler	Second	Cooper &Torczon	Elsevier	2003
3	Compiler Design in C	Second	Allen I. Holub	Prentice Hall India	1992

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Fundamentals of Signal and Image Processing	3	0	2	5	10	3	0	1	4
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS307		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS307.1	Interpret DT signal and perform signal manipulation in Time Domain.
CS307.2	Evaluate the techniques for enhancing and segmenting Images.
CS307.3	Categorize various compression techniques and standards for Images.
CS307.4	Apply signal and image processing algorithms in practical applications.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS307.1	2	2										
CS307.2			3									
CS307.3			3									
CS307.4		2										

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS307.1				3			
CS307.2				3	3		
CS307.3				3	3		
CS307.4				3			

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate ✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Discrete-Time Signal**	T1,T2	10
	1.1	Introduction: Signals, Systems, and Signal, Continuous Time signal, Discrete - Time signal and representation, Digital signal, The Sampling theorem, Some elementary discrete time signals, Classification of Discrete - Time Signals, Modifications of Discrete - Time Signals.	T1,T2	
	1.2	Operations on Discrete - Time Signals: Linear Convolution, Circular Convolution, Matrix Representation of Circular Convolution, Linear Convolution using Circular Convolution, Auto and Cross Correlation.	T1,T2	
	1.3	Discrete - Time systems:	T1,T2	

		Static and dynamic, time variant and time invariant, linear and nonlinear, causal and non causal. Representation of system using impulse response, Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) system, Response of the FIR system using convolution.		
2	**Title**	**Discrete Fourier Transform**	T1,T2	**10**
	2.1	Introduction to DTFT, Relation between DFT and DTFT, DFT of DT signal, Inverse DFT. Properties of DFT, Computations in DFT	T1,T2	
	2.2	Fast Fourier Transform (FFT): Need of FFT, Radix-2 DIT-FFT algorithm, Flow graph for N=4 and 8 using Radix-2 DIT-FFT, Inverse FFT algorithm, Computations in FFT, Linear FIR filtering using Overlap Add Algorithm and Overlap Save Algorithm and implementation using FFT.	T1,T2	
3	**Title**	**Image Enhancement and Segmentation**		**10**
	3.1	Point Processing, Histogram processing, Smoothing and Sharpening Filters.	T4	
	3.2	Detection of discontinuities, Edge linking and Boundary detection, Hough transform, Thresholding, Region oriented segmentation	T4	
4	**Title**	**Morphological Image Processing**		**06**
	4.1	Image Morphology: Structuring Element, Erosion & Dilation, Opening & Closing, Hit and Miss Transform, Region filling.	T4	
5	**Title**	**Image Compression**		**06**
	5.1	Redundancies, Lossy and Lossless Compression	T4	
	5.2	RLE, Huffman Coding, Arithmetic Coding, LZW, Predictive Coding and JPEG		
6	**Self Study ***	Multi-rate Signal Processing: Up sampling and Down sampling, Carl Correlation Coefficient for measurement of degree of similarity between two signals. Object Representation and Object Detection, Object Recognition, Applications of Image Processing		**06**
			Total	**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment	Marks	
1	Signal Operations	5	
2	Discrete Convolution	5	
3	Discrete Correlation	5	
4	Discrete Fourier Transform	5	
5	Image Enhancement using Point Processing Operations.	5	
6	Smoothing and Sharpening of Images.	5	
7	To enhance Image using Histogram equalization.	5	
8	To segment Image using Image Segmentation.	5	
9	To perform morphological operations on Image	5	
10	To implement compression of the Image.	5	

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Digital Signal Processing : Principles, Algorithms and Applications	Fourth edition	Proakis Manolakis	Pearson Education, ISBN 81-317-1000-9	2007
2	Digital Signal Processing	First edition	S. Salivahanan, A. Vallavaraj, C. Gnanapriya	TataMcgraw Hill ISBN 978-0-07-066924-6	2010
3	Digital Signal Processing: A Computer Science Perspective	First Edition published on 25th Sept, 2000	Jonathan (Y) Stein	Copyright © 2000 John Wiley & Sons, Inc Print ISBN:9780471295464 |Online ISBN:9780471200598 |DOI:10.1002/047120059X	2000
4	Digital Image Processing	3rd	Rafael C. Gonzalez and Richard E. Woods	Pearson Education	2010

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Digital Signal Processing: A Practical Approach		Emmanuel C. Ifeachor, Barrie W. Jervis	Pearson Education ISBN 0-201-59619- 9	2001
2	Digital Signal Processing	Sixth Edition	P. Ramesh Babu	Scitech Publication	2014
3	Handbook on Image and Video Processing	--	A.I.Bovik	Academic Press	2009

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-I)	Soft Computing	2	0	2	4	8	2	0	1	3
		Examination Scheme								
1T11		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: This course introduces three important soft computing techniques like Neural network, Fuzzy Logic and Genetic algorithms in brief. Students will be able to understand the supervised and unsupervised learning algorithm for real world applications. The design of fuzzy logic controller helps them to develop an adaptive control system for industrial operations. This course also covers the importance of optimizations and its use in computer engineering fields.	
Course Outcomes (CO):*At the End of the course students will be able to*	
1T11.1	Illustrate the basic principles of soft computing techniques.
1T11.2	Apply the supervised and unsupervised neural network learning algorithm for real world applications
1T11.3	Design fuzzy controller system using different FIS.
1T11.4	Solve optimization problems using genetic algorithms.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T11.1	2	-	-	-	-	-	-	-	-	-	-	-
1T11.2	2	2	-	-	-	-	-	-	2	2	-	-
1T11.3	3	2	2	-	-	-	-	-	2	2	-	-
1T11.4	3	2	2	-	-	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T11.1	1	1	1	-	-	-	-
1T11.2	2	2	2	-	-	-	-
1T11.3	2	2	2	-	-	-	-
1T11.4	2	2	2	-	-	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to Soft Computing**	T3,T4,R1,	04
	1.1	Soft computing Constituents, Characteristics of Neuro Computing and Soft Computing, Difference between Hard Computing and Soft Computing, Concepts of Learning and Adaptation.		
2	Title	**Neural Networks**	T1,T3,R1, R2	10
	2.1	Basics of Neural Networks: Introduction to Neural Networks, Biological Neural Networks and their artificial models, McCulloch Pitt model, Hebb Network, Linear separability. Supervised Learning algorithms: Perceptron (Single Layer, Multilayer), Delta learning rule, Back Propagation algorithm. Un-Supervised Learning algorithms: Winner take all, Self-Organizing Maps, Learning Vector Quantization.		
3	Title	**Fuzzy Set theory**	T2,T3,R1, R3	10
	3.1	Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Fuzzy Max-Min and Max-Product Composition ,Membership function, Fuzzy extension principle, Fuzzy Systems- fuzzification, defuzzification methods, and design of fuzzy controllers.		
4	Title	**Genetic Algorithms**	T3,R1,R4	4
	4.1	Biological Background: The Cell, Chromosomes, Genetics, Reproduction, Selection, Traditional Optimization and Search Techniques Simple GA, Operators in GA, Encoding, Selection, Crossover, Mutation, Stopping Condition for GA .Applications of GA.		
5	Self Study	Recurrent Neural Networks, Deep Learning: Deep Belief Network, Deep Reinforcement Learning		4*
			Total(* Not included)	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

<table>
<tr><th>Sr. No.</th><th>Title of the Experiment</th></tr>
<tr><td>1</td><td>To implement (MP-Neuron) Mc-Culloch Pitts Model.</td></tr>
<tr><td>2</td><td>To implement Transfer/Activation Functions.
A symmetric hard limit transfer function.
A Binary step activation function.
A Bipolar step activation function.
A saturating linear transfer function.
A hyperbolic tangent sigmoid (tansig) transfer function.
A log-sigmoid transfer function</td></tr>
<tr><td>3</td><td>To implement Basic Neural Network learning rules.

PROBLEM TO DISTINGUISH BETWEEN APPLES AND ORANGES
A produce dealer has a warehouse that store a variety of fruits & vegetables. When fruit is brought to the warehouse , a various types of fruits may be mixed together. The dealer wants a machine that will sort the fruit according to type . There is a conveyer belt on which the fruit is loaded .This conveyer passes through a set of sensors, which measure three properties of fruits :shape , texture and weight.
Bias= < Any Value>

<table>
<tr><td>Type of sensor</td><td>Output of sensor</td><td>Condition</td></tr>
<tr><td rowspan="2">Shape sensor</td><td>1</td><td>if fruit is approx. round</td></tr>
<tr><td>0</td><td>if fruit is elliptical.</td></tr>
<tr><td>Texture Sensor</td><td>1</td><td>If surface is smooth</td></tr>
<tr><td></td><td>0</td><td>If surface is rough</td></tr>
<tr><td rowspan="2">Fruit sensor</td><td>1</td><td>Apple</td></tr>
<tr><td>0</td><td>Orange</td></tr>
</table>
Design a perceptron to recognize these patterns using Joone Editor.</td></tr>
<tr><td>4</td><td>Write a program to design a perceptron to recognize these patterns for the problem statement in experiment No.3.(Use any Open source tools)</td></tr>
<tr><td>5</td><td>To implement Multilayer Perceptron Learning algorithm.(EBPTA)</td></tr>
<tr><td>6</td><td>To implement an unsupervised learning algorithm (KSOFM) for pattern classification problem.</td></tr>
<tr><td>7</td><td>To implement an unsupervised learning algorithm (LVQ) for pattern classification problem.</td></tr>
<tr><td>8</td><td>To implement fuzzy set and fuzzy relations for a given problem.</td></tr>
<tr><td>9</td><td>To design and implement Fuzzy Controller for a given problem</td></tr>
<tr><td>10</td><td>To apply genetic algorithms for a given problem.</td></tr>
</table>

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Artificial Neural Systems	--	Jacek M. Zurada	Jaico Publishing House	1992
2	Fuzzy Logic with Engineering Applications	Third Edition	Timothy J. Ross	Wiley India	1995
3	Principles of Soft Computing	Second Edition	S. N. Sivanandam and S. N. Deepa	Wiley, India	2011
4	Deep Learning (Adaptive Computation and Machine Learning)	First Edition	I. Goodfellow, Y. Bengio, A. Courville, F. Bach	O' Reilly	2016
5	Neural Networks, Fuzzy Logic and Genetic Algorithms	Kindle edition	S.Rajasekaran and G.A.Vijayalaks	PHI Learning	2013

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Neuro-Fuzzy and Soft Computing– A Computational Approach to Learning and Machine Intelligence	First Edition	Jang J.S.R, Sun C. T. and Mizutani E.	PHI	1997
2	Fundamentals of Neural Networks – Architectures, Algorithms, And Applications	First Edition	Laurene Fausett	Pearson Education	2004
3	Fuzzy Set Theory and its Applications	Second Edition	H.J. Zimmermann	Allied Publishers Ltd.	1996
4	An Introduction to Genetic Algorithms	Fifth Edition	Melanie Mitchell	The MIT Press	1999
5	Neural Network Design	Second Edition	Hagan, Demuth, Beale	CENGAGE Learning, India Edition	1996

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-III)	Natural Language Processing	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T21		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS303:Artificial Intelligence and Machine learning
Course Objective: To provide the students the techniques and tools to devise and develop Natural Language Processing (NLP) components and applications. The course will cover the foundations, building blocks and applications of NLP, with an emphasis on the necessary linguistic intuitions as well as a broad coverage of statistical and deep learning models that can be used for language tasks. NLP is an important topic in Artificial Intelligence with a wide range of applications, from sentiment analysis to machine translation. Modern NLP is primarily based on statistical methods and machine learning algorithms, where linguistic information is provided by instances of uses of language. For most NLP tasks, state of the art approaches are based on neural models, which will be at the core of this module. However, significant attention will be given to the linguistic principles that underpin the field.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T23.1	Identify the language processing tasks.
1T23.2	Evaluate solutions for a range of natural language components using existing algorithms, techniques and frameworks, including part-of-speech tagging, language modeling, parsing and semantic role labeling.
1T23.3	Apply algorithms for single and multi-class classification problems.
1T23.4	Apply statistical and deep learning techniques to language applications such as machine translation.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T23.1	3	-	2	-	-	-	-	-	-	-	-	-
1T23.2	-	-	2		-	-	-	-	-	-	-	-
1T23.3	3	-	2	-	-	-	-	-	-	-	-	-
1T23.4	3	-	-	-	2	-	-	-	2	-	-	3

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T23.1	2	-	-	-	-	-	-
1T23.2	2	2	-	-	-	-	-
1T23.3	2	-	-	-	-	-	-
1T23.4	2	2	2		2	2	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate ✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introducing NLP: Patterns and structure in language**	1,2	**7**
	1.1	A brief history of natural language processing, language challenges, applications, classical vs statistical vs deep learning-based, Basic concepts in linguistic data Structure: Morphology, syntax, semantics, pragmatics, Tokenized text and pattern matching - Recognizing names, Stemming, Tagging Parts of speech-identify parts of speech, Constituent structure.		
	1.2	Syntax: Coding regular expressions, tree diagrams for a regular language, Regular grammars and Context-free grammar. Usage of regular expressions, Introduction to natural language processing: grammars and parsing, Word structure.		
2	**Title**	**Computational tools for text analysis**	1,2	**5**
	2.1	Natural Language Toolkit (NLTK): Corpora and other data resources, Uses of corpora: Lexicography, Grammar and syntax, Stylistics, Training and evaluation, Basic corpus analysis: Frequency distribution building and analyzing a corpus.		
	2.2	Data structures: strings and sequences, Tokenization in the NLTK, Tokenizing text, Stemming: Comparing stemmers, Tagging: RE tagging, Trained taggers and backoff, Transformation-based tagging.		
3	**Title**	**Statistically based techniques for text analysis**	1,2	**10**
	3.1	Fundamentals of machine learning: Naive Bayes classifiers, Hidden Markov models; Viterbi decoding, Information and entropy; Decision trees and maximum entropy classifiers, N-gram language models, Neural language models (RNNs, LSTMs, GRUs, Bert Model)		
	3.2	Machine learning in action: document classification, Information extraction: Types of information extraction, Regular expressions for personal names, Information extraction as sequential classification: chunking and Named Entity Recognition (NER), Limitations of statistical methods.		
4	**Title**	**Analyzing sentences: Syntax and Parsing**	1,2	**6**
	4.1	Grammars and parsing, Context Free Grammar (CFG), parsing with CFG, Building feature based grammar: Grammatical features; Processing feature structures and extracting feature based grammar. Rules-based and probabilistic parsing: Neural models for parsing; Semantic role labeling; Sequence to sequence modelling - machine translation (SMT, NMT, Attention).		
	4.2	Analyzing meaning of sentences: Propositional Logic, First-order logic, Semantics and discourse semantics.		
5	**Self Study**	Chunking and chinking with NLTK, Generative grammar, Speech Processing.		**2***
			Total (* Not included)	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Install NLTK and perform basic Corpus analysis using NLTK such as (i) frequency distribution (ii) learn about morphological features of a word by analysing it.
2	(i) Generate word forms from root and suffix information.(ii) Understanding the morphology of a word by the use of Add-Delete table
3	(i) Calculate bigrams from a given corpus and calculate probability of a sentence. (ii) to apply add-one smoothing on sparse bigram table
4	Classification using suitable classification model (NB)
5	Calculate emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.
6	Find POS tags of words in a sentence using Viterbi decoding
7	Perform chunking by analyzing the importance of selecting proper features for training a model and size of training.
8	Capture linguistic patterns and grammatical constructions with feature based grammars
9	Build and perform neural model for parsing
10	Analyze the importance of context and size of training corpus in POS.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Natural Language Processing with Python	First Edition	Steven Bird, Ewan Klein & Edward Loper	O'Reilly Media, Inc. ISBN: 9780596516499	2009
2	Natural Language Processing with PyTorch	First Edition	Delip Rao & Brian McMahan	O'Reilly Media, Inc. ISBN:9781491978238	2019

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Neural Network Methods for Natural Language Processing	First Edition	Yoav Goldberg	Morgan and Claypool	2017
2	Linguistic Fundamentals for Natural Language Processing	First Edition	Emily M. Bender	Morgan and Claypool	2013

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Ethical Hacking	2	0	2	2	6	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
1T31		Theory	50		50		100		200	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	IT206: Operating Systems IT207:Computer Communications and Networks IT303A: Cryptography and System Security
Course Objective: To understand the techniques involved in ethical hacking	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T321.1	Demonstrate the understanding of attack vectors
1T321.2	Perform network scanning to identify live and vulnerable machines in a network.
1T321.3	Identify and use viruses, computer worms, and malware to exploit systems.
1T321.4	Perform web application hacking and wireless hacking

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T321.1	3				3	2		1				1
1T321.2	3	2	1	2	3	2		1				1
1T321.3	3	2		2	3	2		1				1
1T321.4	3	2		2	3	2		1				1

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T321.1	2	2		1			
1T321.2	2	2	2	1			
1T321.3	2	2	2	1			
1T321.4	2	2	2	1			

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember ✓	Understand✓	Apply ✓	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to hacking**	T1	8
	1.1	Introduction: Hacking, Types of Hacking/Hackers, Cybercrime, Types of cybercrime, Hacker Mind set, Threats, Concept of ethical hacking, Phases involved in hacking, Role of Ethical Hacking, Common Hacking Methodologies, Profiles of Hackers, Benefits of Ethical Hacking, Limitations of Ethical Hacking		
	1.2	Foot Printing & Reconnaissance: Introduction to foot printing, use of foot printing, Types of foot printing, Understanding the information gathering process, Information on a company website, methodology of the hackers, Tools used for the reconnaissance phase.		
	1.3	System Hacking: System hacking, Types of System hacking, hacking tools, Computer Hole, Hacking Process, Various methods of password cracking, Remote Password Guessing, Role of eavesdropping, Keystroke Loggers, Types of Keystroke Loggers, Detection, Prevention and Removal		
	1.4	Sniffers: Introduction, Sniffer, Types of sniffers, Protocols Susceptible to Sniffing, Active and Passive Sniffing, ARP Spoofing, ARP Spoofing, ARP Poisoning, DNS Spoofing Techniques, MAC Flooding, Sniffing Countermeasures.		
2	**Title**	**Hacking Techniques**	T1,T2, R1	10
	2.1	Trojans, Backdoors, Viruses, and Worms: Trojans and Backdoors, Overt and Covert Channels, Types of Trojans, Reverse-Connecting Trojans, Netcat Trojan ,Indications of a Trojan Attack, Wrapping, Trojan Construction Kit and Trojan Makers , Countermeasure Techniques in Preventing Trojans, Trojan-Evading Techniques, System File Verification Sub objective to Trojan Countermeasures Viruses and Worms, Difference between a Virus and a Worm, Types of Viruses, Understand Antivirus Evasion Techniques, Understand Virus Detection Methods		
	2.2	Session Hijacking: Understanding Session Hijacking, Phases involved in Session, Hijacking, Types of Session Hijacking, and Session Hijacking Tools.		
	2.3	Social Engineering Social Engineering, Common Types of Attacks, Insider Attacks, Identity Theft, Phishing Attacks, Online Scams, URL Obfuscation, Social-Engineering Countermeasures.		
	2.4	Denial of Service: Denial of Service, Types of DoS Attacks, DDoS Attacks, BOTs/BOTNETs, "Smurf" Attack, "SYN", Flooding, DoS/DDoS Countermeasures		
3	**Title**	**Hacking Web applications and Wireless Networks**	T1,T2,R2	10
	3.1	Hacking Web Applications & SQL Injection: Hacking Web Servers, Types of Web Server Vulnerabilities, Attacks against Web Servers, IIS Unicode Exploits, Patch Management Techniques, Web Server Hardening Methods Web Application		

		Vulnerabilities, Objectives of Web Application Hacking, Anatomy of an Attack, Web Application Threats, Google Hacking, Web Application Countermeasures Web-Based Password Cracking Techniques, Authentication Types, Password Cracker, Password Attacks: Classification ,Password Cracking Countermeasures.		
	3.2	SQL Injection and Buffer Overflows: SQL Injection, Steps to Conduct SQL Injection, SQL Server Vulnerabilities, SQL Injection, Countermeasures Buffer Overflows, Types of Buffer Overflows and Methods of Detection, Stack-Based Buffer Overflows, Buffer Overflow Mutation Techniques		
	3.3	Hacking Wireless Networks: Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS, attacks, WLAN Scanners, WLAN Sniffers, Hacking Tools, Securing, Wireless Networks.		
4	**Self-study**	Steganography, cryptography.		
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No	Title of the Experiment
1	Foot printing a target network.
2	Scanning a network using: a) Nmap Network Mapper b) Nessus vulnerability scanner
3	Exploit Windows vulnerability to get unauthorized access.
4	Exploiting Client-side vulnerabilities and establishing a VNC session
5	Performing Man-in-the-Middle Attack using Wireshark & Ettercap
6	Creating a Trojan using Social-Engineer Toolkit.
7	Implementing the DoS attack.
8	Performing SQL injection A. Manual SQL Injection, John the Ripper. B. Automate SQL Injection with Sql Map.
9	Demonstrating the Wireless hacking
10	Case study

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1.	Certified Ethical Hacker Study Guide v9	Study Guide Edition	Sean-Philip Oriyano	Sybex-Wiley	2017
2.	CEH official Certified Ethical Hacking Review Guide	Revised Edition	Kimberly Graves	Wiley	2007

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Certified Ethical Hacker	1	Michael Gregg	Pearson Education	2011
2	Certified Ethical Hacker	3	Matt Walker	McGraw-Hill Education	2016

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-II)	Machine Learning	2	0	2	4	8	2	0	1	3
		Examination Scheme								
1T12		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To learn methodology and tools to apply machine learning algorithms to real data and evaluate their performance.	
Course Outcomes (CO):*At the End of the course students will be able to*	
1T12.1	Define the fundamental principles of Machine learning.
1T12.2	Apply understanding of techniques, mathematical concepts, and algorithms used in machine learning.
1T12.3	Interpret limitations of various machine learning algorithms and the way to evaluate performance of machine learning algorithms
1T12.4	Design an application through software implementation of different concepts and algorithms covered in the course.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T12.1	2	2	--	--	--	--	--	--	2	2	2	2
1T12.2	2	2	2	--	2	--	--	--	2	2	2	2
1T12.3	2	2	2	--	2	--	--	--	2	2	2	2
1T12.4	2	2	2	2	2	--	--	--	2	2	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T12.1	2	2	1	1	1	--	2
1T12.2	2	2	1	1	2	--	2
1T12.3	2	2	1	1	2	--	2
1T12.4	2	2	1	1	2	1	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction Machine learning**	1,2, 3	8
	1.1	Learning Associations, Classification, Regression, Unsupervised Learning, Reinforcement Learning Supervised Learning: Vapnik-Chervonenkis (VC) Dimension,Probably Approximately Correct (PAC) Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization. Parametric methods: Introduction, Maximum Likelihood Estimation: Bernoulli Density; Multinomial Density: Gaussian (Normal) Density, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator Parametric Classification and Regression, Tuning Model Complexity, Model Selection Procedures. Nonparametric Methods: Introduction, Nonparametric Density Estimation, Histogram Estimator, Kernel Estimator, k-Nearest Neighbor Estimator, Generalization to Multivariate Data, Nonparametric Classification, Regression: Smoothing Models.		
2	Title	**Dimensionality Reduction**	1,2, 3	4
	2.1	Introduction. Curse of Dimensionality, Feature selection, Feature Extraction, Subset Selection, Forward and backward selection, Univariate, Multivariate Feature selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis.		
3	Title	**Algorithms and Performance Measures**	1,2, 3	10
	3.1	**Supervised learning Algos**: Linear Regression and Classification (Logistic Regression, Decision Tree, Naïve Bays, KNN, Random Forest), Support Vector Machine (SVM): Maximum Margin Linear Separators; Kernel SVM; Kernels for learning non-linear functions. **Unsupervised Learning Algos:**Association Rules: Market Basket Analysis; The Apriori Algorithm; Example: Market Basket Analysis; Frequent Pattern Tree (FPT)Unsupervised as Supervised Learning; Generalized Association Rules, k-Means Clustering; Expectation-Maximization Algorithm; Mixtures of Latent Variable Models; Supervised Learning after Clustering, Hierarchical Clustering; Choosing the Number of Clusters.		
	3.2	Cross-Validation and Resampling Method, k-Fold Cross-Validation, Bootstrapping, Measuring Error, Interval Estimation, Hypothesis testing, Ensemble Methods, Bagging,Adaboost Gradient Boosting, Grid Search, XGBoost. T-test, P-test.		
4	Title	**Graphical Models**	1,2, 3	6
	4.1	Bayesian Networks, Markov Random Fields, Hidden Markov Model: Discrete Markov Processes; Hidden Markov Models; Problems of HMMs; Evaluation Problem; Finding the State Sequence; Learning Model Parameters; Continuous Observations; The HMM with Input; Model Selection in HMM.		
	Self	**Reinforcement Learning**		

5	**Study**	Elements of Reinforcement Learning, Q Learning, Non deterministic rewards and actions, Temporal Difference Learning, Generalization	**1**	**5***
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

All experiments should be performed through PYTHON Language

Sr. No	Title of the Experiment
1	Implement and analyse Regression (Regression/Classification) Algorithm.
2	Implement and analyse k-nearest Neighbors algorithm
3	Implement and analyse classification using SVM algorithm
4	Implement Association rules for given problem statement
5	Implement K-means/ K-Modes Clustering/ Expectation-Maximization(EM) algorithm to Find Natural Patterns in Data
6	Implement and analyse Principle Component Analysis for Dimensionality Reduction
7	To implement Linear Discriminant Analysis (LDA) for Dimensionality Reduction
8	Implement HMM algorithm for given problem statement.
9& 10	Capstone project covering the concepts of Machine Learning.

Text Books

Sr. No	Title	Edition	Authors	Publisher	Year
1	Introduction to Machine Learning	3rd	Ethem Alpaydın	MIT , PRESS	2012
2	Pattern Recognition and Machine Learning,	1st Edition	C. M. Bishop	Springer	2013
3	Elements of Statistical Learning	2nd Edition	Trevor Hastie Robert Tibshirani Jerome Friedman	Springer	2001

Reference Books

Sr. No	Title	Edition	Authors	Publisher	Year
4	Machine Learning	1st Edition	Tom Mitchell	Mc-Grawhill	1997
5	Machine Learning In Action	1st	Peter Harrington	DreamTech Press	2001

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-II)	Big Data Analytics and Visualization	2	0	2	4	8	2	0	1	3
1T22		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS204: Database Management Systems CS102: Problem Solving using OOP
Course Objective: To Demonstrate understanding of Big Data Technologies and apply acquired knowledge and techniques to solve big data problems. To design effective data visualizations to provide new insights and communicate the information to the viewer. To understand the best practices for the data may be collected, described, or formatted in order to align with the user's discipline. Getting hands-on with Hadoop, Spark, Tableau for data analytics and visualization	

Course Outcomes (CO): ***At the end of the course students will be able to***	
1T22.1	Understand the basic concepts of Big Data and Hadoop Framework
1T22.2	Build a Big data distributed storage using HDFS and Big Data framework
1T22.3	Perform Big Data Processing using various computing algorithms
1T22.4	To understand the purpose and benefits of data visualization, operating it in different stages to get an effective result

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T22.1	2											
1T22.2		2										
1T22.3			2	2		2						
1T22.4	2		2	2	2	2		2				

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T22.1							
1T22.2							
1T22.3							
1T22.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component:

Module No.	Unit No.	Topics	Ref.	Hrs.
	Title	**Introduction to Big Data Analytics**		
1	**1.1**	**Introduction to Big Data** Characteristics of Bigdata, Importance of Big data, Traditional vs. Bid data business approach, big data applications and use cases, big data analytics process and workflow	**1**	**3**
	1.2	**Big Data Storage** Distributed File System, Hadoop Ecosystem, Hadoop Physical Architecture, a) Hadoop Distributed File System (HDFS) b) Cloud-based storage, c) No-SQL databases.	**1**	**4**
2	**2.1**	**Data Collection and Preparation** Data Sources and types, Data collection techniques, Data cleaning and preprocessing, Data Integration and fusion, Data transformation and feature engineering	**2,3**	**3**
	2.2	**Big Data Processing:** Handling Large amount data using Apache Spark ecosystem like Spark CORE and Spark SQL using Spark Data frame	**4**	**4**
3	**3.1**	**Introduction to Data Visualization** Definition and Importance of Data Visualization, Principles of Data Visualization, Basic steps in Data Visualization, Popular tools of Data Visualization, Definition of Dashboard, and their type, Evolution of dashboard, dashboard design and principles, display media for dashboard	**5,6**	**3**
	3.2	**Data Visualization Techniques** Types of Data visualization: Basic charts, plots, Histogram Multivariate Data Visualization, Visualization of groups, trees, graphs, clusters, networks, Hierarchies, Reports, Metaphorical visualization	**5,6**	**4**
4	**4.1**	**Analysis and Preparation for Visualization** Data Aggregation and Transformation, Integration and fusion, Data transformation and feature engineering, Data Exploration and Analysis	**5,6**	**3**
	4.2	**Design and Communication** Visual Design Principles Color Theory and Palettes Typography and Layout Interpretation and Communication of Results	**5,6**	**4**
5	**Self-Study**	Case Study of Big Data Solutions (eg: Twitter data analysis, Sentiment Analysis, Social Networks as Graphs) **Data Visualization Tools:** Tableau, Infogram, ChartBlocks, Datawrapper, D3.js, Google Charts, Fusion Charts, Grafana, Sigma.js, Polymaps		**5***
Total				**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Exp. No.	Experiment Details
1	To setup and install Hadoop in Pseudo-Distributed Mode and monitoring Hadoop
2	Implement the following file management tasks in Hadoop: Adding Files and Directories, Retrieving Files, Deleting Files ii) Exploring various shell commands in Hadoop. iii) Stop Word elimination problem: Input: A large textual file containing one sentence per line. A small file containing a set of Stop Words (One Stop Word per line) Output: A textual file containing the same sentences of the large input file without the words appearing in the small file.
3	Install Apache PySpark(Apache Spark) Using Miniconda
4	Get top 10 customers using Spark (using Txn data set)
5	Define your own schema for Txnfile Derive new column as year from Txn date (Refer Txn file) Write the result on any data Sink.
6	(Refer cust file of exp no 4) 01. Select any 3 columns. 02. Get all the data where age >70 03. Get all the records where designation is missing. 04. Get the counts of records where designation is missing. 05. Get all the records designation is ('Teacher', 'Pilot' and 'Lawyer') 06. Get all the records where age > 65 and designation is Pilot...Sr. Pilots 07. Get all the records where age is in between 60 and 75 08. Get all the records where fname start with 'S'
7	Tableau: Connecting to data sources, Understanding Tableau workspace to find the difference between Live and Extract
8	Visual Analytics in Tableau: Connection with multiple tables, Create data Extracts, Live connection and Data Blending Aim: Create a Report based on passed parameter
9	Visual Analytics in Tableau : Sorting, Grouping, Filtering, Formatting Pane, Trend lines, reference lines Aim : Create a Dashboard for 1) Overall Revenue 2)State-wise Geo Map 3) Top 5 states 4) Bottom 5 states
10	Dashboards and Stories: Dashboards Objects, Interactivity using Actions, Story points, Mapping Aim : Create a report for three categories using calculated field 1. Amount less than 40 2. Between 40 and 80 3. Above 80

Text Books :

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Hadoop, the Definitive Guide	III	Tom White	O'Reilly, Yahoo Press	2015
2	Data Cleaning	I	Ihab F. Ilyas Xu Chu	Association for Computing Machinery (ACM)	2019
3	Bad Data Handbook	I	Ethan McCallum	O'REILLY	2012
4	Spark Definitive Guide	II	Matai Zaharia, Bill Chambers	O'Reilly	2018
5	Storytelling With Data: A Data Visualization Guide for Business Professionals	I	Cole NussbaumerKnaflic	Wiley Publication	2015
6	Designing Data Visualizations: Representing Informational Relationships	I	Julie Seele	O'reilly	

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Mining Massive Datasets	II	Jure Leskove, Anand Rajaraman	Cambridge University Press	2014
2	Hadoop Real-World Solutions Cookbook	II	Tanmay Deshpande	Packt Publishing	2016
3	Data visualization: A practical Introduction	I	Kieran Healy	Princeton University Press	2018

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-II)	Information and System Security	2	0	2	4	8	2	0	1	3
1T32		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS206:Operating Systems CS207:Computer Communications and Networks
Course Objective: To develop basic understanding of policies, standards and practices for evaluation of system security.	
Course Outcomes (CO):*At the End of the course students will be able to*	
1T32.1	Interpret the fundamental results towards the limitation of computer security.
1T32.2	Contrast the different types of security policies and mechanism
1T32.3	Justify the mechanism-policy mapping through assurance and approvals based on evidence.
1T32.4	Describe the options available for receiving an evaluation of trust level of the system.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T32.1	2	1	-	-	-	-	-	-	-	-	-	2
1T32.2	2	-	-	-	-	-	-	-	-	-	-	2
1T32.3	2	-	1	1	-	1	-	2	-	1		2
1T32.4	2	1	1	1	-	-	-	2	-	-	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
1T32.1	1	1	-	-	-
1T32.2	2	1	-	-	-
1T32.3	3	1	2	-	-
1T32.4	3	1	2	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Overview of Information Security**		7
	1.1	**Introduction** - Basic Components, Threats, Policy and Mechanism, Assumptions and Trust, Assurance, Operational and Human Issues	1,2	
	1.2	**Foundation Results** - Protection State, Access Control Matrix Model, General Security Question, Take-Grant Protection Model	1,2	
2	**Title**	**Security Policies - I**		7
	2.1	**Security Policy Basics** - Types, Role of Trust, Types of Access Control, Policy Languages. **Confidentiality Policies** - Goals, Bell-LaPadula Model, Tranquility	1,2	
	2.2	**Integrity Policies** – Goals, Biba Integrity Model, Lipner's Integrity Matrix Model, Trust Models.	1,2	
3	**Title**	**Security Policies - II**		7
	3.1	**Hybrid Policies** - Chinese Wall Model, Role-Based Access Control, Attribute-Based Access Control Model	1,2	
	3.2	**Access Control Mechanisms** - Access Control Lists, Capabilities, Locks, Ring based Access Control, Propagated Access Control Lists	1,2	
4	**Title**	**Assurance and System Evaluation**		7
	4.1	**Assurance and Trust** – Requirements Definition and Analysis, System and Software Design Assurance, Implementation and Integration Assurance, Building Secure and Trusted Systems.	1,2	
	4.2	**System Evaluation**- Principles of Secure Design, Goals of Formal Evaluation, TCSEC: 1983–1999, ITSEC: 1991–2001, CISR Requirements 1991.	1,2	
5	**Self-Study**	a) Formal Verification Techniques b) Formal Specification	1,2	**4***
			Total(* Not included)	**28**

List of Experiments

Sr. No	Title of the Experiment
1	Experiment on Access Control Matrix Model
2	Experiment on Take-Grant Protection Model
3	Experiment on Policy Language
4	Experiment on Bell-LaPadula Model
5	Experiment on Biba Integrity Model
6	Experiment on Role-Based Access Control
7	Experiment on Attribute-Based Access Control Model
8	Experiment on Access Control Mechanisms
9	Capstone project for evaluating the system the level of trust of the system through assurance evidence so that the mechanism meets security policy.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Security: Art and Science	Second Edition	Matt Bishop, Elisabeth Sullivan & Michelle Ruppel	Addison-Wesley Professional	2018
2	Introduction to Computer Security	First Edition	Matt Bishop	Addison-Wesley Professional	2005

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Computer Security: Principles and Practice	Fourth Edition	William Stallings & Lawrie Brown	Pearson Education	2018
2	Cryptography and Network Security Principles and Practices	Fourth Edition	William Stallings	Addison-Wesley Professional	2005
3	Cryptography and Network Security	Second Edition	Behrouz A. Forouzan, Debdeep Mukhopadhyay	McGraw-Hill Education	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(SBC)	Mini Project-II	0	0	0	8	8	0	0	0	3
		Examination Scheme								
CS308		Component	ISE		MSE		ESE		Total	
		Theory	-		-		-		-	
		Laboratory	200		-		100		300	

Pre-requisite Course Codes, if any.	

Course Objective: This course inculcates self-learning, research, and entrepreneurship attitude in students. Students will be able to understand the formal project development process to complete a project in a team. It will help students to develop communication, organizational skills and maturity through discussion, presentation etc.

Course Outcomes (CO): *At the End of the course students will be able to*	
CS308.1	Conduct a survey of basic and contemporary literature in the preferred field by identifying problems based on societal /research needs.
CS308.2	Formulate the problem statement by making judgments on validity of ideas.
CS308.3	Conclude suitable inferences from obtained results through theoretical/experimental/simulations-based analysis.
CS308.4	Develop interpersonal skills to work as member of a team.
CS308.5	Prepare a report of the findings for the study conducted in the preferred domain.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS308.1	2	2	-	-	-	2	1	3	3	3	-	2
CS308.2	2	3	2	2	-	-	1	3	3	3	-	2
CS308.3	2	2	2	2	2	-	-	3	3	3	-	2
CS308.4	-	-	-	-	-	-	-	3	3	3	3	2
CS308.5	2	2	-	-	-	-	-	3	3	3	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
CS308.1	2	2	2	-	2
CS308.2	2	2	2	-	2
CS308.3	2	2	2	-	2
CS308.4	2	2	2	-	2
CS308.5	2	2	2	-	2

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Mini Project II is an opportunity to inculcate the research aptitude in students. It helps them to identify research gaps and come up with possible solutions. Students should be able to analyze these solutions for feasibility of their implementation. Mini project II is based on a small research project correlating scientific knowledge and day to day experience which encourages development of scientific attitude to solve real life problems among students.

Steps for Research:

✓ Keen observation of the surrounding/society

✓ Read existing Literature to understand and identify the research gaps

✓ Analysis of the problem

✓ Formulation of the problem statement

✓ Collection of relevant information by formulating research questions

✓ Suggesting plan of action

✓ Conducting experiments and draw conclusion

✓ To find the possible solution to rectify the problem

✓ To execute experiments and remedial measures wherever possible

Students can seek guidance from teachers, other experts and make effective use of other sources of information available around them. Students must ensure that problem to be manageable in one semester.

Criteria of a good project:

✓ Appropriate idea, clear understanding, and proper presentation of the concept

✓ Quality of work

✓ Project plan and its execution

✓ Credibility of the work

✓ Probable impact of the work on the attitude of students and society

✓ Scientific attitude, creativity and novelty reflected in project work and analysis of the situation

✓ Utility and innovation of the remedial measures

✓ Desirability, Feasibility and Viability in real life

The H/W and S/W resources required to complete the Mini Project II may be beyond the scope of curriculum of courses taken or may be based on the courses but thrust should be on

- ✓ Learning additional skills
- ✓ Development of ability to define and design the problem and lead to its accomplishment with proper planning
- ✓ Learn the behavioral discipline by working in a team. Students should work in groups of three on the Mini Project-II.

Evaluation:

Project report should be submitted on A-4 size pages. Use both printing. Report must carry project title, student details, certificate, and acknowledgements. Other sections of the report shall be decided by the department based on projects. But it must have introduction, necessity of project, objectives, hypothesis, plan, observations, and analysis of results, conclusion, and references along with other sections related to technology.

The ISE and ESE evaluation will be carried out based on the rubrics framed by the Department. ISE marks will be based on the performance of the individual student in three phases of evaluation. The evaluation of the Phase-I will be based on Title approval where the domain and scope of the project will be evaluated. Phase-II will be based on presentation of the selected approach, Justification and Design. Evaluation of Phase-III will be based on demonstration of implementation, testing, presentation and technical report.

The ESE marks will be based on demonstration in front of the expert appointed by the Department. In the ESE examination each individual student would be assessed for his/her contribution in selecting the originality of the problem statement, understanding and knowledge gained about the task completed through presentation/demonstration, work done, and preparing the technical report/poster/technical paper of the project in the standard format provided by the Department.

Semester-VII

Sem VII									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	CS401	Cryptography and System Security	2	0	2	4	8	3
1	OE	OEXXX	OE-II	2	0	2	4	8	3
2	OE	OEXXX	OE-III*	2	0	2	4	8	3
3	PE	CS4X3	PE-III	2	0	2	4	8	3
4	PE	CS4X4	PE-IV	2	0	2	4	8	3
5	SBC	CS402	Main Project Stage-I/ Main-Project Stage-II	0	0	0	6	6	3
6	ABL	SVXX/STXX	SEVA-IV/SATVA-IV	0	0	0	4	4	1
7	S/M/H	SCX4/MNX4 /HOXX	SCOPE-IV/Minor-IV/Honors-I						3
TOTAL									**19**
*OE-III must be from Basic Science Elective or Engineering Science Elective									

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PC)	Cryptography and System Security	2	0	2	4	8	2	0	1	3
		Examination Scheme								
CS402		Component		ISE		MSE	ESE		Total	
		Theory		50		50	100		200	
		Laboratory		50		-	50		100	

Pre-requisite Course Codes, if any.	CS207: Computer Communications and Networks
Course Objective: To apply and analyze different cryptography and system security protocols/techniques	
Course Outcomes (CO): ***At the End of the course students will be able to***	
CS402.1	Describe the different types of the cryptographic algorithms to secure information.
CS402.2	Apply different cryptographic techniques to solve security-related problems.
CS402.3	Create a message digest from data to authenticate authorized user
CS402.4	Use system security practices

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CS402.1	3	-	-	-	-	-	-	-	-	-	-	-
CS402.2	3	3	-	-	-	-	-	-	-	-	-	-
CS402.3	-	3	-	-	-	-	-	-	-	-	-	-
CS402.4	-	3	3	3	2	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

PO	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
CS402.1	-	-	-	-	-	-	-
CS402.2	-	-	-	-	-	-	-
CS402.3	-	-	-	-	-	-	-
CS402.4	-	-	-	-	-	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Security and Cryptography**		5
	1.1	Security Goals, Computer criminals, Methods of defense, Security Services, Security Mechanisms	1,4	
	1.2	Basics of Cryptography Symmetric Cipher Model, Substitution Techniques, Transportation Techniques, Block and Stream Ciphers.	1,2,3	
2	**Title**	**Secret and Public Key Cryptography Techniques**		6
	2.1	Secret Key Cryptography Data Encryption Standard (DES), Strength of DES, Block Cipher Design Principles and Modes of Operations	1,2,3	
	2.2	Public Key Cryptography Principles of Public Key Cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange	1,2,3	
3	**Title**	**Hashing Algorithms and Authentication Protocols**		8
	3.1	Cryptographic Hash Functions, Secure Hash Algorithm, Message Authentication Codes – HMAC, Digital signatures, Digital Signature Schemes	1,2,3	
	3.2	Authentication Protocols, Kerberos, Key Management and Distribution, Authentication service, Public Key Infrastructure, Electronic Mail Security: Pretty Good Privacy, S/MIME.	1,2,3	
4	**Title**	**System Security**		9
	4.1	IDS and Firewalls: Intrusion Detection System, Types of IDS, Firewalls Characteristics, Types of Firewalls	1,2,3,4	
	4.2	Internet Protocol Security (IPSec) Architecture, Authentication Header, Encapsulating Security Payload, Combining security Associations, Internet Key Exchange,	1,2,3,4	
	4.3	Web Security Considerations, Secure Sockets Layer and Transport Layer Security, Electronic Payment. Non-cryptographic protocol Vulnerabilities, DoS, DDoS, Session Hijacking and Spoofing,	1,2,3,4	
	Self Study	International Data Encryption algorithm (IDEA) algorithm, Blowfish algorithm, Elliptic Curve Cryptography, DMZ Architecture, and QR Code generation and scanning, Honeypots, DNSSEC		***8**
			Total (* Not included)	**42**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Implement different substitution techniques.
2	Implement different transportation techniques.
3	Implementation of RSA algorithm.
4	Implementation of Diffie-Hellman key exchange algorithm.
5	Generate and calculate Hashes and checksum files.
6	Implement Pretty Good Privacy (PGP) security method.
7	Implement SNORT Intrusion Detection System.
8	Configure Firewall rules using IP tables.
9	Implement Dos and DDoS
10	Implement Session Hijacking attack.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Cryptography and Network Security: Principles and Practice	Fifth Edition	William Stallings	Pearson	2011
2	Network Security and Cryptography	Second Edition	Bernard Menezes	Cengage Learning	2011
3	Cryptography and Network Security	First Edition	Behrouz A Fourouzan	TMH	2007
4	Security in Computing	Fifth Edition	Charles P. Pfleeger	Pearson Education	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Cryptography and Network	Second Edition	Behrouz A Fourouzan, Debdeep Mukhopadhyay	TMH	2010
2	Computer Security Art and Science	First Edition	Matt Bishop	Addison-Wesley	2002

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE III)	Deep Learning	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component		ISE		MSE		ESE		Total
1T13		Theory		50		50		100		200
		Laboratory		50		--		50		100

Pre-requisite Course Codes, if any.	MA203: Probability and Statistics CS303: Artificial Intelligence and Machine Learning

Course Objective: This course aims to present the mathematical, statistical and computational challenges of building stable representations for high-dimensional data. This data should be 2D-4D images, text and speech. Selected topics of Deep Learning, discussing its origination from neural networks to major trends, giving rise to deep learning models. Special emphasis will be on Optimization techniques, hyper parameters tuning, Convolutional architectures, Sequential architecture and Generative Adversarial Networks. Also lab oriented objectives are full filled through various experiments

Course Outcomes (CO): ***At the End of the course students will be able to***

1T13.1	Compare the architectures of Neural network and deep neural networks and relevant properties.
1T13.2	Identify various ways of selecting suitable model parameters, hyper parameters and stochastic optimization methods that are crucial for training deep neural networks.
1T13.3	Determine characteristics of datasets and suitable computing environment to select suitable building blocks of neural networks including fully connected layers, convolutional and recurrent layers.
1T13.4	Apply deep Learning techniques like generative, representative or discriminative to solve various real life problems using modern tools.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T13.1	3	-	3	-	-	-	-	-	-	-	-	-
1T13.2	-	-	3	-	-	-	-	-	-	-	-	-
1T13.3	3	-	-	-	-	-	-	-	-	-	-	-
1T13.4	3	-	-		3	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T13.1	2	-	-	-	-	-	-
1T13.2	-	2	-	-	-	-	-
1T13.3	2	-	-	-	-	-	-
1T13.4	-	2	-	-	-	2	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate ✓	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Neural Networks and Deep learning**	1,2	**7**
	1.1	Introduction to Deep Learning: What is a Neural Network?, Supervised Learning with Neural Networks, Why is Deep Learning taking off? Analyze the major trends driving the rise of deep learning, and give examples of where and how it is applied today.		
	1.2	Neural Networks: Binary Classification, Logistic Regression. Logistic Regression Cost Function, Gradient Descent. Derivatives and relevant examples, Computation Graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent and relevant example, Vectorization and Vectorizing Logistic Regression's Gradient.		
	1.3	Deep Neural Networks: Deep L-layer Neural Network, Building Blocks of Deep Neural Networks, Forward and Backward Propagation, Parameters vs Hyper parameters		
2	**Title**	**Optimization, Tuning and Interpretability**	1,2,4	**7**
	2.1	Practical Aspects of Deep Learning: Train / Dev / Test sets, Bias / Variance, Basic Recipe for Machine Learning, Regularization, Dropout, Normalizing Inputs, Vanishing / Exploding Gradients, Weight Initialization for Deep Networks, Numerical Approximation of Gradients.		
	2.2	Optimization Algorithm: Mini-batch Gradient Descent, Exponentially Weighted Averages, Bias Correction in Exponentially Weighted Averages, Gradient Descent with Momentum, RMSprop, Adam Optimization Algorithm, Learning Rate Decay and Problem of Local Optima		
	2.3	Hyperparameter Tuning, Batch Normalization and Programming Frameworks: Tuning Process, Using an Appropriate Scale to pick Hyperparameters, Hyperparameters Tuning in Practice: Pandas vs. Caviar, Normalizing Activations in a Network, Batch Normalization, Softmax Regression, Training a Softmax Classifier.		
3	**Title**	**Convolutional Neural Net (CNN) and Sequential Model**	1,2,3	**7**
	3.1	Foundation of CNN: Computer Vision, Edge Detection Example, Padding, Strided Convolutions, Convolutions Over Volume, One Layer of a Convolutional Network, Simple Convolutional Network Example, Pooling Layers, CNN Example		
	3.2	Sequential Model: Introduction, Notations, Recurrent Neural Network Model, Backpropagation Through Time, Different Types of RNNs, Language Model and Sequence Generation, Sampling Novel Sequences, Vanishing Gradients with RNNs, Gated Recurrent Unit (GRU), Long Short Term Memory (LSTM), Bidirectional RNN, Deep RNNs		
4	**Title**	**Representation learning & Generative Learning using Autoencoders and Generative Adversarial Network (GAN)**	1,2, 3,4	**7**
	4.1	Autoregressive, Reversible, Autoencoders, Variational autoencoder Architecture,		
	4.2	Generative Adversarial Networks, GAN Cost Function. DCGAN		
5	**Self Study**	Pytorch, Tensor Flow, Keras, etc		**2***
			Total (* Not included)	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Learning TensorFlow API and Keras API
2	Build and train deep neural networks, identify architecture parameters, implement vectorized neural networks and deep learning to applications
3	Train test sets, analyze variance for DL applications, use standard techniques and optimization algorithms, and build neural network in TensorFlow
4	Implement convolutional neural networks (convnets): Using data augmentation to mitigate overfitting + Using a pre-trained convnet to do feature extraction + Fine-tuning a pre-trained convent + Visualizing what convnets learn and how they make classification decisions
5	Build and train RNNs, work with NLP and word embeddings
6	Use LSTMs and GRUs for implementing a real world problem
7	Use autoencoders to solve a problem
8	Implement variational autoencoders for a given problem
9	Implement a GAN for a given problem
10	Implement DCGAN for a given problem

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Deep Learning	First Edition	Goodfellow, I., Bengio,Y. and Courville, A.	MIT Press	2016
2	Fundamentals of Deep Learning	First Edition	Nikhil Buduma	O'Reilly	2017
3	Generative Deep Learning	First Edition	David Foster	O'Reilly	2019
4	Deep Learning using Python	First Edition	Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka	Wiley	2019

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Deep Learning: Methods and Applications	1st	Deng & Yu	Now Publishers	2011
2	Deep Learning Cookbook	1st	Douwe Osinga	O'Reilly	2017

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-I)	Foundation of Data Science	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T23		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	MA203: Probability and Statistics
Course Objective: Provide students with a comprehensive understanding of the fundamental concepts, tools, and techniques used in data science and data visualization. This course is designed to introduce students to the basic principles of data science and data visualization, including libraries used for Data Science, data exploration, data preprocessing, EDA, data visualization and basic model building.	
Course Outcomes (CO):*At the End of the course students will be able to*	
1T21.1	Understand different types of data description for data science process
1T21.2	Make use of various tools for data visualization and storytelling
1T21.3	Analyze the data performance using the EDA process
1T21.4	Develop a model based on given case study using data science process like correlation and regression

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T21.1		2			2							
1T21.2		2	2		2				1	1		
1T21.3	2	2	2	2	2							
1T21.4		2	2		2				1	1		

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T21.1							
1T21.2							
1T21.3							
1T21.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Descriptive Statistics**	1,2	5
	1.1	Data Types and Scales, Population and Sample		
	1.2	Measures of Central Tendency, Measures of Variation, Measures of Shape		
2	Title	**Data Visualization**	1,3,4, 7,8	5
	2.1	Data Visualization using Matplotlib: Bar Graphs, Scatter Plots, Line Graphs, Histogram, Box Plots, Sub Plots		
	2.2	Data Visualization using Seaborn: Distribution Plots, Pie Charts, Bar Charts, Scatter Plots, Box Plots, Pair Plots, Heat Maps, Line Charts		
	2.3	Data Visualization using Tableau: Bar Charts, Line Charts, Area Charts, Box Plots, Maps, Pie Charts, Dashboard designing and Storytelling		
3	Title	**Exploratory Data Analysis and Data Preprocessing**	5,6	5
	3.1	Data Sourcing: Public Data and Private Data, Web Scraping		
	3.2	Data Cleaning: Fixing the rows and columns, Overfitting and Underfitting, Impute/Remove missing values, Feature Engineering Techniques, Feature Reduction Techniques, Handling Outliers, Standardizing values		
	3.3	Univariate Analysis: Categorical Ordered and Unordered Univariate Analysis		
	3.4	Bivariate and Multivariate Analysis: Numerical-Numerical Analysis, Numerical-Categorical Analysis, Categorical-Categorical Analysis		
4	Title	**Correlation:**	5, 6	5
	4.1	Pearson Correlation Coefficient, Spearman Rank Correlation, Point Bi-Serial Correlation, The Phi-Coefficient		
	4.2	Correlation –Scatter plots –correlation coefficient for quantitative data		
	4.3	computational formula for correlation coefficient		
5		**DESCRIBING RELATIONSHIPS**	5, 6	5
	5.1	Regression –regression line –least squares regression line		
	5.2	Standard error of estimate – interpretation of r2		
	5.3	Multiple regression equations –regression towards the mean		
6	Self Study	Linear Algebra in Dimensionality Reduction, Linear Algebra in Natural Language Processing, Linear Algebra in Machine Learning		3
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Working with Python Basics
2	Working with Python Numpy Library
3	Working with Python Pandas Library
4	Working with Python Matplotlib Library
5	Working with Python Seaborn Library
6	Design a Dashboard and Storytelling using Tableau.
7	Exploratory Data Analysis on the given Case Study
8	Develop Pearson Correlation Model on the given Case Study
9	Develop correlation coefficient for quantitative data on the given Case Study
10	Develop a Linear Regression Model on the given Case Study

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Python for Data Science Handbook: Essentials Tools for Working with Data	Second	Jake VanderPlas	O'Reilly	2022
2	Python for Data Analysis: Data Wrangling with Pandas, NumPy, and Jupyter	Third	Wes McKinney	O'Reilly	2022
3	Python Data Visualization Essentials Guide	First	Kalilur Rahman	BPB	2021
4	Data Visualization Through TABLEAU	First	George Peck	McGraw Hill	2020
5	Hands-On Exploratory Data Analysis with Python	First	Suresh Kumar Mukhiya, Usman Ahmed	Packt	2020
6	Python Data Science Essentials	Third	Alberto Boschetti, Luca Massaron	Packt	2018

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Think Stats: Exploratory Data Analysis in Python		Allen B. Downey	Green Tea Press,	2014
2	Introducing Data Science		David Cielen, Arno D. B. Meysman, and Mohamed Ali	Manning Publications	2016
3	Statistics	Eleventh Edition	Robert S. Witte and John S. Witte	Wiley Publications	2017
4	Python Data Science Handbook		Jake VanderPlas	O'Reilly	2016

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE-III)	Cloud Architecture	2	0	2	5	10	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T33		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS206: Operating Systems, CS207: Computer Communications and Networks, CS304: Distributed Computing
Course Objective: To get the knowledge of Basics of cloud computing, Key concepts of virtualization, Different Cloud Computing services, Cloud Implementation, Programming and Mobile cloud computing	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T33.1	Illustrate cloud service models, deployment models and mobile cloud computing.
1T33.2	Compare different virtualization technologies.
1T33.3	Use different cloud computing services for a given scnerios.
1T33.4	Analyze the components of open stack and Google Cloud platform.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T33.1	-	3	-	-	-	-	-	-	-	2	-	-
1T33.2	-	-	2		3	-	-	-	-	-	-	-
1T33.3	-	-	2	-	-	-	-	-	-	2	-	2
1T33.4	-	-	-	-	2	-	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T33.1	2	-	-	-	-	-	-
1T33.2	-	-	-	-	-	-	-
1T33.3	2	-	-	-	-	-	-
1T33.4	-	-	2	-	2	-	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	Introduction to Cloud Computing	**1,2**	**4**
	1.1	Defining Cloud Computing, Cloud and other similar configurations, Components of Cloud Computing, Cloud types: NIST and Cloud Cube Models, Cloud Deployment Models and Service Models		
	1.2	Cloud computing architecture, Advantages and Disadvantages of Cloud Computing.		
2	**Title**	**Virtualization**	**1,2**	**8**
	2.1	Virtualization: Characteristics of virtualized environment, Understanding the importance of Hypervisors, Type I & Type II Hypervisors.		
	2.2	Taxonomy of virtualization, Implementation Levels of Virtualization, Virtualization of CPU, Memory and I/O Devices , Virtualization and Cloud Computing		
	2.3	Pros and Cons of virtualization, Technology Examples: KVM, Xen, Vmware and HyperV, VirtualBox, Containers/docker, image building registry ,volumes secrets, networks		
3	**Title**	**Cloud Computing Services**	**1,2,3**	**8**
	3.1	Exploring Cloud Computing Services: SPI Model: Software as a service, Platform as a service, and Infrastructure as a service.		
	3.2	Anything as a service or Everything as a service (XaaS): Security as a Service, Identity management as a Service, Database as a Service, Storage as a Service, Collaboration as a Service		
	3.3	Compliance as a Service, Monitoring as a Service, Communication as a Service, Network as a Service, Disaster recovery as a service, Analytics as a Service, Backup as a Service.		
4	**Title**	**Cloud Implementation, Programming and Mobile Cloud Computing**	**2,3,4**	**8**
	4.1	OpenStack Cloud Architecture: Feature of Open stack, Components of Open stack, mode of operations		
	4.2	Programming support for Google apps engine GFS, Bigtables, Chubby, Google APIs.		
	4.3	Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile cloud computing		
5	**Self Study**	AWS cloud computing Platform, a) Elastic Compute Cloud(EC2): Compute Basics, Instance types, Life cycle of instances. b) Simple Storage Service (S3): Basics and Operations, Features, Amazon Glacier, Glacier vs S3. c) Elastic Block Storage (EBS):Basics and Types of EBS Volumes d)Amazon Virtual Private Cloud (Amazon VPC): Subnets, Route tables, Elastic IP Addresses (EIP).	**1 to 5**	**5***
			Total (* Not included)	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Creating and running virtual machines on Hosted Hypervisors like KVM Type1. Vmware Workstation, Oracle Virtualbox
2	Creating and running virtual machines on Bare-Metal Hypervisors Type 0 like Xen,Vmware ESXI or HyperV
3	Implement IaaS using your resources. Technology: OpenStack / Eucalyptus
4	Installation and Configuration of Ulteo to demonstrate on demand Application delivery over web browser to explore SaaS Environment.
5	To demonstrate installation and Configuration of Open stack Private cloud.(MS AZ and Google Cloud)
6	Create IAM role in AWS
7	Create EC2 instance How to connect with the instance
8	Demonstrate Platform as a Service using Google app Engine/IBM BlueMix/tSuru
9	Create a private cloud for the institute using the available resources. Apply security concepts to secure a private cloud.
10	Implement efficient load balancing for a private cloud. Compare various virtualization technologies with given resources.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Enterprise Cloud Computing	First Edition	Gautam Shroff	Cambridge	2010
2	Cloud Computing Principles and Paradigms	Second Edition	Rajkumar Buyya, James Broberg, Andrzej Goscinski	Wiley	2013
3	Distributed and Cloud Computing	First Edition	Kai Hwang Geoffrey C. Fox Jack J. Dongarra	Morgan Kofmann	2012

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Cloud Computing: Web Based Applications that Change the Way You Work and Collaborate Online	First Edition	Miller Michael	Pearson Education India	2008
2	Cloud Computing – A practical Approach	First Edition	Velte T., Velte A., Elsenpeter R.	Tata McGrawHill	2017

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE IV)	Program Elective-IV: AI for Industrial Applications (1T14)	2	0	2	4	8	2	0	1	3
1T14		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS303: Artificial Intelligence and Machine Learning
Course Objective: This course provides an introduction to the principles, techniques, and applications of Artificial Intelligence (AI) in industrial settings. The course focuses on the practical aspects of AI, including machine learning, natural language processing, computer vision, and robotics. Students will learn how to apply AI techniques to solve real-world problems in manufacturing, supply chain management, quality control, predictive maintenance, and other industrial domains.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T14.1	Apply fundamental tools within modern artificial intelligence (AI) with a focus on intelligent agents and systems for industrial analytics.
1T14.2	To apply NLP and CV for industrial application
1T14.3	To apply modern AI tools and techniques for industrial applications.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T14.1												
1T14.2												
1T14.3												

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T14.1							
1T14.2							
1T14.3							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze ✓	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**AI for Industry**		**3**
	1.1	Need for AI in different industries - IT, Robotics, Healthcare, Manufacturing, etc	1,2	
	1.2	Emerging trends in AI for various industrial applications (marketing, finance, banking, agriculture, space exploration, autonomous vehicles, chatbots, artificial creativity, healthcare, gaming, etc.)	3,4	
2	**Title**	**ML for Optimizing maintenance of Industrial Machinery**		**2**
	2.1	Use of Machine learning techniques to optimize processes, reduce cost, and improve efficiency.	1,2,3	
3	**Title**	**Natural language processing and Computer Vision for industrial applications**		**5**
	3.1	Basics of natural language processing, Applications of natural language processing in industrial settings, chatbot development	1,3,6	
	3.2	Basics of computer vision, Applications of computer vision in industrial settings,Deep Learning Framework for People Detection in Overhead Images	4, 10	
4	**Title**	**Artificial Intelligence in Manufacturing Industry**		**9**
	4.1	AI as a catalyst to smart manufacturing - reducing asset downtime, improving manufacturing efficiency, automating production, predicting demand, optimizing inventory levels or enhancing risk management to drive intelligent industrial applications.	7, 8	
	4.2	Use Cases - Warehouse Automation and Industrial Robots (Amazon Warehouse),Machine Learning Techniques for Grocery Sales Forecasting by Analyzing Historical Data	10	
5	**Title**	**Robotics in industrial applications**		**9**
	5.1	Introduction to robotics and their use in industrial settings Applications of robotics in manufacturing, logistics, and other industrial domains	3, 5,9	
	5.2	AI-based quality control and predictive maintenance, Automation of routine industrial operations and maintenance tasks, Application of AI techniques to improve quality control and predictive maintenance in industrial settings	3, 5,9	
	5.3	Use Cases - Predictive Maintenance and Quality Control, Application of AI in SCM or Supply Chain 4.0	10	
6	**Self Study**	Case study on Anomaly Detection in Industrial IoT Applications,Medical Image Segmentation,Internet of Things and Advanced Applications in Healthcare	10	**5***
			Total	**28**

Laboratory Component:

Sr. No.	Title of the Experiment
1	Recommendation system for Industry
2	Industrial material cost prediction
3	Industrial material classification
4	Robotics based troubleshooting FAQ automation in Industry
5	Healthcare FAQ automation
6	Quality control and predictive maintenance
7	Warehouse automation in any Industry
8	Objects/Products detection and classification in Industry
9	Waste classification and monitoring system for industry
10	Deep belief network for smart and secured industry

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Artificial Intelligence for Industrial Applications		N. Narendra Kumar, P. Radha Krishna and D. Jude Hemanth		
2	Artificial Intelligence Business Applications: Artificial Intelligence Marketing and Sales Applications		Bob Mather		
3	Industrial Artificial Intelligence: Fundamentals and Applications		S. K. Saha		
4	Machine Learning for Manufacturing: Applications, Case Studies, and Tools for Predictive Maintenance		Vijay Srinivas Agneeswaran		
5	Artificial Intelligence Concepts And Applications		Lavika Goel	Wiley India	
6	Artificial Intelligence Fundamentals and Applications		Cherry Bhargava, Pradeep Kumar Sharma	Routledge	
7	Intelligent Automation: Learn how to harness Artificial Intelligence to boost business & make our world more efficient		Pascal Bornet		
8	AI for Industrial Engineering: Methods and Application		Mokhtar M. Hasan, Kalyanmoy Deb, and Jugal K. Kalita		
9	Applied Artificial Intelligence: A Handbook for Business Leaders		Mariya Yao, Adelyn Zhou, and Marlene Jia		
10	Artificial Intelligence for Industrial Applications. Volume 25		Steven Lawrence Fernandes Tarun K. Sharma	Springer Nature	

Web References:

1. "Artificial Intelligence for Business: A Roadmap for Getting Started with AI" by Jason L. Anderson, Jeffrey L. Coveyduc, ISBN: 978-1-119-65180-2 April 2020 240 Pages
2. "Artificial Intelligence for Business: A Roadmap for Getting Started with AI" by Niraj Kumar is Wiley

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Data Driven Internet of Things	2	0	2	4	8	2	0	1	3
1T24		Examination Scheme								
		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS207: Computer Communications and networks CS304: Distributed Computing
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T24.1	Analyze various protocols for IoT.
1T24.2	Apply data driven approaches in IoT.
1T24.3	Analyze and visualize the data from IoT devices.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T24.1	2											
1T24.2	2				2							
1T24.3	2				2							

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T24.1	1						
1T24.2	1						
1T24.3	1						

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction to IoT**		5
	1.1	The Internet Of Things (IoT), IoT Application Domains IoT Reference Model, Performance Evaluation And Modeling Of IoT Systems Machine Learning And Statistical Techniques For IoT	1	
	1.2	The situation, Defining IoT analytics, Defining analytics, Defining the Internet of Things, The concept of constrained, IoT analytics challenges, The data volume, Problems with time, Problems with space, Data quality, Analytics challenge	2	
2	Title	**IoT Devices and Networking Protocols**		7
	2.1	IoT devices, The wild world of IoT devices: Healthcare,5 Manufacturing, Transportation and logistics, Retail, Oil and gas, Home automation or monitoring, Wearables, Sensor types	2	
	2.2	IoT networking data messaging protocols: Message Queue Telemetry Transport (MQTT), Hyper-Text Transport Protocol (HTTP), Constrained Application Protocol (CoAP), Data Distribution Service (DDS)	2	
3	Title	**IoT Analytics for the Cloud**		9
	3.1	Exploring the Data Analysis (EDA), and Visualizing data, attributes study for predictive modeling, industry-specific problem analysis	2	
	3.2	Building elastic analytic, Elastic analytics concepts, Designing for Scale, Cloud security and analytics, Apache Hadoop, Apache Spark	2	
	3.3	The AWS overview, Designing data processing for analytics, Applying big data technology to storage, Apache Spark for data processing		
4	Title	**Security in IoT**		6
	4.1	Vulnerabilities of IOT, Security requirements, Challenges for a secure Internet of Things, Threat modeling, Threat analysis, Use cases and misuse cases, Activity modeling of threats, Security Architecture, Security Model, Attacks Modeling, Security attacks, Key Elements of IOT Security	2	
	4.2	Security Engineering for IOT Development : Building Security into design and Development, Secure Design, safety and security design, process and agreement, Technology Selection IOT Security Life Cycle: Implementation and integration, IOT security CONOPS document, Network and security integration, Operations and Maintenance, Managing identities, roles and attributes, security monitoring	4	
6	Self Study	i. Solving industry-specific analysis problems: Manufacturing, Healthcare, Retail. Autonomous vehicles, Supply chain management, Smart Agriculture,Smart City,, tracking and monitoring livestock ii. Power saving and Unique identification & authenticity.	2	4
			Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Programming the Arduino/Raspberry Pi, Basic electronic components such as LED, resistors, battery.
2	Interfacing IoT device with Cloud using mobile phone demonstrating MQTT protocol
3	Detecting Human Stress by Sleep cycle tracked by sensors. Human Stress Detection in and through Sleep | Kaggle
4	Analyze Maternal Health from IoT Sensors data at hospitals. Classification Maternal Health 5 Algorithms ML | Kaggle
5	Analyze and visualize weather information for Smart Home. Smart Home Dataset with weather Information | Kaggle
6	Analyze and visualize data from Temperature Sensors for a given scenario. Temperature Readings : IOT Devices | Kaggle
7	Analyze Room Occupancy using IoT Sensor dataset Room Occupency IOT Data | Kaggle
8	Detecting IoT botnet. N-BaIoT Dataset to Detect IoT Botnet Attacks | Kaggle
9	Detecting the smoke from IoT Sensors data. Smoke Detection Dataset | Kaggle
10	Analyze and visualize data from Smart City IoT Sensors. Smart Cities Index Datasets | Kaggle

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	An Introduction to IoT Analytics	First	Harry G. Perros	CRC Press	2021
2	Analytics for the Internet of Things (IoT)	-	Andrew Minteer	Packt Publishing	July 2017

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Internet of Things-A Hands-On Approach	First	Arshdeep Bahga, Vijay Madisetti	University Press	2015
2	Practical Internet of Things Security	First	Brian Russel and Drew Van Duren	Packt Publication	2016

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
(PE)	Digital Forensics and Cyber Security	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
1T34		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS207:Computer Communications and Networks
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1T34.1	Illustrate the science of digital forensic
1T34.2	Categorize the different areas within digital forensics and apply solid foundational grounding for digital investigations and protection of resources from unauthorized activity.
1T34.3	Apply the tools and tactics associated with digital forensics
1T34.4	Identify the requirements of cyber security for critical infrastructure and learn to comply such requirements within suitable cyber security framework.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T34.1	-	2	-	-	-	-	-	-	-	-	-	-
1T34.2	-	2	-	-	-	-	-	-	-	-	-	-
1T34.3	-	-	-	-	3	-	-	-	-	-	-	-
1T34.4	-	-	-	-	-	2	-	-	-	-	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1T34.1	2	-	-	-	-	-	-
1T34.2	-	2	-	-	-	-	-
1T34.3	2	-	-	-	-	-	-
1T34.4	-	2	-	-	-	2	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze ✓	Evaluate	Create ✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Introduction to Digital Forensics Science**	1,2	**5**
	1.1	Introduction to Digital Forensic Science, Planning and development of Digital Forensic lab.		
	1.2	The phases of Digital Forensic investigative process: Identification, Preservation, Collection, Examination, Analysis, Presentation, Decision.		
2	**Title**	Sub categories of Digital Forensic	1,2	**7**
	2.1	Media Analysis (Hard drives, RAM, flash memory, PDAs, diskettes etc): Examining physical media for evidence, Chain of Custody (CoC),Powered-on versus powered-off device acquisition, Write blocking, Data imaging and hashing, Mobile and portable Device forensics, Device and data acquisition guidelines and best practices,		
	2.2	Code Analysis: Review of software for malicious signatures, Network Analysis: Scrutinize network traffic and logs to identify and locate.		
3	**Title**	**Incident Response Methodology and Tools**	1,2	**8**
	3.1	Preparation, Detection, Containment, Analysis, Eradication, Recovery and Follow up.		
	3.2	Evidence Acquisition and Preservation, Drive and partition recognition in Linux, Maintaining evidence integrity, Image acquisition using *Guymager*. File Recovery and Data Carving with *Foremost*, *Scalpel*, and *Bulk Extractor*, Forensic test images used in *Foremost* and *Scalpel*, Using Foremost for file recovery and data carving, Using *Scalpel* for data carving, Bulk_extractor. Memory Forensics with *Volatility*.		
	3.3	Autopsy – The Sleuth Kit, Kit, Sample, Network and Internet Capture Analysis with Xplico, Packet capture analysis using Xplico,		
4	**Title**	**Cybersecurity**	3,4	**8**
	4.1	Introduction to Cybersecurity framework of NIST, Five functions of cybersecurity and critical infrastructure security (Nuclear power plant, smart grid, SCADA, Industrial Control System Security)		
	4.2	Introduction to SOC/SIEM, Advance techniques in Cyber security like Machine learning and Game theory		
5	**Self-study**	Cloud Forensic, IT security policy for any given sector (BFSI),		**2***
			Total (* Not included)	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Setting up Digital Forensic lab
2	Computer Forensic using open source tool (Autopsy, Sleuth kit and TCT)
3	Memory Forensics using open source tool (Volatality)
4	Network Forensics using open source tools (Xplico and Tshark)
5	Email Forensics using online utilities
6	Evaluating commercial Digital forensic tools (EnCase Forensic)
7	IoT Forensic Case Study
8	Cloud Forensic
9	Implementing SIEM
10	Mini Project on Cybersecurity using advance Technique

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Digital Forensics with Kali Linux	Second Edition	Shiva V. N. Parasram	Packt	2017
2	Computer Forensics: Incident Response Essentials	--	First Warren G. Kruse II and Jay G. Heiser	Addison-Wesley Professional	2001
3	NIST Cyber Security Framework https://www.nist.gov/cyberframework/online-learning			NIST online	
4	Framework for improving critical infrastructure of Cyber security https://nvlpubs.nist.gov/nistpubs/CSWP/NIST.CSWP.04162018.pdf			NIST Online	

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Guide to Computer Forensics and Investigations	Second Edition	Nelson, B, Phillips, A, Enfinger, F, Stuart, C	Thomson Course Technology	2006
2	Computer Forensics, Computer Crime Scene Investigation	First Edition	Vacca, J	Charles River Media,	2005

Semester-VIII

Sem VIII (Option A: Cat1/Cat2)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	PC	CS403	High Performance Computing	2	0	2	4	8	3
2	OE *	OEHXX	OE-IV	2	0	2	4	8	3
3	PE	CS4X5	PE-V	2	0	2	4	8	3
4	PE	CS4X6	PE-VI	2	0	2	4	8	3
5	SBC	CS404	Main Project Stage-II	0	0	0	6	6	3
6	H	HOXX	Honors-II						3
	*May be taken from MOOCs, Essentially Humanities, Management related								
TOTAL									**15**

Sem VIII (Option B: Only for Cat1 students)									
No	**Type**	**Code**	**Course**	**L**	**T**	**P**	**O**	**E**	**C**
1	SBC	CS405	Industry Internship/ Major Project	0	0	0	36	36	15
3	H	HOXX	Honors-II						3
	*May be taken from MOOCs, Essentially Humanities, Management related								
TOTAL								**40**	**15**

The 'Major Project' in the "Option B" must be completed from an institute of national interest. If a student wishes to complete a Major Project under the mentorship of SPIT faculty, approval from the Dean Academics and Research is required.

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PC	High Performance Computing	2	0	2	4	8	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE			Total
CS403		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any	CS206:Operating Systems, CS207:Computer and Communication Networks, CS203: Computer Architecture and Organization
Course Objective: To familiarize students with the fundamental concepts, techniques and design of parallel computing and use of parallel computing application area.	
Course Outcomes (CO):*At the End of the course students will be able to*	
1T31.1	Comprehend fundamental concepts and communication pattern of parallel programming in high performance computing.
1T31.2	Use MPI and OpenMP message passing paradigm in parallel programs for loosely and tightly coupled parallel systems.
1T31.3	Analyze the performance of parallel programs of high performance computing systems.
1T31.4	Design parallel algorithm for achieving high performance of standard single threaded algorithm

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1T31.1	3	-	-	-	-	-	-	-	-	-	-	-
1T31.2	-	-	-	-	3	-	-	-	-	-	-	-
1T31.3	2	3	-	-	-	-	-	-	-	-	-	-
1T31.4	1	1	3	-	-	-	-	-	-	-	-	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PSO1	PSO2
1T31.1	-	-	2	-	-
1T31.2	-	-	-	-	-
1T31.3	-	-	-	-	-
1T31.4	-	-	2	-	1

BLOOM'S Levels Targeted

Remember	Understand	Apply	Analyze	Evaluate	Create ✔

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	**Parallel Programming and Platforms**		7
	1.1	Implicit Parallelism, Limitations of Memory System Performance, Parallel Computing Platforms, Parallel Platforms Physical Organization	1	
	1.2	Parallel Machine Communication Costs, Interconnection Networks Routing, Process-Processor Mapping, Mapping Techniques, MPI and OpenMP, Examples of MPI* and OpenMP* Programming – Conjugate Gradient Method, Jacobi Method	1,2	
2	**Title**	**Analytical Modeling of Parallel Programs**		7
	2.1	Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, Granularity Effect on Performance, Parallel Systems Scalability	1	
	2.2	Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Examples of Analysis of Parallel Programming – Boundary Value Problem, n-Body Problem	1,2	
3	**Title**	**Parallel Algorithm Design**		7
	3.1	Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads	1	
	3.2	Task/Channel Model, Foster's Design Methodology, Examples of Parallel Programming Design – Sieve of Eratosthenes, Floyd's Algorithm	1,2	
4	**Title**	**Communication Operations**		7
	4.1	One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations	1	
	4.2	Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Examples of Parallel Programming Communication – Matrix Vector Multiplication, Matrix Multiplication	1,2	
5	**Self Study**	• **MPI –** Building Blocks, Communication-Computation Overlapping, Collective Communication, Computation Operations, Groups and Communicators • **OpenMP –** Shared-Memory Model, Critical Sections, Reductions, Data and Functional Parallelism • **GPU Programming –** Basic Programming Concepts.	1,2	**4 ***
			Total(* Not included)	**28**

List of Experiment

Sr. No.	Title of the Experiment
1	Implement Circuit Satisfiability Problem and comment on NP-Hard by increasing number of input to Boolean circuit.
2	Implement Minimum Vertex Cover and comment on NP-hard by increasing number on set size.
3	Implement Linear Systems solution using Conjugate Gradient Method through Parallel MPI and OpenMP programming and then analyze the algorithm.
4	Implement Linear Systems solution using Jacobi Method through Parallel MPI and OpenMP programming and then analyze the algorithm.
5	Implement Boundary Value Problem using Foster's Design Methodology
6	Implement n-Body Problem using Foster's Design Methodology
7	Implement Sieve of Eratosthenes with different data decomposition options using Parallel MPI programming
8	Implement Floyd's version of All-Pair Shortest-Paths Problem through all steps of parallel algorithm design namely partitioning, communication, agglomeration and mapping using Parallel MPI programming.
9	Implement Matrix-Vector Multiplication using various Data Decomposition Options using Parallel MPI programming and then analyze the algorithm.
10	Implement Matrix Multiplication algorithm through i) Sequential Algorithm, ii) Parallel Algorithm - a) Rowwise Block-Striped Decomposition and b) Cannon's Algorithm using Parallel MPI programming and then analyze the algorithm.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Introduction to Parallel Computing	Second Edition	Ananth Grama	Addison Wesley,	2003
2	Parallel programming in C with MPI and Open MP	First Edition	Michael J Quinn	McGraw-Hill	2003

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Advanced Computer Architecture: Parallelism, Scalability, Programmability	Second Edition	Kai Hwang, Naresh Jotwani	McGraw-Hill	2008
2	Introduction to High Performance Computing for Scientists and Engineers	First Edition	Georg Hager, Gerhard Wellein	CRC Press	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	HMI (Human Machine Interaction)	2	0	2	4	8	2	0	1	3
		Examination Scheme								
[1X]		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		--		50			100

Pre-requisite Course Codes, if any.	CS305: Cloud and Internet Technology Lab
Course Objective: This course provides an opportunity to learn and apply the design principles of Human Machine Interaction. Learners will learn the basic human psychology of everyday actions and will be able to design an UI prototype of an application. This course covers the discussion on various interaction design concepts. The laboratory experiments are designed to practice the concepts and to adopt the systematic approach for interface design using various UX tools.	
Course Outcomes (CO):*At the End of the course students will be able to*	
1X.1	Identify the various design principles used for interacting between human and machine.
1X.2	Apply human psychology of everyday actions and UI design processes for real world applications.
1X.3	Implement mobile, windows, and web-based application
1X.4	Evaluate and justify UI design
1X.5	Create an application for a social and technical task.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PO1	PO2	PO3	PO5
1X.1	2	-	2	-
1X.2	2	-	2	-
1X.3	2	3	-	**2**
1X.4	2	-	2	-
1X.5	2	3	-	-

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

CO	PEO1	PEO2	PEO3	PSO1	PSO2
1X.1					
1X.2					
1X.3					
1X.4					
1X.5					

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply ✓	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	Title	**Introduction**	T1-T4	06
	1.1	Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields.		
	1.2	The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction;		
	1.3	Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error;		
2	Title	**Graphical User Interface and Web Interface**	T2,T4	04
	2.1	The Graphical User Interface: Popularity of graphics, the concept of direct manipulation, characteristics of GUI,		
	2.2	Web user Interface: Interface popularity, characteristics. Principles of user interface design.		
3	Title	**Understanding Goal-Directed Design**	T1-T4	06
	3.1	Goal-directed design; Implementation models and mental models; Beginners, experts, and intermediates – designing for different experience levels		
	3.2	Understanding users; Modeling users – personas and goals.		
4	Title	**Design Guidelines**	T1-T4	06
	4.1	perception, Gestalt principles, visual structure, reading is unnatural, color, vision, memory, six behavioral patterns, recognition and recall, learning, factors affecting learning, and time.		
5	Title	**Interaction Styles and Communication:**	T2,T4	06
	5.1	**Interaction Styles:** Menus, Windows, Device-based and Screen-based Controls.		
	5.2	**Communication:** Text messages, Feedback, and Guidance, Icons, Multimedia, and colors.		
	Self Study	UX tools: Figma, Just In Mind, and any open-source tool for prototype designing Mobile Ecosystem: Platforms, Application frameworks: Types of Mobile Applications: Widgets, Applications.		04
Total				**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	To Study of open-source UX tools (Justinmind Prototype, Pidoco, Marvel ,Figma Prototype) and create a simple design for a given problem definition.
2	**Know your client.** ● Design an app that can teach mathematics to children of 4-5 years age in schools in Rural Sector. ● Design an app that can teach mathematics to children of 4-5 years age in schools in Urban Sector. ● Design a site that can help people to sell their handmade products in metro cities. ● Design a site that can connect housewives and keep them engaged. **Note : Students should be able to do the following for any given problem statement** ● Analysis of user's/client's behavior eg their preferences, interests etc ● What kind of interfaces will they like and why? ● Existing apps - analyze and rate them. ● What will be your choice of screen elements? ● How will your app/web design be better than the existing one?
3	**Goal-oriented design** - Design an experience for passengers whose flight /train is delayed.
4	**Design Principles** - Understand principles of good UI design by heuristic evaluation. Design UI for a given problem statement.
5	**Menus & Navigation** – Redesign of a user interface (Suggest and implement changes in Existing User Interface) for a given problem statement.
6	**Windows & Screen controls** – Design UI for a given problem statement. **a.** Design a navigator for a student new in your Institute. **b.** Design a navigator for a person new in tourist city/ village. **c.** Motor paralysis for differently able people. **d.** Vaccination App design with localization
7	**Icons** - Design appropriate icons pertaining to a given domain. (Eg. Greeting cards, Travelling, restaurants, Education, Medical, security at Airport, Malls etc)
8	**Colors** – Design a personal website for any socio-technical problem. Use color guidelines with statistical graphics for better visualization.
9	Design a Map-based UI(Web User) for the given problem statement. Example: Mumbai Dabbawallas with localization feature. Pet Care New Visitors to Hospital
10	To calculate the screen complexity of the existing Graphical User Interface and redesign the interface to minimize the screen complexity.

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Human Computer Interaction	3rd	Alan Dix, J. E. Finlay, G. D. Abowd, R. Beale	Peason,Prentice Hall	2003
2	The Essential Guide to User Interface Design	3rd	Wilbert O. Galitz,	Wiley publication	2007
3	Design of everyday things	2nd	Donald A. Normann	Basic Books; Reprint edition	2013
4	Galitz's Human Machine Interaction	1st	Kalbande,Kanade,Iyer	Wiley Publications	2015

Reference Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Interaction Design:Beyond Human Computer Interaction	5th	Rogers Sharp Preece	Wiley publications	2019
2	Mobile Design and Development	1st	Brian Fling	O'Reilly Media Inc.,	2009.

Note: If a learner has studied this subject earlier in the previous semester, it will not be offered again.

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	Computer Vision	2	0	2	5	10	2	0	1	3
		Examination Scheme								
		Component	ISE		MSE		ESE		Total	
1Y		Theory	50		50		100		200	
		Laboratory	50		--		50		100	

Pre-requisite Course Codes, if any.	
Course Objective:	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1Y.1	Understand the basics of 2D and 3D Computer Vision
1Y.2	Describe various geometric techniques in computer vision
1Y.3	Perform shape analysis and extract features from Images and do analysis of Images.
1Y.4	Explore the diverse applications of computer vision.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1Y.1	2	2	2		3							1
1Y.2	3	2	3		3							1
1Y.3	3	2	3	1	3							1
1Y.4	3	3	3	1	3				3	2	2	2

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

PO	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1Y.1							
1Y.2							
1Y.3							
1Y.4							

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	**Title**	Introduction Camera Geometry		6
	1.1	Image Processing, Computer Vision and Computer Graphics , What is Computer Vision - Low-level, Mid-level, High-level ,		
	1.2	**Camera Models and 3D Computer Vision,** Camera Calibration, Stereo Vision, Generating 3D images from 2D views, Overview of Diverse Computer Vision Applications		
	..			
2	**Title**	Digital Image Processing		6
	2.1	Image Formation, Image Filtering, Edge Detection, Principal Component Analysis		
	2.2	Corner Detection, SIFT, Applications, Large Scale Image Search		
	..			
3	**Title**	Geometric Techniques in Computer Vision		8
	3.1	Image Transformations, Camera Projections, Camera Calibration		
	3.2	Depth from Stereo, Two View Structure from Motion, Object Tracking		
4	**Title**	Shape Representation and Segmentation:		8
	4.1	Shape Representation and Segmentation: Contour based representation, Region based representation, De-formable curves and surfaces,		
	4.2	Snakes and active contours, Level set representations, Fourier, and wavelet descriptors, Medial representations, Multi-resolution analysis, Object recognition.		
5	**Title**	Computer Vision Applications		8
	5.1	Pattern recognition methods, Face detection, Face recognition,		
	5.2	3D shape models of faces Application: Surveillance – foreground-background separation –human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians		
6	**Self-Study**	Machine learning in computer Vision: Introduction to Machine Learning, Image Classification, Object Detection, Semantic Segmentation		4
			Total	**40**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Perform basic Image Handling and Processing operations on the image.
2	Geometric Transformation
3	Compute Homographic Matrix
4	Perspective Transformation
5	Edge Detection, Line Detection and Corner Detection
6	Camera Calibration
7	SIFT Feature descriptor
8	SURF and HOG feature descriptor
9	Object detection and Recognition
10	Project based on Computer Vision Applications

Text Books

Sr. No.	Title	Edition	Authors	Publisher	Year
1.	Computer Vision A modern approach		D. Forsyth and J. Ponce	Prentice Hall	
2.	Computer Vision: Algorithms and Applications		Richard Szeliski	Springer	2010

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	Robotics and Automation	2	-	2	4	8	2	-	1	3
		Examination Scheme								
1P		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50				50			100

Pre-requisite Course Codes, if any.	
Course Objective: To give students exposure about process automation, its working, importance and security related to it.	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1P.1	Explain the basics of Process Automation
1P.2	Analyze the methodologies and techniques used in Process Automation
1P.3	Develop the BOTs using Process Automation
1P.4	Explain different intelligent Process Automation techniques
1P.5	Analyze the securities required for Process Automation

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1P.1	3											
1P.2		2		2								
1P.3			3		3		2			1		
1P.4	2	2										
1P.5		3		1								

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

PO	PEO1	PEO2	PEO3	PSO1	PSO2
1P.1					
1P.2					
1P.3			2		2
1P.4					
1P.5					

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Theory Component

Module No.	Topics	Ref.	Hrs.
1	**Robotics Process Automation : Foundations and Skills** Introduction to RPA, Different types of RPA Approaches, History of RPA, Benefits and Limitations of RPA, Terms and concepts used in RPA, Levels of RPA.	1, 2	5
2	**RPA Methodologies, Planning and Vendor Evaluation**	1	5
	Introduction to Lean, Introduction to Six Sigma, Six Sigma roles and levels, Lean Six Sigma, Finding the right balance and apply lean and six sigma to RPA, ROI for RPA.		
3	**Developing BOTs using RPA** Analysis of Business Process and development of BOT, Activities, Flowcharts and sequences, Log Message, loops and conditions, Best practices for BOT Development, Evaluating BOT Performance, Testing, Monitoring.		
4	**Intelligent Automation** Cognitive Automation, Intelligent Process Automation or IPA, Examples of cognitive RPA, Web Scraping	3	6
5	**Security of Process Automation** Security Challenges for RPA, Secured BOT Development and Secured BOT Deployment, , Secured BOT architecture design	6, 7	6
6	**Self-Study Topics** RPA compared to BPA, BPM and BPO, Key challenges in RPA, RPA use cases and the planning, RPA vendor evaluation, Type of Data for RPA, Data Process and Types of Algorithms, Managing RPA Implementation Cycle, Types of BOTs, Examples of BOTs	1, 2, 7	
		Total	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	● Working with Linux commands: ● Basic Linux/Unix commands ● Changing file permissions and ownership ● Types of links soft and hard link ● Filter commands ● Simple filter and advance filter commands ● Start and stop services ● Find and kill the process with id and name ● Package installation using RPM and YUM
2	Demonstrate the use of Docker : ● Installation ● Downloading Dockers images. ● Uploading the images in Docker Registry and AWS ECS ● Understanding the containers ● Running commands in container. ● Running multiple containers.
3	Part 1: Use of recorder, editors and basic commands to build simple tasks. Part 2: Run Bot from Control Room and Schedule Bot from Control Room
4	Automate task of replacing few characters from a string and copying files from a source folder to destination folder.
5	Automate task of writing text into Notepad file
6	Extract data from JSON file and display output in message box
7	Part 1: Automate the task of extracting the data from an Excel File according to some condition and storing the extracted data in another File. Part 2: Automate the task of extracting the data from multiple PDF documents and storing the data into a CSV file.
8	Manipulate web-based components like textbox, drop down and Extract data and table from website and store it in excel or database.
9	Demonstrate Scheduler and trigger
10	Design IQ BOT and resilience BOT

Practicals 3-10 to be done in "Automation Anywhere / UiPath" software.

Text Books:

[1] Tom Taulli, "*The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems*", 1st Edition, Apress Publisher, 2019.

[2] Gerardus Blokdyk, "*Robotic Process Automation RPA a Complete Guide - 2020 Edition*", 1st Edition, 5STARCooks, 2019.

Reference Books:

[1] Mathias Kirchmer, Peter Franz and Danny Bathmaker and Danny Bathmaker , "*Value-Driven Robotic Process Automation Enabling Effective Digital Transformation Effective Digital Transformation*" ,White paper: BPM-D Paper - London, Philadelphia 2019 .
[2] Alok Mani Tripathi,"*Learning Robotic Process Automation*", Packt Publishing, 2018.

Web References:

[1] https://www.infobeans.com/robotic-process-automation-lifecycle
[2] https://www.uipath.com/blog/the-evolution-of-rpa-past-present-and-future
[3] https://www.chatbot.com/blog/6-types-of-bots-that-can-serve-your-clients/
[4] https://www.onesourcevirtual.com/resources/blogs/technology-and-innovation/prepare-for-robotic-process-automation-with-lean-six-sigma.html
[5] https://docs.automationanywhere.com/bundle/enterprise-v11.3/page/enterprise/topics/aae-client/bot-creator/commands/commands.html
[6] https://university.automationanywhere.com/rpa-learning-trails/automation-anywhere-university-essential-level-prep-courses-mba-students/

Course (Category) Code	Course Name	Teaching Scheme (Hrs/week)					Credits Assigned			
		L	T	P	O	E	L	T	P	Total
PE	Blockchain Technology and Applications	2	0	2	5	10	2	0	1	3
		Examination Scheme								
1Q		Component	ISE		MSE		ESE			Total
		Theory	50		50		100			200
		Laboratory	50		-		50			100

Pre-requisite Course Codes, if any.	
Course Objective: To apply and analyze different cryptography and system security protocols/techniques	
Course Outcomes (CO): ***At the End of the course students will be able to***	
1Q.1	Describe the basic concepts of blockchain technology, Bitcoin, and Ethereum.
1Q.2	Apply and implement a smart contract on the Ethereum test network
1Q.3	Build a Decentralized Application running on a decentralized peer-to-peer network.
1Q.4	Evaluate and propose use cases for a new blockchain and/or cryptocurrency.

CO-PO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1Q.1	2											
1Q.2			2									
1Q.3					2							
1Q.4		2	2		3	2						

CO-PEO/PSO Correlation Matrix (3-Strong, 2-Moderate, 1-Weak Correlation)

	PEO1	PEO2	PEO3	PEO4	PSO1	PSO2	PSO3
1Q.1	2	-	-	-	-	2	-
1Q.2	2	-	-	-	-	2	-
1Q.3	2	-	-	-	-	2	-
1Q.4	2	-	-	-	-	2	-

BLOOM'S Levels Targeted (Pl. Tick appropriate)

Remember	Understand	Apply	Analyze	Evaluate	Create ✓

Theory Component

Module No.	Unit No.	Topics	Ref.	Hrs.
1	1.1	**Introduction to Blockchain Technology**		08
		Blockchain Basic, Four Core building blocks of blockchain, the Life cycle of Blockchain, Blockchain working, Difference between blockchain and databases, Centralized, Decentralized and Distributed system, Distributed Ledger Technology, Blockchain ecosystem and structure, Features of Blockchain, Advantages of Blockchain. Blockchain Primitives-Cryptography, PKI, Hash functions, properties of Hash Functions, Merkle Tree, Zero Knowledge Proof (ZKP), ZK-SNARK	1,2	
	1.2	**Distributed Consensus:** The consensus problem - Asynchronous Byzantine Agreement - AAP protocol and its analysis - Nakamoto Consensus on the permissionless, Proof of Work (PoW) as a random oracle - formal treatment of consistency, liveness, and fairness - Proof of Stake (PoS) based Chains – Hybrid models (PoW + PoS).	2	
2	2.1	**Cryptocurrencies- Bitcoin and Ethereum**		08
		History of Cryptocurrency, Bitcoin,Monetary Policy, The Halving, Block Frequency,Bitcoin Ecosystem, Bitcoin Network, Bitcoin Mining, Mining Pool, Mining Systems-CPU,GPU,FPGA and ASIC, Nonce range,Timestamp, Wallet, UTXOs,SegWit, Wallet Address, Bitcoin Network Payment and API, Bitcoin-core, bitcoind, bitcoin-cli, bitcoin-qt, Bitcoin Improvement Proposal (BIP)	1,2,3, 4	
	2.2	**Introduction to Ethereum:** Ethereum Technology Stack, Ethereum Characteristics, Types of Ethereum, Ethereum Virtual Machine (EVM) Ethereum Network, Nodes, Smart contract, Solidity, Consensus, Gas, Gas Price,Gas Limit, Out of Gas, Mining, DApps, EVM, ICOs, DAOs, DAO Attack, Forking, Hard and Soft Fork, Sharding, Ethereum 2.0, Enterprise use cases Alternative coins- Ethereum and Smart contracts Alternative coins- Ethereum continued, IOTA, Solana vs Ethereum Advantages and Drawbacks of ethereum, Smart Contract, Wallets for Ethereum, Solidity Smart Contracts - some attacks on smart contracts.	1,2,3, 4	
	2.3	**Non-Fungible Tokens (NFTs) and Decentralized Finance (DeFi):** Tokenization of Assets, Types of Tokens, Non-fungible Tokens(NFTs), Properties of NFTs, ERC20 and ERC721 Ethereum Standards, NFT Market Place Decentralized Finance Ecosystem, Traditional Finance vs DeFi, Building DeFi system, Concerns of DeFi, NFTs vs DeFi	1,2	

3	**3.1**	**Digital Ledger Technologies (DLT) and Hyperledger**		**06**
		Digital Ledger Technology(DLT), Hyperledger Project, IBM, Linux Foundation, HF Framework, Libraries, Tools, Business Critical Applications, Consortium, HF Architecture, HF Components, HFC Client, Fabric-CA, Membership Services, Endorser, Orderer, Commiter, Ledger, Chaincode, Notifications, Secure Channel, transaction flow-Life cycle, SOLO, Apache Kafka Hyperledger Fabric Network Setup, Hyperledger Composer – Application Development. Hyperledger Composer - Network Administration	2	
4	**4.1**	**Applications Blockchain Technology**		**06**
		Uses of Blockchain in E-Governance, Land Registration, Medical Information Systems, and smart cities, innovative industries, Cybersecurity, FinTech, Security Standards, and Compliances, European Union (EU) Data Privacy- Fundamental Right, Emergence Blockchain and Personal Data Privacy Act- GDPR	1,2,3, 4	
	Self Study	Smart-contract vulnerabilities Scaling the blockchain: payment channels and state channels Scaling the blockchain using optimism and using SNARK Privacy in the public blockchain	online resources	**04***
			Total (* Not included)	**28**

Laboratory Component, if any. (Minimum 10 Laboratory experiments are expected)

Sr. No.	Title of the Experiment
1	Cryptosystems - I
2	Cryptosystems - II
3	Merkle Tree and Genesis block
4	Ethereum Blockchain Setup
5	Smart contract-Solidity Programming Language (Remix IDE, Metamask Wallet, Truffle Suite)
6	Develop Blockchain applications for Cybersecurity (Two-Factor Authentication)
7	Building DApp for Auction- full stack development (Front-end, Back-end, Business Logic-Web3.0 and Blockchain)
8	Hypeledger fabric for Supply Chain Management (SCM)
9	Development of NFTs
10	Bitcoin
11	Development of the DeFi application
12	Multichain

Text Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Blockchain in Action	First Edition	Bina Ramamurthy	Manning Publications	2020
2	Mastering Blockchain	Third Edition	Imran Bashir	Packt Publications	2021
3	Building Ethereum Dapps	First Edition	Roberto Infante	Manning Publications	2019
4	Blockchain by Example	First Edition	Bellaj Badr Richard Horrocks	Packt Publications	2018

Reference Books:

Sr. No.	Title	Edition	Authors	Publisher	Year
1	Bitcoin and Cryptocurrency Technologies- A Comprehensive Introduction	First Edition	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller	Princeton University	2019
2.	Beginning Ethereum Smart Contracts Programming: With Examples in Python, Solidity, and JavaScript	First Edition	Wei-Meng Lee	Apress	2019