B-Tech (CSE) 4 years

Amity University Punjab, Mohali								
Amity School of Engineering and Technology								
Semester-Wise Programme structure for B. Tech (CSE) (Batch-2023) [4 year]								
Sr. No.	**Year 1**		**Year 2**		**Year 3**		**Year 4**	
	Semester 1	**Semester 2**	**Semester 3**	**Semester 4**	**Semester 5**	**Semester 6**	**Semester 7**	**Semester 8**
1	Engineering Physics (PHY118)[**CU : 5**, L-4, P-1] {BSC}	Basic Electrical Engineering (PHY110) [**CU: 5**, L-4, P-1] {ESC}	Data Structures and Algorithms [**CU:5**, L-3, P-2] {CC}	Discrete Mathematics [**CU: 4**, L-4] {BSC}	Database Management System [**CU:5**, L-3, P-2] {CC}	Compiler Design [**CU:4**, L-3, P-1] {CC}	Specialization Elective-III [**CU:4**, L-3, P-1] {SE}	Specialization Elective-V [**CU:4**, L-3, P-1] {SE}
2	Mathematics-I (MAT101)[**CU : 4**, L-4] {BSC}	Mathematics-II (MAT111) [**CU: 4**, L-4] {BSC}	Computer Organization and Architecture [**CU:3**, L-3] {CC}	Introduction to Cloud Computing [**CU:5**, L-4, P-1] {CC}	Formal Language and Automata Theory [**CU:3**, L-3] {CC}	Agile Software Development [**CU:4**, L-3, P-1] {CC}	Specialization Elective-IV [**CU:4**, L-3, P-1] {SE}	Open Elective-III [**CU:3**, L-3] {OE}
3	Programmimg for Problem Solving-I (CSE107) [**CU:5,** L-3, P-2] {ESC}	Object Oriented Programming Using C++ (CSE-104) [**CU:5**, L-3, P-2] {ESC}	Python Programming[**CU: 4**, L-3, P-1] {ESC}	Java Programming[**CU: 5**, L-3, P-2] {ESC}	Foundations of Artificial Intelligence [**CU:4**, L-3, P-1] {CC}	Design Thinking [**CU:3**, L-3] {CC}	Open Elective-II [**CU:3**, L-3] {OE}	Domain Elective-V [**CU:3**, L-3] {DE}

4	Engineering Design and Graphics [**CU:3,** DS-2, P-1] {ESC}	General Chemistry (CHE112) [**CU:4**, L-3, P-1] {BSC}	Computer Networks [**CU:4**, L-3, P-1] {CC}	Software Engineering [**CU:4**, L-3, P-1] {CC}	Specialization Elective-I [**CU:4**, L-3, P-1] {SE}	Specialization Elective-II [**CU:4**, L-3, P-1] {SE}	Domain Elective-III [**CU:3**, L-3] {DE}	Industrial Training [**CU:14**] {NTCC}
5	Understanding Self for Effectiveness (PSY101) [**CU:1,** L-1] {VAC}	Manufacturing Practices-I (CSE108) [**CU:3**, L-3] {ESC}	Probability and Statistics [**CU: 4**, L-4] {BSC}	Fundamentals of IOT and Blockchain [**CU: 4**, L-, P-1] {CC}	Introduction to Entrepreneurship [**CU:3**, L-3] {HUM}	Open Elective-I [**CU:3**, L-3] {OE}	Domain Elective-IV [**CU:3**, L-3] {DE}	
6	Communication Skills -I (ENG101) [**CU:1,** L-1] {VAC}	Communication Skills -II (ENG103) [**CU:1,** L-1] {VAC}	Operating Systems [**CU:4**, L-3, P-1] {CC}	Design and Analysis of Algorithms [**CU:4**, L-3, P-1] {CC}	Domain Elective-I [**CU:3**, L-3] {DE}	Domain Elective-II [**CU:3**, L-3] {DE}	Major Project [**CU:4**] {NTCC}	
7	Introduction to French Culture & Language (FOL101)/ Introduction to German Culture & Language (FOL102) [**CU:1,** L-1] {VAC}	Individual, Society and Nation (PSY106) [**CU:1,** L-1] {VAC}	IT Workshop [**CU:1**, P-1] {SEC}		Industrial Training [**CU:2**] {NTCC}	Minor Project [**CU:3**] {NTCC}	Industrial Training [**CU:3**] {NTCC}	

8	Environmental Studies 1 (ENV101) [**CU:2**, L-2] {AEC}	French Grammar (FOL-103)/German Grammar (FOL-104) [**CU:1**, L-1] {VAC}						
9	Principles of Economics for Engineers (ECN109) [CU:3, L-3] {HUC}	Environmental Studies 2 (ENV106) [**CU:2**, L-2] {AEC}						
Credits	**25**	**26**	**25**	**26**	**24**	**24**	**24**	**24**
Total Programme Credits								**198**

AC	**Allied Course**	**SEC**	**Skill Enhancement Course**
AEC	**Ability Enhancement Course**	**VAC**	**Value Added Course**
CC	**Core Course**	**HUC**	**Humanities Course**
GE	**General Elective**	**BSC**	**Basic Science Course**
OE	**Open Elective**	**ESC**	**Engineering Science Course**

SC	**Skill component**	**NTCC**	**Non Teaching Credit Course**
SE	**Specialization Elective Course**		

Proposed Model Framework

Sr. No.	Category	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Sem-VII	Sem-VIII	Total	AICTE MFW
1.	Basic Sciences	9	8	4	4	0	0	0	0	25	23
2.	Engg. Science	8	13	0	0	0	3	0	0	28	29
3.	Humanities	3	0	0	0	3	0	0	0	6	12 including English & Other VAC
4.	VAC (BS)	1	1	0	0	0	0	0	0	2	NA
5.	VAC (FOl)	1	1	0	0	0	0	0	0	2	NA
6.	VAC (CS)	1	1	0	0	0	0	0	0	2	NA (included above in Humanities)
7.	AECC (EVS)	2	2	0	0	0	0	0	0	4	Mandatory Course
8.	Core Courses	0	0	20	22	12	8	0	0	58	59
9.	Spl. Elective	0	0	0	0	4	4	8	4	20	18-20
10.	Domain Elective	0	0	0	0	3	3	6	3	15	18
11.	Open Elective	0	0	0	0	0	3	3	3	9	9
12.	NTCC	0	0	0	0	2	3	7	14	26	15
13.	SEC	0	0	1	0	0	0	0	0	1	
	TOTAL	**25**	**26**	**25**	**26**	**24**	**24**	**24**	**24**	**198**	

List of Specialization subjects

Specialization	Subject 1	Subject 2	Subject 3	Subject 4	Subject 5
AI & ML	**AI & ML**	Statistical Computing Techniques Using R	Machine Learning	Soft Computing	Natural Language Processing
Cloud Computing	**Cloud Computing**	Virtualization and Cloud Architecture	AI & ML on Cloud	Big Data on Cloud	Cloud Application Development & Deployment
Cyber Security	**Cyber Security**	Secure Communication and Cryptography	Web And Mobile Security	Cyber Forensics	Risk Analysis & Assessment
Data Science	**Data Science**	Statistical Computing Techniques Using R	Machine Learning	Fundamentals of Data Science and Analytics	Big Data Analytics
IOT & Block Chain	**IOT & Block Chain**	IOT Security	Introduction to Raspberry	IOT architecture	Blockchain Components

			Pi & Arduino	and its Protocols	and Architecture

Program Structure for B. Tech. CSE (Batch 2023)

Semester I

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L/DS*	**T**	**P**	
1		Engineering Physics -I (Semiconductor Physics)	Basic Science course	4	0	2	5
2		Mathematics-I	Basic Science course	4	0	0	4
3		Programming for Problem Solving-I	Engineering Science Course	3	0	4	5
4		Engineering Graphics & Design	Engineering Science Course	1*	0	4	3
5	PSY-101	Understanding Self for Effectiveness	Value Added Course (Behavioral Science)	1	0	0	1
6	FOL-101/FOL-102	Introduction to French Culture & Language/ Introduction to German Culture & Language	Value Added Course (Foreign Business Language)	1	0	0	1
7	ENG-101	Communication Skills-I	Value Added Course (Communication Skills)	1	0	0	1
8		Fundamentals of Economics for Engineers	Humanities Course	3	0	0	3
9	ENV-101	Environmental Sciences-I	AECC	2	0	0	2
		TOTAL		**20**	**0**	**10**	**25**
			Total Credits	**Min Required: 25**			

				Semester Credits: 25

Course Title: Engineering Physics

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
4	0	2	0	5

	Weightage	Teaching Hours
Unit I: Modern Physics	**25%**	**12 H**
Qualitative review of different experiments-Black body, Planck's Hypothesis, Photoelectric and Compton Effect. de-Broglie waves, Dual Nature of Matter, Matter waves, Significance of Wave Functions, Uncertainty principle, Schrodinger Wave Equation, Operators in Quantum Mechanics, Particle in a One-Dimensional Box, Application of a particle in a box (dimensional confinement)		
Unit II: Physics of Solids	**25%**	**11 H**
Types of solids, Crystal structure: Lattice points and space lattice, basis, unit cell, primitive cell, crystal systems, Bravais space lattice, diamond structure, Electrical conduction in solids**:** band theory of solids, distinction between metals, semiconductors and insulators, Semiconductors: intrinsic and extrinsic semiconductors, Density of states, Occupation probability, Fermi level, Effective mass, Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky)		
Unit III: Measurements	**25%**	**12 H**
Four-point probe and van der Pauw measurements for carrier density, resistivity, and hall mobility; Hot-point probe measurement, capacitance-voltage measurements, parameter extraction from diode I-V characteristics, DLTS, band gap by UV-Vis absorption and Emission properties of semiconductors.		
Unit IV: Light semiconductor interactions	**25%**	**11 H**
Coherent Sources, Interference, Newton's rings, Diffraction: Fresnel and Fraunhofer diffraction, Fraunhofer diffraction at a Single Slit, Plane Transmission grating, Induced Absorption, Spontaneous and Stimulated Emission, Einstein Coefficients, Population inversion, Concept of three and four level Lasers, semiconductor laser (construction and working), photovoltaic effect and LEDs.		

List of Experiments (Total:60 Hours)

1. To determine the dispersive power of a given prism
2. To measure the angle of prism with the help of a spectrometer
3. To determine the wavelength of the given laser source using standard grating
4. Experimental Determination of Planck's constant using Light Emitting Diodes (LEDs) and Photoelectric Effect
5. To determine the wavelength of sodium light by Newton's ring experiment
6. To plot the characteristics curves of a p-n junction diode and calculate its resistance
7. To determine percentage of transmission of light for a semi-transparent film using Lummer Brodhum photometer
8. To determine Hall Potential and Hall Coefficient.
9. To measure resistivity of a semiconductor by Four Probe method at different temperatures and determine the Band-gap
10. To study the characteristics of LED and Laser diodes.

Course Learning Outcomes: After studying this course students will be able to:

1. Get familiar about the basics of quantum mechanics to understand the band theory of solids
2. To understand the physics of crystalline solids specifically aiming to semiconductor structures like silicon and germanium
3. To familiarize students about basic semiconducting devices such as p-n junction and related such as solar cells, LED' and their theoretical aspects
4. To understand the measurement equipment to measure conductivity, carrier concentration and band gap in semiconductor
5. To Learn the various physical aspects on the light semiconductor interactions like interference, diffraction, absorption and emission and related applications

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
J. Singh	Semiconductor Optoelectronics: Physics and Technology	McGraw-Hill Inc.	1995	978-0071135771
B. E. A. Saleh and M. C. Teich	Fundamentals of Photonics	John Wiley & Sons, Inc.	2007	9780471839651
S. M. Sze	Semiconductor Devices: Physics and Technology	Wiley	2008	978-0470537947
A. Yariv and P. Yeh	Photonics: Optical Electronics in Modern Communications	Oxford University Press, New York	2007	978-0195179460
P. Bhattacharya	Semiconductor Optoelectronic Devices	Prentice Hall of India	1997	978-0134956565

Course Title: Mathematics-I

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
4	0	0	0	4

		Teaching Hours
Module I : Matrix Algebra	**Weightage**	**15 H**

• Elementary operations • Reduction of matrices to row echelon form • Rank of matrix, Rank of a matrix by Echelon form and Normal form • System of Linear Equations (Homogeneous and Non-homogeneous) • Consistency of system linear equations using Rank • Solution of system of linear equations by Gauss Elimination method and Gauss-Jordan method • Cayley-Hamilton theorem (without proof) Application of Cayley-Hamilton for finding inverse and power of matrix	**25%**	
Module II: Differential Calculus		**15 H**
• Function with two or more variable, Limit, continuity and Partial differentiation • Euler's theorem for homogeneous functions • Maxima and Minima of two variable, Method of Lagrange's multiplier Taylor's series and Maclaurin's series for function with one and two variables	**25%**	
Module III: Integral calculus		**15 H**
• Definite integral: Area of plane region and length of plane curve • Double Integral, change of order of integration • Triple integral • Application to area and volume using double and triple integral	**25%**	
Module IV Vector Calculus		**15 H**
• Scalar and vector fields • Gradient, Directional derivative, Divergence, Curl and their properties • Line integral • Green's theorem in plane (without proof) • Surface integral • Stokes' theorem (without proof) • Volume Integral Gauss-Divergence theorem (without proof)	**25%**	

Course Learning Outcomes: After studying this course students will be able to:

1. Recognize, identify, differentiate and describe the problems like they can classify rows and columns and then to apply different transformations and explain the solutions of system of equations
2. Analyze and find solution of systems of equations, partial derivatives, maxima and minima of two variables and expand the functions using Taylor's series
3. Understand and calculate single, double and triple integrals and apply knowledge to find area, volume etc.
4. Analyze line integral, surface integral and volume integral and some important theorems of vector calculus.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir	Thomas' Calculus (14th edition)	Pearson Education	2018	978-9353060411
James Stewart	Multivariable Calculus (8th edition)	Cengage	2015	978-1305266643
Erwin Kreyszig	Advanced Engineering Mathematics (10th Edition)	Wiley		9781119455929, 978-8126554232
Bernard Kolman & David R Hill	Elementary Linear Algebra with Applications	Pearson Education, New Jersey		978-0130182654
N.P.Bali	A textbook of Engineering Mathematics	Laxmi publications	2009	978-8131808320
B.S. Grewal	Engineering Mathematics	Khanna Publishers	2014	978-8193328491
H.K. Dass	Higher Engineering Mathematics	S. Chand	2014	978-8121938907

Course Title: Programming for Problem Solving- I

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	4	0	5

	Total Teaching Hours
Unit I: Introduction to computer and programming	**15 H**
Introduction, Basic block diagram and functions of various components of computer, Concepts of Hardware and software, Types of software, Compiler and interpreter, Concepts of Machine level, Assembly level and high-level programming, Flowcharts and Algorithms	
Unit II: Fundamentals & Structure of C	**15 H**
Features of C language, structure of C Program, comments, header files, data types, constants and variables, operators, expressions, evaluation of expressions, type conversion, precedence and associativity, I/O functions	
Unit III: Array, String & Functions	**15 H**
Concepts of array, one- and two-dimensional arrays, declaration and initialization of arrays, string, string storage, Built-in string functions, Concepts of user defined functions, prototypes, definition of function, parameters, parameter passing, calling a function, recursive function, Macros, Pre-processing	
Unit IV: Pointers	**15 H**
Basics of pointers, pointer to pointer, pointer and array, pointer to array, array to pointer, function returning pointer. Basics of structure, structure members, accessing structure members, nested structures, array of structures, structure and functions, structures and pointers	

Lab/ Practical details, if applicable: (Total: 60 Hours)

Objective: The laboratory exercises in this section have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out hands on experience in programming

1) Write a program to that performs as calculator (addition, multiplication, division, subtraction).
2) Write a program to find area of triangle(a=h*b*.5) a = area h = height b = base
3) Write a program to calculate simple interest (i = (p*r*n)/100) i = Simple interest p = Principal amount r = Rate of interest n = Number of years
4) Write a C program to interchange two numbers.
5) Write a C program to enter a distance in to kilometre and convert it in to meter, feet, inches and centimetre
6) Write a program to compute Fahrenheit from centigrade (f=1.8*c +32)
7) Write a C program to find out distance travelled by the equation d = ut + at^2
8) Write a C program to find that the accepted number is Negative, or Positive or Zero.
9) Write a program to read marks of a student from keyboard whether the student is pass or fail (using if else)
10) Write a program to read three numbers from keyboard and find out maximum out of these three. (nested if else)
11) Write a C program to check whether the entered character is capital, small letter, digit or any special character.
12) Write a C program to read no 1 to 7 and print relatively day Sunday to Saturday.
13) Write a C program to find out the Maximum and Minimum number from given 10 numbers
14) Write a C program to input an integer number and check the last digit of number is even or odd.
15) Write a C program to find factorial of a given number.
16) Write a program to reverse a number.
17) Write a program to generate first n number of Fibonacci series
18) Write a program to find out sum of first and last digit of a given number.
19) Write a C program to find the sum and average of different numbers which are accepted by user as many as user wants
20) Write a program to calculate average and total of 5 students for 3 subjects (use nested for loops)
21) Read five persons height and weight and count the number of person having height greater than 170 and weight less than 50, 24. Write a program to check whether the given number is prime or not.
22) Write a program to evaluate the series 1^2+2^2+3^2+……+n^2
23) Write a C program to find 1+1/2+1/3+1/4+....+1/n.
24) Write a C program to find 1+1/2!+1/3!+1/4!+.....+1/n!.
25) Write a program to evaluate the series sum=1-x+x^2/2!-x^3/3!+x^4/4!.....-x^9/9!

Course Learning Outcomes:

1. Formulate algorithm/flowchart for given arithmetic and logical problem
2. Translate algorithm/flowchart into C program using correct syntax and execute it
3. Write programs using conditional, branching, iteration, and recursion
4. Decompose a problem into function
5. Develop an application using the concepts of array, pointer, structure, and file management to solve engineering and/or scientific problems

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Pradip Dey, Manas Ghosh	Fundamentals of Computing and Programming in C	Oxford University Press	2009	978-0198084563
Gottfried	Programming with C	Tata McGraw-Hill Publishing Company Limited	2nd edition, 2005	978-0070593695
Kernighan B W and Ritchie D M	C Programming language, Second edition	Prentice Hall	2nd edition, 1988	978-0131103627
R.G. Dromey	How to Solve it by Computer	Pearson Education	Fourth Reprint, 2007	978-8131705629

Course Title: Engineering Graphics and Design

Course Level: UG (B. Tech. Computer Science)

L/DS*	T	P/S	SW/FW	TOTAL CREDIT UNITS
1*	0	4	0	3

Course Contents/Syllabus:

	Teaching Hours
Unit I: Introduction to Engineering Drawing and Computer Aided Drawing	**08 H**
Drawing instruments and accessories, Types of lines and lettering. Use of Plain Scales, Diagonal Scales and Representative Fraction. **AutoCAD LT**:: Introduction to AutoCAD, Basic commands for 2D drawing like: Line, Circle, Polyline and Rectangle	
Unit II: Projections of Points and Lines	**10 H**
Introduction to Projections of the points located in Ist quadrant. Projections of line with its inclination to a reference plane. True length and inclination with the reference planes. **AutoCAD LT**: Basic commands draw lines and shapes in 2D. Basic Text annotating and dimensioning style	
Unit III: Projections of Planes, Solids	**06 H**
Projections of planes (polygons, circle and ellipse) with its inclination to a reference plane Projection of regular rectilinear and circular solids (prisms, pyramids. cones, cylinders, spheres etc.) in Ist Quarter **AutoCAD LT**: Commands on 2D drafting and modify tools like copy, paste, stretch, offset, move, chamfer, fillet, extend, trim. Develop and draw plans of objects in 2D.	
Unit IV: Sections of Solids and Surface Development and Orthographic projections in AutoCAD.	**12 H**
Section of solids and Development of surfaces: Simple Geometrical Solids e.g. Cube, Cuboids, Cone, Cylinder, Pyramid, Prism etc. Interpenetration of Solids. **AutoCAD LT**: Develop and draw projections of objects in elevations and sections through 2D CAD. Basic rendering in the AutoCad LT. Manipulate, alter and present existing drawings in 2D CAD through various tools and techniques of rendering.	

Course Learning Outcomes:

At the end of the course, the students will be able to:

1. Know and understand the conventions and the methods of engineering drawing.
2. Identify and develop understanding of interrelationship between 2D and 3D form of simple object, with the help of orthographic Projections
3. Analyse basic geometry and comprehend the theory of projection
4. Build and Create models of simple built form with computer software for engineering drawing.

Lab/ Practical details: (Total Hours: 60)

Objective*:* The laboratory exercises in this section have been so designed that the students learn to adapt to technology.

They must prepare portfolio of drawing sheets on the following topics

1. Practice sheet (which includes dimensioning methods, different types of line, construction of different polygon, divide the line and angle in parts, use of stencil)
2. Plane scale and diagonal scale
3. Projection of line
4. Orthographic Projection of planes
5. Orthographic Projection of solids, section of solids and development of surfaces
6. In addition, experiments /exercises will be performed on AutoCAD also.
7. At least one orthographic drawing on Computer using AutoCAD commands.

Text / Reference Books:

Author	Title	Publisher	Year of publication	ISBN
Bhatt, N. D.	Engineering Drawing; Plane and Solid Geometry.	Charotar Publishing House Pvt. Limited.	2010	978-9380358178
Dhawan R K	Fundamentals of Engineering Drawing	S Chand	2014	978-1219392623

COURSE CODE: PSY101 (Understanding Self for Effectiveness)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Total Teaching Hours
Unit I: Self: Core Competency	**4.5 h**
Understanding of Self, Components of Self – Self identity , Self concept, Self confidence , Self image , BIG5 Factors	
Unit II: Techniques of Self Awareness	**4.5 h**
Exploration through Johari Window, Mapping the key characteristics of self, Framing a charter for self Stages – self awareness, self acceptance and self realization	

Unit III: Self Esteem & Effectiveness	4.5 h
Meaning, Importance, Components of self esteem, High and low self esteem, Measuring your self esteem	
Unit IV: Building Positive Attitude and Emotional Competence	**4.5 h**
Meaning and nature of attitude, Components and Types of attitude ,Importance and relevance of attitude Emotional Intelligence – Meaning, components, Importance and Relevance Positive and negative emotions, Healthy and Unhealthy expression of emotions	

Course Learning Outcomes: At the end of this course, the students will be able to:

1. The student will apply self-introspection as a tool for self-awareness.
2. The student will understand self-concept for self-recognition, self-improvement and perception of others.
3. The student will be able to analyze their physical self, social self, the competent self and psychological self.
4. The student will be able to analyze what motivates his/her actions and the actions of others

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Singh A.	Achieving Behavioural Excellence for Success	Wiley Publication	2012	9788126580027
Towers, Marc	Self Esteem	American Media	1995	9781884926297
Pedler Mike, Burgoyne John, Boydell Tom	A Manager's Guide to Self-Development	McGraw-Hill	2006	978-0077114701
Covey, R. Stephen	Seven habits of Highly Effective People	Simon & Schuster Ltd	2013	978-1451639612
Khera Shiv	You Can Win	Macmillan	2005	978-0333937402
Gegax Tom	Winning in the Game of Life	Harmony Books	1999	978-0609603925
Singh, Dalip	Emotional Intelligence at Work	Publications	2006	9780761935322
Goleman, Daniel	Emotional Intelligence	Bantam Books	2007	9780553095036
Goleman, Daniel	Working with E.I	Bantam Books	1998	9780553104622

COURSE CODE: FOL101 (Introduction to French Culture & Language)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Total Teaching hours

Unit-I Introduction to French language	**3 h**
• Brief introduction of French and Francophone countries • Presenting oneself • Getting information about someone else • Greeting and taking leave • Asking/giving personal information	
Unit-II- A rendez-vous ; Visiting a place	**6 h**
• Pronouncing and writing numbers in French • Spell and count numbers • Telling the time • Temporal expressions • Communicating in class • Fixing an hour, place for a meeting. • Describing a person. • Identifying a person, object and place • Describing relation in a family • A specific person, object and place	
Unit-III- An interview	**4.5 h**
• Description of objects, people and places • Nationalities • Speaking about one's professions • Expressing Actions using regular –er ending verbs; avoir, être; reflexive verbs – usage, conjuagation • Interview of celebrity	
Unit-IV- At the discotheque	**4.5 h**
• Portrait by a journalist • Giving a positive or negative reply • Asking questions • Discussion with a person • Activities in a day	

Course Learning Outcomes: At the end of this course, the students will be able to express themselves in writing and orally in basic French. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to :

1. Understand information; Express in his own words; Paraphrase; Interpret and translate.
2. Apply information in a new way in a practical context
3. Analyse and break-down information to create new ideas
4. Evaluate and express opinion in a given context

Text / Reference Books:

Author	Title	Publisher	Year	ISBN No
Christine Andant, Chaterine Metton, Annabelle Nachon, Fabienne Nugue	A Propos - A1 Livre De L'Eleve, Cahier D' Exercices	Langers International Private Limited	2010	978-9380809069

Manjiri Khandekar and Roopa Luktuke	Jumelage - 1 Methode De Fraincais - French	Langers International Private Limited	2020	978-9380809854
Michael Magne, Marie-Laure Lions-Olivieri	Version Originale 1: Cahier d'exercices	Maison Des Langues	2010	978-8484435617

COURSE CODE: FOL102 (Introduction to German Culture & Language)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Total Teaching hours
Unit-I Introduction to German Language (Einführung)	**3 h**
• Introduction to German as a global language, Self-introduction and Greetings, Die Alphabeten, Phonetics: the sound of consonants and vowels, Wie buchstabieren Sie Ihren Name?	
Unit-II- Numbers and everyday conversation (die Zahl und Gespräche)	**6 h**
• Counting in German from 1-100, Simple Calculation and verb 'kosten' - Wie viel kostet das? Plural Forms, Vocabulary: Wochentage, Monate, Jahreszeiten, Ordinal numbers and the question - Wann haben Sie Geburtstag?	
Unit-III- Regular verbs and nominative case: articles and pronouns (Regelmässige Verben und Nominativ Kasus: Artikel und Pronomen)	**4.5 h**
• Introduction to all personal pronouns and conjugation of Regular verbs Detailed exercise on regular verbs. Reading a text on regular verbs. Introduction to definite. Vocabulary: Schulsachen und Getränke, Nominative case/ Articles (der, die, das) Nominative Pronouns: - Applicability of pronouns for both persons and things. Usage of nominative Personal Pronouns Introduction of nominative possessive pronouns usage of nominative possessive pronouns	
Unit-IV- The Family, Work-life and Professions (Familienmitglieder und Berufe) & Interrogative sentences (W-Fragen)	**4.5 h**
The Family, Work-life and Professions (Familienmitglieder und Berufe) • Vocabulary: Professions and conjugation of the verb 'sein' Introduction to simple possessive pronouns with the help of the verb ‘haben’ Usage of possessive pronouns. Interrogative sentences (W-Fragen) W-Fragen: who, what, where, when, which, how, how many, how much, etc. Exercises on the question pronouns	

Course Learning Outcomes: At the end of this course, the students will be able to express themselves in writing and orally in basic German. This course content focuses on the speech of the students in a lucid and a concurrent manner using appropriate vocabulary and pronunciation techniques. Extra stress will be given on their understanding of grammatical structures and the foreign accent of the language. At the end of the course, the student shall be able to:

1. Understand information; Express in his own words; Paraphrase; Interpret and translate.
2. Apply information in a new way in a practical context

3. Analyse and break-down information to create new ideas
4. Evaluate and express opinion in a given context

Text / Reference Books:

Author	Title	Publisher	Year	ISBN
Rolf Bruseke	Starten Wir A 1	Langers International Pvt Ltd (Max Hueber Verlag)	2017	978-3190160006
Giorgio Motta	Wir Plus Grundkurs Deutsch fur Junge Lerner Book	Ernst Klelt Verlog	2011	978-8183072120
Heimy Taylor, Werner Haas	Station en Deutsch Self Study Course German Guide	Wiley	2007	978-0470165515

COURSE CODE: ENG101 (Communication Skills-I)

L	T	P	Total Credits
1	0	0	1

Course Contents/syllabus:

	Total Teaching hours
Unit I: Basic Concepts in Communication	3.5 h
Definition of communication, Nature and process of communication, role and purpose of communication, types and channels of communication, communication networks/flow of communication: vertical, diagonal, horizontal, barriers to communication: physical, language, and semantic, socio-psychological, organizational, gateway to effective communication, towards communicative competence, choosing the appropriate channel and medium of communication, social communication: small talk and building rapport, barriers in communication.	
Unit II: Communication Types	5.5 h
Verbal communication: Oral Communication: Forms, Advantages & Disadvantages, Written Communication: Forms, Advantages & Disadvantages, Introduction of Communication Skills (Listening, Speaking, Reading, Writing), Nonverbal communication: functions and effective use, KOPPACT(Kinesics, Oculesics, Proxemics, Para-language, Artifacts, Chronemics, Tactilics). The implication of appropriate communication; effective ways of using social media, importance of digital literacy.	
Unit III: Reading and Writing Skills	3 h
Significance of reading; Reading Comprehension, gathering ideas from a given text, identify the main purpose and context of the text, evaluating the ideas, interpretation of the text, Paragraph development; essay writing.	
Unit IV: Speaking and Presentation Skills	6 h

Speaking skills: fluency, vocabulary, grammar, and pronunciation; effective speaking: selection of words, your voice, and non-verbal communication, functions of speaking: interaction, transaction, and performance; structuring the message; effective speaking strategies. Planning, preparation, practice, and performance; audience analysis, audio-visual aids, analyzing the non-verbal communication, methods of delivery: impromptu, extemporaneous, memorization, manuscript, and outlining.	

Course Learning Outcomes:

1. Students will be able to understand the basic processes of communication, both verbal as well as non-verbal—nature, scope, and power of communication processes.
2. Students will be able to demonstrate cultural sensitivity in communication and appreciation of cultural variations of diverse socio-cultural contexts.
3. Students will be able to develop an awareness of the role of mass media in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
4. Students will be able to analyze situations and audiences to make right choices about the most effective and efficient ways to communicate and deliver messages.
5. Students will be able to assess various barriers in communication and develop communicative competence thereby for effective communication.

Books/literature

AUTHOR	TITLE	Publisher	Year of publication	ISBN
P. D. Chaturvedi and Mukesh Chaturvedi	Business Communication: Concepts, Cases and Applications	Pearson Education	2006	9788131701720
Meenakshi Raman and Prakash Singh	Business Communication	Oxford University Press	2012	9780198077053
Jeff Butterfield	Soft Skills for Everyone	Cengage Learning	2017	9789353501051

Course Title: Principles of Economics for Engineers

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction to Economics		**13 H**
Nature and definition of Economics, Basic problems of Economics, Economics as a positive science. Relationship of Economics with other social sciences and Computer engineering. Production possibility Curve		
Unit II: Concept of Demand and Supply		**13 H**

Demand, its types, its determinants, elasticity of demand, how the concept is used in decision making. Supply and its determinants, elasticity of supply. Utility analysis: cardinal and ordinal utility analysis. Laws of utility. Consumer equilibrium in cardinal approach and ordinal approach, Indifference curves and its properties.		
Unit III: Economic behavior of firms		**13 H**
Production function, law of variable proportion, law of returns to scale, Concepts of Isoquants, Marginal rate of Technical Substitution, producer equilibrium by using isoquants. Cost concepts and its classification, short run and long run cost theories. Relationship between Marginal cost and average cost		
Unit IV: Markets and introduction to Macro economics		**13 H**
Different market structure, perfect competition, monopoly, Monopolistic, Oligopoly, and duopoly market structure. Break even analysis. Circular flow of income, national income concepts, inflation, unemployment, Consumption: Keynesian consumption function.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand and analyze how society manages its scarce resources for achieving maximum utility
2. To make familiar with various economic concepts and tools to analyze economic problems and enable the students how to use in decision making process.
3. Learn about how an economic agent behaves as a consumer and as a producer.
4. Understand the different forms of markets in an economy and expose to basic concepts in macroeconomics

Text / Reference Books:

Author	Title	Publisher	Year of Publication	ISBN
Ahuja H. L	Modern Economics	S. Chand & Co.Ltd	2016	935-2531469
Ahuja H. L	Business Economics	S. Chand & Co.Ltd	2018	978-9352533312
Dornbusch, R., Fischer, S., Startz, R	Macroeconomics, 12th ed	McGraw-Hill	2018	978-0073375922
Mankiw, N	Macroeconomics	Worth Publishers	2016	978-9386668424
Mankiw, N	Principles of Economics	Cengage Learning	2000	978-0030270178

COURSE CODE: (Environmental Studies-I)

L	T	P	Total Credits
2	0	0	2

Course Contents/syllabus:

	Teaching hours
Unit-1- Multidisciplinary nature of environmental studies	**9 h**

Multidisciplinary nature of environmental studies: Definition, scope and importance; components of environment –atmosphere, hydrosphere, lithosphere and biosphere. Concept of sustainability and sustainable development.	
Unit-2-Ecosystems	**9 h**
Ecosystem: What is an ecosystem; Structure and function of an ecosystem; Energy flow in the ecosystem; Food chains, food webs and ecological succession. Case studies of the following ecosystems: Forest ecosystem, Grassland ecosystem, Desert ecosystem Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).	
Unit-3- Natural Resources	**9 h**
Natural resources: Land resources and land use change, land degradation, soil erosion and desertification. Deforestation: causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal population. Water Resources-Use and over-exploitation of surface and groundwater, floods, drought, conflicts over water (international and inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources- renewable and non-renewable energy sources, use of alternate energy sources, Growing energy needs, Case studies.	
Unit-4- Biodiversity and its conservation	**9 h**
Biodiversity: Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; biodiversity patterns and global biodiversity hot spots. India as a mega–biodiversity nation; endangered and endemic species of India. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions; conservation of biodiversity: in-situ and ex-situ conservation of biodiversity. Ecosystem and biodiversity services: ecological, economic, social, ethical, aesthetic and information value.	

Course Learning Outcomes: At the end of this course, the students will be able to develop:

1. Appreciate the multi-disciplinary nature of environmental science
2. Understand natural resources and evaluate limitations surrounding renewable and non-renewable resources
3. Understand the nuances of ecosystem and learn about behaviour of various ecosystem
4. Learn about the types, services and threats to our biodiversity and importance of conserving it.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
William P. Cunningham, Mary Ann Cunningham	Principles of Environmental Science	McGraw-Hill	2019	9781260219715
Dash and Dash	Fundamentals of ecology	Tata McGraw-Hill Education	2009	978-0070083660
William P. Cunningham, Mary Ann Cunningham, Barbara Woodworth Saigo	Environmental Science: A global concern,	McGraw-Hill	2021	9781260363821
Gaston K.J. and Spicer, J. I.	Biodiversity – An Introduction 2nd edition	Blackwell Publishing	2004	978-1-405-11857-6

Program Structure for B. Tech. CSE

Semester II

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	**T**	**P**	
1		Basic Electrical Engineering	Engineering Science course	4	0	2	5
2		Mathematics-II	Basic Science course	4	0	0	4
3	CSE-104	Object Oriented Programming using C++	Engineering Science Course	3	0	4	5
4		General Chemistry-I	Basic Science course	3	0	2	4
5		Manufacturing Practices-I	Engineering Science Course	3	0	0	3
6	ENG-103	Communication Skills-II	Value Added Course (Communication Skills)	1	0	0	1
7	PSY-106	Individual, Society and Nation	Value Added Course (Behavioral Science)	1	0	0	1
8	FOL-103/FOL-104	French Grammar/ German Grammar	Value Added Course (Foreign Business Language)	1	0	0	1
		TOTAL		**20**	**0**	**08**	**24**
			Total Credits	**Min Required: 24** **Semester Credits: 24**			

Course Title: Basic Electrical Engineering

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
4	**0**	**2**	**0**	**5**

	Weightage	Teaching Hours
Unit I: DC circuits and Networks	**25%**	**18 H**
Introduction to electrical circuit elements (R, C and L), Ohm's law, series and parallel combination of resistance, capacitance and inductance, Kirchhoff's current and voltage law, voltage, and current sources (ideal and practical), concept of open and short, Network theorems: Thevenin, Norton and Maximum power transfer theorem, Transient analysis in DC circuits: first order RC and RL circuit		
Unit II: Alternating circuits	**25%**	**18 H**
Generation of alternating voltages and currents, Peak, Average and RMS values for alternating currents, Form and Peak factor, Power calculation, Reactive power, Active power, Complex power, Power factor, Ac through resistance, capacitance and inductance and LCR circuit, impedance, reactance, conductance, susceptance Series and Parallel circuits, Resonance: series Resonance, basic definition of Q factor & Band-width., Power in choking coil.		
Unit III: Magnetism and electromagnetism	**25%**	**18 H**
Elementary electrostatics, Magnetic Effect of Electric Current (wire and coil), Electromagnetic fields, Magnetic field due to electric current (straight wire and coil), Force on Current-carrying Conductor Placed in a Magnetic Field, Ampere's Circuital Law, Biot-Savart Law, torque experienced by a coil, introduction to magnetic circuits: Magnetomotive force (m.m.f.), Reluctance, Permeance, theory of magnetic circuits, Electromagnetic induction, self and mutual inductance		
Unit IV: Materials for Electrical engineering and devices	**25%**	**18 H**
Elementary concepts of materials, Dielectric Properties of Insulators in Static and Alternating field, Magnetic Properties and Superconductivity, Semiconductor Materials, transformer, concepts of Electrical machines: DC and AC machines		

List of Experiments (Total:60 Hours)

1. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
2. To study C.R.O. as display and measuring device by recording sines and square waves, output from a rectifier, verification (qualitative) of law of electromagnetic induction and frequency of A.C. mains.
3. To plot the Lissajous figures and determine the phase angle by C.R.O
4. To determine self inductance of a coil by Anderson's bridge
5. To determine the mutual inductance of two coils by Absolute method.
6. To determine an unknown Low Resistance using Potentiometer
7. To verify the Thevenin and Norton theorems. In digital meters
8. To verify the Superposition, and Maximum power transfer theorems
9. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency,(b) Impedance is not available at resonance, (c) Quality factor Q, and (d) Band width.
10. To determine the frequency of A.C. mains using sonometer
11. To study B-H curves for different ferromagnetic materials using C.R.O. w/o CRO

Course Learning Outcomes: After studying this course students will be able to:

1. Develop an ability to apply fundamental and advance knowledge of mathematics, science and engineering to solve and analyze the electrical and magnetic circuits
2. To understand the fundamentals and applications of Alternative currents
3. Learn the concepts of electromagnetism

4. Apply electrical and magnetic circuits in different types of machines, along with concepts of superconductivity

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
V.K Mehta and Rohit Mehta	Basic Electrical Engineering	S.Chand publication	2006	978-8121908719
D. P. Kothari and I. J. Nagrath	Basic Electrical Engineering: 4th edition	Tata McGraw Hill	2010	978-9353165727
D. C. Kulshreshtha	Basic Electrical Engineering:2nd edition	McGraw Hill	2009	978-9353167219
L. S. Bobrow	Fundamentals of Electrical Engineering	Oxford University Press	2011	978-0195105094
E. Hughes	Electrical and Electronics Technology	Pearson	2010	978-8131733660
V. D. Toro	Electrical Engineering Fundamental: 2nd edition	Prentice Hall India	2015	978-9332551763
V.N Mittle and Arvind Mittle	Basic Electrical Engineering: 2nd edition	TMG publication	2017	978-0070593572

Course Title: Mathematics-II

Course Level: UG (B. Tech. Computer Science)

Course Code:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
4	0	0	0	4

Course Objectives:

The knowledge of Mathematics is necessary for a better understanding of almost all the Engineering and Science subjects. By the end of the semester, students will be able to analyze techniques to solve differential equations, complex analysis problems and Laplace transform which can be further applied to solve practical engineering problems in fluid dynamics, mechanics and modelling of simple electrical circuits etc.

Prerequisites:

Students must have a background of Differential Calculus, Integral Calculus, and Complex numbers.

Course Contents/Syllabus:

	Teaching Hours
Module I: Ordinary Differential Equations	**15 H**

• Overview of solution of ordinary Differential Equations of First Order and first degree • Exact Differential Equations, equations reducible to exact differential equation • Linear Differential Equations of Higher Order and their solutions, Particular Integrals • Euler Cauchy Equation • Legendre's Linear Equation • Simultaneous linear equations with constant coefficient	
Module II: Laplace Transform	**15 H**
• Existence of Laplace transform • First shifting theorems • Change of scale property • Laplace transform of derivative and integrals • Multiplication by t^n, division by t • Evaluation by integrals using Laplace transform • Inverse Laplace transform • Convolution theorem • Laplace transform of periodic functions • Heaviside function unit step function formula • Unit impulse functions • Second shifting theorems • Solution of initial value problem by Laplace transform	
Module III: Functions of Complex Variables	**15 H**
• De Movier's Theorem and Roots of Complex Numbers • Logarithmic Functions • Functions of a Complex Variables • Limits, Continuity and Differentiability • Analytic Function, Necessary and sufficient condition for function to be analytic (without proof) • Cauchy-Riemann Equations • Harmonic Conjugate	
Module IV: Complex Integration	**15 H**
• Complex Line Integrals • Real Line Integrals • Connection between Real and Complex Line Integrals • Cauchy Integral Theorem (without proof) • Cauchy Integral Formula (without proof) • Power Series, Taylor Series, Laurent Series • Zeroes and Singularities • Residues, Cauchy Residue Theorem (without proof)	

Course Learning Outcomes:

At the end of the course, the students will be able to

1. Analyze and solve first second and higher order ordinary differential equations using different analytical and numerical methods.
2. Learn Laplace Transform and its application.
3. Understand the concept of analyticity using Cauchy Riemann Equations and analyze harmonic function and its conjugate.
4. Evaluate complex contour integral by applying Cauchy Integral Theorem and Cauchy Integral Formula and understand to classify singularities and poles and find residue.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
George B. Thomas Jr., Joel Hass, Christopher Heil & Maurice D. Weir	Thomas' Calculus (14th edition)	Pearson Education	2018	978-9353060411
James Stewart	Multivariable Calculus (8^{th} edition)	Cengage	2015	978-1305266643
Erwin Kreyszig	Advanced Engineering Mathematics (10^{th} Edition)	Wiley		9781119455929, 978-8126554232
Bernard Kolman & David R Hill	Elementary Linear Algebra with Applications	Pearson Education, New Jersey	2019	978-0130182654
Ruel Churchill,	Complex Variables and Applications	McGraw Hill Education India	2013	978-9339205157
R.K Jain and S.R.K Iyenger	Advanced Engineering Mathematics	Narosa Publishing House Pvt.,	2016	978-8184875607
N.P.Bali	A textbook of Engineering Mathematics	Laxmi publications	2009	978-8131808320
B.S. Grewal	Engineering Mathematics	Khanna Publishers	2014	978-8193328491
H.K. Dass	Higher Engineering Mathematics	S. Chand	2014	978-8121938907

Course Title: Object Oriented Programming using C ++ (CSE-107)

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	4	0	5

Course Contents/syllabus:

	Teaching Hours
Unit I: Objects and classes	**12 H**

Introduction to OOP, C vs C++, Encapsulation and aabstraction, Class definition, Class structure, Objects, Passing and returning objects as arguments, Static data member, array of objects, member functions, Inline functions.	
Unit II: Constructors, Destructors and Overloading	**11 H**
Constructors, Destructors, Dynamic creation and destruction of objects Array of objects, this pointer, Friend function, Operator overloading: Unary, Binary operators.	
Unit III: Inheritance	**11 H**
Inheritance, Base class and derived class, Public, private and protected inheritance, Single, Multiple, Multilevel, Hybrid inheritance.	
Unit IV: Polymorphism, Exceptions and Templates	**11 H**
Polymorphism, Compile Time and run Time, static and dynamic binding, virtual functions, pure virtual functions, Exception handling, Templates.	

Lab/ Practical details:

List of Experiments -with basic instructions (Total: 60 Hours)

Objective*:* The aim of this section of Lab is to teach experiments of object-oriented programming using C++ pertaining to the units being taught in the theory paper specifically related to classes, objects, inheritance and overloading.

1. WAP in C++ to find the sum of individual digits of a positive integer.
2. WAP in C++ to generate the first n terms of the sequence
3. WAP to find both the largest and smallest number in a list of integers.
4. WAP to illustrate New and Delete Keywords for dynamic memory allocation
5. WAP Illustrating Class Declarations, Definition, and Accessing Class Members.
6. WAP to illustrate default constructor, parameterized constructor and copy constructors
7. WAP to Implement a Class STUDENT with appropriate member functions and variables.
8. WAP to demonstrate the i) Operator Overloading. ii) Function Overloading.
9. WAP to demonstrate Friend Function
10. WAP to access Members of a STUDENT Class Using Pointer to Object Members.
11. Write C++ programs that illustrate how the following forms of inheritance are supported: a) Single inheritance b) Multiple inheritance c) Multi level inheritance
12. WAP containing a Possible Exception. Use a Try Block to Throw it and a Catch Block to Handle it Properly.

Course Learning Outcomes:

1. The student is expected to get familiar about concepts of object-oriented programming.
2. To understand the use of classes and objects and implement the design of object-oriented programs.
3. To familiarize with constructors, destructors and their types.
4. To demonstrate operator overloading, inheritance and their various forms.
5. To use polymorphism in object-oriented scenarios, exception handling and templates.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
E Balagurusamy	Object Oriented Programming with C++ (2017) 7th ed.	McGraw Hill Education	2017	9352607996

Schildt H.	C++: The Complete Reference,	Tata McGraw Hill	2003	007053246X
Robert Lafore	Object Oriented Programming in Turbo C++	Galgotia Publications	1991	8185623228
Walter Savitch	Problem solving with C++: The Object of Programming	Pearson Education.	2002	0321136640

Course Title: General Chemistry

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	1	0	4

	Weightage	Teaching Hours
Unit-1- The Atomic Theory	**25%**	**14 H**
Bohr's theory, Wave mechanics: de' Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, Quantum numbers and their significance. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations, Variation of orbital energy with atomic number.		
Unit-2- The Periodic Table : History and Periodic Trends	**25%**	**14 H**
Periodic properties s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s and p-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b)Atomic radii (van'der Waals) (c)Ionic and crystal radii. (d)Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling, Mullikan, Allred Rachow scales, electronegativity and bond order, partial charge		
Unit-3-Fundamentals of Organic Chemistry	**25%**	**13 H**
Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Acid-Base Equilibria: Brönsted-Lowry concept of acid-base reactions, solvated proton, factors affecting relative strength of inorganic and organic acids and bases, types of acid-base reactions. Classification of		

Lewis acids, Hard and Soft Acids and Bases (HSAB) Application of HSAB principle. Application of HSAB principle. Qualitative treatment of acid – base titration curves (calculation of pH at various stages). Theory of redox indicators; selection of indicators and their limitations. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes). Organic reactions and their mechanism: Addition, Elimination and Substitution reactions.		
Unit-4- States of matter: Gases	**25%**	**13 H**
Deviations from ideal gas behavior, compressibility factor, and its variation with pressure for different gases. Causes of deviation from ideal behavior. van der Waals equation of state, its derivation and application in explaining real gas behaviour; van der Waals equation expressed in virial form, Boyle temperature. Isotherms of real gases and their 45 comparison with van der Waals isotherms, continuity of states, critical state, critical and van der Waals constants, law of corresponding states. Kinetic molecular model of a gas: postulates and derivation of the kinetic gas equation; collision frequency; collision diameter; mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy of gaseous molecules.		

List of Experiments (Total:30 Hours)

Inorganic Chemistry Practicals

- Titrimetric Analysis: Acid-Base Titrations
  (i) Apparatus calibration and preparation of solutions of different molarity/normality of titrants.
- (ii) Estimation of carbonate and hydroxide present together in mixture.
  (iii) Estimation of carbonate and bicarbonate present together in a mixture.

Organic Chemistry Practicals

- Separation of a mixture of organic compounds by thin layer chromatography and ascending paper chromatography.

Physical Chemistry Practicals

- Surface tension measurements.
  a. Determine the surface tension of different liquids by (i) drop number (ii) drop weight method.
  b. Determination of viscosity of aqueous solutions of (i) polymer (ii) ethanol and (iii) sugar at room temperature using Ostwald's viscometer.

Course Learning Outcomes: After studying this course students will be able to:

1. Knowledge of evolution of scientific theories to explain the atomic structure, molecular geometry and physico-chemical behaviour of atomic matter made from elements in periodic table.
2. Focus on fundamentals of organic molecules, structure, stereochemistry, bonding, reactivity and reaction mechanisms.
3. Familiarization with gaseous state of matter and its physical laws governing it

Text / Reference Books:

A. Theory

- J.D. Lee, Concise Inorganic Chemistry, John Wiley and Sons Ltd,5th edition (2016), ISBN 978-8126515547
- Greenwood, Earnshaw, Chemistry of the Elements, Butterworth-Heinemann, 2nd edition (1997) , ISBN 978-0750633659
- M. B. Smith, J. March, March's Advanced Organic Chemistry: Reactions, Mechanisms, and Structure, Wiley-Interscience, 8th Edition (2015) , ISBN 978-8126556588
- Atkins P.W, Julio de Paula, Physical Chemistry, Oxford University Press, ELBS 11th edition (2018), ISBN 978-0198814740

B. Practical

- J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas, Vogel's Quantitative Chemical Analysis, Longman , 6th edition (1999), ISBN 978-0582226289
- A.I. Vogel, A.R. Tatchell, B.S. Furnis, Vogel's Textbook of Practical Organic Chemistry, Prentice Hall, 5th edition (2003), ISBN 978-0582462366
- Shoemaker, D.P Garland, C.W Nibler, J.W., Experiments in Physical Chemistry, McGraw Hill Inc, 8th edition (2008), ISBN 978-0070570078

Course Title: Manufacturing Practices-I

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

Course Contents/syllabus:

	Weightage	Teaching Hours
Unit I: Manufacturing methods	**25%**	**13 H**
Casting, forming, machining, joining, advanced manufacturing methods		
Unit II: CNC Machining and Fitting tools	**25%**	**14 H**
CNC machining, Additive manufacturing, Fitting operations & power tools		
Unit III: Electronics and Carpentry	**25%**	**13 H**
Electrical & Electronics, Carpentry, Plastic moulding, glass cutting		
Unit IV: Welding	**25%**	**14 H**
Metal casting, Welding (arc welding & gas welding), brazing		

Course Learning Outcomes: After studying this course students will be able to:

1. Gain knowledge of the different manufacturing processes
2. Gain knowledge of CNC machining and other tools
3. Understand the concepts of carpentry & Glass cutting
4. Understand about significance of Electricals and Electronics in manufacturing industry.
5. Gain in-sights on Welding techniques.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K.	Elements of Workshop Technology	Media Promoters	2008	978-8185099149
Kalpakjian S. And Steven S. Schmid	Manufacturing Engineering and Technology	Pearson	2018	978-9332587908
Gowri P. Hariharan and A. Suresh Babu	Manufacturing Technology – I	Pearson	2008	978-9332582705
Roy A. Lindberg	Processes and Materials of Manufacture	Prentice Hall	1990	978-8120306639

Course Title: INDIVIDUAL, SOCIETY AND NATION

L	T	P/S	SW/FW/ PSDA	TOTAL CREDIT UNITS
1	0	0	0	1

Course Contents/syllabus:

	No. of Session
Unit-1- Individual differences & Personality	**4 H**
• Personality: Definition& Relevance • Importance of nature & nurture in Personality Development • Importance and Recognition of Individual differences in Personality • Accepting and Managing Individual differences Intuition, Judgment, Perception & Sensation (MBTI) BIG5 Factors	
Unit-2- Managing Diversity	**4 H**
• Defining Diversity • Affirmation Action and Managing Diversity • Increasing Diversity in Work Force • Barriers and Challenges in Managing Diversity	
Unit-3- Socialization, Patriotism and National Pride	**4 H**
• Nature of Socialization • Social Interaction • Interaction of Socialization Process • Contributions to Society and Nation	

• Sense of pride and patriotism • Importance of discipline and hard work • Integrity and accountability	
Unit-4- Human Rights, Values and Ethics	**3 H**
• Meaning and Importance of human rights • Human rights awareness • Values and Ethics- Learning based on project work on Scriptures like- Ramayana, Mahabharata, Gita etc.	

List of Professional Skill Development Activities (PSDA):

- Project on Understanding Diversity
- Term Paper on Patriotism among Youth

Course Learning Outcomes: On completion of the course:

- To recognize individual differences
- To manage individual differences
- To develop patriotic feelings
- To recognize their self in relation to society & nation

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN	Pages
Department of English, University of Delhi	The Individual & Society	Pearson Education	2010	978-8131704172	266
Umang Malhotra	Individual, Society, and the World	iUniverse	2004	978-0595662401	188
Tonja R. Conerly & Kathleen Holmes	Introduction to Sociology 3e	Openstax	2015	9781711493978	458
Daksh Tyagi	"A Nation of Idiots"	Every Protest	2019	978-8194275015	350

Course Title: French Grammar

L	T	P/S	SW/FW	Total Credit Units
1	0	0	0	1

Course Contents/syllabus:

	Teaching Hours
Unit-I: My family and my house	**4 H**
Descriptors/Topics • Talk about your family members • Usage of possessive adjectives	

• Describe your house/apartment • Prepositions of location • Negation	
Unit-II- Lifestyle	**3 H**
Descriptors/Topics • Talk about your hobbies and pastimes • Usage of appropriate articles: definite and contracted • Talk about your daily routine • Usage of pronominal verbs	
Unit-III- In the city	**3 H**
Descriptors/Topics • Filling up a simple form • Ask for personal information • Usage of interrogative adjectives • Give directions about a place • Ordinal numbers • Usage of demonstrative adjectives	
Unit-IV- Week-end	**3 H**
Descriptors/Topics • Talk about your week-end plans • Usage of disjunctive pronouns • Usage of Near Future tense • Talk about weather • Write a simple post card	

Course Learning Outcomes: At the end of the course, the student shall be able to:

1. Understand information; Express in his own words; Paraphrase; Interpret and translate.
2. Apply information in a new way in a practical context
3. Analyze and break-down information to create new ideas
4. Evaluate and express opinion in a given context

Text / Reference Books:

Author	**Title**	**Publisher**	**Year of Publication**	**ISBN No**
Christine Andant, Catherine Metton, Annabelle Nachon, Fabienne Nugue,	A Propos - A1, Livre de l'élève et Cahier d'exercices.	Langers International Pvt. Ltd.	2010	978-9380809069
Collins Dictionaries	Easy Learning French Complete Grammar, Verbs and Vocabulary	Collins	2016	978-0008141721
Nikita Desai, Samapita Dey Sarkar	Apprenons La Grammaire Ensemble - French	Langers International Pvt. Ltd.	2017	978-8193002681

Course Title: German Grammar

L	T	P/S	SW/FW	Total Credit Units
1	0	0	0	1

Course Contents/syllabus:

	Teaching Hours
Module I: Time (Uhrzeit); People and the World: Land, Nationalität und Sprache	**4 H**
• Introduction of time • Read text related to time and teach the students the time expressions • Exercises related to Time • Adverbs of time and time related prepositions • Vocabulary: Countries, Nationalities, and their languages • Negation: "nicht/ kein" • Ja/Nein Fragen. • All the colors and color related vocabulary, adjectives, and opposites • Exercises and comprehension for the same.	
Module II: Irregular verbs (unregelmässige Verben)	**3 H**
• Introduction to irregular verbs and their conjugation e.g. fahren, essen, lesen etc • Read a text related to the eating habits of Germans • Vocabulary: Obst, Gemüse, Kleiderstück with usage of irregular verbs • Free time and hobbies • Food and drinks	
Module III: Accusative case: articles and pronouns (Akkusativ Kasus: Artikel und Pronomen)	**3 H**
• Introduction to the concept of object (Akkusativ) • Formation of sentences along with the translation and difference between nominative and accusative articles • Usage of accusative Definite articles • Usage of accusative Indefinite articles	
Module IV: Accusative case: possessive pronouns (Akkusativ Kasus: Possessivpronomen) Family and Relationship	**3 H**
• Accusative Personal Pronouns: - Revision of the nominative personal pronouns and introduction of accusative. Applicability of pronouns for both persons and things. • Usage of accusative Personal Pronouns • Introduction of accusative possessive pronouns • Difference between nominative and accusative possessive pronouns • usage of accusative possessive pronouns	

At the end of the course, the student shall be able to:

1. Understand information; Express in his own words; Paraphrase; Interpret and translate.

2. Apply information in a new way in a practical context
3. Analyze and break-down information to create new ideas
4. Evaluate and express opinion in a given context

Text / Reference Books:

Author	**Title**	**Publisher**	**Year**	**ISBN No**	**Pages**
Dora Schulz, Heinz Griesbach	Deutsche Sprachlehre Fur Auslander	Max Hueber Verlag	1984	978-3190010066	-
Hartmut Aufderstrasse, Jutta Muller, Helmut Muller	Themen Aktuell: Glossar Deutsch	Max Hueber Verlag	2003	978-3190816903	-
Giorgio Motta	Wir Plus Grundkurs Deutsch fur Junge Lerner Book German Guide	Goyal Publishers	2011	9788183072120	248

Course Title: Communication Skills—II (ENG-102)

Course Contents/syllabus:

L	**T**	**P/S**	**SW/FW**	**TOTAL CREDIT UNITS**
1	0	0	0	1

	Teaching Hrs (H)
Unit I: Basic Concepts in Communication	3 H
Towards communicative competence; choosing the appropriate channel and medium of communication; ways to develop communication skills in the areas of Listening, Speaking, Reading, and Writing.	
Unit II: Communication Types	4 H
Nonverbal communication: detailed analysis, KOPPACT (Kinesics, Oculesics, Proxemics, Paralanguage, Artefacts, Chronemics, Tactilics).	
Unit III: Communication and Technology	3 H
Importance of digital literacy and communication on digital platforms.	
Unit IV: Presentation Skills	5 H
Planning, preparation, practice, and performance; audience analysis, audio-visual aids, analyzing the non-verbal communication, methods of delivery: impromptu, extemporaneous, memorization, manuscript, and outlining.	

Course Learning Outcomes:

- Students will be able to understand the need and the methods required to develop communication skills in the areas of listening, speaking, reading, and writing.
- Students will be able to understand the significance of non-verbal communication in various contexts.
- Students will be able to develop an awareness of the role of digital platforms in shaping public psyche, beliefs, and perceptions about social realities and build an informed and critical perspective.
- Students will be able to develop and upgrade their presentation skills.

Text / Reference Books:

AUTHOR	**TITLE**	**Publisher**	**Year of publication**	**ISBN**
P. D. Chaturvedi and Mukesh Chaturvedi	Business Communication: Concepts, Cases and Applications	Pearson Education	2006	9788131701720
Meenakshi Raman and Prakash Singh	Business Communication	Oxford University Press	2012	9780198077053
Jeff Butterfield	Soft Skills for Everyone	Cengage Learning	2017	9789353501051

Program Structure for B. Tech. CSE

Semester III

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	**T**	**P**	
1		Data Structures and Algorithms	Core Course	3	0	4	5
2		Computer Organization and Architecture	Core Course	3	0	0	3
3		Python Programming	Engineering Science Course	3	0	2	4
4		Design Thinking	Engineering Science Course	3	0	0	3
5		Probability and Statistics	Basic Science course	4	0	0	4
6		Operating System	Core Course	3	0	2	4
7		IT Workshop	Core Course	0	0	2	1
		TOTAL		**19**	**0**	**10**	**24**
			Total Credits	**Min Required: 24** **Semester Credits: 24**			

Course Title: Data Structures (BTech. CSE)

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	4	0	5

Course Contents/syllabus:

	Teaching Hours
Unit I: Linear Data Structures and sorting	**15 H**

Introduction to data structures, Arrays, Stack, Queues and their operations, Applications. Infix to postfix conversions, Evaluation of postfix expression. Searching- (sequential & binary), Sorting techniques: (bubble sort, selection sort, insertion sort, quick sort, merge sort).	
Unit II: Linked List	**10 H**
Linked lists, doubly linked list, Circular linked list, operations on linked lists: create, insert, display, delete, traverse.	
Unit III: Trees	**10 H**
Tree terminologies, Binary tree, Tree Transversals (pre-order, post-order and in-order), Operations on trees. Binary search tree. AVL Trees.	
Unit IV: Graphs	**10 H**
Graph terminology, Representation of graphs: Adjacency matrix, traversing a Graph (Breadth first search, Depth first search), Shortest-path algorithms (Dijkstra and Floyd) Minimum spanning tree (Prim and Kruskal)	

Lab/ Practical details:

List of Experiments -with basic instructions (Total: 60 Hours)

Objective: The aim of this section of Lab is to teach experiments of data structures pertaining to the units being taught in the theory paper specifically related to arrays, stacks, queues, trees and graphs.

1. To implement insert, delete, create and other operations on arrays.
2. To implement push and pop on stacks.
3. To implement enqueue and dequeue in queues.
4. To implement different operations related to linear and circular queues
5. To implement TOH and Fibonacci Series using Recursion
6. To implement sorting techniques: bubble, insertion, selection, quick, merge sort.
7. To implement operations related to linked list: singly and doubly.
8. WAP to implement a menu driven approach for given operations: Create, Display, merge, union, intersection in single list.
9. Write a menu driven program that implements doubly linked list.
10. Write a menu driven program that implements Singly circular linked list for the given operations: Create, Display, Count, Insert, Delete, Search.
11. WAP to create a binary tree.
12. WAP for in order, preorder and post order traversal in binary tree.
13. Implementation of creation of graphs.
14. Implementation of Graphs: Graph traversals.
15. Implementation of MST: Prims and Kruskal.

Course Learning Outcomes:

1. The student is expected to get familiar about the concept of data organization in memory and data structures.
2. Understand and apply linear data structures like stack, queue, arrays.
3. Learn and implement various searching and sorting techniques.
4. Learn and understand concept of linked data structures.
5. Understand, analyze and apply nonlinear data structures, trees and graphs.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Seymour Lipschutz	Data Structures With C - by Schaum series	Tata McGraw Hill	2017	978-0070701984
Robert Kruse, C.L. Tondo, Bruce Leung Pearson.	Data structures and Program Design in C	Pearson India	2006	8177584235
Tremblay & Sorenson	An Introduction to Data Structures with Application	McGraw Hill Education	2017	0074624717

Course Title: Computer Organization and Architecture

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**12 H**
CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction set of 8085 processor. Data representation: signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic		
Unit II: CPU Design and Peripheral devices		**11 H**
CPU control unit design: Hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU. Memory system design: semiconductor memory technologies, memory organization. Peripheral devices and their characteristics: Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes –role of interrupts in process state transitions, I/O device interfaces – SCII, USB.		
Unit III: Pipelining		**11 H**
Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.		
Unit IV: Memory Organization		**11 H**
Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand functional block diagram of microprocessor.
2. Apply instruction set for Writing assembly language programs.
3. Design a memory module and analyze its operation by interfacing with the CPU.
4. Classify hardwired and microprogrammed control units.
5. Understand the concept of pipelining and its performance metrics

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Morris Mano	Computer System Architecture	Pearson	2017	978-9332585607
David A. Patterson and John L. Hennessy	Computer Organization and Design: The Hardware/Software Interface	Elsevier	2016	978-9351073376
Carl Hamacher	Computer Organization and Embedded Systems	TMH	2017	978-9339218317
John P. Hayes	Computer Architecture and Organization	Pearson	2017	978-1259028564
William Stallings	Computer Organization and Architecture: Designing for Performance	Pearson	2016	978-9332570405

Course Title: Python Programming

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**13 H**
History of Python, Need of Python Programming, Applications, Basics of Python Programming, Using the IDLE, Running Python Scripts, Installation of Jupyter Notebook, Variables, Assignment, Keywords, Input-Output, Indentation, comments		
Unit II: Types, Operators and Expressions		**14 H**
Types - Integers, Strings, Booleans; Operators- Arithmetic, Comparison (Relational), Assignment, Logical, Bitwise, Membership, Identity, Precedence, Control Flow- if, if-elif-else, for, while, break, continue, loops, types of loops.		
Unit III: Data Structures in Python		**14 H**

Lists - Operations, Slicing, Methods; Tuples: Creating, Printing, properties of tuples, Sets, Dictionaries, Sequences and their properties. Defining Functions, Calling Functions, Passing and Returning Arguments, Scope of the Variables in a Function - Global and Local Variables		
Unit IV: Python packages and OOPS		**13 H**
Introduction to PIP, Installing Packages via PIP, Using Python Packages, OOPs in Python, Classes, self-variable, Methods, Constructor Methods.		

List of Experiments (Total:36 Hours)

1. Perform installation of python, of jupyter notebook
2. Execute a basic python program with a print message.
3. WAP to Check the Python version on command line
4. WAP to display the current date and time.
5. WAP to get Multiple inputs From a User in One Line
6. WAP which accepts the user's first and last name and print them in reverse order with a space between them.
7. WAP to implement show Operators Precedence and loops.
8. WAP to declare, access and print a dictionary
9. WAP to check whether a given key already exists in a dictionary.
10. WAP to implement functions: call by value
11. WAP to show use of local and global variables
12. WAP to implement classes and objects in python.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basics of programming and implement basic python programs, input output functions, types and operators.
2. Develop programs using conditional, branching, iteration.
3. Learn the functions declaration, implementation, arguments.
4. Develop an application using the concepts of list, dictionary, tuples solve engineering and/or scientific problems
5. Implement object-oriented principles via python programming.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Paul Barry	Head First Python	O'Reilly Media, Inc.	2016	9781491919538
John V. Guttag	Introduction to computation and programming using python	PHI Publisher.	2016	978-0262529624
Kenneth A. Lambert	Fundamentals of Python	Cengage	2019	9789353502898
Vamsi Kurama	Python Programming: A Modern Approach	Pearson	2018	978-9332587526

Course Title: Design Thinking

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**11 H**
Introduction to Design Thinking, Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components, Definition, Design thinking Mindset, Design Thinking business Applications		
Unit II: Solution Based Thinking		**11 H**
Design Thinking Vs Scientific Method, Problem Focused Vs Solution Focused, Analysis Vs Synthesis, Divergent Thinking Vs Convergent Thinking, Visual Thinking, Assumption Testing, Prototyping, Time for Learning and Validation		
Unit III: Design thinking attributes and Processes		**11 H**
Challenges, Resources –People, Place, Material, Organizational Fit, The Aha-Moment, Design Methods, Design thinking Processes – Double Diamond Process, 5 step Process etc.		
Unit IV: Design Thinking in Practice		**12 H**
Design Thinking in Practice: Process Stages of Designing for Growth, Design Thinking Tools and Methods, Applications of Design Thinking in various sectors with case studies, Social Innovation, IT Industry, Health care Industry etc.		

Course Learning Outcomes: After studying this course students will be able to:

1. Explain the fundamentals of Design thinking.
2. Model the action plan for various problems using Solution Oriented approach.
3. Analyze the significance of various stages in design thinking process.
4. Decide the use of tools and methods in alignment with processes.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Shrrutin N Shetty	Design the Future	Notion Press	2018	978-1644296202
Tim Brown	Change by design	Harper Business	2012	978-0062337382
David Lee	Design Thinking in the Class Room	Ulysses press	2018	978-1612438016
William lidwell, Kritina Holden, Jill Butler	Universal principles of design	Rockport Publishers	2010	978-1592535873
A.K. Chitale and R.C. Gupta	Product Design and Manufacturing	Prentice Hall	2011	978-8120342828

Course Title: Probability and Statistics

L	T	P	TOTAL CREDIT UNITS
4	0	0	4

Course Contents/syllabus:

	Teaching Hours
Unit I	**15 H**
Descriptive Statistics: Measure of central tendency, dispersion, skewness and kurtosis. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability and Independence, Bayes' theorem, and its applications.	
Unit II	**15 H**
Random variables: discrete and continuous, density and mass functions. Expected values and moment generating functions. Discrete distributions: Uniform, Bernoulli, Binomial, Poisson, Geometric, Negative Binomial, Hypergeometric, and their properties.	
Unit III	**15 H**
Continuous distributions: Uniform, Exponential, Gamma, Beta, Weibull, Normal and Lognormal, and their properties. Common families of distributions: location and scale families. Transformation of random variable and Probability integral transformation.	
Unit IV	**15 H**
Multiple random variable, Joint and Marginal distributions, Bivariate transformation, Covariance and correlation, random sample, and properties of random sample.	

Course Learning Outcomes: On the successful completion of this course the student will be able to understand the

1. Basics of descriptive statistics
2. Basics of the probability
3. Concept of random variable and transformation of random variable
4. Statistical distributions and their applications in the real-world problems
5. Random sample and their properties

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Rohatgi V. K. and Saleh, A.K. Md. E.	An Introduction to Probability and Statistics	2nd Edition, John Wiley and Sons	2009	9788126519262, 9788126519262
Casella G. and Berger R. L.	Statistical Inference	2nd Edition, Cengage Learning India	2002	9788131503942, 9788131503942
Hogg R. V., Mckean J. and Craig A. T	Introduction to Mathematical Statistics	7th Edition, Pearson Education India	2013	9789332519114, 9789332519114

Mukhopadhyay P	Mathematical Statistics	Books and Allied	2016	9788187134930

Course Title: Operating System

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System. Processes Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,		
Unit II: Scheduling and Process Communication		**11 H**
Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF. Inter-process Communication Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.		
Unit III: Deadlocks and Memory Management		**12 H**
Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery. Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation –Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation–Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).		
Unit IV: I/O and File Management		**11 H**

I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free Space Management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks Linux Case Study		

List of Experiments (Total Hours: 30)

1. Installation Process of various operating systems.
2. Implementation of CPU scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority.
3. Virtualization, Installation of Virtual Machine Software and installation of Operating System on Virtual Machine.
4. Commands for files & directories: cd, ls, cp, md, rm, mkdir, rmdir. Creating and viewing files using cat. File comparisons. Disk related commands: checking disk free spaces. Processes in linux, connecting processes with pipes,vbackground processing, managing multiple processes. Background process: changing process priority, scheduling of processes at command, batch commands, kill, ps, who, sleep. Printing commands, grep, fgrep, find, sort, cal, banner, touch, file. File related commands ws, sat, cut, grep.
5. Shell Programming: Basic of shell programming, various types of shell, Shell Programming in bash, conditional & looping statement, case statements, parameter passing and arguments, shell variables, shell keywords, creating shell programs for automate system tasks, report printing.
6. Implementation of Bankers algorithm for the purpose of deadlock avoidance.

Course Learning Outcomes: After studying this course students will be able to:

1. Explain basic operating system concepts such as overall architecture, system calls user mode and kernel mode.
2. Distinguish concepts related to processes, threads, process scheduling, race conditions and critical sections.
3. Analyze and apply CPU scheduling algorithms, deadlock detection and prevention algorithms.
4. Examine and categorize various memory management techniques like caching, paging, segmentation, virtual memory, and thrashing.
5. Design and implement file management system.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Avi Silberschatz, Peter Galvin, Greg Gagne	Operating System Concepts Essentials	Wiley	2014	978-1118804926
William Stallings	Operating Systems: Internals and Design Principles	Prentice Hall	2018	978-9352866717

Charles Crowley	Operating System: A Design-oriented Approach	TMH	2017	978-0074635513
Gary J. Nutt	Operating Systems: A Modern Perspective	Pearson	1997	978-0805312959
Maurice Bach	Design of the Unix Operating Systems	Pearson	2015	978-9332549579

Course Title: IT workshop

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
0	0	2	0	1

List of Experiments (Total:30 Hours)

1. Introduction to Matlab Environment.
2. Variables declaration, initialization and usage in Matlab
3. Use of various In-build functions in Matlab
4. Use of various branching statements in Matlab
5. Use of various Looping statements in Matlab.
6. Creation & use of functions in Matlab.
7. Use of additional Datatypes in Matlab.
8. Understanding various methods of plots in Matlab.
9. Use of arrays in Matlab.
10. Use of Input & output in Matlab.
11. Introduction to advanced analysis properties of Matlab
12. Introduction to various tools in Matlab like Image processing, neural networks, fuzzy logic etc.

Note: Experiments may be done in Matlab or SciLab

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the simulation environment.
2. Use various control statements in Matlab/Sci Lab.
3. Create and use functions in Matlab/SciLab
4. Understand various types of datatypes inbuild functions of Matlab/SciLab.
5. Gain In-sight on various toolboxes of Matlab.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Stephen J. Chapman	MATLAB Programming for Engineers	Cengage Learning India	2019	978-9353502874
Amos Gilat	MATLAB: An Introduction with Applications	Wiley	2012	978-8126537204

R. Balaji	Basics of MATLAB Programming	Notion Press	2020	978-1648926235
Rudra Pratap	Getting Started with MATLAB	Oxford University press	2019	978-0190091972

Program Structure for B. Tech. CSE

Semester IV

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	**T**	**P**	
1		Discrete Mathematics	Basic Science course	4	0	0	4
2		Introduction to Cloud Computing	Core Course	4	0	2	5
		Java Programming	Core Course	3	0	4	5
4		Software Engineering	Core Course	3	0	2	4
5		Fundamentals of IOT and Blockchain	Core Course	3	0	2	4
6		Design and Analysis of Algorithms	Core Course	3	0	2	4
		TOTAL		**20**	**0**	**12**	**26**
			Total Credits	**Min Required: 26** **Semester Credits: 26**			

**6-8 Weeks Industrial/institutional training after 4th Semester*

Course Title: Discrete Mathematics

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
4	0	0	0	4

	Teaching Hours
Unit I	**18 H**
Set and set operations, Logic and proof techniques, induction and recursion, relations and their properties, partial orderings, functions, and their properties, sequences, sums, and matrices	
Unit II	**18 H**
Lattice Theory and Boolean Algebra: Lattices as partially ordered sets, their properties. Lattices and algebraic systems. Sub lattices, direct products, and homomorphism. Boolean Algebra as Lattices, uniqueness of finite Boolean expressions, applications of Boolean Algebra	

Unit III	18 H
Group, subgroups, Permutation groups, normal subgroup, Isomorphism, automorphism, homomorphism,	
Unit IV	**18 H**
Graph Theory: Introduction to graphs, graph terminology, representing graphs and graph isomorphism, Euler and Hamiltonian paths, planar graphs, graph colouring and introduction to tress, application of trees	

Course Learning Outcomes: On the successful completion of this course the student will be able to

1. Construct mathematical arguments using logical connectives and quantifiers.
2. Verify the correctness of an argument using symbolic logic and truth tables.
3. Construct proofs using direct proof, proof by contradiction, and proof by cases, or mathematical induction.
4. Perform operations on discrete structures such as sets, functions, relations, sequences, and groups.
5. Understand the basics of graph theory, Lattices, and their applications

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Rosen K.	Discrete Mathematics and Its Applications	7th Edition, Tata McGraw-Hill Education	2011	9780070681880, 0070681880
Tremblay J. P. and Manohar R.	Discrete Mathematical Structures with Applications to Computer Science	Tata McGraw-Hill Education	1997	9780074631133, 9780074631133
Kolman B., Busby R. and Ross S. C.	Discrete Mathematical Structures	6th Edition, Pearson	2015	9789332549593, 8131755541

Course Title: Introduction to Cloud Computing

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
4	0	2	0	5

	%ge	Teaching Hours
Unit I: Introduction	**30%**	**15 H**
Definition of cloud, characteristics of cloud, historical developments & challenges ahead, the vision of cloud computing, Driving factors towards cloud, Comparing grid with utility computing, cloud computing and other computing systems, types of workload patterns for the cloud, IT as a service, Applications of cloud computing Introduction to virtualization techniques, Characteristics of virtualization, Pros and Cons of virtualization Technology, Hypervisors, Types of hypervisors, Multitenancy, Application programming interfaces (API), Elasticity and scalability.		
Unit II: Cloud Service Models	**20%**	**12 H**

Cloud service models, Infrastructure as a service (IaaS) architecture- details and example, Platform as a service (PaaS) architecture- details and example, Software as a service (SaaS) architecture-- details and example, Comparison of cloud service delivery models.		
Unit III: Cloud Deployment	**30%**	**12 H**
Introduction to cloud deployment models, Public clouds, Private clouds, Hybrid clouds, Community clouds, Migration paths for cloud, Selection criteria for cloud deployment.		
Unit IV: Cloud Security	**20%**	**15 H**
Understanding security risks, Principal security dangers to cloud computing, Internal security breaches, User account and service hijacking, measures to reduce cloud security breaches Case Studies: Comparison of existing Cloud platforms /Web Services.		

List of Experiments (Total:30 Hours)

1. Install VirtualBox/VMware Workstation on different OS.
2. Install different operating systems in VMware.
3. Simulate a cloud scenario using simulator.
4. Implement scheduling algorithms.
5. To study cloud security management.
6. To study and implementation of identity management
7. Case Study - Amazon Web Services/Microsoft Azure/Google cloud services.
8. Hands on open-source simulator like cloudSim.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the core concepts of the cloud computing paradigm
2. Understanding importance of virtualization along with their technologies
3. Analyze various cloud computing service
4. Analyze various deployment models and apply them to solve problems on the cloud.
5. Implementation of various security strategies for different cloud platform.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Raj Kumar Buyya, James Broberg, Andrezei M. Goscinski	Cloud Computing: Principles and Paradigms	Wiley	2013	978-8126541256
Anthony T. Velte, Toby J. Velte and Robert Elsenpeter	Cloud Computing: A practical Approach	Mc Graw Hill	2017	978-0070683518
Barrie Sosinsky	Cloud Computing Bible	Wiley	2011	978-0470903568
Judith Hurwitz, Robin Bllor, Marcia Kaufman, Fern Halper	Cloud Computing for dummies	Wiley	2009	978-8126524877

Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi	Mastering Cloud Computing	Mc Graw Hill	2017	978-1259029950

Course Title: Java Programming

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	4	0	5

		Teaching Hours
Unit I: Introduction		**12 H**
Java Programming Fundamentals: Introduction to Java, Stage for Java, Origin, Challenges of Java, Java Features, Java Program Development, Object Oriented Programming. Java Essentials: Elements of Java Program, Java API, Variables and Literals, Primitive Data Types, The String class, Variables, Constants, Operators, Scope of Variables & Blocks, Types of Comment in Java.		
Unit II: Control Structure & Object Oriented Java		**11 H**
Control Statements: Decision making statements (if, if-else, nested if, else if ladder, switch, conditional operator), Looping statements (while, do-while, for, nested loops), Jumping statements (Break and Continue). Classes and Objects: Basic concepts of OOPS, Classes and Objects, Modifiers, Passing arguments, Constructors, Overloaded Constructors, Overloaded Operators, Static Class Members, Garbage Collection. Inheritance: Basics of inheritance, Inheriting and Overriding Superclass methods, Calling Superclass Constructor, Polymorphism, Abstract Classes, Final Class.		
Unit III: Arrays, Interfaces & Packages		**12 H**
Arrays and Strings: Introduction to array, Processing Array Contents, Passing array as argument, Returning array from methods, Array of objects, 2D arrays, Array with three or more dimensions. String class, string concatenation, Comparing strings, Substring, Difference between String and String Buffer class, String Tokenizer class. Interface and Packages: Basics of interface, Multiple Interfaces, Multiple Inheritance Using Interface, Multilevel Interface, Packages, Create and Access Packages, Static Import and Package Class, Access Specifiers.		
Unit IV: Exceptions, Multithreading & Applets		**11 H**
Exception Handling: Introduction, Try and Catch Blocks, Multiple Catch, Nested Try, Finally, Throw Statement, Built-In Exceptions Multithreading: Introduction, Threads in Java, Thread Creation, Lifecycle of Thread, Joining a Thread, Thread Scheduler, Thread Priority, Thread Synchronization. Applets: Introduction, Applet Class, Applet Life Cycle, Graphics in Applet, Event-Handling.		

List of Experiments (Total:60 Hours)

1. Write a program to perform following operations on two numbers input by the user:

1) 1)Addition 2) subtraction 3) multiplication 4) division

2. Write a Java program to print result of the following operations.

-15 +58 * 45

(35+8) % 6
24 + -5*3 / 7
15 + 18 / 3 * 2 - 9 % 3

3. Write a Java program to compute area of: 1)Circle 2) rectangle 3) triangle 4) square
4. Write a program to convert temperature from Fahrenheit to Celsius degree using Java.
5. Write a program through Java that reads a number in inches, converts it to meters.
6. Write a program to convert minutes into a number of years and days.
7. Write a Java program that prints current time in GMT.
8. Design a program in Java to solve quadratic equations using if, if else
9. Write a Java program to determine greatest number of three numbers.
10. Write program that gets a number from the user and generates an integer between 1 and 7 subsequently should display the name of the weekday as per that number.
11. Construct a Java program to find the number of days in a month.
12. Write a program to sum values of an Single Dimensional array.
13. Design & execute a program in Java to sort a numeric array and a string array.
14. Calculate the average value of array elements through Java Program.
15. Write a Java program to test if an array contains a specific value.
16. Find the index of an array element by writing a program in Java.
17. Write a Java program to remove a specific element from an array.
18. Design a program to copy an array by iterating the array.
19. Write a Java program to insert an element (on a specific position) into Multidimensional array.
20. Write a program to perform following operations on strings:
    i. Compare two strings.
    ii. Count string length.
    iii. Convert upper case to lower case & vice versa.
    iv. Concatenate two strings.
    v. Print a substring.
21. Developed Program & design a method to find the smallest number among three numbers.
22. Compute the average of three numbers through a Java Program.
23. Write a Program & design a method to count all vowels in a string.
24. Write a Java method to count all words in a string.
25. Write a method in Java program to count all words in a string.
26. Write a Java program to handle following exceptions:

- Divide by Zero Exception.
- Array Index Out of B bound Exception.

Course Learning Outcomes: After studying this course students will be able to:

1. Define various Object Oriented concepts in Java Programming.
2. Compare different data types in java.
3. Differentiate between built-in and user defined functions/methods, interfaces and packages etc.
4. Outline the importance of exception handling in programs.
5. Explain advanced concepts like multithreading, applet used in java

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Balagurusamy	Programming with Java: A Primer, 6th Ed.	TMH	2019	978-9353162344
Sagayaraja, Denis, Karthik, Gajalakshmi	Java Programming for Core and Advanced Learners,	The Orient Blackswan	2018	978-9386235329
Herbert Schildt and Dale Skrien	Java Fundamentals, A Comprehensive Introduction	McGraw Hill	2017	978-1259006593
H. Schildt	Java, The complete Reference, 11	TMH	2020	978-9390491629

Course Title: Software Engineering

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Evolution and impact of Software engineering, software life cycle models: Waterfall, prototyping, Evolutionary, and Spiral models. Feasibility study, Functional and Non-functional requirements, Requirements gathering, Requirements analysis and specification		
Unit II: Software Design		**11 H**
Basic issues in software design, modularity, cohesion, coupling and layering, function-oriented software design: DFD and Structure chart, object modeling using UML, Object-oriented software development, user interface design. Coding standards and Code review techniques		
Unit III: Software Project Management		**12 H**
Software project management, Project planning and control, cost estimation, project scheduling using PERT and GANTT charts, cost-time relations: Rayleigh-Norden results, quality management		
Unit IV: Software Quality		**11 H**
ISO and SEI CMMI, PSP and Six Sigma. Computer aided software engineering, software maintenance, software reuse, Component-based software development.		

List of Experiments (Total:30 Hours)

1. Study and usage of OpenProj or similar software to draft a project plan
2. Study and usage of OpenProj or similar software to track the progress of a project
3. Preparation of Software Requirement Specification Document, Design Documents and Testing Phase
4. Related documents for some problems
5. Preparation of Software Configuration Management and Risk Management related documents
6. Study and usage of any Design phase CASE tool

7. To perform unit testing and integration testing
8. To perform various white box and black box testing techniques
9. Testing of a web site

Suggested Tools - Visual Paradigm, Rational Software Architect. Visio, Argo UML, Rational

Application Developer etc. platforms.

Course Learning Outcomes: After studying this course students will be able to:

1. Students should be able to identify the need for engineering approach to software development and various processes of requirements analysis for software engineering problems.
2. Analyse various software engineering models and apply methods for design and development of software projects.
3. Work with various techniques, metrics and strategies for Testing software projects.
4. Identify and apply the principles, processes and main knowledge areas for Software Project Management
5. Proficiently apply standards, CASE tools and techniques for engineering software projects

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Roger Pressman	"Software Engineering: A Practitioners Approach	Mc-Graw Hill	2009	978-0071267823
Sommerville	Software Engineering	Pearson	2017	978-9332582699
Pankaj Jalote	An integrated approach to Software Engineering	Narosa	2005	978-8173197024
Rajib Mall	Fundamentals of Software Engineering	PHI	2018	978-9388028028
Watts Humphrey	Managing software process	Pearson	2002	978-8177583304

Course Title: Fundamentals of IOT & Blockchain

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**

IoT definition, IoT conceptual and architectural framework, Physical and logical design of IoT, IoT applications, M2M communications, IoT vs M2M, IoT vs WoT, IoT reference architecture, Introduction to Blockchain and Distributed Ledger, Blockchain Properties, Types of Blockchain, Blockchain Platforms, Applications of Blockchain		
Unit II: IoT Sensors, Architecture and protocols		**11 H**
Basic components and challenges of a sensor node, , Sensor resolution, Sensor classes, Actuator: Actuator types, IoT Components, Functional components of IoT, IoT service oriented architecture, 6LowPAN, IEEE 802.15.4, ZigBee and its types, RFID, Bluetooth, Wireless Sensor Networks, IoT Protocols.		
Unit III: Bitcoin Platform and Architectures, Smart Contract and Ethereum Platform		**11 H**
Distributed peer-to-peer network, nodes, consensus protocol, mining: Type, Process, Bitcoin Crypto: Hashing, Digital Signatures, Wallet and Transactions in Bitcoin, Introduction Ethereum, Architecture, Smart Contracts, Elements of Smart Contracts, Ethereum Operations, Incentive Model, Transactions in Ethereum, Introduction Solidity		
Unit IV: Consensus Protocols and Security Issues		**11 H**
Trust Essentials: Decentralized Systems, Consensus Protocols: Proof-of-Work (PoW), Proof-of-Stake (PoS), Delegated Proof-of-Stake (DPoS), Proof-of-Burn (PoB), Byzantine Fault Tolerance (BFT), Practical Byzantine Fault Tolerance (PBFT), Proof-of-Activity (PoA), Proof of Elapsed Time (PoET). Blockchain Security.		

List of Experiments (Total:30 Hours)

1. Displaying Time over 4-Digit 7-Segment Display using Raspberry Pi.
2. Raspberry Pi Based Oscilloscope 3. Controlling Raspberry Pi with WhatsApp.
3. Setting up Wireless Access Point using Raspberry Pi
4. Fingerprint Sensor interfacing with Raspberry Pi
5. Raspberry Pi GPS Module Interfacing.
6. IoT based Web Controlled Home Automation using Raspberry Pi
7. Visitor Monitoring with Raspberry Pi and Pi Camera.
8. Interfacing Raspberry Pi with RFID.
9. Building Google Assistant with Raspberry Pi.
10. Implement Smart Contracts in Ethereum using Solidity.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand Internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Analyze data from various sources in real-time and take necessary actions in an intelligent fashion
4. Introduce and define Blockchain, explain Blockchain types, Platforms, Components and Its Applications.
5. Discuss the innovation of the Smart Contract, Ethereum Blockchain, review its protocol, and explore the payment model for code execution in solidity

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Pethuru Raj and Anupama C. Raman	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	CRC Press	2017	978-1498761284
Honbu Zhou	The Internet of Things in the Cloud: A Middleware Perspective	CRC Press	2012	978-1439892992
Debjani Mohanty	Blockchain from Concept to Execution: Bitcoin, Ethereum, Quorum, Ripple, R3 Corda, Hyperledger Fabric/Saw Tooth/Indy, Multi Chain, IOTA, CoCo	BPB Publications	2018	978-1439892992

Course Title: Design and Analysis of Algorithms

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	4	0	5

		Teaching Hours
Unit I: Introduction		**12 H**
Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.		
Unit II: Algorithmic Strategies		**11 H**
Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving: Bin Packing, Knap Sack, TSP.		
Unit III: Graphs & Trees		**12 H**
Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.		
Unit IV: Tractable and In-Tractable problems		**11 H**
Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques. Approximation algorithms, Randomized algorithms, Heuristics and their characteristics.		

List of Experiments (Total: 30 Hours)

1. Code and analyze solutions to following problem with given strategies:
    i. Knap Sack using greedy approach
    ii. Knap Sack using dynamic approach
2. Code and analyze to find an optimal solution to matrix chain multiplication using dynamic programming.
3. Code and analyze to find an optimal solution to TSP using dynamic programming.
4. Implementing an application of DFS such as:

i. to find the topological sort of a directed acyclic graph
ii. to find a path from source to goal in a maze.

5. Implement an application of BFS such as:
   i. to find connected components of an undirected graph
   ii. to check whether a given graph is bipartite.
6. Code and analyze to find shortest paths in a graph with positive edge weights using Dijkstra's algorithm.
7. Code and analyze to find shortest paths in a graph with arbitrary edge weights using Bellman-Ford algorithm.
8. Code and analyze to find shortest paths in a graph with arbitrary edge weights using Flyods' algorithm.
9. Code and analyze to find the minimum spanning tree in a weighted, undirected graph using Prims' algorithm
10. Code and analyze to find the minimum spanning tree in a weighted, undirected graph using Kruskals' algorithm.
11. Coding any real world problem or TSP algorithm using any heuristic technique.

Course Learning Outcomes: After studying this course students will be able to:

1. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms;
2. Explain when an algorithmic design situation calls for which design paradigm (greedy/ divide and conquer/backtrack etc.);
3. Explain model for a given engineering problem, using tree or graph, and writethe corresponding algorithm to solve the problems;
4. Demonstrate the ways to analyze approximation/randomized algorithms (expected running time, probability of error); &
5. Examine the necessity for NP class based problems and explain the use of heuristic techniques.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein	Introduction to Algorithms	PHI	2010	978-8120340077
Adam Drozdek	Data Structures and Algorithms in C++	Cengage	2013	978-8131521267
E. Horowitz, Sartaj Saini	Fundamentals of Computer Algorithms	Galgotia Publications	1999	978-817515257
Jon Kleinberg and Éva Tardos	Algorithm Design	Pearson	2013	978-9332518643

Udi Manber	Algorithms -- A Creative Approach	Pearson	1989	978-0201120370

Program Structure for B. Tech. CSE
Semester V

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	**T**	**P**	
1		Database Management System	Core Course	3	0	4	5
2		Formal Language and Automata Theory	Core Course	3	0	0	3
3		Foundations of Artificial Intelligence	Core Course	3	0	2	4
4		Specialization -I	Specialization Electives	3	0	2	4
5		**Open Elective-I	Inter-Disciplinary Elective	3	0	0	3
6		Domain Elective-I	Domain Elective Course	3	0	0	3
7		*Industrial Training	Non- Teaching Course	0	0	0	2
		TOTAL		**18**	**0**	**8**	**24**
			Total Credits	**Min Required: 24** **Semester Credits: 24**			

** Open Elective to be taken from the subjects offered by other Schools/departments of AUP.

Domain Elective I

Information System Design and Implementation
IPR & Cyber Laws
Cyber Security

Course Title: **Database Management Systems**

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	4	0	5

	%ge	Teaching Hours
Unit I: Introduction	**25%**	**14 H**
Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object-oriented Data models, integrity constraints, data manipulation operations.		
Unit II: Relational Query Languages	**25%**	**13 H**
The relational model, Keys, Relational algebra, Domain relational calculus, Tuple relational calculus: Domain and data dependency, SQL fundamentals, Fundamental operations, Additional operations, Integrity, Triggers, Views		
Unit III: Normalization	**25%**	**13 H**
Functional Dependency, Armstrong's axioms, Normalization using Functional Dependency, Multivalued dependency and Join dependency. First Normal form 2nd Normal form, 3rd Normal form, Boyce Codd Normal form, 4th Normal form 5th Normal form		
Unit IV: Concurrency control	**25%**	**14 H**
Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, multi-version and optimistic Concurrency Control schemes, Database recovery Database Security Authentication, Authorization, and access control. SQL injection.		

List of Experiments **(Total:60 Hours)**

1. Introduction to SQL and installation of SQL Server / Oracle.
2. Data Types, Creating Tables, Retrieval of Rows using Select Statement,
3. Conditional Retrieval of Rows, Alter and Drop Statements.
4. Working with Null Value, Ordering the Result of a Query.
5. Aggregate Functions, Grouping the Result of a Query, Update and Delete Statements.
6. Set Operators, Nested Queries, Joins, Sequences.
7. Views, Indexes, Database Security and Privileges: Grant and Revoke Commands, Commit and Rollback Commands.
8. PL/SQL Architecture, Assignments and Expressions, Writing PL/SQL Code Referencing Non-SQL parameters.
9. Stored Procedures and Exception Handling.
10. Triggers and Cursor Management in PL/SQL

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the various database models.
2. Construct the SQL queries for DDL and DML.
3. Normalize the tables in various normal forms.
4. Design the schedules of transactions with control on concurrency.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Abraham Silberschatz, Henry F. Korth, S. Sudarshan	Database System Concepts	Mc-Graw Hill	2021	978-9390727506
J. D. Ullman	Principles of Database and Knowledge–Base Systems	Computer Science Press	1989	978-0716781622
R. Elmasri and S. Navathe	Fundamentals of Database Systems	Pearson	2017	978-9332582705
Serge Abiteboul, Richard Hull, Victor Vianu	Foundations of Databases	Pearson	1994	978-0201537710

Course Title: Formal Languages and Automata Theory

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**11 H**
Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.		
Unit II: Regular Expressions and Languages		**12 H**
Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata		
Unit III: Context Free and Context Sensitive Grammar		**12 H**
Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG		
Unit IV: Turing Machines		**09 H**

The basic model for Turing machines (TM), Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators.		

Course Learning Outcomes: After studying this course students will be able to:

1. Write a formal notation for strings, languages and machines.
2. Design finite automata to accept a set of strings of a language.
3. Design context free grammars to generate strings of context free language
4. Design context sensitive grammars.
5. Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman	Introduction to Automata Theory, Languages, and Computation	Pearson	2008	978-8131720479
Harry R. Lewis and Christos H. Papadimitriou	Elements of the Theory of Computation	Pearson	2015	978-9332549890
Dexter C. Kozen	Automata and Computability, Undergraduate Texts in Computer Science	Springer	2007	978-0387949079
Michael Sipser	Introduction to the Theory of Computation	Cengage	2014	978-8131525296
John Martin	Introduction to Languages and The Theory of Computation	TMH	2007	978-0070660489

Course Title: Foundations of Artificial Intelligence

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree		
Unit II: Search Algorithms		**11 H**

Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search		
Unit III: Probabilistic Reasoning		**12 H**
Probability, conditional probability, Bayes Rule, Bayesian Networks-representation, construction and inference, temporal model, hidden Markov model. MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.		
Unit IV: Reinforcement Learning		**10 H**
Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning-Q learning.		

List of Experiments (Total:30 Hours)

1. Write a program to conduct uninformed and informed search.
2. Write a program to conduct game search.
3. Write a program to construct a Bayesian network from given data.
4. Write a program to infer from the Bayesian network.
5. Write a program to run value and policy iteration in a grid world.
6. Write a program to do reinforcement learning in a grid world

Any Other Program as per syllabus

Course Learning Outcomes: After studying this course students will be able to:

1. Build intelligent agents for search and games
2. Solve AI problems by learning various algorithms and strategies
3. Understand probability as a tool to handle uncertainty
4. Learning optimization and inference algorithms for model learning
5. Design and develop programs for an reinforcement agent to learn and act in a structured environment

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Stuart Russell and Peter Norvig	Artificial Intelligence: A Modern Approach	Pearson	2010	978-0136042594
Elaine Rich and Kevin Knight	Artificial Intelligence	Tata Mc Graw Hill	1991	978-0070522633
Trivedi, M.C.	A Classical Approach to Artificial Intelligence	Khanna book Publication	2018	978-8190698894
Saroj Kaushik	Artificial Intelligence	Cengage Learning	2011	978-8131510995
David Poole and Alan Mackworth	Artificial Intelligence: Foundations for Computational Agents	Cambridge University Press	2017	978-1107195394

Course Title: Statistical Computing Techniques using R (Specialization AI & ML)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

	%ge	Teaching Hours
Unit I: INTRODUCTION	**20%**	**10 H**
General introduction to computing, Using R as a calculator, Numbers, words and logicals; missing values (NA), Vectors and their attributes (names, length, type), System- and user-defined objects, Accessing data (data()). Data in the system and date outside the system (read.table, scan)		
Unit II: Graphics in R and control statements	**30%**	**15H**
First steps in graphics, the basics of R syntax, The R workspace, Matrices and lists, Subsetting System-defined functions; the help system, Errors and warnings; coherence of the workspace Data input and output; interface with other software packages, Writing your own code; R script Good programming practice, R syntax -- further steps The parentheses and brackets; =, == and <_ Apply-type functions Compiling and applying functions Documentation, Conditional statements Loops and iterations		
Unit III: Exploratory and Statistical Analysis in R	**25%**	**12 H**
I Exploratory data analysis, Range, summary, mean, variance, median, sd, histogram, box plot, scatterplot Probability distributions, Random number generation Distributions, the practice of simulation Statistical functions in R, Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models, advanced modelling methods, the bootstrap method to compute s.e.f		
Unit IV: Big Data Analysis	**25%**	**13 H**
Graphics; beyond the basics Graphics and tables, working with larger datasets, Principles of exploratory data analysis (big data analysis) Data frames in R, Defining your own classes and operations Models and methods in R, Customizing the user's environment		

List of Experiments (Total:30 Hours)

1. Familiarization of environments in R.
2. Perform simple arithmetic's using R.
3. Perform basic R functions.
4. Use various graphical techniques in EDA.
5. Create different charts for visualization of given set of data.
6. Find the mean, median, standard deviation and quartiles of a set of observations.
7. Find the Skewness and Kurtosis of a given dataset distribution.
8. Given the scenario, implement the Bayes rule by finding the posterior probability.

9. Find the mass function of a binomial distribution with n=20,p=0.4n=20,p=0.4. Also draw the graphs of the mass function and cumulative distribution function.
10. Generate and draw the cdf and pdf of a normal distribution with mean=10 and standard deviation=3. Use values of xx from 0 to 20 in intervals of 1.
11. Construct a scatter plot to investigate the relationship between two variables.
12. Perform the Z- test for single proportion, single mean etc.
13. Calculate the regression coefficient and obtain the lines of regression for the given data.
14. Compute confidence intervals for the mean when the standard deviation is known.
15. Perform F test
16. Perform Chi-Square test.

Course Learning Outcomes: After studying this course students will be able to:

1. To use a fundamental tool for computing in the practice of quantitative analytical methods
2. Programming, data handling, transformations, subsetting, exploratory data analysis, probability distributions and simulations, regression and linear models, summarising data.
3. To handle large data sets, effective graphics.
4. Modern concepts of statistics based on simulations and writing a report of a quantitative analysis.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Matloff, N.	The Art of R Programming: A Tour of Statistical Software Design	No Starch Press	2011	978-1593273842
Philip H. Pollock	An R Companion to Political Analysis	CQ Press	2017	978-1506368849
Chihara, L. and Hesterberg, T.	Mathematical statistics with resampling and R	Wiley	2011	
Lander, J. P.	R for Everyone: Advanced Analytics and Graphics	978-0134546926	2017	978-0134546926

Course Title: Virtualization and Cloud Architecture (Specialization: Cloud Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Virtualization		**11 H**

Physical and virtual machines, Traditional and virtual computing, understanding virtualization, Need and Applications of virtualization, Pros and Cons of Virtualization. Limitations, Simulations and Emulations, Challenges in Virtualized environment, tools and technologies in virtualized environments.		
Unit II: Types of Virtualizations:		**12 H**
Various forms of virtualization: Desktop, Application, Server, Hardware, Storage, Memory and I/O virtualization. Full Virtualization, Para Virtualization, Hardware Assisted Virtualization, Implementation of Hardware Assisted Virtualization, Algorithms for implementation of Virtualization, Challenges.		
Unit III: Cloud Architecture- Layers and Models:		**12 H**
Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. The conceptual reference model, Service Deployment, Cloud service management.		
Unit IV: Web Service Architecture		**10 H**
Web Service Architecture – Web Service APIs, Web service Authentication - Web service authentication methods, Technologies and the processes required when deploying web services, Deploying a web service from inside and outside a cloud architecture, advantages and disadvantages		

List of Experiments (Total:30 Hours)

1. Installation of Ubuntu, CentOS on VMware.
2. Exercise on KVM on CentOS
3. Introduction and simulation with packet tracer
4. Exercise on installation of VMware ESXi Server on VMware.
5. Creating and assigning instances using ESXi server on VMware
6. Introduction to AWS Identity and Access Management (IAM).
7. Deploy a Web Application on AWS
8. Implementing a Serverless Architecture with AWS Managed Services
9. Create and configure content delivery network (CDN).

Course Learning Outcomes: After studying this course students will be able to:

1. Apply the fundamental and essential concepts of Cloud Computing in deploying web applications.
2. Analyze the various cloud service providers on the basis of requirements and constraints.
3. Implement the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Microsoft Azure.
4. Design and implement the concept of traffic manager and perform load balancing in cloud environment.
5. Simulate concepts of virtualization and its migration over the cloud.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Gautam Shroff	Enterprise Cloud Computing Technology Architecture Applications	Cambridge University Press;	2010	978-0521137355

Anthony T.Velte, Toby J. Velte Robert Elsenpeter	Cloud computing a practical approach	TATA McGraw-Hill	2009	978-0071626941
Lee Chao	Virtualization and Private Cloud with VMware Cloud Suite	Auerbach Publications	2016	978-1498784320
Rajkumar Buyya, James Broberg, Andrzej M. Goscinski	Cloud Computing: Principles and Paradigms	Wiley	2011	978-0470887998

Course Title: Secure Communication and Cryptography (Specialization: Cyber Security)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction:		**11 H**
Introduction on security, security goals, targets and types of attacks: Passive attack, active attack, attacks on confidentiality, attacks on integrity and availability, Security services and mechanisms.		
Unit II: – Block Cipher and Data Encryption Standards:		**12 H**
Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles, Evaluation Criteria for AES, the AES Cipher.		
Unit III: Public Key Cryptography And RSA:		**12 H**
Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, Distribution of public key, public key certificates, Distribution of secret keys, Diffie Hellman key exchange – Man-in-the Middle Attack		
Unit IV: Message Authentication and Hash Functions:		**10 H**
Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs, Hash Algorithms - SHA, One-way hash functions and their applications, Intrusion Detection Systems Overview		

List of Experiments (Total:30 Hours)

1. Program to implement Ceaser Cipher
2. Program to implement Playfair Cipher with key ldrp
3. Program to implement polyalphabetic Cipher
4. Program to implement AutoKey Cipher
5. Program to implement Hill Cipher.
6. Program to implement Advanced Columner Transposition technique
7. Program to implement Simple RSA Algorithm with small numbers
8. Program to implement Euclidean Algorithm

Course Learning Outcomes: After studying this course students will be able to:

1. Understand cryptography and network security concepts and application
2. Apply security principles to system design.
3. Identify and investigate network security threat.
4. Analyze and design network security protocols
5. Conduct research in network security

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Douglas R. Stinson	Cryptography: Theory and Practice	CRC Press	2018	978-1138197015
William Stallings	Network Security Essentials: Applications and Standards	Prentice Hall	2017	978-9332585225
Wenbo Mao	Modern Cryptography: Theory and Practice	Pearson	2008	978-8131702123
William Stallings	Cryptography And Network Security Principles and Practice	Pearson Education	2017	978-9332585225

Course Title: Statistical Computing Techniques using R (Specialization: Data Science)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

	%ge	Teaching Hours
Unit I: INTRODUCTION	**20%**	**10 H**
General introduction to computing, Using R as a calculator, Numbers, words and logicals; missing values (NA), Vectors and their attributes (names, length, type), System- and user-defined objects, Accessing data (data()). Data in the system and date outside the system (read.table, scan)		
Unit II: Graphics in R and control statements	**30%**	**15H**
First steps in graphics, the basics of R syntax, The R workspace, Matrices and lists, Subsetting System-defined functions; the help system, Errors and warnings; coherence of the workspace Data input and output; interface with other software packages, Writing your own code; R script Good programming practice, R syntax -- further steps The parentheses and brackets; =, == and <_ Apply-type functions Compiling and applying functions Documentation, Conditional statements Loops and iterations		
Unit III: Exploratory and Statistical Analysis in R	**25%**	**12 H**

I Exploratory data analysis, Range, summary, mean, variance, median, sd, histogram, box plot, scatterplot Probability distributions, Random number generation Distributions, the practice of simulation Statistical functions in R, Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models, advanced modelling methods, the bootstrap method to compute s.e.f		
Unit IV: Big Data Analysis	**25%**	**13 H**
Graphics; beyond the basics Graphics and tables, working with larger datasets, Principles of exploratory data analysis (big data analysis) Data frames in R, Defining your own classes and operations Models and methods in R, Customizing the user's environment		

List of Experiments (Total:30 Hours)

1. Familiarization of environments in R.
2. Perform simple arithmetic's using R.
3. Perform basic R functions.
4. Use various graphical techniques in EDA.
5. Create different charts for visualization of given set of data.
6. Find the mean, median, standard deviation and quartiles of a set of observations.
7. Find the Skewness and Kurtosis of a given dataset distribution.
8. Given the scenario, implement the Bayes rule by finding the posterior probability.
9. Find the mass function of a binomial distribution with n=20,p=0.4n=20,p=0.4. Also draw the graphs of the mass function and cumulative distribution function.
10. Generate and draw the cdf and pdf of a normal distribution with mean=10 and standard deviation=3. Use values of xx from 0 to 20 in intervals of 1.
11. Construct a scatter plot to investigate the relationship between two variables.
12. Perform the Z- test for single proportion, single mean etc.
13. Calculate the regression coefficient and obtain the lines of regression for the given data.
14. Compute confidence intervals for the mean when the standard deviation is known.
15. Perform F test
16. Perform Chi-Square test.

Course Learning Outcomes: After studying this course students will be able to:

1. To use a fundamental tool for computing in the practice of quantitative analytical methods
2. Programming, data handling, transformations, subsetting, exploratory data analysis, probability distributions and simulations, regression and linear models, summarising data.
3. To handle large data sets, effective graphics.
4. Modern concepts of statistics based on simulations and writing a report of a quantitative analysis.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Matloff, N.	The Art of R Programming: A Tour of Statistical Software Design	No Starch Press	2011	978-1593273842

Philip H. Pollock	An R Companion to Political Analysis	CQ Press	2017	978-1506368849
Chihara, L. and Hesterberg, T.	Mathematical statistics with resampling and R	Wiley	2011	
Lander, J. P.	R for Everyone: Advanced Analytics and Graphics	978-0134546926	2017	978-0134546926

Course Title: IOT Security (Specialization: IOT & Blockchain)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

	%ge	Teaching Hours
Unit I: IOT Architecture	**25%**	**12 H**
IoT-Architecture, Functional-Architecture, Layered model, Phases of IoT system, Internet of Things Attack surface, Applied Physical Attacks-Recon and Passive Analysis, Recognizing and communicating hardware impact, Sourcing documentation and tools, Reading datasheets and inferring system functionality		
Unit II: Threat Modeling and System Analysis	**25%**	**13 H**
Threat Modeling and System Analysis, Threat modeling when hardware is in scope, Dynamic analysis, analyzing interconnects, Analyzing an unknown protocol, Firmware vulnerability analysis and exploitation. Static vs Dynamic analysis and tools, Dynamic analysis in-circuit vs emulator, Tooling for dynamic analysis.		
Unit III: Trust and Security	**25%**	**12 H**
Trust and security from a device perspective, Secure key storage, Trust and security from a network perspective, PKI Architecture Components, A Public Key Reference Infrastructure for the Iot.		
Unit IV: Complex Systems	**25%**	**13 H**
Characterizing Complex Systems: Wireless networks, biological networks, social networks, Economic networks, Computer networks. Computational Tools for Complex Systems: Signal processing tools, Network science tools, Controllability and observability of networks, Network tomography, Lessons from communications engineering.		

List of Experiments (Total:30 Hours)

Perform at least 10 exercises related to cyber-attacks on a simulator. Faculty may choose the simulator and exercises as per syllabus contents market requirements.

Course Learning Outcomes: After studying this course students will be able to:

1. Understanding IoT Architectures and Attack surface.
2. Learn Recon and Passive Analysis on Hardware Layer.
3. Learn Threat Modelling and System Analysis.
4. Learn Firmware Vulnerability Analysis and Exploitation.

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Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Fei HU	Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations	CRC Press	2020	
Russell, Brian and Drew Van Duren BorkoFurht	Practical Internet of Things Security	Packt Publishing	2016	978-1785889639
Ollie Whitehouse	Security of Things: An Implementers' Guide to Cyber-Security for Internet of Things Devices and Beyond	NCC Group	2014	

Course Title: Introduction to Quantum Computing (Specialization: Quantum Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**11 H**
Basics of Quantum Computing, Perspective Qubits, quantum gates Hilbert spaces, Dirac's notation Entanglement, EPR paradox, Bell's inequality, teleportation Postulates of quantum mechanics, super dense coding.		
Unit II: Quantum Correlations		**12 H**
Elementary quantum mechanics, linear algebra for quantum mechanics, Quantum states in Hilbert space, The Bloch sphere, Density operators, generalized measurements, no-cloning theorem. Bell inequalities and entanglement, Schmidt decomposition.		
Unit III: Quantum Cryptography		**12 H**

Quantum cryptography: quantum key distribution, Classic McEliece, HQC, Applications of code based and lattice-based cryptography, superdense coding, teleportation		
Unit IV: Quantum Gates and Algorithm		**10 H**
Universal set of gates, quantum circuits, Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, factoring Programming a quantum computer:The IBMQ, coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.		

List of Experiments (Total:30 Hours)

1. Implement and understand quantum gates.
2. Learn how information can be encrypted and sent using EPR paradox.
3. Implement the linear algebra for quantum mechanics.
4. Encrypt Transmit, and Decrypt a Secret Message.
5. Examine how an eavesdropper causes errors in transmission that can be detected
6. Understand and implement Lattice based cryptography algorithm.
7. Understand and implement code-based cryptography algorithm.
8. Implement a real-world application of secure quantum keys.
9. Implement the quantum circuits using universal set of gates.
10. Code a quantum computer using simulator to carry basic quantum measurement.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the advent of quantum computing in security.
2. Comprehend the concepts of public-key cryptography standardization procedure.
3. Analyse various cryptographic algorithms.
4. Implement post-quantum post-quantum secure public-key algorithms focusing on both key-encapsulation and digital signature.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Phillip Kaye, Raymond Laflamme	An introduction to Quantum Computing	Oxford University press	2007	019857049X
Chris Bernhardt	Quantum Computing for Everyone	The MIT Press	2020	0262039257
M. A. Nielsen &I.Chuang	Quantum Computation and Quantum Information	Cambridge University Press	2013	9781107002173

Course Title: Introduction to Web Technology (Specialization: Full Stack Development)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Basics of Web Technology		**11 H**
Introduction to the internet and World Wide Web, Client-server architecture and its components, Understanding HTTP, URL, and DNS, Web development tools and technologies, Web standards and protocols.		
Unit II: Web Design and Development		**12 H**
User Interface design principles, Understanding HTML and CSS for web design, Responsive web design, Introduction to client-side scripting, Introduction to server-side scripting.		
Unit III: Web Programming and Database Connectivity		**11 H**
Introduction to databases and SQL, Understanding server-side scripting with PHP, Introduction to AJAX, Web Security and Best Practices.		
Unit IV: Advanced Web Technologies and Emerging Trends		**11 H**
Introduction to Web Services and API, Introduction to Content Management Systems (CMS), Introduction to Cloud Computing, Mobile Web Development		

List of Experiments (Total:30 Hours)

1. Introduction to Web Browsers
2. HTML Markup
3. Cascading Style Sheets (CSS)
4. Introduction to JavaScript
5. HTML Forms
6. CSS Layouts
7. Responsive Web Design
8. Introduction to PHP
9. Database Connectivity with PHP and MySQL
10. AJAX and JSON
11. Introduction to Web Services
12. CMS Development
13. Cloud Computing
14. Mobile Web Development

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basics of web technology and the internet.
2. Develop web applications using HTML, CSS, JavaScript, and PHP.
3. Understand web programming concepts and database connectivity.
4. Demonstrate knowledge of emerging web technologies and trends.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Randy Connolly and Ricardo Hoar	Fundamentals of Web Development	Pearson	2019	978-0134481268
Jennifer Niederst Robbins	Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics	O'Reilly Media	2018	978-1491960202
Luke Welling and Laura Thomson	PHP and MySQL Web Development	Addison-Wesley Professional	2016	978-0321833891
Terry Felke-Morris	Web Development and Design Foundations with HTML5	Pearson	2019	978-0134801148

Course Title: Information System Design and Implementation

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

			Teaching Hours
Unit I: Introduction			**15 H**
Definition and characteristics of a system. Elements of a system Environment: Boundaries and interface. Types of systems: Physical or Abstract Systems, Open and Closed System, Man - made information systems. The System Development Life Cycle: Introduction to various phases-Recognition of Need, Feasibility Study, Analysis, Design, Implementation, Post– Implementation and Maintenance. The Role of System Analyst: Skills of a System Analyst, various roles of the Analyst.			
Unit II: Planning and Information Gathering			**15 H**

System Planning and the Initial Investigation: Bases for planning in system analysis, Initial investigation, determining the users information requirements, Problem definition and Project Initiation, Background Analysis, Fact Finding, Fact Analysis, Determination of Feasibility. Information Gathering: Introduction, Information Gathering tools: Review of Literature, Procedures and forms. On -site observation. Interviews and questionnaires. Tools of Structured Analysis: Various tools of structured analysis: Data flow diagram (DFD), Data Dictionary, Decision tree and structured English, Decision table, Pros and cons of each tools.			
Unit III: Feasibility and System Design			**15 H**
Feasibility Study: System Performance-statement of Constraints, Identification of Specific System Objectives, description of Outputs. Feasibility Study – Feasibility considerations, Steps in feasibility analysis. Feasibility Report. System Design: The Process of Design-Logical and Physical Design, Design methodologies: Structured design, Functional Decomposition. System Testing and Quality Assurance: Testing, System testing, Quality assurance and its goals in its system life cycle, Levels of quality assurance, Trends in testing.			
Unit IV: Implementation and Maintenance			**15 H**
Introduction, Conversion- Activity network for Conversion, File Conversion, User Training: Elements of user Training Post implementation review. Software Maintenance - Primary activities of a Maintenance Procedure, Reducing Maintenance Costs. Hardware and Software Selection: Types of Software, Procedure for Hardware/Software selection: Major phases in selection, Evaluation and Validation, Vendor Selection, Post – Installation Review. Software selection- Criteria for Software Selection, the evaluation process.			

Course Learning Outcomes: After studying this course students will be able to:

1. Understand key elements of system Design
2. Understand about planning and information gathering methods.
3. To gain insights on physical and logical design of an system.
4. Implement various testing methodologies.
5. Analyze the quality of an information system.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
E.M. Awad	Systems Analysis and Design	Galgotia	2010	978-8175156180
Hardgrave Bill C., Siau Keng, Chiang Roger H. L.	Systems Analysis and Design: Techniques, Methodologies, Approaches and Architectures	Routledge	2009	978-0765623522

Perry Edwards, Kathleen Edwards	Systems Analysis and Design	Mc Graw Hill	1993	978-0070195738

Course Title: IPR & Cyber Laws

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**10 H**
Overview of Computer and Web Technology, Need for Cyber Law, Jurisdictional Aspects in Cyber Law, Issues of jurisdiction in cyberspace, Types of jurisdictions, Minimum Contacts Theory, Sliding Scale Theory, Effects Test and International targeting, Jurisdiction under IT Act, 2000.		
Unit II: Cyber Crime and Legal Framework		**12 H**
Cyber Crimes against Individuals, Institutions and State: Hacking, Digital Forgery, Cyber Stalking/Harassment, Cyber Pornography, Identity Theft & Fraud, Cyber Terrorism, Cyber Defamation; Concept of privacy, Right to Privacy and Data Protection on Internet, Threat to privacy on internet		
Unit III: Intellectual Property		**12 H**
Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, Concept of Patents; Patentability; Non-patentable inventions, Process of obtaining a patent; Rights of a patentee		
Unit IV: Copyright and Trademark		**11 H**
Copyright: Idea-expression Dichotomy, Works Protected by Copyright, Registration of Copyright, Term of Copyright Protection, Rights conferred by Copyright, Doctrine of Fair-use, Infringement and Remedies. **Trademark**: Essential features of a Trademark, Conventional and Contemporary marks, Registration; Grounds for Refusal of Registration; Difference between infringement of Trademark and Passing off; Infringement and Remedies		

Course Learning Outcomes: After studying this course students will be able to:

1. Identify statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.
2. Categorize case law and common law to current legal dilemmas in the technology field.
3. Outline the primary forms of intellectual property rights.
4. Compare the different forms of intellectual property protection in terms of their key differences and similarities.
5. Analyze the effects of intellectual property rights on society as a whole.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Anirudh Rastogi	Cyber Law-Law of Information Technology And Internet	Lexis Nexis	2014	978-9351432548
Vakul Sharma	Information Technology Law and Practice Cyber Laws and Laws Relating to E-Commerce	Universal Law Publishing	2016	978-9350358917
Pankaj Sharma	Information Security and Cyber Laws	Kataria S. K., & Sons	2010	978-9350140710
Navneet Nagpal	Intellectual Property Right	Educreation Publishing	2017	978-1545707975
Dr. S.K. Singh	Intellectual Property Rights	Central law agency	2019	9788194003649

Course Title: **Cyber Security**

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Introduction to Cyber Space: History of Internet, Cyber Crime, Information Security, Computer Ethics and Security Policies, Choosing the Best Browser according to the requirement and email security, Guidelines to choose web browsers, Securing web browser, Antivirus, Email. Guidelines for secure password and wi-fi security: Guidelines for setting up a Secure password, Two-steps Password management, Wi-Fi Security. Guidelines for social media and basic Windows security: Guidelines for social media		
Unit II: Mobile Phone Security and Initiatives		**15 H**
Introduction to mobile phones, Smartphone Security, Android Security, IOS Security. Cyber Security Initiatives in India: Counter Cyber Security Initiatives in India, Cyber Security Exercise, Cyber Security Incident Handling		
Unit III: Online Banking Security		**15 H**
Overview of Online Banking Security, Mobile Banking Security, Security of Debit and Credit Card, UPI Security		
Unit IV: Cyber Security Threats and Mitigation		**15 H**
Cyber Security Threat Landscape, Emerging Cyber Security threats, Cyber Security Techniques, Firewall. IT Security Act and Misc. Topics: IT Act, Hackers-Attacker Countermeasures, Web Application Security, Digital Infrastructure Security, Defensive Programming		

Course Learning Outcomes: After studying this course students will be able to:

1. Define key knowledge areas of cyber security
2. Justify the need of various measures to protect cyber space
3. Identify various threats to cyber security
4. Take countermeasures against hacking
5. Perform secure online banking.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Anand Shinde	Introduction to Cyber Security: Guide to the World of Cyber Security	Notion Press	2013	978-1637816424
Sanil Nadkarni	Fundamentals of Information Security	BPB	2016	978-9389328400
J.S. Sandhu	Cybersecurity for Executives	Notion Press	2021	979-8885036221
Rajesh Kumar Goutam	Cyber Security Fundamentals	BPB	2021	978-9390684731
George Reynolds, Ralph Stair	Information System	Cengage	2014	978-1259029950
Jatindra Pandey	Introduction to Cyber Security	Uttarakhand Open University	2017	978-93-84813-96-3

Program Structure for B. Tech. CSE
Semester VI

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	T	P	
1		Compiler Design	Core Course	3	0	2	4

2		Agile Software Development	Core Course	3	0	2	4
3		Computer Networks	Core Course	3	0	2	4
4		**Open Elective -II	Inter-Disciplinary Elective	3	0	0	3
5		Domain Elective -II	Domain Elective Course	3	0	0	3
6		Specialization – II	Specialization Elective	3	0	2	4
7		Minor Project	NTCC	0	0	4	2
		TOTAL		**18**	**0**	**12**	**24**
			Total Credits	**Min Required: 24** **Semester Credits: 24**			

***6-8 Weeks Industrial/Institutional training after 6th Semester*

** Open Elective to be taken from the subjects offered by other Schools/departments of AUP.

Domain Elective II

Enterprise resource Planning
Internet of Things
Data Warehousing and Data Mining

Course Title: Compiler Design

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA		
Unit II: Syntax Analysis		**11 H**
Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar, Top-Down Parsing – General Strategies Recursive Descent Parser – Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser- LR (0) Item Construction of SLR Parsing Table - Introduction to LALR Parser – Error Handling and Recovery in Syntax Analyzer-YACC		
Unit III: Intermediate Code Generation		**12 H**

Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.		
Unit IV: Code Optimization & Code Generation		**11 H**
Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management – Issues in Code Generation – Design of a simple Code Generator. Principal Sources of Optimization – Peep-hole optimization – DAG- Optimization of Basic Blocks-Global Data Flow Analysis – Efficient Data Flow Algorithm		

List of Experiments (Total:60 Hours)

1. Design a lexical analyser for given language and the lexical analyser should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Write a C program to identify whether a given line is a comment or not.
3. Write a C program to recognize strings under 'a', 'a*b+', 'abb'.
4. Write a C program to test whether a given identifier is valid or not.
5. Write a C program to simulate lexical analyzer for validating operators.
6. Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools.
7. Write a C program for implementing the functionalities of predictive parser for the mini language.
8. a) Write a C program for constructing of LL (1) parsing.
   b) Write a C program for constructing recursive descent parsing.
9. Write a C program to implement LALR parsing.
   a) Write a C program to implement operator precedence parsing.
   b) Write a C program to implement Program semantic rules to calculate the expression that takes an expression with digits, + and * and computes the value.
10. Convert the BNF rules into YACC form and write code to generate abstract syntax tree for the mini language.
11. Write a C program to generate machine code from abstract syntax tree generated by the parser.

Course Learning Outcomes: After studying this course students will be able to:

1. Build concepts on lexical analysis.
2. Understand strategies of syntax analysis.
3. Learn techniques of Intermediate code generation.
4. Understand code design issues and design code generator.
5. Design and develop optimized codes.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
A.V. Aho, Monica, R.Sethi, J.D.Ullman	Compilers, Principles, Techniques and Tools	Pearson	2013	978-9332518667

Andrew W. Appel	Modern Compiler Implementation in Java	Cambridge University Press	2002	978-0521820608
J.P. Tremblay and P.G. Sorrenson	The Theory and Practice of Compiler Writing	PSP Books	2005	978-8178000770

Course Title: Agile Software Development

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Basics and Fundamentals of Agile Process Methods, Values of Agile, Principles of Agile, stakeholders, Challenges Lean Approach: Waste Management, Kaizen and Kanban, add process and products add value. Roles related to the lifecycle, differences between Agile and traditional plans, differences between Agile plans at different lifecycle phases. Testing plan links between testing, roles and key techniques, principles, understand as a means of assessing the initial status of a project/ How Agile helps to build quality		
Unit II: Agile and Scrum Principles		**11 H**
Agile Manifesto, Twelve Practices of XP, Scrum Practices, Applying Scrum. Need of scrum, working of scrum, advanced Scrum Applications, Scrum and the Organization, scrum value Agile Requirements: User Stories, Backlog Management. Agile Architecture: FeatureDriven Development. Agile Risk Management: Risk and Quality Assurance, Agile Too		
Unit III: Agile Product Management		**11 H**
Communication, Planning, Estimation Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement, Escalating issue. Quality, Risk, Metrics and Measurements, Managing the Agile approach Monitoring progress, Targeting and motivating the team, Managing business involvement and Escalating issue		
Unit IV: Agile Testing & Review		**11 H**
Agile Testing Techniques, Test-Driven Development, User Acceptance Test Agile Metrics and Measurements, The Agile approach to estimating and project variables, Agile Measurement, Agile Control: the 7 control parameters. Agile approach to Risk, The Agile approach to Configuration Management, The Atern Principles, Atern Philosophy, The rationale for using Atern, Refactoring, Continuous integration, Automated Build Tools		

List of Experiments (Total: 30 Hours)

1. Understand a given business scenario and identify product backlog, user stories and sprint tasks.
2. Define user stories for a given feature
3. Fill user stories, sprint schedule and sprint tasks in an Agile tool such as Agile Fantto
4. To study and use automated build tool.
5. To study-- version control tool.

6. To study Continuous Integration tool
7. Write unit tests aligned to xUnit framework for TDD
8. Apply Design principle and Refactoring to achieve agility.
9. Perform Testing activities within an agile project.
10. Refactor a given design for next sprint requirements
11. Execute continuous integration using a tool such as Jenkins
12. Mini Project: based on tools

**Note: Experiments may be performed on any open-source tool available.*

Course Learning Outcomes: After studying this course students will be able to:

1. Understand concept of agile software engineering and its advantages in software development
2. Explain the role of design principles in agile software design.
3. Analyze the core practices behind Scrum framework.
4. Apply design principles and refactoring to achieve Agility
5. Build testing activities within an Agile project

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Ken Schawber, Mike Beedle	Agile Software Development with Scrum	Pearson	2002	978-0130676344
Lisa Crispin, Janet Gregory	Agile Testing: A Practical Guide for Testers and Agile Teams	Addison Wesley	2009	978-0321534460
Robert C. Martin	Agile Software Development, Principles, Patterns and Practices	Prentice Hall	2013	978-1292025940
Alistair Cockburn	Agile Software Development: The Cooperative Game	Addison Wesley	2006	978-0321482754
Andrew Stellman, Greene Jennifer	Learning Agile	O'Reilly Series	2014	978-9351108986

Course Title: Computer Networks

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Networks		**12 H**

Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum.		
Unit II: Data Link Layer and Medium Access Layer		**11 H**
Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA, CSMA/CDCDMA/CA		
Unit III: Network and Transport Layer		**12 H**
Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols. Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.		
Unit IV: Application Layer		**11 H**
Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography		

List of Experiments **(Total: 30 Hours)**

1. To study the different types of Network cables and network topologies.
2. Practically implement and test the cross-wired cable and straight through cable using clamping tool and network lab cable tester.
3. Study and familiarization with various network devices.
4. Familiarization with Packet Tracer Simulation tool/any other related tool.
5. Study and Implementation of IP Addressing Schemes
6. Creation of Simple Networking topologies using hubs and switches
7. Simulation of web traffic in Packet Tracer
8. Study and implementation of various router configuration commands
9. Creation of Networks using routers.
10. Configuring networks using the concept of subnetting
11. Practical implementation of basic network command and Network configuration commands like ping, ipconfig, netstat, tracert etc. for troubleshooting network related problems.
12. Configuration of networks using static and default routes.

Course Learning Outcomes: After studying this course students will be able to:

1. Explain the functions of the different layer of the OSI Protocol.
2. Understand the Error detection and correction in computer networks.
3. Describe the function of each block of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
4. Develop the network programming for a given problem related TCP/IP protocol.
5. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open-source available software and tools

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Behrouz A. Forouzan	Data Communication and Networking	TMH	2017	978-1259064753
William Stallings	Data and Computer Communication	Pearson	2017	978-9332586932
Andrew S. Tanenbaum	Computer Networks	Pearson	2013	978-9332518742
Douglas Comer	Internetworking with TCP/IP	Pearson	2015	978-9332550100
W. Richard Stevens	TCP/IP Illustrated	Pearson	2014	978-9332535954

Course Title: Enterprise Resource Planning

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Related Technologies – Business Intelligence – ECommerce and EBusiness – Business Process Reengineering – Data Warehousing – Data Mining – OLAP – Product life Cycle management – SCM – CRM		
Unit II: ERP Implementation		**15 H**
Implementation Challenges – Strategies – Life Cycle – Pre-implementation Tasks – Requirements Definition – Methodologies – Package selection – Project Teams –Process Definitions – Vendors and Consultants – Data Migration – Project management – Post Implementation Activities.		
Unit III: ERP in Business		**15 H**
Operation and Maintenance – Performance – Maximizing the ERP System – Business Modules – Finance – Manufacturing – Human Resources – Plant maintenance – Materials Management – Quality management – Marketing – Sales, Distribution and service		
Unit IV: ERP Market and Applications		**15 H**
Marketplace – Dynamics – SAP AG – Oracle – PeopleSoft – JD Edwards – QAD Inc – SSA Global – Lawson Software – Epicor – Intuitive. ERP Application: Enterprise Application Integration – ERP and E-Business – ERP II – Total quality management – Future Directions – Trends in ERP.		

Course Learning Outcomes: After studying this course students will be able to:

1. Develop model for ERP for large projects
2. Develop model for E-commerce architecture for any application
3. Describe the advantages, strategic value, and organizational impact of utilizing an ERP system for the management of information across the functional areas of a business: sales and marketing, accounting and finance, human resource management, and supply chain
4. Demonstrate a working knowledge of how data and transactions are integrated in an ERP system to manage the sales order process, production process, and procurement process.
5. Evaluate organizational opportunities and challenges in the design system within a business scenario.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Alexis Leon	ERP DEMYSTIFIED	Mc Graw Hill	2014	978-9383286676
Mary Sumner	Enterprise Resource Planning	Pearson	2013	978-1292039800
Jim Mazzullo	SAP R/3 for Everyone	Prentice Hall	2005	978-0131860858
Jose Antonio Hernandz et al.	The SAP R /3 Handbook	Mc Graw Hill	2006	78-0070634800
Biao Fu	SAP BW: A Step-by-Step Guide	Pearson	2002	978-0201703665

Course Title: Internet of Things

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals- Devices and gateways, Data management, Business processes in IoT, Everything as a Service (XaaS), Role of Cloud in IOT and Security aspects of IOT.		
Unit II: Data Representation and Analysis		**15 H**
Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components-Programming API's (using Python /Node.js /Arduino) for Communication, Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP		
Unit III: Coding and Compression		**15 H**

Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.		
Unit IV: Multimedia Technology Development		**15 H**
IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Remotely monitor data and control devices
4. Understand the concept of authorization and authentication of devices.
5. Develop real life IoT based projects

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Vijay Madisetti, Arshdeep Bahga	Ïnternet of Things: A Hands-on Approach	Orient Blackswan Private Limited	2015	978-8173719547
Rahul Dubey	An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications	Cengage Learning	2019	978-8177584417
Pethuru Raj and Anupama C. Raman	The Internet of Things: Enabling Technologies, Platforms, and Use Cases	Auerbach Publications	2017	978-1498761284
Raj Kamal	Internet of Things: Architecture and Design	Mc-Graw Hill	2017	978-9352605224
Adrian McEwen	Designing the Internet of Things	Wiley	2013	978-1118430620

Course Title: Data Warehouse and Data Mining

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**

Need for strategic information, difference between operational and Informational data stores Data warehouse definition, characteristics, Data warehouse role and structure, OLAP Operations, Data mart, Different between data mart and data warehouse, approaches to build a data warehouse, Building a data warehouse, Metadata & its types.		
Unit II: Data Pre-processing & Schemas		**15 H**
Data Pre-processing: Need, Data Summarization, Methods. Denormalization, Multidimensional data model, Schemas for multidimensional data (Star schema, Snowflake Schema, Fact Constellation Schema, Difference between different schemas. Data warehouse architecture, OLAP servers, Indexing OLAP Data, OLAP query processing, Data cube computation		
Unit III: Data Mining		**15 H**
Data Mining: Definition, Data Mining process, Data mining methodology, Data mining tasks, Mining various Data types & issues. Attribute-Oriented Induction, Association rule mining, Frequent itemset mining, The Apriori Algorithm, Mining multilevel association rules.		
Unit IV: Classification and Clustering		**15 H**
Overview of classification, Classification process, Decision tree, Decision Tree Induction, Attribute Selection Measures. Overview of classifier's accuracy, evaluating classifier's accuracy, Techniques for accuracy estimation, Increasing the accuracy of classifier. [CO4] Introduction to Clustering, Types of clusters, Clustering methods, Data visualization & various data visualization tools		

Course Learning Outcomes: After studying this course students will be able to:

1. Highlight the need of Data Warehousing & Mining
2. Differentiate between the Transactional and Analytical data models.
3. Identify the real-life applications where data mining can be applied.
4. Apply different data mining algorithms on wide range of data sets.
5. Explain the role of visualization in data representation and analysis.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
A. Berson	Data Warehousing, Data Mining & Olap	Mc Graw Hill	2017	978-0070587410
Han J., Kamber M., and Pei J	Data mining concepts and techniques	Elsevier	2007	978-9380931913
Pudi V., Krishana P.R.	Data Mining	OUP India	2009	978-0195686289
Adriaans P., Zantinge D.	Data mining	Pearson	2002	9788131707173
Pooniah P.	Data Warehousing Fundamentals	Wiley	2012	978-8126537297

Course Title: **Machine Learning (Specialization: AI & ML)**

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**11 H**
Introduction to ML, Terminologies, applications, learning associations, Types of ML: Supervised learning, Unsupervised learning and Reinforcement learning. Learning a Class from Examples, Linear, Non-linear, Multi-class and multi-label classification, Data Pre-processing, Splitting dataset (Test +Train)		
Unit II: Classification		**12 H**
Introduction to classification, Need, Logistic Regression, Decision tree, split algorithm based on Information gain, Gini index, Random Forest classification, Naïve Bayes algorithm, K-Nearest Neighbours (K-NN), Support Vector Machine (SVM), Performance metrices.		
Unit III: Clustering		**12 H**
Introduction to clustering, Need, Hierarchical Clustering, Partitional, Density based, K-means clustering, K- Mode Clustering		
Unit IV:		**10 H**
Ensembles: Bagging boosting, Genetic Algorithms, Principal components analysis (PCA), Other applications of machine learning.		

List of Experiments **(Total:30 Hours)**

1. Implement Naive Bayes, Decision Tree learning.
2. Implement Linear Regression.
3. Implement Logistic Regression.
4. Implement classification using SVM
5. Implement Bagging using Random Forests
6. Implement K-means Clustering to Find Natural Patterns in Data.
7. Implement K-mode clustering
8. Implement Hierarchical clustering.
9. Implement ensemble learning.
10. Perform comparison of Machine Learning algorithms.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basics of machine learning along with its relevance in real life world.
2. Develop an understanding of various machine learning approaches and their use.
3. Choose classification models and apply them on datasets to perform prediction tasks.
4. Gain knowledge about clustering techniques and implement them on real life datasets.
5. Analyze different applications of machine learning and examine the performance of ML models on them.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Ethem Alpaydin,	Introduction to Machine Learning	MIT Press, Prentice Hall of India,	2014	978-0262043793
Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar	Foundations of Machine Learning	MIT Press	2012	978-0262018258
Tom Mitchell	Machine Learning	McGraw Hill	1997	0-07-15467-1
Charu C. Aggarwal	Data Classification Algorithms and Applications	CRC Press	2014	978-1466586741

Course Title: AI & ML on Cloud (Specialization: Cloud Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Data Science and AI & ML:		**12 H**
Introduction to AI & ML, AI Techniques, The Level of the Model, Criteria for Success. Defining the Problem as a State Space Search, Problem Characteristics, Production Systems, Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A* Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.		
Unit II: – Experts Systems:		**10 H**
Overview of an Expert System, Structure of an Expert Systems, Different Types of Expert Systems- Rule Based, Model Based, Case Based and Hybrid Expert Systems, Knowledge Acquisition and Validation Techniques.		
Unit III: Machine Learning Basics:		**12 H**
Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.		
Unit IV: Linear Models:		**11 H**

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multilayer Perceptron in Practice – Examples of using the MLP –Deriving Back-Propagation – Radial Basis Functions and Splines –RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines		

List of Experiments (Total:30 Hours)

1. Implement A* Search algorithm.
2. Implement AO* Search algorithm.
3. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
4. Write a python program to implement simple Chatbot
5. Write a python program to implement List methods (Add, Append, Extend & Delete)
6. Write a python program to implement Water Jug Problem?
7. Write a program to implement Tic-Tac-Toe game using python.
8. Write a program to implement Hangman game using python

Course Learning Outcomes: After studying this course students will be able to:

1. To learn the overview of artificial intelligence principles and approaches
2. Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing.
3. To enable students to understand different techniques related to Machine Learning.
4. Build and deploy production grade AI/ML applications
5. Construct algorithms to learn linear and non-linear models

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
S. Russell and P. Norvig	Artificial Intelligence: A Modern Approach	Prentice Hall	2010	978-0136042594
M. Tim Jones	Artificial Intelligence: A Systems Approach (Computer Science)	Jones and Bartlett Publishers	2009	978-0763773373
Ethem Alpaydin	Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)	Third Edition, MIT Press	2014	978-8120350786
Jason Bell	Machine learning – Hands on for Developers and Technical Professionals	Wiley	2014	978-8126553372

Course Title: Web and Mobile Security (Specialization: Cyber Security)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Web Application Vulnerabilities:		**12 H**
Introduction to Web Application, Web Functionality, OWASP Top 10 Vulnerabilities, SQL Injection: SQL commands using XAMPP, NoSQL Injection, Manual SQL (Union Based), Authentication Based SQL Injection, Error Based SQL Injection, Blind SQL Injection, Boolean Based Blind SQL Injection, Time Based SQL Injection, Brute force attack, Path Traversal Attacks		
Unit II: – Broken Authentication and Sensitive Data Exposure Vulnerabilities:		**12 H**
Broken Authentication/ session id, Types of Broken Authentication, Weak Session ID, Improper Error Handling, Session Management, **Authentication Security:** Authentication Techniques, Design Flaws in Authentication, Implementation Flaws in Authentication, Securing Authentication		
Unit III: Scripting Attacks:		**10 H**
Introduction to JavaScript, **Cross Site Scripting (XSS):** Types of Cross site scripting: Reflected XSS, Stored XSS, DOM XSS, XSS in Real World, Finding and Exploiting XSS Vulnerabilities, Preventing XSS Attacks		
Unit IV: Mobile Security and its Exploitation:		**11 H**
Common Mobile Threats, Mobile platform access and application analysis. Manipulating application behavior, Mobile access Trojans. Exploit using AndroRAT. Web Framework Attacks: Exploiting Mobile application using Metasploit. Client-side injection attacks, Unlocking, rooting mobile devices, Weak wireless attacks.		

List of Experiments (Total:30 Hours)

1. Installation of XAMPP and creating Database and performing various commands of SQL
2. Implement Blind Based SQL injection in SQLi/Less-8/?id=1
3. Implement Broken Authentication and Session Management for: Insecure login Form
4. Implement Directory Traversal (Directories), Directory Traversal (Files) on vulnerable application.
5. Implement cross site request forgery (CSRF) using Burp Suite.
6. Identify and exploit Joomla Vulnerabilities and implement various attacks on it
7. Hack an Android device using ANDROID RAT
8. Data extraction from Android smart phone using mobile forensic tools
9. Exploit an Android device using Metasploit Framework
10. Implement Server-side request forgery (SSRF) using with and without Burp suite

Course Learning Outcomes: After studying this course students will be able to:

1. Develop skills to design applications to host on server and to understand the Social Engineering Techniques and Tools
2. Ability to discover top 10 OWASP Vulnerabilities in web applications and analyze them using various vulnerable applications and tools.
3. Discovering the Insights into common web application attacks, Exploit and Mitigate.

4. Exploits and expose XSS, sensitive data and security mis-configuration vulnerabilities in Web Apps
5. Identify threats, Analyze and Exploit mobile applications and Apply best practices to secure them

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Bryan Sullivan and Vincent Liu	Web Application Security: A beginner Guide	McGraw-Hill Education	2011	978-0071776165
Steven Furnell	Mobile Security: a pocket Guide	IT Governance Publishing	2009	978-1849280204
Nikolay Elenkov	Android Security Internals: An In-Depth Guide to Android's Security Architecture	No Starch Press	2014	978-1593275815
Ben Walther and Paco Hope	Web Security Testing Cookbook: Systematic Techniques to Find Problems fast	O'Reilly Media	2008	978-0596514839

Course Title: Machine Learning (Specialization: Data Science)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**11 H**
Introduction to ML, Terminologies, applications, Learning associations, Types of ML: Supervised learning, Unsupervised learning and Reinforcement learning. Learning a Class from Examples, Linear, Non-linear, Multi-class and multi-label classification, Data Pre-processing, Splitting dataset (Test + Train)		
Unit II: Classification		**12 H**
Introduction to classification, Need, Logistic Regression, Decision tree, split algorithm based on Information gain, Gini index, Random Forest classification, Naïve Bayes algorithm, K-Nearest Neighbours (K-NN), Support Vector Machine (SVM), Performance metrices.		
Unit III: Clustering		**12 H**
Introduction to clustering, Need, Hierarchical Clustering, Partitional, Density based, K-means clustering, K- Mode Clustering		
Unit IV:		**10 H**
Ensembles: Bagging boosting, Genetic Algorithms, Principal components analysis (PCA), Other applications of machine learning.		

List of Experiments (Total:30 Hours)

1. Implement Naive Bayes, Decision Tree learning.
2. Implement Linear Regression.
3. Implement Logistic Regression.
4. Implement classification using SVM
5. Implement Bagging using Random Forests
6. Implement K-means Clustering to Find Natural Patterns in Data.
7. Implement K-mode clustering
8. Implement Hierarchical clustering.
9. Implement ensemble learning.
10. Perform comparison of Machine Learning algorithms.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basics of machine learning along with its relevance in real life world.
2. Develop an understanding of various machine learning approaches and their use.
3. Choose classification models and apply them on datasets to perform prediction tasks.
4. Gain knowledge about clustering techniques and implement them on real life datasets.
5. Analyze different applications of machine learning and examine the performance of ML models on them.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Ethem Alpaydin,	Introduction to Machine Learning	MIT Press, Prentice Hall of India,	2014	978-0262043793
Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar	Foundations of Machine Learning	MIT Press	2012	978-0262018258
Tom Mitchell	Machine Learning	McGraw Hill	1997	0-07-15467-1
Charu C. Aggarwal	Data Classification Algorithms and Applications	CRC Press	2014	978-1466586741

Course Title: Introduction to Raspberry Pi & Arduino (Specialization: IOT & Blockchain)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I:: Getting Started with Raspberry Pi		**12 H**

Basic functionality of Raspberry Pi B+ board, implications of an operating system on the behavior of the Raspberry Pi as an IoT device, booting Raspberry Pi 3, Downloading an Operating System, format an SD card and booting the OS. Basics of Linux and its use, main features including navigating the file system and managing processes, overview of the graphic user interface for Raspian Linux distribution.		
Unit II: Interfacing with the Raspberry Pi		**12H**
Interfacing Hardware with the Raspberry Pi, Raspberry Pi Remote Access, operate the Raspberry Pi in "headless mode", Bash Command line, operating Raspberry Pi without needing a GUI interface, Basics of the Python programming language, programming on the Raspberry Pi. Communication with devices through the pins of the Raspberry Pi, RPi. GPIO library, setting up the pins, General purpose IO Pins, applying digital voltages, and generating Pulse Width Modulated signals, Tkinter Python library		
Unit III: The Arduino Environment		**10 H**
Introduction to the Arduino environment, the Arduino board, the Arduino IDE, and the Arduino compatible shields together with their libraries. Arduino board main components, inputs, and outputs. Arduino Integrated Development Environment (IDE), Compiling Code, Arduino Shields and Libraries.		
Unit IV: C programming for Arduino		**11 H**
Basics of C programming, composition of an Arduino programs, Arduino tool chain, Arduino IDE, basic structure of a sketch, including the use of the setup() and loop() functions. Accessing the pins from a sketch for input and output, introduction on debugging embedded software on an Arduino, UART communication protocol, Synchronization, parity and stop, the use of the Serial library to communicate with the Arduino through the serial monitor.		

List of Experiments (Total:30 Hours)

1. Getting started with Raspberry Pi, Install Raspian on your SD card
2. Linux basic commands.
3. Coding simple programs in Python.
4. How to use Python-based IDE (integrated development environments) for the Raspberry Pi and how to trace and debug Python code on the device
5. How to have your Raspberry Pi interact with online services through the use of public APIs and SDKs.
6. Arduino basic setup, and installation process.
7. Learning of Arduino use
8. Arduino Shields to extend the functionality of an Arduino based system.

Course Learning Outcomes: After studying this course students will be able to:

1. Explain solid theoretical foundation, systematic professional knowledge.
2. Perform practical in the Raspberry Pi and Arduino.
3. Focuses on higher-level operating systems, advanced networking, user interfaces, multimedia and uses more computing intensive IoT applications.
4. Exposing Raspberry Pi running Linux as the platform of choice and comparable platforms like Arduino.
5. Design and deploy multiple IoT devices that could connect to the gateway.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Simon Monk	Programming the Raspberry Pi: Getting Started with Python	Mc-Graw Hill Professional	2012	978-1259587405
Rajesh Singh, Anita Gehlot, Lovi Raj Gupta, Bhupendra Singh, Mahendra Swain	Internet of Things with Raspberry Pi and Arduino	CRC Press	2019	978-0367248215
Eben Upton and Gareth Halfacree	Raspberry Pi User Guide	John Wiley & Sons	2016	978-1119264361
Alex Bradbury and Ben Everard	Learning Python with Raspberry Pi	John Wiley & Sons	2014	978-1118717059

Course Title: Quantum Algorithms and Complexity (Specialization: Quantum Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Quantum Algorithms and Complexity		**13 H**
Introduction to quantum computing, Basic quantum operations and quantum circuits, Quantum parallelism and superposition, Overview of quantum algorithms for factoring, search, and simulation, Classical complexity theory and quantum speedup.		
Unit II: Quantum Algorithms for Factoring and Search		**10 H**
Shor's algorithm for factoring, Grover's algorithm for search, Applications of factoring and search algorithms in cryptography and optimization		
Unit III: Quantum Simulation and Quantum Computational Models		**12 H**
Quantum simulation algorithms and their applications, Quantum computational models, including quantum Turing machines and quantum circuits, Comparison of quantum computational models to classical models		
Unit IV: Quantum Error Correction and Quantum Lower Bounds		**10 H**
Quantum error correction codes and their properties, Lower bounds for quantum algorithms and their relationship to quantum error correction, Quantum fault tolerance and the threshold theorem		

List of Experiments (Total:30 Hours)

1. Grover's Algorithm: Implementing Grover's algorithm to search an unsorted database using a quantum computer.
2. Shor's Algorithm: Implementing Shor's algorithm to factorize large numbers using a quantum computer.
3. Simon's Algorithm: Implementing Simon's algorithm to find periodicity in a function using a quantum computer.
4. Quantum Fourier Transform: Implementing the quantum Fourier transform (QFT) algorithm using a quantum computer.
5. Quantum Phase Estimation: Implementing the quantum phase estimation (QPE) algorithm to estimate the eigenvalues of a unitary operator using a quantum computer.
6. Deutsch-Jozsa Algorithm: Implementing the Deutsch-Jozsa algorithm to determine whether a given function is constant or balanced using a quantum computer.
7. Bernstein-Vazirani Algorithm: Implementing the Bernstein-Vazirani algorithm to determine the hidden bitstring in an oracle function using a quantum computer.
8. Quantum Walks: Implementing quantum walks to simulate random walks on graphs using a quantum computer.
9. Quantum Error Correction: Implementing quantum error correction codes to protect quantum information from decoherence and other errors.
10. Quantum Complexity Theory: Exploring the theoretical foundations of quantum computing, including the complexity classes BQP and QMA.

Course Learning Outcomes: After studying this course students will be able to:

1. Analyze the computational complexity of quantum algorithms for various problems, including factoring, search, and simulation.
2. Understand the relationships between quantum and classical algorithms, and be able to compare their advantages and disadvantages.
3. Evaluate the performance of quantum algorithms using the tools of quantum information theory and complexity theory.
4. Apply the principles of quantum error correction and quantum lower bounds to the analysis of quantum algorithms.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Michael A. Nielsen and Isaac L. Chuang	Quantum Computation and Quantum Information	Cambridge University Press	2011	978-1107002173
Richard J. Lipton and Kenneth W. Regan	Quantum Algorithms via Linear Algebra	The MIT Press	2014	978-0262512502
Marius Junge, Clemente L. Canales, and Rolando D. Somma	Introduction to Quantum Algorithms	Springer	2017	978-3319511569

Noson S. Yanofsky and Mirco A. Mannucci	Quantum Computing for Computer Scientists.	Cambridge University Press	2008	978-0521879965

Course Title: Mobile Application Development (Specialization: Full Stack Development)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to mobile application development		**11 H**
Types of mobile applications, Overview of mobile operating systems, Mobile application development platforms, Characteristics and Benefits – Application Model, Android Introduction & Building Blocks: Android Features, Architecture, Building Blocks, Application Components- Development Environment: Using Eclipse IDE for Mobile Development, Android Sdk, Emulator.		
Unit II: Mobile Application Design		**12 H**
Principles of mobile application design, User experience design, User interface design, Wireframing and prototyping tools		
Unit III: Mobile Application Development Platforms, Tools and Frameworks		**12 H**
Android app development, iOS app development, Cross-platform app development using React Native, Android Studio, Xcode, React Native framework, Ionic framework		
Unit IV: Testing, Debugging, Deployment of Mobile Applications and Security		**10 H**
Testing mobile applications, debugging mobile applications, deploying mobile applications to app stores, App store optimization, Security threats to mobile applications, Techniques for securing mobile applications, best practices for securing mobile applications		

List of Experiments (Total:30 Hours)

Lab 1: Developing a simple Android application using Android Studio

Lab 2: Developing a simple iOS application using Xcode

Lab 3: Developing a simple cross-platform application using React Native

Lab 4: Designing a mobile application interface using Adobe XD

Lab 5: Designing a mobile application prototype using In Vision

Lab 6: Debugging a mobile application using Android Studio

Lab 7: Testing a mobile application using Firebase Test Lab

Lab 8: Deploying a mobile application to Google Play Store

Lab 9: Deploying a mobile application to Apple App Store

Lab 10: Analyzing and optimizing a mobile application using Google Play Console

Course Learning Outcomes: After studying this course students will be able to:

1. Develop mobile applications using various development platforms.
2. Understand the principles of mobile application design and user experience.
3. Use mobile application development tools and frameworks.
4. Test, debug, and deploy mobile applications

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Tom White	Hadoop: The Definitive Guide	O'Reilly Media	2015	978-1491901632
Reto Meier	Professional Android 4 Application Development	Wrox	2012	978-1118102275
Craig Grannell, Victor Sumner, and Wei Meng Lee	Beginning iOS 13 & Swift App Development: Develop iOS Apps with Xcode 11, Swift 5, Core ML, ARKit and more	Apress	2019	978-1484254039
Chris T. Nguyen	Xamarin Mobile Application Development for Android - Second Edition	Packt Publishing	2016	978-1785280370

Program Structure for B. Tech. CSE

Semester VII

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	**T**	**P**	
1		Specialization – III	Specialization Elective	3	0	2	4
2		Specialization – IV	Specialization Elective	3	0	2	4
3		Domain Elective -III	Domain Elective Course	3	0	0	3
4		Domain Elective -IV	Domain Elective Course	3	0	0	3
5		**Open Elective -III	Inter-Disciplinary Elective	3	0	0	3
6		Major Project	NTCC	0	0	8	4
7		**Industrial Training	NTCC	0	0	0	3
		TOTAL		**15**	**0**	**12**	**24**
			Total Credits	**Min Required: 24** **Semester Credits: 24**			

Domain Elective III

Blockchain Technology
Distributed Databases
Network Security

Domain Elective IV

Parallel Computing
Ethical Hacking
Information Theory and Coding

Course Title: Soft Computing (Specialization: AI& ML)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Biological Neural Network: Structure and working, Artificial Neural Networks & Applications, Fundamentals, Characteristics, History of neural networks, characteristics of neural networks terminology		
Unit II: Neural Network Models		**11 H**
Models of neuron McCulloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture, Multilayer Neural Networks		
Unit III: Learning methods and propagation		**11 H**
Learning Methods, Backpropagation, Counter propagation, ART, BAM, Associative memories		
Unit IV: Fuzzy Logic		**11 H**
Fuzzy sets, Fuzzy model, Fuzzy rule generation Fuzzy inference system, Defuzzification Introduction to Neuro-Fuzzy system, Architecture and its applications. Applications: Genetic Algorithms.		

List of Experiments (Total:30 Hours)

1. Implement OR, AND Using Perceptron.
2. Implement OR, AND X-OR gate, Using back propagation algorithm
3. Apply operations using Fuzzy Logic.
4. Apply operations using Neuro Fuzzy Logic.
5. Implement the problem of max-min composition using fuzzy logics.
6. To find the solution of the function Maximize, given the constraints using GA approach

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the concept of soft computing techniques and their use to solve real life problems.
2. Implement various fuzzy logic problems and evaluate their performance.
3. Analyze real world problems and identify the soft computing approaches and tools that should be applied.
4. Understand the concept of neural networks and their relationship with other learning models.
5. Apply various tool and techniques on application domains related to fuzzy, GA.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Jyh-Shing Roger Jang	Neuro fuzzy and soft computing	Pearson Education	1996	978-0132610667
Kecman	Learning and Soft Computing	Pearson Education	2001	978-8131703052

George Klir , Bo Yuan	Fuzzy Sets and Fuzzy Logic	PHI	1995	978-0131011717
Fu	Neural Network in computer Intelligence	TMH	2003	978-0070532823

Course Title: Big Data on Cloud (Specialization: Cloud Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Big data:		**11 H**
Introduction to Big Data and its importance, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Four Vs, Drivers for Big Data, Big data Analytics, Algorithm Using Map reduce, Matrix – Vector Multiplication by Map-Reduce		
Unit II: – Architecture Components:		**12 H**
Massively Parallel Processing (MPP) Platforms, Unstructured Data Analytics and Reporting: Search and Count, Context-Sensitive and Domain-Specific Searches, Categories and Ontology, Qualitative Comparisons, Data Privacy Protection, Real-Time Adaptive Analytics and Decision Engines		
Unit III: Analysis of data at Rest:		**10 H**
Hadoop analytics: Limitations of existing distributing systems, Hadoop Approach, Hadoop Architecture, Distributed file system: HDFS and GPFS, Internals of Hadoop MR engine, Need for High level language- JAQL and PIG		
Unit IV: Mining Data Streams:		**12 H**
Stream Data Mode l and Management Stream Source, Stream Queries, and issues, Sampling Data in a Stream, Filtering Streams, Counting Distinct Elements in a Stream, Estimating Moments, Counting Ones in a Window, Decaying Windows Link Analysis: Page Ranking in web search engines, Efficient Computation of PageRank using MapReduce and other approaches.		

List of Experiments (Total:30 Hours)

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Implementation of K-means clustering using Map Reduce.
6. Installation of Hive along with practice examples
7. Installation of HBase, Installing thrift along with Practice examples
8. Patrice importing and exporting data from various data bases

Course Learning Outcomes: After studying this course students will be able to:

1. Describe the concepts and technologies of big data analytics
2. Apply the techniques in handing and analysis of big data.
3. Demonstrate cloud frameworks and technologies.
4. Describe and apply fine data intensive computing
5. Demonstrate cloud applications

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
DT Editorial Services	Big Data, Black Book: Covers Hadoop 2, MapReduce	Dreamtech Press	2016	978-8184891430
Vignesh Prajapati	Big Data Analytics with R and Hadoop	Packt Publishing	2013	978-1782163282
Sourabh Mukherjee , Amit Kumar Das , Sayan Goswami	Big Data Simplified	Pearson Education	2019	978-9353435110
Subhashini Chellappan, Seema Acharya	Big Data and Analytics	Wiley	2019	978-8126579518

Course Title: Cyber Forensics (Specialization: Cyber Security)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Cybercrime		**11 H**
Introduction to Cybercrime, Jurisdictional Issues, Quantifying Cybercrime, Differentiating Crimes That Use the Net from Crimes That Depend on the Net, Standard Definition of Cybercrime, Categorizing Cybercrime, Prioritizing Cybercrime Enforcement, Reasons for Cybercrimes.		
Unit II: Actors involved in Computer Investigation Process		**11 H**
Understanding Cybercriminals, Profiling and Categorizing Cybercriminals, Cyber victims, Cyber investigators by Skill Set. Demystifying Computer/Cybercrime, Investigation Startup, and Methodology, Securing Evidence, Professional Conduct, Investigating Company Policy Violations, Warning Banners, Conducting Forensic Investigation, The Investigation Process.		
Unit III: Acquiring, Duplicating and Recovering Deleted Files		**11 H**
Recovering Deleted Files and Deleted Partitions, recovering "Deleted" and "Erased" Data, Data Recovery in Linux, Data Acquisition and Duplication, Data Acquisition Tools, Recovering Data from Backups, Finding Hidden Data, Locating Forgotten Evidence, Data Recovery Techniques		

Unit IV: Collecting and Preserving Evidence and Building the Cybercrime Case		**12 H**
Defining Evidence, Role of Evidence in a Criminal Case, Forensic Examination Standards, Collecting Digital Evidence, Evidence Collection, Preserving Digital Evidence, Preserving Volatile Data, Computer Forensic Information, Understanding Legal Issues, Major Factors Complicating Prosecution, Difficulty of Defining the Crime, Jurisdictional Issues, Human Factors, The Investigative Process		

List of Experiments (Total:30 Hours)

1. Study of Computer Forensics and different tools used for forensic investigation
2. How to Recover Deleted Files using Forensics Tools
3. Study the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt.
4. How to Extract Exchangeable image file format (EXIF) Data from Image Files using Exifreader Software
5. How to make the forensic image of the hard drive using EnCase Forensics.
6. How to Restoring the Evidence Image using EnCase Forensics
7. How to Collect Email Evidence in Victim PC
8. How to View Last Activity of Your PC
9. Find Last Connected USB on your system (USB Forensics)
10. Comparison of two Files for forensics investigation by Compare IT software

Course Learning Outcomes: After studying this course students will be able to:

1. Familiarize with cybercrime& forensics ontology
2. Analyze & demonstrate the crime scene and criminology.
3. Redesign the crime scene using digital investigation process
4. Recovery of evidence and creating document for judicial proceedings.
5. Understand the Legal Issues faced during the investigation process

Text / Reference Books:

AUTHOR	**TITLE**	**Publisher**	**Year of publication**	**ISBN**
Shinder L. D., Cross M.	Scene of the Cybercrime	Syngress	2008	978-1597492768
Marcella J. A., Guillossou F.	Cyber Forensics: From Data to Digital Evidence	Wiley	2012	978-1118273661
Nina Godbole, Sunit Belapure,	Cyber Security	Wiley	2011	978-8126521791
Marcella J. A., Menendez D.	Cyber Forensics: A Field Manual for Collection, Examining and preserving Evidence of computer crimes	Auerbach Publication	2010	978-0849383281

Course Title: FUNDAMENTALS OF DATA SCIENCE AND ANALYTICS (Specialization: Data Science)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

	%ge	Teaching Hours
Unit I: INTRODUCTION TO DATA SCIENCE	**15%**	**8 H**
Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.		
Unit II: DESCRIPTIVE ANALYTICS & INFERENTIAL STATISTICS	**35%**	**19 H**
Frequency distributions – Outliers –interpreting distributions – graphs – averages - describing variability – interquartile range – variability for qualitative and ranked data - Normal distributions – z scores –correlation – scatter plots – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean. Populations – samples – random sampling – Sampling distribution- standard error of the mean - Hypothesis testing – z-test – z-test procedure –decision rule – calculations – decisions – interpretations - one-tailed and two-tailed tests – Estimation – point estimate – confidence interval – level of confidence – effect of sample size		
Unit III: ANALYSIS OF VARIANCE	**25%**	**12 H**
t-test for one sample – sampling distribution of t – t-test procedure – t-test for two independent samples – p-value – statistical significance – t-test for two related samples. F-test – ANOVA – Two-factor experiments – three f-tests – two-factor ANOVA –Introduction to chi-square tests.		
Unit IV: PREDICTIVE ANALYTICS	**25%**	**13 H**
Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling. Regression using Stats Models – multiple regression – nonlinear relationships – logistic regression – estimating parameters – Time series analysis – moving averages – missing values – serial correlation – autocorrelation. Introduction to survival analysis.		

List of Experiments (Total:30 Hours)

1. Perform linear regression using a dataset.
2. Perform data pre-processing techniques on real datasets.
3. Analyze behavior of customers for any online purchase model.
4. Implement performance evaluation of compared models for real-life dataset.
5. Automate email classification task.
6. Analyze twitter data for real and fake news.
7. Implement data frames for collection of series.

Course Learning Outcomes: After studying this course students will be able to:

1. Explain the data analytics pipeline.
2. Perform statistical inferences from data.
3. Analyze the variance in the data.
4. Build models for predictive analytics.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
David Cielen, Arno D. B. Meysman, and Mohamed Ali	Introducing Data Science	Manning Publications	2016	978-9351199373
Robert S. Witte and John S. Witte	Statistics	Wiley	2017	978-1119254515
Jake Vander Plas,	Python Data Science Handbook: Essential Tools for Working with Data	O' Reilly Media	2016	978-1491912058

Course Title: IOT Architecture and its Protocols (Specialization: IOT & Blockchain)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I:Overview		**12 H**
IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Business processes in IoT, Everything as a Service(XaaS)		
Unit II: – Reference Architecture		**12 H**
IoT Architecture-State of the Art – Introduction, Reference Model and architecture, IoT reference Model - IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Real-World Design Constraints, Technical Design constraints, Data representation and visualization, Interaction and remote control.		
Unit III:– IoT Data Link Layer, Network Layer, Transport Layer Protocols		**11 H**

PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP, Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS)		
Unit IV: Session Layer and Service Layer protocols & security		**10 H**
Session Layer- HTTP, CoAP, XMPP, AMQP, MQTT, Service Layer - oneM2M, ETSI M2M, OMA, BBF – Security in IoT Protocols – MAC 802.15.4 , 6LoWPAN, RPL, Application Layer		

List of Experiments (Total:30 Hours)

1. Introduction to IoT architecture.
2. Use a simulator or design a prototype to demonstrate M2M technology.
3. Practical implementation of Everything as a Service (XaaS).
4. Design a real-world project to study a real world constraint and technical design constraints
5. Write a practical to study Wireless HART, ZWave

Course Learning Outcomes: After studying this course students will be able to:

1. Differentiate M2M and IoT Analytics.
2. Identify the IoT Reference Architecture and Real-World Design Constraints
3. Understand the security issues in IoT protocols
4. Utilize various IoT Protocols (Datalink, Network, Transport, Session, Service)
5. Specify the technical design constraints at remote locations.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and Stamatis Karnouskos, David Boyle	From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence	Academic Press	2014.	978-0124076846
Peter Waher	Learning Internet of Things	PACKT publishing	2015	978-1783553532.
Daniel Minoli	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications	Willy Publications	2013	978-1118473474
Vijay Madisetti, Arshdeep Bahga	Internet of Things (A Hands-on Approach)	VPT	2015	978-8173719547

Course Title: Quantum Computing and Machine Learning (Specialization: Quantum Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**10 H**
Forms of quantum computing, Quantum Computing: Abstraction Levels, Quantum Circuit, Quantum Operators, Single-qubit operators, Multi-qubit operators, Quantum State, Quantum Evolution, Quantum Measurement, POVM Operators, Density Operators		
Unit II: Data Encoding		**11 H**
Data Representations, Basis encoding, Amplitude encoding, Dynamic encoding, Angle encoding, Qsample Encoding, QuAM encoding, Divide-and-conquer encoding, Decoherence, Quantum Supremacy, Quantum Annealing		
Unit III: Quantum Fourier Transform and Related Algorithms		**12 H**
Quantum Fourier Transform, Quantum Phase estimation, Expectation Values, Shor's Period Finding Algorithm and Factoring, Hidden Subgroup Problem, Quantum Random Access Memory, Quantum Support Vector Machines, Adiabatic quantum computing		
Unit IV: Quantum Machine Learning		**12 H**
HHL Algorithm, HHL, Quantum Linear Regression, Quantum Swap Test Subroutine, Swap Test Implementation, Quantum Euclidean Distance Calculation, Quantum K-Means Clustering, Quantum Principal Component Analysis, Quantum Support Vector Machines, variational quantum classifier		

List of Experiments (Total:30 Hours)

1. Implement Quantum Fourier Transform.
2. Execute Quantum phase implementation and phase estimation.
3. Execute quantum enhanced support vector machine.
4. Write a program for quantum K-means clustering.
5. Write a program visualize multidimensional data with quantum computing.
6. Write a program for multi-class classification with quantum computing.
7. Write a program for variational quantum classifier.
8. Implement HHL algorithm.
9. Implement SVM algorithm.
10. Implement variational quantum classifier.

Note: Phyton Cirq and Qiskit may be used for implementation

Course Learning Outcomes: After studying this course students will be able to:

1. Understand Principles of Quantum Computing
2. Comprehend the differences between Conventional Computing & Quantum Computing.
3. Analyze various types of Quantum Computing Algorithms
4. Implement applications of Quantum Computing in Machine Learning.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Peter Wittek	Quantum Machine Learning: What Quantum Computing Means to Data Mining	Academic Press	2016	978-0128100400
Siddhartha Bhattacharyya	Quantum Machine Learning	De Gruyter; 1st edition	2020	978-3110670646
Santanu Ganguly	Quantum Machine Learning: An Applied Approach	Apress Berkeley, CA	2021	978-1-4842-7098-1
Frank Zickert	Hands-On Quantum Machine Learning With Python	Independent	2021	979-8516564499

Course Title: Introduction to NoSQL Database (Specialization: Full Stack Development)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to NoSQL Databases and its types		**11 H**
Overview of NoSQL databases, Characteristics of NoSQL databases, Advantages and disadvantages of NoSQL databases, Comparison with traditional relational databases, Document-oriented databases, Key-value databases, Column-family databases, Graph-based databases		
Unit II: Comparison with other databases and challenges		**12 H**
Comparison of relational databases to new NoSQL stores, MongoDB, Cassandra, HBASE, Neo4j use and deployment, Application, RDBMS approach, Challenges NoSQL approach		
Unit III: NoSQL Data Models		**12 H**

JSON and BSON data models, Querying NoSQL databases, Indexing in NoSQL databases, Replication and sharding, MapReduce on databases. Distribution Models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication		
Unit IV: NoSQL Platforms and Tools		**10 H**
MongoDB, Cassandra, Couchbase, Neo4j, Riak, HBase, DynamoDB, Redis		

List of Experiments (Total:30 Hours)

Lab Experiment 1: Installing and Configuring MongoDB

Lab Experiment 2: Creating and Querying MongoDB Database

Lab Experiment 3: Installing and Configuring Cassandra

Lab Experiment 4: Creating and Querying Cassandra Database

Lab Experiment 5: Installing and Configuring Couchbase

Lab Experiment 6: Creating and Querying Couchbase Database

Lab Experiment 7: Installing and Configuring Neo4j

Lab Experiment 8: Creating and Querying Neo4j Database

Lab Experiment 9: Comparing NoSQL Database Performance with Traditional Relational Database

Lab Experiment 10: Designing and Implementing a NoSQL Database Project

Course Learning Outcomes: After studying this course students will be able to:

1. Analyze the characteristics of NoSQL databases and their applications in real-world scenarios.
2. Evaluate the various types of NoSQL databases and choose the appropriate type based on the requirements of the application.
3. Design, implement, and query NoSQL databases using different NoSQL platforms and tools.
4. Compare and contrast the features and performance of NoSQL databases with traditional relational databases.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Martin Fowler and Pramod J. Sadalage	NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence	Addison-Wesley Professional	2012	978-0321826626

Luc Perkins, Eric Redmond, and Jim Wilson	Seven Databases in Seven Weeks: A Guide to Modern Databases and the NoSQL Movement	Pragmatic Bookshelf	2012	978-1934356920
Dan Sullivan	NoSQL for Mere Mortals	Pearson Education	2015	978-0134023212
Kristina Chodorow	MongoDB: The Definitive Guide	O'Reilly Media	2013	978-1449344689

Course Title: Natural Language Processing (Specialization: AI & ML)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**10 H**
Introduction to NLP, Brief origin, Challenges, Motivations, Applications, NLP tasks: syntax, semantics, and pragmatics.		
Unit II: Morphology and Language models		**12 H**
Inflectional and Derivation Morphology, Morphological Analysis and Generation using finite state transducers **POS Tagging and Language Modelling:** The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.		
Unit III: Parsing and Semantics		**12 H**
Introduction to phrases, clauses and sentence structure, various parsing techniques: (shift-reduce, chart, Shallow, Statistical), Scope Ambiguity and Ambiguity resolution, Approaches to discourse, generation. **Semantic Analysis:** Lexical semantics& word-sense disambiguation. Compositional semantics. Thematic Role, Semantic Role Labeling and Semantic Parsing.		
Unit IV: Machine Translation and Applications		**11 H**
Machine Translation (Issues in MT, various MT approaches: Direct, Rule-Based, Knowledge Based, Statistical). NLP aapplications: Sentiment analysis**, Information Extraction etc.**		

List of Experiments (Total:30 Hours)

1. Install Python and understand NLTK toolkit.
2. To implement and familiarize with the APIs provided by the NLTK python.
3. To practice various functions applied on text strings.
4. To write a function to generate bigrams in a text.

5. To write a function to generate collocations.
6. To write a program to construct dictionary from words from text of book of nltk.
7. To use concordance, similar, common context, FreqDist functions of nltk toolbox.
8. To write functions to compute lexical diversity of text, tokenize text.
9. From user provided text generate collocations and check your result using statistical test. (Assume consecutive words as bigrams.)
10. Generate POS tagging using function pos_tagging(). Use the nltk list for your own tagging.
11. To test RE for finding verbs forms of a word. (inflextions).
12. To test RE for finding adjectives forms of a word. (inflextions).

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the concept of natural language processing, various challenges and applications.
2. Acquire knowledge about various morphological forms and selecting a suitable language modelling technique.
3. Understand and apply various parsing techniques after having a knowledge of semantics.
4. Comprehend the use of machine translation and distinguish between its approaches.
5. Design and implement the NLP concepts on real life applications.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Jurafsky D. and Martin H. J	Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition	Prentice Hall	2014	978-0131873216
Manning and Schutze	Foundations of Statistical Natural Language Processing	MIT Press	1999	978-0262133609
Steven Bird, Ewan Klein, Edward Loper	Natural Language Processing with Python – Analyzing Text with the Natural Language Toolkit	O'Reilly	2009	978-0596516499
Dipanjan Sarkar	Text Analytics with Python	Apress	2019	978-1484243534

Course Title: Cloud Application Development and Deployment (Specialization: Cloud Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Cloud Based Applications:		**10 H**
Introduction, Contrast traditional software development and development for the cloud. Public v private cloud apps. Understanding Cloud ecosystems – what is SaaS/PaaS, popular APIs, mobile.		
Unit II: – Designing Code For The Cloud:		**11 H**
Class and Method design to make best use of the Cloud infrastructure; Web Browsers and the Presentation Layer: Understanding Web browsers attributes and differences. Building blocks of the presentation layer: HTML, HTML5, CSS, Silverlight, and Flash.		
Unit III: Web Development Techniques And Frameworks:		**12 H**
Building Ajax controls, introduction to Javascript using JQuery, working with JSON, XML, REST. Application development Frameworks e.g., Ruby on Rails, .Net, Java API's or JSF; Deployment Environments – Platform as A Service (PAAS), Amazon, VMForce, Google App Engine, Azure, Heroku, AppForce		
Unit IV: Cloud Deployment Techniques		**12 H**
Cloud Deployment Techniques: Factors for Successful Cloud Deployment – Network Requirements – Potential Problem areas in a cloud Network and their Mitigation – Cloud Network Topologies. Automation and Self-service feature in a cloud –cloud performance. Comparison of Various Cloud Deployment models		

List of Experiments (Total:30 Hours)

1. Apply the security model for cloud application with network, data and security considerations
2. Develop an information security framework model for cloud operation
3. Building an application using the lamp stack
4. Developing and deploying an application in the cloud.
5. Analyze a real-world problem and develop a cloud/lamp-based software solution.
6. Deploy a Web Application on AWS
7. Deploying VM on Open Stack platform
8. Building applications on VM in open stack platform

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the applications of cloud computing
2. Develop an application in Cloud.
3. Describe various Cloud Deployment models and differentiate the various models.
4. Illustrate private cloud deployment key features
5. Analyze the various cloud service providers on the basis of requirements and constraints

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Gautam Shroff	Enterprise Cloud Computing Technology Architecture Applications	Cambridge University Press;	2010	978-0521137355

Thomas Erl, Zaigham Mahmood, and Ricardo Puttini	Cloud Computing Concepts, Technology & Architecture	Prentice Hall	2013	
Greg Schulz	Cloud and Virtual Data Storage Networking	Auerbach Publications	2012	978-1439851739
Rajkumar Buyya, James Broberg, Andrzej M. Goscinski	Cloud Computing: Principles and Paradigms	Wiley	2011	978-0470887998

Course Title: Risk Analysis & Assessment (Specialization: Cyber Security)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**12 H**
Cybersecurity risk Terminologies, position of risk analysis and management in relation to the other components of a cybersecurity programme. Principles: Assets, vulnerabilities, threats, threat actors, likelihood. Management of risks compared to simple acceptance. Risk treatment options: avoidance, mitigation, transfer, acceptance.		
Unit II: Assets and Vulnerabilities		**11 H**
Assets: Tangible and intangible assets in the cyber world (hardware / software / data, classification, criticality analysis, dependencies, potential for critical national infrastructure. Vulnerabilities: Sources of cyber vulnerability, complexity of modern software, attack surface of modern systems, development of software for functionality and not with security considerations, zero-day system vulnerabilities, vulnerability databases and open information.		
Unit III: Threats and Risk analysis		**11 H**
Threats: Cyber threat categorization, sources, motivation, type, technical vs. non-technical, threat actors, exploitation of cyber vulnerabilities leading to impact and associated likelihood. Risk analysis: Risk as a combination of possible impact of a threat exploiting a vulnerability and its probability, evaluation of cyber risks, categorization, qualitative and quantitative risk analysis, pre-requisites for meaningful quantitative cyber risk assessment, methodologies, risk register.		
Unit IV: Risk management and Assessment		**11 H**
Risk management/ Assessment: Risk evaluation, Risk treatment options, risk avoidance, mitigation, transfer, acceptance, risk management as an iterative process, risk profile stemming from modifications in an organisation's environment, building an organisation's cybersecurity control environment from the results of risk analysis, cybersecurity controls.		

List of Experiments (Total:30 Hours)

1. Perform. a Simple Risk Assessment
2. Conduct a risk assessment Case Study
3. Analyze various formal Risk Assessment Tools
4. Perform log parsing to identify risks.
5. Analyze some of the cyber-attacks like ransomware and data leaks.

Course Learning Outcomes: After studying this course students will be able to:

1. To understand and apply principles of risk analysis and assessment and their benefits.
2. Acquire understanding of terminologies of risk, analysis, management, vulnerability, threats, actors, impact, etc.
3. Perform a complete risk assessment.
4. Distinguish between various of different risk assessment/management methodologies and assets.
5. Evaluate and select appropriate risk treatment options according to the combination of impacts.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Evan Wheeler	Security Risk Management: Building an Information Security Risk Management Program from the Ground Up	Syngress	2011	978-1597496155
Douglas W. Hubbard and Richard Seiersen	How to Measure Anything in Cybersecurity Risk	Audible Studios	2016	978-1536669749
Anne Kohnke and Dan Shoemaker	The Complete Guide to Cybersecurity Risks and Controls	Auerbach Publications	2016	978-1498740548
Carl Young	Metrics and Methods for Security Risk Management	Syngress	2010	978-1856179782

Course Title: Big Data Analytics (Data Science)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**11 H**
Data and Relations, Data Storage and Analysis, Big Data Analytics, Big data Architecture, Challenges, Types of Big Data, Characteristics - 5 Vs of Big Data, Need of big data frameworks. ETL in Big Data, Structured and Unstructured Data		
Unit II: Hadoop		**12 H**

Introduction to Hadoop, History, Hadoop components, Hadoop EcosystemHDFS, Map-Reduce Programming, Comparison with other system, Working with HDFS Commands. Overview of Spark – Hadoop vs Spark		
Unit III: Map Reduce Programming		**12 H**
Map Reduce working principle, Map Reduce types and formats, MapReduce features, Combiner optimization, Map side join, Reduce Side Join, Secondary sorting, Pipelining MapReduce jobs.		
Unit IV: Data Analytics		**10 H**
Understanding Text Analytics and Big Data, Predictive analysis on Big Data, Role of Data analyst. Association and correlation analysis, regression models.		

List of Experiments (Total:30 Hours)

1. Implement relevant big data tools and technologies.
2. Perform Installation of Hadoop.
3. Upload and download a file in HDFS.
4. Display last few lines of a file.
5. Implement the file management tasks in Hadoop:
6. Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
7. Write a Map Reduce program that mines weather data

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the need and fundamental concepts related to Big Data.
2. Comprehend the concepts of Hadoop, Map-Reduce and HDFS commands.
3. Analyse various big data frameworks and technologies.
4. Implement some techniques related to data analytics with sample data sets.
5. Implement different programs to understand Hadoop architecture.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Seema Acharya, Subhashini Chellapan	Big Data and Analytics	Wiley	2015	978-8126579518
Raj Kamal, Preet Saxena	Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning	McGraw-Hill Education	2019	9789353164966.
White T.	Hadoop: The Definitive Guide	O' Reilly Media	2012	978-1-49190163-2
Donald Miner, Adam Shook,	MapReduce Design Pattern	O'Reilly,	2012	978-1449327170

Course Title: Blockchain Components and Architecture (Specialization: Blockchain & IOT)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Blockchain		**11 H**
Basic components of blockchain architecture, Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature, Hashchain to Blockchain, Basic consensus mechanisms		
Unit II: Consensus		**11 H**
Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains		
Unit III: Hyperledger Fabric		**11 H**
Hyperledger Fabric (A): Decomposing the consensus process, Hyperledger fabric components, Chain code Design and Implementation **Hyperledger Fabric (B):** Beyond Chain code: fabric SDK and Front End, Hyperledger composer tool		
Unit IV: Blockchain at different platforms		**12 H**
Use case 1: Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance **Use case 2:** Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management, etc. **Use case 3:** Blockchain for Government: (i) Digital identity, land records and other record keeping between government entities.		

List of Experiments (Total:30 Hours)

1. Introduction to blockchain architecture and its components.
2. Basic crypto primitives considered during designing of blockchain
   - ✓ Hash
   - ✓ Signature
   - ✓ Hashchain to Blockchain
3. Implementation of Proof of work (PoW)
4. Implementation of permissioned blockchain using Consensus protocols
5. Implementation of Decomposing the consensus process
6. Implementation of Hyperledger composer tool
7. Implementation of Blockchain in Financial Software and Systems
8. Implementation of Blockchain in trade/supply chain
9. Implementation of Blockchain for Government

Course Learning Outcomes: After studying this course students will be able to:

1. Familiar with the Blockchain, which is fundamentally a public digital ledger to share information in a trustworthy and secure way.
2. Applicate Blockchain in cryptocurrencies to various other domains, including business process management, smart contracts, IoT and so on.
3. Learn about fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different domains.
4. Implement various consensus protocols in blockchain designing
5. Decompose and compose the consensus processes

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Andreas Antonopoulos	Mastering Bitcoin: Unlocking Digital Cryptocurrencies	O, Reilly	2014	978-1449374044
Singh Arun, Jerry Cuomo, Nitin Gaur	Blockchain for Business	Addison-Wesley Professional	2019	978-0135581360
Nakul Shah	Blockchain For Business with Hyperledger Fabric: A Complete Guide To Enterprise Blockchain Implementation Using Hyperledger Fabric	BPB	2019	978-9388511650
Chandramouli Subramanian	Blockchain Technology	Universities Press (India)	2020	978-9389211634

Course Title: Quantum Computing with Information Theory (Specialization: Quantum Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**10 H**
Introduction and IBM Quantum Perspective, Q Mission in India – Invited talk, Quantum Computing Applications, Quantum Computing Basics, Quantum Measurements Density Matrices Positive-Operator Valued Measure		
Unit II: Quantum Composer		**12 H**
IBM Quantum Composer and Quantum Lab using Qiskit, Simon's Algorithm, Grover's Algorithm, Fragility of quantum information: Decoherence, Quantum Superposition and Entanglement, Quantum Gates and Circuits		
Unit III: Quantum Algorithms		**11 H**
No cloning theorem & Quantum Teleportation, Bell's inequality and its implications, Quantum Algorithms & Circuits, Deutsch and Deutsch–Jozsa algorithms, Grover's Search Algorithm, Quantum Fourier Transform		
Unit IV: Quantum Error Correction		**12 H**
Quantum Error Correction, NISQ era Quantum Algorithms (VQE/QAOA and industrial applications), Quantum Error Correction: Fault tolerance, Quantum Cryptography, Implementing Quantum Computing: issues of fidelity, Scalability in quantum computing, NMR Quantum Computing, Spintronics and QED approaches		

List of Experiments (Total:30 Hours)

1. Implement and understand Decision Tree Algorithm.
2. Implement and understand K-NN Algorithm.
3. Execute quantum enhanced support vector machine.
4. Write a program for quantum Hierarchical clustering.
5. Write a program visualize n-dimensional data with quantum computing.
6. Write a program for binary-class classification with quantum computing.
7. Write a program for variational quantum classifier using machine learning algorithm.
8. Write a program to simulate the behavior of qubits in a superposition state and observe the probabilities of the qubit collapsing into one of the basis states upon measurement.
9. Implement the protocol of quantum teleportation using C programming and test the program on different quantum states.
10. Study the concept of quantum error correction using the three qubit bit-flip code and implement it using C programming.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand Principles of Quantum Computing
2. Comprehend the differences between Conventional Computing & Quantum Computing.
3. Analyze various types of Quantum Computing Algorithms
4. Implement applications of Quantum Computing in Machine Learning.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Phillip Kaye, Raymond Laflamme	An introduction to Quantum Computing	Oxford University press	2007	019857049X
Chris Bernhardt	Quantum Computing for Everyone	The MIT Press	2020	0262039257
M. A. Nielsen &I.Chuang	Quantum Computation and Quantum Information	Cambridge University Press	2013	9781107002173
Frank Zickert	Hands-On Quantum Machine Learning With Python	Independent	2021	979-8516564499

Course Title: Big Data Analytics (Specialization: Full Stack Development)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**11 H**
Data and Relations, Data Storage and Analysis, Big Data Analytics, Big data Architecture, Challenges, Types of Big Data, Characteristics - 5 Vs of Big Data, Need of big data frameworks. ETL in Big Data, Structured and Unstructured Data		
Unit II: Hadoop		**12 H**
Introduction to Hadoop, History, Hadoop components, Hadoop EcosystemHDFS, Map-Reduce Programming, Comparison with other system, Working with HDFS Commands. Overview of Spark – Hadoop vs Spark		
Unit III: Map Reduce Programming		**12 H**
Map Reduce working principle, Map Reduce types and formats, MapReduce features, Combiner optimization, Map side join, Reduce Side Join, Secondary sorting, Pipelining MapReduce jobs.		
Unit IV: Data Analytics		**10 H**
Understanding Text Analytics and Big Data, Predictive analysis on Big Data, Role of Data analyst. Association and correlation analysis, regression models.		

List of Experiments (Total:30 Hours)

1. Implement relevant big data tools and technologies.
2. Perform Installation of Hadoop.
3. Upload and download a file in HDFS.
4. Display last few lines of a file.
5. Implement the file management tasks in Hadoop:
6. Run a basic word count Map Reduce program to understand Map Reduce Paradigm.
7. Write a Map Reduce program that mines weather data

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the need and fundamental concepts related to Big Data.
2. Comprehend the concepts of Hadoop, Map-Reduce and HDFS commands.
3. Analyse various big data frameworks and technologies.
4. Implement some techniques related to data analytics with sample data sets.
5. Implement different programs to understand Hadoop architecture.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Seema Acharya, Subhashini Chellapan	Big Data and Analytics	Wiley	2015	978-8126579518
Raj Kamal, Preet Saxena	Big Data Analytics: Introduction to Hadoop, Spark, and Machine-Learning	McGraw-Hill Education	2019	9789353164966.
White T.	Hadoop: The Definitive Guide	O' Reilly Media	2012	978-1-49190163-2
Donald Miner, Adam Shook,	MapReduce Design Pattern	O'Reilly,	2012	978-1449327170

Course Title: Blockchain Technology

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**

Blockchain- Public Ledgers, Blockchain as Public Ledgers -Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions- Distributed Consensus, The Chain and the Longest Chain - Cryptocurrency to Blockchain 2.0 - Permissioned Model of Blockchain, Cryptographic - Hash Function, Properties of a hash function-Hash pointer and Merkle tree		
Unit II: Bitcoin and Cryptocurrency		**15 H**
A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay, Consensus introduction, Distributed consensus in open environmentsConsensus in a Bitcoin network		
Unit III: Bitcoin Consensus		**15 H**
Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW, Bitcoin PoW, Attacks on PoW, monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool- Permissioned model and use cases, Design issues for Permissioned Blockchains, Execute contracts- Consensus models for permissioned blockchain-Distributed consensus in closed environment Paxos		
Unit IV: Blockchain Applications		**15 H**
Internet of Things-Medical Record Management System-Block chain in Government and Block chain Security-Block chain Use Cases –Finance.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand emerging abstract models for Block chain Technology.
2. Identify major research challenges and technical gaps existing between theory and practice in crypto currency domain.
3. Develop conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
4. Apply Hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5. Develop the ability to create crypto currencies and give a strong technical understanding of Block chain technologies with an in-depth understanding of applications, open research challenges, and future directions.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Bashir, Imran	Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks	Packt Publishing	2017	978-1787125445

Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder	Bitcoin and cryptocurrency technologies: a comprehensive introduction	Princeton University Press	2016	978-0691171692
Nakul Shah	Blockchain For Business With Hyperledger Fabric: A Complete Guide To Enterprise Blockchain Implementation Using Hyperledger Fabric	BPB Publication	2019	978-9388511650
Joseph Bonneau et al.	SoK: Research perspectives and challenges for Bitcoin and cryptocurrency	IEEE Symposium on Security and Privacy	2015	DOI 10.1109/SP.2015.14

Course Title: Distributed Databases

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Distributed data processing: What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts. Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issue.		
Unit II: Distributed Database Deign		**15 H**
Alternative design strategies; Distributed design issues; Fragmentation; Data allocation. View management; Data security; Semantic Integrity Control. Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data.		
Unit III: Transaction and Concurrency Control		**15 H**
Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms. Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms. Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management.		
Unit IV: Reliability and Parallel Databases		**15 H**

Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols. Parallel architectures; parallel query processing and optimization; load balancing Databases, Distributed Object Management, Multi-databases.		

Course Learning Outcomes: After studying this course students will be able to:

1. Design trends in distributed systems.
2. Apply network virtualization in distributed environment.
3. Apply remote method invocation and objects.
4. Understand the concepts of parallel databases.
5. Get insight on Transaction and Concurrency control mechanisms.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
M.T. Ozsu and P. Valduriez	Principles of Distributed Database Systems	Springer	2019	978-3030262525
D. Bell and J. Grimson	Distributed Database Systems	Addison-Wesley	1992	978-0201544008
Stefano Ceri, Giuseppe Pelagatti	Distributed Databases: Principles and Systems	Mc Graw Hill	2017	978-0070265110
Judith Hurwitz, Robin Bllor, Marcia Kaufman, Fern Halper	Cloud Computing for dummies	Wiley	2009	978-8126524877
Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi	Mastering Cloud Computing	Mc Graw Hill	2017	978-1259029950

Course Title: Network Security

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Internet Architecture Vulnerabilities, Network Security Terminology: Identification, Confidentiality, Authentication, Authorization, Access Control, Integrity, Non-Repudiation, Freshness, and Availability, Network Threats and Types of attacks, Introduction to malwares.		

Unit II: Cryptography		**15 H**
Symmetric Cipher Model, Classical Cryptographic Algorithms: Monoalphabetic Substitutions such as Caesar Cipher, Cryptanalysis of Monoalphabetic ciphers; Polyalphabetic Ciphers such as Vigenere, Vernam Cipher; Transposition Cipher. Stream and Block Ciphers, Block cipher: principles, Data Encryption Standard (DES), Analyzing and Strengthening of DES, Introduction to Advance Encryption Standard (AES), modes of operations, Concept of Asymmetric Cryptography, Rivets-Shamir-Adleman (RSA) Key Generation, Encryption and Decryption Algorithm		
Unit III: Key Management and Hashing		**15 H**
Solving Symmetric Key Distribution Problem, Diffie-Hellman Algorithm, Key Exchange with Public Key Cryptography or Asymmetric Cryptography, Digital Envelope, ELGamal Cryptosystem, Public Key Certificate Structure, Distribution of Public Key, Certificate Authority Hash concept, Hash Function Requirements, Popular Message Digest and Hash Algorithms: MD4 and MD5, Secure Hash Algorithms such as SH1 and SHA2, Digital Signature, Digital Signature Standard (DSA)		
Unit IV: Authentication, Security and Firewalls		**15 H**
Basic authentication protocols, concept of Key distribution centre (KDC), Needham-Schroeder Authentication Protocol, Kerberos, writing authentication protocols using KDC and public key cryptography Why IP security: IP security Architecture, Authentication Header, Encapsulating Security Payload. Web security consideration, Secure Socket Layer Protocol, Transport Layer Security, Secure Electronic Transaction Protocol. Firewall Design principles, Trusted Systems, Virtual Private Networks.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand real time systems for identifying security threats.
2. Compare public and private cryptographic algorithms and make use of the same for encryption and decryption of messages.
3. Design confidential systems with minimum possible threats.
4. Apply both cryptography and hashing to create digital signatures and certificates for achieving integrity.
5. Understand application of cryptosystems in design of, IPSec, AH, and ESP protocols.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
William Stallings	Cryptography and Network Security - Principles and Practice	Pearson	2017	978-9332585225
Charles P.Pfleeger	Security in Computing	Pearson	2007	978-8131727256
Atul Kahate	Cryptography & Network Security	Mc Graw Hill	2017	978-1259029882

Bruce Schneier	Applied Cryptography: Protocols, Algorithms, and Source Code in C	Wiley	2015	978-1119096726
William R. Cheswick and Steven M. Bellovin	Firewalls and Internet Security: Repelling: The Wily Hacker	Addison Wesley	1994	978-0201633573
Rolf Oppliger	Security Technologies for the world wide web	Artech House	2000	978-1580530453

Course Title: Parallel Computing

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Paradigms of parallel computing: Synchronous - vector/array, SIMD, Systolic; Asynchronous - MIMD, reduction paradigm. Flynn's classifications, Handler's classifications. Software taxonomy: Kung's taxonomy, SPMD.		
Unit II: Computation Models and Performance Metrices		**15 H**
Combinational circuits, Sorting network, PRAM models, Interconnection RAMs. Parallelism approaches - data parallelism, control parallelism. Laws governing performance measurements. Metrices - speedups, efficiency, utilization, communication overheads, single/multiple program performances, benchmarks.		
Unit III: Parallel Programming		**15 H**
Taxonomy and topology - shared memory multiprocessors, distributed memory networks. Processor organization - Static and dynamic interconnections. Embeddings and simulations. Shared memory programming, distributed memory programming, object-oriented programming, data parallel programming, functional and dataflow programming.		
Unit IV: Scheduling		**15 H**
Scheduling parallel programs. Loop scheduling. Parallelization of sequential programs. Parallel programming support environments.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the core concepts and classifications of parallel computing.
2. Understand the concept of computation in parallel computing.

3. Analyze the performance in parallel computing scenarios.
4. Understanding about parallel computing and Programming.
5. Analyze various scheduling techniques in parallel computing.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
M. J. Quinn	Parallel Computing: Theory and Practice	Tata McGraw Hill	2017	978-0070495463
T. G. Lewis and H. El-Rewini	Introduction to Parallel Computing	Prentice Hall	1992	978-0134989242
T. G. Lewis	Foundations of Parallel Programming: A Machine-Independent Approach	IEEE Computer Society	1994	978-0818656927

Course Title: Ethical Hacking

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**15 H**
Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking.		
Unit II: Foot Printing & Scanning		**15 H**
Foot printing: Authoritative, Non -Auth reply by DNS, Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase. Scanning: Detecting live systems on the target network, discovering services running /listening on target systems, understanding port scanning techniques, Identifying TCP and UDP services running on the target network, Understanding active and passive fingerprinting.		
Unit III: Hacking		**15 H**
System Hacking: Aspect of remote password guessing, Role of eavesdropping, Various methods of password cracking, Keystroke Loggers, Understanding Sniffers, Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing. Hacking Wireless Networks: Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Securing Wireless Networks.		
Unit IV: Cryptography		**15 H**
Cryptography: Understand the use of Cryptography over the Internet through PKI, RSA, MD-5, Secure Hash Algorithm and Secure Socket Layer.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the significance of Ethical Hacking.
2. Understand the methods of scanning and looking for footprints,
3. Analyze the methods involved in hacking systems and wireless networks.
4. Implement cryptography algorithms,
5. Understand the security aspects need to be adopted against hacking.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Rajat Khare	Network Security and Ethical Hacking	Luniver Press	2006	978-1905986002
Thomas Mathew	Ethical Hacking	OSB Press	2003	9780972936217
Stuart McClure, Joel Scambray and George Kurtz	Hacking Exposed: Network Security Secrets & Solutions	Tata Mc Graw Hill	2012	978-0071780285

Course Title: Information Theory and Coding

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Information Theory		**15 H**
Information theory: Concept of amount of information, information units Entropy: marginal, conditional, joint and relative entropies, relation among entropies Mutual information, information rate, channel capacity, redundancy and efficiency of channels Discrete channels – Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Noise-Free Channel, Channel with independent I/O, Cascaded channels, repetition of symbols, Binary asymmetric channel, Shannon theorem.		
Unit II: Source Coding		**15 H**
Source coding – Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes – Shannon Fano coding, Shannon Fano Elias coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding, Arithmetic coding, Dictionary coding – LZ77, LZ78, LZW, ZIP coding Channel coding, Channel coding theorem for DMC.		
Unit III: Error Detection and Correction		**15 H**
Codes for error detection and correction – Parity check coding, Linear block codes, Error detecting and correcting capabilities, Generator and Parity check matrices, Standard array and Syndrome decoding, hamming codes Cyclic codes – Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, BCH codes, RS codes, Burst error correction.		
Unit IV: Convolutional Codes		**15 H**

Convolutional codes – Encoding and State, Tree and Trellis diagrams, Maximum likelihood decoding of convolutional codes -Viterbi algorithm, Sequential decoding -Stack algorithm. Interleaving techniques – Block and convolutional interleaving, Coding and interleaving applied to CD digital audio system - CIRC encoding and decoding, interpolation and muting. ARQ – Types of ARQ, Performance of ARQ, Probability of error and throughput.		

Course Learning Outcomes: After studying this course students will be able to:

1. Quantify the notion of information in a mathematically sound way
2. Calculate entropy, joint entropy, relative entropy, conditional entropy, and channel capacity of a system
3. Differentiate between lossy and lossless compression techniques
4. Decide an efficient data compression scheme for a given information source
5. Explain the impact of feedback and/or many senders or receivers on the communication systems

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
T. M. Cover, J. A. Thomas	Elements of Information Theory	Wiley	2006	978-0471241959
R. Togneri, C.J.S deSilva	Fundamentals of Information Theory and Coding Design	CRC	2003	978-1584883104
R. J. McEliece	The Theory of Information and Coding	Cambridge Univ. Press	2004	978-0521831857
R. Bose	Information Theory Coding and Cryptography	Mc Graw Hill	2017	978-9385880568

Program Structure for B. Tech. CSE
Semester VIII

Sr. No.	Course Code	Course Title	Type of course	Hours per week			Credits
				L	T	P	
1		Specialization –V	Specialization Elective	3	0	2	4
2		Domain Elective -V	Domain Elective Course	3	0	0	3

3		Domain Elective -VI	Domain Elective Course	3	0	0	3
4		**Open Elective -IV	Inter-Disciplinary Elective	3	0	0	3
5		**Industrial Training	NTCC	0	0	0	10
		TOTAL		**09**	**0**	**10**	**23**
			Total Credits	**Min Required: 23** **Semester Credits: 23**			

****Students may be given permission to undergo internship for complete 8th semester (or to take early joining in the company) under special circumstances subject to fulfillment of certain conditions (to be decided later on by Hon'ble Vice Chancellor) and approval by Hon'ble Vice Chancellor. Following conditions is mandatory for such cases in addition to conditions set by Hon'Ble Vice Chancellor.**

i. The conduct of the student was good throughout the degree.
ii. The student is academically good and preformed consistently well during the period he studied in Amity University for the said program.
iii. The student is ready to fulfill any special requirement put up by the Hon'ble Vice Chancellor to grant the permission.
iv. The internship has been offered by the company of international repute along with preplacement offer (PPO).

Domain Elective V

Digital Image processing
Computational Biology
Simulation and Modelling

Domain Elective VI

Adhoc and Wireless sensor networks
Quantum Computing
Computer Vision

Course Title: Deep Learning (Specialization: AI & ML)

Course Contents/syllabus:

L	**T**	**P/S**	**SW/FW**	**TOTAL CREDIT UNITS**
3	**0**	**2**	**0**	**4**

		Teaching Hours
Unit I: Introduction		**12 H**
Basics of machine learning, Introduction to deep learning, Neural Network Basics, Linear Classifiers and Gradient Descent, Shallow Neural Networks, Deep Neural Networks (creation and training).		

Unit II:		**11 H**
Autoencoders (standard, denoising, contractive, etc) Variational Autoencoders, Properties of CNN representations, Deep Convolutional Models		
Unit III:		**11 H**
Generalization (dropout and convolutional networks), Model sequence data using Recurrent Neural Networks (RNNs), Gated Recurrent Units GRU, Long Short-Term Memory LSTM. Data representation/feature learning.		
Unit IV:		**11 H**
Basics of generative adversial networks (GANs), GAN training, Synthesizing and manipulating images with GANs., Applications of neural networks		

List of Experiments (Total:30 Hours)

1. To implement and practice Python Basics with Numpy
2. To implement the learning models using open-source libraries.
3. To build a simple classifier in Python.
4. To implement Logistic Regression with a neural network mindset
5. To practice softwares relevant to deep learning such as Numpy, Matplotlib etc.
6. To implement image recognition using convolutional nets.
7. To generate text using recurrent nets.
8. To work on projects related to deep learning applications.

Course Learning Outcomes: After studying this course students will be able to:

1. To understand basic concepts of deep learning.
2. To be able to compare and analyse differences between usage of machine learning and deep learning.
3. To understand concepts and working of various sequence and generative models and CNNS.
4. To learn representations for high-dimensional data, such as images, text and data.
5. To implement some of the deep learning open-source libraries for solving real life problems.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Ian Goodfellow and Yoshua Bengio and Aaron Courville,	Deep Learning	MIT Press	2016	978-0262035613
Charu C. Aggarwal,	Neural Networks and Deep Learning",	Springer	2018	978-3-319-94462-3
Eugene Charniak	Introduction to Deep Learning	MIT Press	2019	978-0262039512
Francois Chollet	Deep Learning with Python	Manning Publications.		978-1617294433

Course Title: **Could Security (Specialization: Cloud Computing)**

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Fundamentals of Cloud Computing		**11 H**
Introduction to Cloud computing, Understand the Cloud deployment models: Public, Private, Community and Hybrid models. **Scope of Control:** SaaS, PaaS, IaaS. **Risks and Security Concerns:** Common attack vectors & threats and CSA, NIST and ENISA guidelines for Cloud Security.		
Unit II: Data Protection for Cloud Infrastructure and Services		**12 H**
Understand the Cloud based Information Life Cycle, Data protection for Confidentiality and Integrity, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key, Management. Enforcing Access Control for Cloud Infrastructure based Services: Access control for Cloud infrastructure, Enforcing Access Control Strategies: Authentication and Authorization, Roles-based Access Control, Multi-factor authentication, Host, storage and network access control options, OS Hardening and minimization, securing remote access.		
Unit III: Cloud Design Pattern		**10 H**
Introduction to Design Patterns, Understanding Design Patterns Template. Architectural patterns for Cloud Computing: Platform-to-Virtualization & Virtualization-to-Cloud, Cloud bursting.		
Unit IV: Security Design Patterns		**12 H**
Cloud Computing Security Design Patterns: Security Patterns for Cloud Computing: Trusted Platform, Geo-tagging, Cloud VM Platform Encryption, Trusted Cloud Resource Pools, Cloud Resource Access Control, Cloud Data Breach Protection, Permanent Data Loss Protection, In-Transit Cloud Data Encryption. Network Security, Identity & Cloud Security Access Management & Trust		

List of Experiments (Total:30 Hours)

1. Install VirtualBox/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
5. Find a procedure to transfer the files from one virtual machine to another virtual machine.
6. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version).
7. Program on various cloud sim.
8. Program based on cloud sim in security

Course Learning Outcomes: After studying this course students will be able to:

1. Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services.

2. Apply the concepts and guiding principles for designing and implementing appropriate safeguards and countermeasures for Cloud based IT services
3. Analyze approaches to designing cloud services that meets essential Cloud infrastructure characteristics – on demand computing, shared resources, elasticity and measuring usage.
4. Design security architectures that assure secure isolation of physical and logical infrastructures including compute, network and storage, comprehensive data protection at all layers.
5. Summarize the industry security standards, regulatory mandates, audit policies and compliance requirements for Cloud based infrastructures.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Vic (J.R.) Winkler	Securing The Cloud: Cloud Computing Security Techniques and Tactics	Syngress/Elsevier	2011	978-1597495929
Thomas Erl	Cloud Computing Design Patterns	Pearson Education India	2015	978-9332557307
Barrie Sosinsky	Cloud Computing Bible	Wiley-India	2011	978-8126529803
Ronald L. Krutz, Russell Dean Vines	Cloud Security: A Comprehensive Guide to Secure Cloud Computing,	Wiley	2010	978-0470589878

Course Title: Could Security (Specialization: Cyber Security)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Fundamentals of Cloud Computing		**11 H**
Introduction to Cloud computing, Understand the Cloud deployment models: Public, Private, Community and Hybrid models. **Scope of Control:** SaaS, PaaS, IaaS. **Risks and Security Concerns:** Common attack vectors & threats and CSA, NIST and ENISA guidelines for Cloud Security.		
Unit II: Data Protection for Cloud Infrastructure and Services		**12 H**
Understand the Cloud based Information Life Cycle, Data protection for Confidentiality and Integrity, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key, Management. **Enforcing Access Control for Cloud Infrastructure based Services:** Access control for Cloud infrastructure, Enforcing Access Control Strategies: Authentication and Authorization, Roles-based Access Control, Multi-factor authentication, Host, storage and network access control options, OS Hardening and minimization, securing remote access.		
Unit III: Cloud Design Pattern		**10 H**

Introduction to Design Patterns, Understanding Design Patterns Template. **Architectural patterns for Cloud Computing:** Platform-to-Virtualization & Virtualization-to-Cloud, Cloud bursting.		
Unit IV: Security Design Patterns		**12 H**
Cloud Computing Security Design Patterns: Security Patterns for Cloud Computing: Trusted Platform, Geo-tagging, Cloud VM Platform Encryption, Trusted Cloud Resource Pools, Cloud Resource Access Control, Cloud Data Breach Protection, Permanent Data Loss Protection, In-Transit Cloud Data Encryption. Network Security, Identity & Cloud Security Access Management & Trust		

List of Experiments (Total:30 Hours)

1. Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
5. Find a procedure to transfer the files from one virtual machine to another virtual machine.
6. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version).
7. Hands on practice on CloudSim.
8. Program based on cloud sim in security

Course Learning Outcomes: After studying this course students will be able to:

1. Identify the known threats, risks, vulnerabilities and privacy issues associated with Cloud based IT services.
2. Apply the concepts and guiding principles for designing and implementing appropriate safeguards and countermeasures for Cloud based IT services
3. Analyze approaches to designing cloud services that meets essential Cloud infrastructure characteristics – on demand computing, shared resources, elasticity and measuring usage.
4. Design security architectures that assure secure isolation of physical and logical infrastructures including compute, network and storage, comprehensive data protection at all layers.
5. Summarize the industry security standards, regulatory mandates, audit policies and compliance requirements for Cloud based infrastructures.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN

Vic (J.R.) Winkler	Securing The Cloud: Cloud Computing Security Techniques and Tactics	Syngress/Elsevier	2011	978-1597495929
Thomas Erl	Cloud Computing Design Patterns	Pearson Education India	2015	978-9332557307
Barrie Sosinsky	Cloud Computing Bible	Wiley-India	2011	978-8126529803
Ronald L. Krutz, Russell Dean Vines	Cloud Security: A Comprehensive Guide to Secure Cloud Computing,	Wiley	2010	978-0470589878

Course Title: Business Intelligence and Data Visualization (Specialization: Data Science)

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	**0**	**2**	**0**	**4**

	%ge	Teaching Hours
Unit I: INTRODUCTION TO BUSINESS INTELLIGENCE	**25%**	**12 H**
Business Intelligence (BI), Scope of BI solutions and their fitting into existing infrastructure, BI Components and architecture, BI Components, Future of Business Intelligence, Functional areas of BI tools, End user assumptions, setting up data for BI, Data warehouse, OLAP and advanced analytics, Supporting the requirements of senior executives including performance management, Glossary of terms and their definitions specific to the field of BI and BI systems.		
Unit II: ELEMENTS OF BUSINESS INTELLIGENCE SOLUTIONS	**25%**	**13 H**
Business Query and Reporting, Reporting, Dashboards and Scorecards Development, Development, Scorecards, Metadata models, Automated Tasks and Events, Mobile Business Intelligence, Software development kit (SDK). Stages of Business Intelligence Projects, Project Tasks, Risk Management and Mitigation, Cost justifying BI solutions and measuring success, BI Design and Development, Building Reports, Building a Report, Drill-up, Drill-down Capabilities.		
Unit III: DATA VISUALIZATION	**25%**	**12 H**
Introductions and overview: What Tableau can and cannot do well, Debug and troubleshoot installation and configuration of the software. **Creating Your First visualization:** Getting started with Tableau Software, Using Data file formats, connecting your Data to Tableau, creating basic charts (line, bar charts, Tree maps), Using the Show me panel **Tableau Calculations:** Overview of SUM, AVR, and Aggregate features Creating custom calculations and fields, Applying new data calculations to your visualization. **Formatting Visualizations:** Formatting Tools and Menus, formatting specific parts of the view, Editing and Formatting Axes.		

Manipulating Data in Tableau: Cleaning-up the data with the Data Interpreter, structuring your data, Sorting, and filtering Tableau data, Pivoting Tableau data. **Advanced Visualization Tools:** Using Filters, Using the Detail panel Using the Size panels, customizing filters, Using and Customizing tooltips, Formatting your data with colours. **Creating Dashboards & Stories:** Using Storytelling, creating your first dashboard and Story, Design for different displays, Adding interactivity to your Dashboard **Distributing & Publishing Your Visualization:** Tableau file types, Publishing to Tableau Online, sharing your visualization, Printing, and exporting. **Given a case study**: Perform Interactive Data Visualization with Tableau		
Unit IV: INTRODUCTION TO POWER BI	**25%**	**13 H**
Describe the Power BI ecosystem, Define Power BI and its relationship with Excel, Discuss the Power BI suite of products, Describe how the Power BI products integrate, Explain the typical analytics process flow, Differentiate between the various data sources, Connect Power BI to a data source, Clean and transform data to ensure data quality, Load the data to the Power BI Data Model, Describe the Power BI ecosystem, Define Power BI and its relationship with Excel, Discuss the Power BI suite of products, Describe how the Power BI products integrate, Explain the typical analytics process flow.		

Course Contents/syllabus:

List of Experiments (Total:30 Hours)

Perform at least 10 exercises on **Tableau and Power BI.** Faculty may choose the and exercises as per syllabus contents market requirements.

Course Learning Outcomes: After studying this course students will be able to:

1. Apply quantitative modelling and data analysis techniques to the solution of real-world business problems.
2. Understand the importance of data visualization and the design and use of many visual components.
3. Learn the basics of troubleshooting and creating charts using various formatting tools.
4. Learn basics of structuring data and creating dashboard stories adding interactivity dashboard stories.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Efraim Turban, Ramesh Sharda, Dursun Delen	Decision Support and Business Intelligence Systems	Pearson (9th Edition)	2010	978-0136107293

Learning Tableau 10 - Business Intelligence and data visualization that brings your business into focus"	Joshua N. Milligan	Ingram short title; 2nd edition	2016	978-1786466358
Tableau Your Data!	Daniel G. Murray	Wiley	2014	978-8126551392
Larissa T. Moss, S. Atre	Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making	Wesley	2003	978-0201784206
Carlo Vercellis	Business Intelligence: Data Mining and Optimization for Decision Making	Wiley	2003	978-8126541881
David Loshin Morgan, Kaufman	Business Intelligence: The Savvy Manager‟s Guide	Morgan Kaufmann Publishers	2003	978-1558609167

Course Title: Public Blockchain: Ethereum (Specialization: IOT & Blockchain)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction of Cryptography and Blockchain:		**12 H**
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.		
Unit II: Ethereum		**11 H**

Introduction to Ethereum, Ethereum vs bitcoin, Consensus Mechanisms, How Smart Contracts Work, Meta mask Setup, Ethereum Accounts, Receiving Ether's, concept of a Transaction, Smart Contracts, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain.		
Unit III: Solidity Programming:		**11 H**
Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address), Hyperledger		
Unit IV: Cryptocurrency Regulation:		**11 H**
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy. Applications: Internet of Things, Medical Record Management System, Domain Name Service and future of Blockchain.		

List of Experiments (Total:30 Hours)

1. Create a Simple Blockchain in any suitable programming language.
2. Naive Blockchain construction,
3. Memory Hard algorithm - Hashcash implementation,
4. Play with Go-Ethereum,
5. Smart Contract Construction,
6. Use Geth to Implement Private Ethereum Block Chain.
7. Create Case study of Block Chain being used in illegal activities in real world.
8. Using Python Libraries to develop Block Chain Application.

Course Learning Outcomes: After studying this course students will be able to:

1. Understand and explore the working of Blockchain technology.
2. Design principles of Bitcoin and Ethereum.
3. Analyze the working of Smart Contracts.
4. Understand and analyze the working of Hyperledger.
5. Apply the learning of solidity and de-centralized apps on Ethereum.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Andreas Antonopoulos, Gavin Wood	Mastering Ethereum: Building Smart Contracts and DApps	O'Reilly	2018	978-1491971949
D. Drescher	Blockchain Basics: A Non-Technical Introduction in 25 Steps	Apress	2017	978-1484226032
Mayukh Mukhopadhyay	Ethereum Smart Contract Development: Build blockchain-based decentralized applications using solidity	Packt Publishing Limited	2018	978-1788473040

Xun (Brian) Wu, Zhihong Zou, Dongying Song	Learn Ethereum: Build your own decentralized applications with Ethereum and smart contracts	Packt Publishing Limited	2019	978-1789954111

Course Title: Quantum Security (Specialization: Quantum Computing)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction		**11 H**
Introduction and overview, Fundamental concepts of quantum information: pure and mixed quantum states, the partial trace, classical-quantum states, generalized measurements, Encrypting quantum bits with the quantum one-time pad, trace distance and its use in security definitions, (min)-entropy, Uncertainty principles as a guessing game		
Unit II: Quantum key distribution protocols		**12 H**
Introduction to key distribution: the challenge of being correct and secure, Key distribution over a noisy channel, BB84 Protocol, Warmup: Security against a classical eavesdropper, E91 Protocol: purifying protocols using entanglement, Quantum key distribution: definitions and concepts		
Unit III: Quantum cryptography using untrusted devices		**13 H**
Introduction to device-independent quantum cryptography, Testing devices using a Bell experiment, Security of device-independent quantum key distribution against collective attacks, Two-party cryptography: bit commitment and oblivious transfer, Impossibility of bit commitment, Weak commitments and coin tossing		
Unit IV: Advance Algorithms		**10 H**
Shor's Algorithm, Finite Field Operations, Karatsuba and Number Theoretic Transformation Based Multiplication, Montgomery Multiplication, Lattice based cryptography algorithm, code based cryptography algorithm		

List of Experiments (Total: 30 Hours)

1. Learn how information can be encrypted and sent using quantum algorithms.
2. Generate an Encryption Key that Allows for Private Communication.
3. Encrypt Transmit, and Decrypt a Secret Message.
4. Implement key distribution protocol.
5. Examine how an eavesdropper causes errors in transmission and that can be detected.
6. Understand and implement Lattice based cryptography algorithm.
7. Understand and implement code based cryptography algorithm.
8. Implement and understand Shor's Algorithm.
9. Use Montgomery Multiplication for real –world application.
10. Implement a real-world application of secure quantum keys.

Note: QKDNetSim simulator and python may be used for the implementation.
Course Learning Outcomes: After studying this course students will be able to:

1. Understand the advent of quantum computing in security.
2. Comprehend the concepts of public-key cryptography standardization procedure.
3. Analyse various cryptographic algorithms.
4. Implement post-quantum post-quantum secure public-key algorithms focusing on both key-encapsulation and digital signature.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Debdeep Mukhopadhyay and Rajat Subhra Chakraborty	Hardware Security: Design, Threats, and Safeguards	CRC Press	2014	978-439895832
Daniel J. Bernstein, Johannes Buchmann and Erik Dahmen	Post-Quantum Cryptography	McGraw-Hill Education	2009	978-540887010
Federico Grasselli	Quantum Cryptography	Springer Cham	2021	978-3-030-64359-1

Course Title: Web Frameworks (Specialization: Full Stack Development)

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	2	0	4

		Teaching Hours
Unit I: Introduction to Web Frameworks		**6 H**
Introduction to web frameworks, Understanding the architecture of web applications, Overview of popular web frameworks, Choosing the right framework for your project.		
Unit II: React		**12 H**

Introduction to React, creating components in React, State and props in React, Handling events in React, Routing in React, Integrating with backend APIs		
Unit III: Angular		**12 H**
Introduction to Angular, creating components in Angular, Data binding in Angular, Routing in Angular, Services and dependency injection in Angular, Integrating with backend APIs		
Unit IV: Vue.js, Tools and Technologies		**15 H**
Introduction to Vue.js, Creating components in Vue.js, Directives and data binding in Vue.js, Routing in Vue.js, Vuex for state management, integrating with backend APIs, Version control with Git, Package management with NPM, Module bundling with Webpack, Building and deploying web applications		

List of Experiments (Total:30 Hours)

Experiment 1: Setting up the development environment for React

Experiment 2: Creating a basic React component

Experiment 3: Implementing state and props in React

Experiment 4: Implementing routing in React

Experiment 5: Integrating a React application with a backend API

Experiment 6: Setting up the development environment for Angular

Experiment 7: Creating a basic Angular component

Experiment 8: Implementing data binding in Angular

Experiment 9: Implementing routing in Angular

Experiment 10: Integrating an Angular application with a backend API

Experiment 11: Setting up the development environment for Vue.js

Experiment 12: Creating a basic Vue.js component

Experiment 13: Implementing directives and data binding in Vue.js

Experiment 14: Implementing routing in Vue.js

Experiment 15: Integrating a Vue.js application with a backend API

Experiment 16: Version control with Git

Experiment 17: Package management with NPM

Experiment 18: Module bundling with Webpack

Experiment 19: Building and deploying a web application

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basic concepts of web frameworks and their application in web development.
2. Design and develop web applications using various web frameworks such as React, Angular, and Vue.js.
3. Use various tools and technologies to develop web applications, including Git, NPM, and Webpack.
4. Analyze and evaluate the effectiveness of different web frameworks in various scenarios.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
James Holmes, Struts	The Complete Reference, 2nd Edition	Mc.Graw Hill Professional	2006	978-0072263865
Miguel Grinberg	Flask Web Development: Developing Web Applications with Python	O'Reilly Media	2018	9781491991732
David Herron	Node.js Web Development: Server-side development with Node 10 made easy	Packt Publishing	2018	9781788626859

Course Title: Digital Image Processing

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction of Digital Image Processing		**11 H**
Introduction to the DIP areas and applications; Components of Digital Image Processing; Elements of Visual Perception; Image Sensing and Acquisition; Image Sampling and Quantization; Relationships between pixels; color models.		
Unit II: Image Enhancement & Restoration		**15 H**

Spatial Domain: Gray level transformations; Histogram processing; Basics of Spatial Filtering; Smoothing and Sharpening Spatial Filtering Frequency Domain: Introduction to Fourier Transform; Smoothing and Sharpening frequency domain filters; Ideal, Butterworth and Gaussian filters. Noise models; Mean Filters; Order Statistics; Adaptive filters; Band reject Filters; Band pass Filters; Notch Filters; Optimum Notch Filtering; Inverse Filtering; Wiener filtering		
Unit III: Feature Extraction and Image Segmentation		**14 H**
Feature Extraction: Contour and shape dependent feature extraction, Extraction of textural features Segmentation: Detection of Discontinuities; Edge Linking and Boundary detection; Region based segmentation; Morphological processing- erosion and dilation.		
Unit IV: Image Compression and Encoding		**14 H**
Entropy-based schemes, Transform-based encoding, Predictive encoding and DPCM, Vector quantization, Huffman coding.		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basic concepts of DIP.
2. Improve the quality of digital images.
3. Segment digital images and extract various features from digital images
4. Understand various image compression techniques and apply such techniques to compress digital images for reducing the sizes of digital images.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Rafael C. Gonzales, Richard E. Woods	Digital Image Processing	Pearson	2018	978-9353062989
Anil Jain K	Fundamentals of Digital Image Processing	Pearson	2015	978-9332551916
Willliam K Pratt	Digital Image Processing	Wiley	2010	978-8126526840
Nick Efford	Digital Image Processing a practical introduction using Java	Addison Wesley	2000	978-0201596236

Course Title: Computational Biology

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: Introduction		**14 H**

Nature and scope of life science: Branches of life sciences, Characteristics of life, Levels of Organization, Origin of life, Biochemical evolution- evolution of Proteins and Nucleotide. Cell Biology: The cell as basic unit of life- Prokaryotic cell and Eukaryotic cell, Cell Structure and Function- cell membrane, cell organelles, Cell Division; Mitosis & Meiosis. Cell Energetics: Laws of Thermodynamics, Photosynthesis, Anaerobic & aerobic respiration, Structure and function of mitochondria, respiratory pathways: Glycolysis, Kreb's Cycle, Electron transport chain.		
Unit II: More about RNA and DNA		**13 H**
Chromosome-Genome-Genes-Databases: Bio-molecules- DNA, RNA, Protein and amino acids, Chargaff's Rules, GC content. Central Dogma: Replication, Transcription, Translation, Post transcriptional & post translational modifications, RNA processing, RNA splicing and RNA editing. Sense/coding and antisense/template strands, Genetic code. Introduction to DNA and Protein sequencing.		
Unit III: Proteins		**13 H**
Proteins and Databases: Protein structure and function, Protein Primary structure, Amino acid residues, Secondary, Tertiary, Quaternary Structure of Protein, Protein sequence databases, SwissProt/ TrEMBL, PIR, Sequence motif databases -Pfam, PROSITE, Protein structure databases.		
Unit IV: Computation and Biology		**14 H**
Molecular computational biology: Gene prediction, sequencing genomes, similarity search, restriction mapping, Sequence Analysis: Principles and its uses, Hidden Markov models for sequence analysis. Introduction of Markov Chain and Hidden Markov models. Forward backward algorithm, Viterbi and Baum-Welch algorithms		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the basic of cell structure, divisions involved in reproduction of a cell, and its generic functionality.
2. Recognize the base line elements of a RNA and DNA; including fundamental behind their complex structure.
3. Comprehend primary structure of the protein and various related data-sets.
4. Demonstrate the concept of gene sequence alignment and simulate various related algorithms for the same.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Pevzner, P. A.	Computational Molecular Biology- An Algorithmic Approach	MIT Press	2000	978-0262161978
Ghosh, Z. and Mallick, B	Bioinformatics Principles and Applications	Oxford University	2008	9780195692303
Mount, D. W	Bioinformatics – sequence and genome analysis	Cold Spring Harbor Laboratory Press	2004	978-0879697129

Fall, C.P., Marland, E.S., Wagner, J.M., Tyson, J.J.	Computational Cell Biology	Springer	2002	978-0387953694

Course Title: Simulation and Modeling

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

	Weightage	Teaching Hours
Unit I: Introduction and General Principles	**25%**	**14 H**
Introduction to simulation and modeling, Application areas, System and system environment, Components of a system, Discrete and continuous systems, Basic model forms and its types, Discrete-event simulation, Steps in a simulation study, Simulation examples. Concepts in discrete event simulation, Handling Stepped and Event-based Time in Simulations, Event scheduling/time advance algorithms, World views, List processing using dynamic allocation and linked list.		
Unit II: Statistical and Queuing Model	**25%**	**13 H**
Terms and concepts, Statistical models, Discrete and continuous distributions, Poisson distributions, Empirical distributions, Little's equation. Characteristics of queuing systems, Queuing notation, Long-Run measures of performance of queuing systems, Steady state behavior of infinite and finite calling population models, Use of network of queues.		
Unit III: Random Number Generation	**25%**	**13 H**
Pseudo random numbers, Techniques for generation of pseudo random numbers, Tests for random numbers, Random variate generation, Inverse Transform Technique- Exponential, Uniform, Weibull, Triangular distributions, Direct transformation for Normal and lognormal distributions.		
Unit IV: Input Modeling and Output Analysis of Single Model	**25%**	**14 H**
Data collection, Identifying the distribution of data - histograms and quantile plots, Parameter estimation, Goodness of fit tests applied to simulation inputs, Verification and validation of simulation models, Output analysis and measures of performance and estimation		

Course Learning Outcomes: After studying this course students will be able to:

1. Discuss the fundamental elements of discrete-event simulation including statistical models, random processes, random variates, and inputs to simulation.
2. Analyze a real-world problem and apply modelling methodologies to develop a discrete-event simulation model.
3. Interpret discrete-event techniques for solving a simulation problem.
4. Analyze the output of single model.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Jerry Banks, John S. Carson II, Barry L.Nelson and David M.Nicol	Discrete- event system and simulation	Prentice Hall	2009	978-0136062127
Averill M.Law	Simulation modeling and analysis (SIE)	Tata McGraw Hill	2017	978-0070667334
David Cloud, Larry Rainey	Applied Modeling and Simulation	Tata McGraw Hill	1998	978-0072283037
Gabriel A. Wainer	Discrete-event modeling and simulation: a practitioner's approach	CRC Press	2009	978-1420053364
Bernard P. Zeiger, Herbert Praehofer, Tag Gon Kim	Theory of modeling and simulation: integrating discrete event and continuous complex dynamic systems	Academic Press	2002	978-8178670430
Walter J. Karplus, George A. Bekey, Boris YakobKogan	Modeling and simulation: theory and practice	Springer	2012	978-1461502357

Course Title: Adhoc and Wireless Sensor Networks

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: – INTRODUCTION AND ROUTING PROTOCOLS		**09 H**
Wireless Sensor Networks (WSNs): concepts and architectures - Applications of Ad Hoc and Sensor Networks - Design Challenges in Ad hoc and Sensor Networks. Wireless Networks, Issues in Ad hoc wireless networks, Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols – Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV)		
Unit II: WSN NETWORKING CONCEPT AND MAC PROTOCOLS		**18 H**

Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks - Design Goals of a MAC Protocol for Ad Hoc Wireless Networks, MAC Protocols for wireless sensors Networks, Low duty cycle Protocols and Wakeup concepts, Classification of MAC Protocols, S-MAC, Contention based protocols -PAMAS schedule-based protocols –LEACH, IEEE 802.15.4. MAC protocols, Energy efficient routing challenges and issues in transport layer **ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS:** Routing Protocol: Issues in designing a routing protocol for Ad hoc networks - Classification- proactive routing - reactive routing (on-demand) - hybrid routing - Transport Layer protocol for Ad hoc networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer solutions-TCP over Ad hoc wireless		
Unit III: SENSOR NETWORKS INTRODUCTION AND ARCHITECTURES		**13 H**
Overview of Online Banking Security, Mobile Banking Security, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture – Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture – Sensor Network Scenarios, Transceiver Design Considerations.		
Unit IV: SENSOR NETWORK SECURITY		**14 H**
Security in Ad Hoc Wireless Networks - Network Security Requirements. Network Security requirements issues and Challenges in security provisioning Network, Security Attacks. Layer wise attack in wireless sensor networks, possible solutions for Jamming, tampering black hole attack, Flooding attack, Key distribution and Management, Secure Routing -SPINS reliability requirements in sensors Networks. Sensor Network Platforms and Tools		

Course Learning Outcomes: After studying this course students will be able to:

1. Explain the Fundamental Concepts and applications of ad hoc and wireless sensor networks and apply this knowledge to identify the suitable routing algorithm based on the network Justify the need of various measures to protect cyber space
2. Apply the knowledge to identify appropriate physical and MAC layer protocols Take countermeasures against hacking
3. Be familiar with the OS used in Wireless Sensor Networks and build basic modules.
4. Understand the Challenges in security provisioning, Security Attacks and security issues possible in Adhoc and Sensors Networks

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
C. Siva Ram Murthy, and B. S. Manoj	Ad Hoc Wireless Networks: Architectures and Protocols	Pearson	2006	978-8131706886
Labiod. H	Wireless Adhoc and Sensor Networks	Wiley	2007	978-1848210035

Li, X	Wireless ad -hoc and sensor Networks: theory and applications	Cambridge University Press	2008	978-1107006805
Carlos De Morais Cordeiro, Dharma Prakash Agrawal	Ad Hoc & Sensor Networks: Theory and Applications	World Scientific Publishing	2011	978-9814338899

Course Title: Quantum Computing

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: – Introduction		**09 H**
Fundamental Concepts: Global Perspectives, Quantum Bits, Quantum Computation, Quantum Algorithms, Quantum Information, Postulates of Quantum Mechanisms		
Unit II: Quantum Computations		**18 H**
Quantum Computation: Quantum Circuits – Quantum algorithms, Single Orbit operations, Control Operations, Measurement, Universal Quantum Gates, Simulation of Quantum Systems, Quantum Fourier transform, Phase estimation, Applications, Quantum search algorithms – Quantum counting – Speeding up the solution of NP – complete problems – Quantum Search for an unstructured database. Quantum Computers: Guiding Principles, Conditions for Quantum Computation, Harmonic Oscillator Quantum Computer, Optical Photon Quantum Computer – Optical cavity Quantum electrodynamics, Ion traps, Nuclear Magnetic resonance		
Unit III: Quantum Information		**13 H**
Quantum Information: Quantum noise and Quantum Operations – Classical Noise and Markov Processes, Quantum Operations, Examples of Quantum noise and Quantum Operations – Applications of Quantum operations, Limitations of the Quantum operations formalism, Distance Measures for Quantum information.		
Unit IV: Quantum Error Correction		**14 H**
Quantum Error Correction: Introduction, Shor code, Theory of Quantum Error –Correction, Constructing Quantum Codes, Stabilizer codes, Fault – Tolerant Quantum Computation, Entropy and information – Shannon Entropy, Basic properties of Entropy, Von Neumann, Strong Sub Additivity, Data Compression, Entanglement as a physical resource		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand the quantum model of computation and the basic principles of quantum mechanics.
2. Be familiar with basic quantum algorithms and their analysis.
3. Be familiar with basic quantum protocols such as teleportation and super dense coding.

4. See how the quantum model relates to classical models of deterministic and probabilistic computation.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Micheal A. Nielsen. &Issac L. Chiang	Quantum Computation and Quantum Information	Cambridge University Press	2013	978-1107619197
Eleanor G. Rieffel, Wolfgang H. Polak	Quantum Computing - A Gentle Introduction	MIT Press	2014	978-0262526678
Scott Aaronson	Quantum Computing since Democritus	Cambridge University Press	2013	978-0521199568
Yanofsky's and Mannucci	Quantum Computing for Computer Scientists	Cambridge University Press	2008	978-0521879965

Course Title: Computer Vision

Course Contents/syllabus:

L	T	P/S	SW/FW	TOTAL CREDIT UNITS
3	0	0	0	3

		Teaching Hours
Unit I: – Introduction		**13 H**
Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis.		
Unit II: Edge Detection and Segmentation		**14 H**
Edge detection, Edge detection performance, Hough transform, corner detection. Segmentation, Morphological filtering, Fourier transform.		
Unit III: Feature Extraction		**13 H**
Feature extraction, shape, histogram, color, spectral, texture, using CVIP tools, Feature analysis, feature vectors, distance /similarity measures, data pre- processing.		
Unit IV: Pattern Analysis		**14 H**
Pattern Analysis: Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised. Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non- parametric methods. Recent trends in Activity Recognition, computational photography, Biometrics		

Course Learning Outcomes: After studying this course students will be able to:

1. Understand image detection and analysis.
2. Analyze the pros and cons of various edge detection and segmentation techniques.
3. Identify features to recognize object, scene and categorization from images.
4. Develop the skills necessary to build computer vision applications.

Text / Reference Books:

AUTHOR	TITLE	Publisher	Year of publication	ISBN
Richard Szeliski	Computer Vision: Algorithms and Applications	Springer	2010	978-1848829343
Goodfellow, Bengio, and Courville	Deep Learning	MIT Press	2016	978-0262035613
Fisher, Breckon et al.	Dictionary of Computer Vision and Image Processing	Wiley	2005	978-0470015261