ASSAM UNIVERSITY, SILCHAR
TRIGUNA SEN SCHOOL OF TECHNOLOGY
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

UG PROGRAMME COURSE STRUCTURE & SYLLABUS 2023

[Approved in 93rd Academic Council and 95th Academic Council Meetings]

ASSAM UNIVERSITY, SILCHAR
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

(A) Vision

To meet the changing needs of the society by:

- Building a tradition of innovation.
- Solving problem with interdisciplinary collaboration.
- Enabling students to discover and apply knowledge for the benefit of society.

(B) Mission

- To educate the students in the areas of Computer Science & Engineering by providing best practices of teaching-learning process for careers in industries, higher education and research.
- To provide the students with foundation of both the theory and practice through inclusive undergraduate and postgraduate curriculum, and strengthening them for creativity and innovation for serving the society.

For B. Tech (CSE) Programme

Programme Outcomes (PO):

PO1 **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Educational Objectives (PEOs):

Graduates of the B. Tech (CSE) program:

PEO1 Will demonstrate successful professional career by impacting cutting-edge technologies to accomplish social responsibilities.

PEO2 Will demonstrate lifelong learning, critical thinking to extract innovative technical solutions using research-oriented, complex problem-solving skills.

PEO3 Will demonstrate professionalism, ethical behaviour, inter-personal skills to develop leadership qualities.

Programme Specific Outcomes (PSOs):

At the time of graduation, B. Tech (CSE) students will be able to:

PSO1 **Academic Competence:** Apply various concepts of Computing, Statistics, Mathematics and Electronics appropriately to conduct research as well as to provide solution to the real-life societal problems.

PSO2 **Professional Competence:** Develop strong problem-solving abilities for professional software development as well as to analyse the critical problem.

PSO3 **Entrepreneurial Competence:** Acquire the skills necessary to support their career in software development, entrepreneurship in recent trends of computer science like data analytics, artificial intelligence, healthcare imaging, networking, embedded systems.

Chapter-1
General, Course structure & Theme
&
Semester-wise credit distribution

A. General, Course structure & Theme

Definition of Credit:

1 Hour Lecture (L) per week	1 Credit
1 Hour Tutorial (T) per week	1 Credit
2 Hours Practical/ Lab (L) per week	1 Credit

B. Range of credits: The total credit for the B.Tech. programme is kept as **166** which is three extra credit more than to AICTE proposed total credit.

C. Structure of Undergraduate Engineering programme:

Sl. No	Category	Credit Breakup	AICTE Proposed Credit
1.	Humanities and Social Sciences including Management courses **(HC)**	16	16
2.	Basic Science courses **(BC)**	20	23
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc **(EC).**	27	29
4.	Professional core courses **(PC)**	62	59
5.	Professional Elective courses relevant to CSE **(PE)**	15	12
6.	Open subjects – Electives from other technical and /or emerging specialization/branch/ MOOC cources **(OE)**	09	09
7.	Project work, Seminar, Grand Viva, and Summer internship in industry or elsewhere **(PR)**	17	17
8.	Mandatory Courses Environmental Sciences, Summer Training, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition **(MC)**	(non-credit)	
	Total Credit	**166**	**163**

D. Composition of Types of Courses of Undergraduate Engineering programme:

Sl. No	Category	Credit Breakup	Course Types	Percentage
1.	Humanities and Social Sciences including Management courses **(HC)**	16	IKS based, Value based, Management based	10
2.	Basic Science courses **(BC)**	20	Foundation Courses	12
3.	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc **(EC).**	27	Engineering Skill development	16
4.	Professional core courses **(PC)**	62	Engineering Skill development	37
5.	Professional Elective courses relevant to CSE **(PE)**	15	Employability enhancement	10
6.	Open subjects – Electives from other technical and /or emerging specialization/branch/ MOOC cources **(OE)**	09	Inter-disciplinary, Employability enhancement	5
7.	Project work, Seminar, Grand Viva, and Summer internship in industry or elsewhere **(PR)**	17	Skill development, employability enhancement, entrepreneurship based	10
8.	Mandatory Courses Environmental Sciences, Summer Training, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition **(MC)**	(non-credit) 4 nos.	Value based, IKS based	
	Total Credit	**166**	**166**	**100**

E. Code Definitions:

Code	Definition
PC	Professional core courses
EC	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc **.**
BC	Basic Science courses
HC	Humanities and Social Sciences including Management courses
MC	Mandatory Courses Environmental Sciences, Summer Training, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition
PE	Professional Elective courses relevant to CSE
OE	Open subjects – Electives from other technical and /or emerging specialization/branch/ MOOC courses
PR	Project work, Seminar, Grand Viva, Summer Training and internship in industry or elsewhere
L	Lecture
T	Tutorial
P	Practical
C	Credits

F. Credit distribution in the First year of Undergraduate Engineering programme:

	Lecture(L)	Tutorial(T)	Laboratory/Practical(P)	Total Credit(C)
Physics-I	3	1	0	4
Mathematics-I	3	1	0	4
Basic Electrical Engineering	3	1	0	4
Engineering Graphics & Design	1	0	4	3
Physics- I Lab	0	0	2	1
Basic Electrical Engineering Lab	0	0	2	1
Design Thinking	0	0	2	1
IDEA Lab Workshop	2	0	4	0
Chemistry-I	3	1	0	4
Mathematics-II	3	1	0	4
Programming for Problem Solving	3	0	0	3
English	2	0	2	3
Universal Human Values	2	1	0	3
Chemistry- I Lab	0	0	2	1
Programming for Problem Solving Lab	0	0	4	2
Workshop//Manufacturing Practices	1	0	4	3
Sports and Yoga or NCC/NSS	2	0	0	0

G. Category of Courses:

BASIC SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASHP101	Physics-I	3	1	0	4	I
2.	ASHB102	Mathematics-I	3	1	0	4	I
3.	ASHP105	Physics-I Lab	0	0	2	1	I
4.	ASHC151	Chemistry-I	3	1	0	4	II
5.	ASHB152	Mathematics-II	3	1	0	4	II
6.	ASHC156	Chemistry-I Lab	0	0	2	1	II
7.	ASHB201	Mathematics III	2	0	0	2	III
		Total Credit				20	

ENGINEERING SCIENCE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASHE103	Basic Electrical Engineering	3	1	0	4	I
2.	ASHE104	Engineering Graphics & Design	1	0	4	3	I
3.	ASHE106	Engineering Graphics & Design Lab	0	0	2	1	I
4.	ASHE153	Programming for Problem Solving	3	0	0	3	II
5.	ASHE157	Programming for Problem Solving Lab	0	0	4	2	II
6.	ASHE158	Workshop/Manufacturing Practices	1	0	4	3	II
7.	CSE202	Signals and Systems	3	0	0	3	III
8.	CSE204	Digital Electronics	3	0	0	3	III
9.	CSE206	Digital Electronics Lab	0	0	4	2	III
10.	CSE351	Research Methods in Computer Science	3	0	0	3	VI
		Total Credit				27	

HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	ASHH107	Design Thinking	0	0	2	1	I
2.	ASHH154	English	2	0	2	3	II
3.	ASHH155	Universal Human Values	2	1	0	3	II
4.	ASHH202	Humanities I	3	0	0	3	III
5.	ASHH251	Management I	3	0	0	3	IV
6.	ASHH301	Management II	3	0	0	3	V
		Total Credit				16	

PROFESSIONAL CORE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE201	Discrete Mathematics	3	1	0	4	III
2.	CSE203	Data Structure	3	0	0	3	III
3.	CSE205	Data Structure Lab	0	0	4	2	III
4.	CSE207	IT Workshop I (Web Technology)	1	0	4	3	III
5.	CSE251	Software Engineering	3	1	0	4	IV
6.	CSE252	Object Oriented Programming	3	0	0	3	IV
7.	CSE253	Database Management Systems	3	0	0	3	IV
8.	CSE254	Computer Organization and Architecture	3	0	0	3	IV
9.	CSE255	Object Oriented Programming Lab	0	0	4	2	IV
10.	CSE256	Database Management Systems Lab	0	0	4	2	IV
11.	CSE257	Computer Organization and Architecture Lab	0	0	4	2	IV

12.	CSE301	Design and Analysis of Algorithms	3	1	0	4	V
13.	CSE302	Theory of Computation	3	1	0	4	V
14.	CSE303	Operating System	3	0	0	3	V
15.	CSE304	Computer Networks	3	0	0	3	V
16.	CSE305	Operating System Lab	0	0	4	2	V
17.	CSE306	Computer Networks Lab	0	0	4	2	V
18.	CSE307	IT Workshop II (Python)	1	0	4	3	V
19.	CSE352	Machine Learning	3	0	0	3	VI
20.	CSE353	Compiler Design	3	0	0	3	VI
21.	CSE356	Machine Learning Lab	0	0	4	2	VI
22.	CSE357	Compiler Design Lab	0	0	4	2	VI
		Total Credit				**56**	

PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE354	Elective – I	3	0	0	3	VI
2.	CSE355	Elective – II	3	0	0	3	VI
3.	CSE401	Cryptography and Network Security	3	0	0	3	VII
4.	CSE402	Elective – III	3	0	0	3	VII
5.	CSE451	Elective – IV	3	0	0	3	VIII
		Total Credit				**15**	

OPEN ELECTIVE COURSES

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.		Open Elective – I	3	0	0	3	VII
2.		Open Elective – II	3	0	0	3	VIII
3.		Open Elective – III	3	0	0	3	VIII
		Total Credit				**09**	

PROJECT, SUMMER INTERNSHIP, GRAND VIVA

Sl. No.	Course Code	Course Title	Hours per week			Credits	Semester
			L	T	P		
1.	CSE358	Project – I	0	0	6	3	VI
2.	CSE404	Internship (6-8 weeks)	0	0	0	2	VII
3.	CSE405	Project – II	0	0	8	4	VII
4.	CSE454	Project-III	0	0	12	6	VIII
5.	CSE455	Grand Viva	0	0	0	2	VIII
		Total Credit				**17**	

Mandatory Induction Program

Induction program (mandatory)	**3 weeks duration** (Please refer Appendix-A for guidelines & also details available in the curriculum of Mandatory courses)
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

B. Semester-wise structure of curriculum

[L= Lecture, T = Tutorials, P = Practicals & C = Credits]

Semester-I (First Year) Curriculum

Sl No	Type	Course Code	Course Title	L	T	P	Credit	Remarks
1.	Basic Science Course	ASHP101	Physics-I	3	1	0	4	Theory Paper
2.	Basic Science Course	ASHB102	Mathematics-I	3	1	0	4	Theory Paper
3.	Engineering Science Course	ASHE103	Basic Electrical Engineering	3	1	0	4	Theory Paper
4.	Engineering Science Course	ASHE104	Engineering Graphics and Design	1	0	4	3	Practical Paper
5.	Basic Science Course	ASHP105	Physics-I Lab	0	0	2	1	Practical Paper
6.	Engineering Science Course	ASHE106	Basic Electrical Engineering Lab	0	0	2	1	Practical Paper
7.	Humanities Social Science including Management Courses	ASHH107	Design Thinking	0	0	2	1	Practical Paper
8.	Audit Course	ASHA108	IDEA Lab Workshop	2	0	4	0	Practical Paper
			Total Credits				**18**	

Semester-II (First Year) Curriculum

Sl No	Type	Course Code	Course Title	L	T	P	C	Remarks
1.	Basic Science Course	ASHC151	Chemistry-I	3	1	0	4	Theory Paper
2.	Basic Science Course	ASHB152	Mathematics-II	3	1	0	4	Theory Paper
3.	Engineering Science Course	ASHE153	Programming for Problem Solving	3	0	0	3	Theory Paper
4.	Humanities Social Science including Management Courses	ASHH154	English	2	0	2	3	Theory Paper
5.	Humanities Social Science including Management Courses	ASHH155	Universal Human Values	2	1	0	3	Theory Paper
6.	Basic Science Course	ASHC156	Chemistry-I Lab	0	0	2	1	Practical Paper
7.	Engineering Science Course	ASHE157	Programming for Problem Solving Lab	0	0	4	2	Practical Paper
8.	Engineering Science Course	ASHE158	Workshop/ Manufacturing Practices	1	0	4	3	Practical Paper
9.	Audit Course	ASHA159	Sports and Yoga or NCC/ NSS	2	0	0	0	Practical Paper
			Total Credits				**23**	

Semester-III (Second Year) Curriculum

Sl. No.	Type	Course Code	Course Title	L	T	P	C	Remarks
1	PC	CSE201	Discrete Mathematics	3	1	0	4	Theory
2	EC	CSE202	Signals and Systems	3	0	0	3	Theory
3	PC	CSE203	Data Structure	3	0	0	3	Theory
4	EC	CSE204	Digital Electronics	3	0	0	3	Theory
5	BC	ASHB201	Mathematics III	2	0	0	2	Theory
6	HC	ASHH202	Humanities I	3	0	0	3	Theory
7	PC	CSE205	Data Structure Lab	0	0	4	2	Practical
8	EC	CSE206	Digital Electronics Lab	0	0	4	2	Practical
9	PC	CSE207	IT Workshop I (Web Technology)	1	0	4	3	Practical
				Total Credits			**25**	

Semester-IV (Second Year) Curriculum

Sl. No.	Type	Course Code	Course Title	L	T	P	C	Remarks
1	PC	CSE251	Software Engineering	3	1	0	4	Theory
2	PC	CSE252	Object Oriented Programming	3	0	0	3	Theory
3	PC	CSE253	Database Management Systems	3	0	0	3	Theory
4	PC	CSE254	Computer Organization and Architecture	3	0	0	3	Theory
5	HC	ASHH251	Management I	3	0	0	3	Theory
6	MC	ASHA252	Environmental Science	2	0	0	0	Mandatory Course
7	PC	CSE255	Object Oriented ProgrammingLab	0	0	4	2	Practical

8	PC	CSE256	Database Management Systems Lab	0	0	4	2	Practical
9	PC	CSE257	Computer Organization and Architecture Lab	0	0	4	2	Practical
				Total Credits			**22**	

Semester-V (Third Year) Curriculum

Sl. No.	**Type**	**Course Code**	**Course Title**	**L**	**T**	**P**	**C**	**Remarks**
1	PC	CSE301	Design and Analysis ofAlgorithms	3	1	0	4	Theory
2	PC	CSE302	Theory of Computation	3	1	0	4	Theory
3	PC	CSE303	Operating System	3	0	0	3	Theory
4	PC	CSE304	Computer Networks	3	0	0	3	Theory
5	HC	ASH301	Humanities II	3	0	0	3	Theory
6	MC	ASHA302/ASHA304	Constitution of India/ Essence of Indian KnowledgeTradition	2	0	0	0	Mandatory Course
7	PC	CSE305	Operating System Lab	0	0	4	2	Practical
8	PC	CSE306	Computer Networks Lab	0	0	4	2	Practical
9	PC	CSE307	IT Workshop II (Python)	1	0	4	3	Practical
10	MC	CSE308	Summer Training (4 Weeks)	0	0	0	0	Project
				Total Credits			**24**	

Semester-VI (Third Year) Curriculum

Sl. No.	Type	Course Code	Course Title	L	T	P	C	Remarks
1	EC	CSE351	Research Methods inComputer Science	3	0	0	3	Theory
2	PC	CSE352	Machine Learning	3	0	0	3	Theory
3	PC	CSE353	Compiler Design	3	0	0	3	Theory
4	PE	CSE354	Elective I	3	0	0	3	Theory
5	PE	CSE355	Elective II	3	0	0	3	Theory
6	PC	CSE356	Machine Learning Lab	0	0	4	2	Practical
7	PC	CSE357	Compiler Design Lab	0	0	4	2	Practical
8	PR	CSE358	Project I	0	0	6	3	Project
				Total Credits			**22**	

Semester-VII (Fourth Year) Curriculum

Sl. No.	Type	Course Code	Course Title	L	T	P	C	Remarks
1	PE	CSE401	Cryptography and Network Security	3	0	0	3	Theory
2	PE	CSE402	Elective III	3	0	0	3	Theory
3	OE		Open Elective I	3	0	0	3	Theory
4	PR	CSE404	Internship (6 – 8 weeks)	0	0	0	2	Project
5	PR	CSE 405	Project II	0	0	8	4	Project
				Total Credits			**15**	

Semester-VIII (Fourth Year) Curriculum

Sl. No.	Type	Course Code	Course Title	L	T	P	C	Remarks
1	PE	CSE451	Elective IV	3	0	0	3	Theory
2	OE		Open Elective II	3	0	0	3	Theory
3	OE		Open Elective III	3	0	0	3	Theory
4	PR	CSE454	Project III	0	0	12	6	Project
5	PR	CSE455	Grand Viva	0	0	0	2	Project
6				**Total Credits**			**17**	

List of Elective Papers

1. Artificial Intelligence.
2. Neural Network.
3. Deep Learning.
4. Soft Computing (Department / open).
5. Speech and Natural Language Processing.
6. Data Mining
7. Internet of Things
8. Mobile Computing (Department /Open).
9. Social Network Analysis.
10. Data Analytics.
11. Image Processing.
12. Computer Graphics.
13. Computational Complexity.
14. Basic Programming Concept (Open).
15. Software Engineering (Open)
16. Embedded Systems.
17. Advanced Operating System.
18. Network on Chip
19. Information Retrieval.
20. Advanced Java Programming.
21. Machine Learning.
22. Web and Internet (Department / Open).
23. Python (Open).
24. Matlab (Open).
25. Cloud Computing.
26. Quantum Computing.
27. Advanced Computer Architecture.
28. Computational Geometry.

29. Distributed Systems.
30. Formal Methods for System Verifications.
31. Operations Research.
32. Advanced Algorithms
33. Cyber security
34. Computer Vision
35. Digital Forensics

CHAPTER 2
DETAILED 4-YEAR CURRICULUM CONTENTS
B.Tech. in COMPUTER SCIENCE AND ENGINEERING

[L= Lecture, T = Tutorial, P = Practical & C = Credit]

Semester-I

Physics- I (Theory and Lab)

COURSE CODE:	**COURSE NAME:**	L	T	P	C
i) ASHP101 ii) ASHP105	i) Physics-I (Introductory Physics)	3	1	0	4
	ii) Physics-I Lab (Introductory Physics Lab)	0	0	2	1

Category of Course: Basic Science Course

Pre-requisites: Basic knowledge of 10+2 level Physics

Course Objectives:

1. To use scalar and vector analytical techniques for analysing forces
2. To understand basic kinematics concepts – displacement, velocity and acceleration (and their angular counterparts);
3. To study Bragg's Law and introduce the basic concept of crystallography
4. To study the basic concepts of quantum physics.
5. To understand the principles of semiconductor Physics
6. Physics lab provides students with the first-hand experience of verifying various theoretical concepts learnt in theory courses.

Course Outcomes:

At the end of the course, the students will be able to learn the basics of physics and apply them to solve engineering problems.

1. Understand and be able to apply Newton's laws of motion.
2. Understand and be able to apply other basic dynamics concepts - the Work-Energy principle and Impulse-Momentum.
3. Knowledge to solve simple quantum mechanics calculations
4. Understand and utilize the mathematical models of semiconductor junctions
5. Understand various laws which they have studied through experiments
6. Apply basic knowledge of physics to solve real-world problems

Course Contents:

UNIT I: Mechanics

Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Solving Newton's equations of motion in polar coordinates; Potential energy function; F = - Grad V; Conservative and non-conservative forces; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits and its application.

UNIT II: Crystal structure

Seven systems of crystals, Bravais space lattice, crystal structure (bce, fee and sc) lattice dimensions, lattice planes, and miller indices and their significance, X-rays-absorption of X- rays diffraction, Bragg's law. Bragg's X-ray spectrometer.

UNIT III: Introduction of quantum mechanics

Wave particle duality, Uncertainty principle, Free-particle wave function and wave-packets, probability current, Expectation values, Schrodinger equation and its application to particle in a box and harmonic oscillator.

UNIT-IV: Band theory of solids

Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Fermi level, Effective mass, Phonons.

UNIT V: Semiconductor

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift, p-n junction, Metal-semiconductor junction (Ohmic and Schottky), Semiconductor materials of interest for optoelectronic devices.

Text Books:

1. Introduction to Mechanics — MK Verma
2. Introduction to Quantum Physics D. J. Griffiths,
3. Charks Kittle, Introduction to Solid State Physics, John Wiley & Sons
4. Chottopadhyay and Rakshit, Quantum Mechanics, Statistical Mechanics and Solid State Physics

References:

1. Engineering Mechanics, 2nd ed. — MK Harbola
2. An Introduction to Mechanics — D Kleppner & R Kolenkow
3. Principles of Mechanics — JL Synge & BA Griffiths
4. Mechanics — JP Den Hartog
5. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).
6. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
7. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008)

Physics-I Lab

Physics Laboratory [L : 0; T:0 ; P : 2 (1 credit)]

Experiments from the following:

Introduction to Electromagnetic Theory

1. Magnetic field from Helmholtz coil
2. Measurement of Lorentz force in a vacuum tube.

Introduction to Mechanics

1. Coupled oscillators
2. Experiments on an air-track
3. Experiment on the moment of inertia measurement
4. Experiments with gyroscope
5. Resonance phenomena in mechanical oscillators.

Quantum Mechanics for Engineers

1. Frank-Hertz experiment
2. Photoelectric effect experiment
3. Recording hydrogen atom Spectrum

Oscillations, waves and optics

1. Diffraction and interference experiments (from ordinary light or laser pointers)
2. Measurement of the speed of light on a tabletop using modulation
3. Minimum deviation from a prism.

Mathematics-I (Calculus and Linear Algebra)

COURSE CODE: ASHB102	**COURSE NAME:**	L	T	P	C
	Mathematics-I (Calculus and Linear Algebra)	3	1	0	4
Category of course: Basic Science Courses					
Pre-requisites: Basic knowledge of +2 level calculus and algebra					
Course Objectives: 1. To introduce the idea of applying differential and integral calculus to the notions of Curvature and to improper integrals. Apart from some engineering applications, it gives a basic introduction on Beta and Gamma functions. 2. To discuss Mean Value Theorems that is fundamental to application of analysis to Engineering problems. 3. To develop the tool of matrices to solve systems of linear equations arising in many engineering problems by different methods. 4. To familiarize the students with the concepts of vector spaces that is essential in most branches of engineering.					
Course Outcomes: At the end of the course the students should be able to 1. understand the basic knowledge of Calculus and its applications 2. be familiar with the concept of Matrices and solution of system of linear equations 3. be thorough with the concept of Linear Algebra and its applications in engineering					

Course Contents:

Unit I: Differential Calculus
Rolle's Theorem; Mean value theorems; indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit II: Integral Calculus
Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit III: Matrices
Matrices, vectors: addition and scalar multiplication, matrix multiplication; Linear systems of equations, linear independence, rank of a matrix, determinants.

Unit IV: Vector Spaces and Linear Transformation
Vector Space, linear dependence and independence of vectors, basis, dimension; Linear transformations

(maps), range and kernel of a linear map, rank and nullity, rank-nullity theorem, Matrix associated with a linear map.

Unit V: Eigenvalues, eigenvectors and diagonalization
Eigenvalues, eigenvectors. Diagonalization. Their applications in the solution of system of linear equations

Text Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002. (Unit-I, II)
2. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. (Unit-III, IV, V)

References:

1. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.

Basic Electrical Engineering (Theory and Lab)

COURSE CODE:	COURSE NAME:	L	T	P	C
i) ASHE103 ii) ASHE106	i) Basic Electrical Engineering	3	1	0	4
	ii) Basic Electrical Engineering Lab	0	0	2	1
Category of Course: Basic Engineering Course					
Pre-requisites: Basic knowledge of 10+2 level Physics					
Course Objectives: 1. To understand and analyze basic electric and magnetic circuits. 2. To study the working principles of electrical machines and power converters. 3. To introduce the components of high and low-voltage electrical installations.					
Course Outcomes: The students will learn: 1. To explain the strong basics of Electrical Engineering and practical implementation of Electrical fundamentals. 2. To identify different applications of commonly used electrical machinery.					

Course Contents:

UNIT I: Single Phase and three A.C. Circuits

Generation of sinusoidal voltage, form factor and peak factor of sinusoidal voltage and current and analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, Necessity and Advantages of three-phase systems, Generation of three-phase power, Relationship between line and phase values of balanced star and delta connections;

UNIT II: Transformers

Principle of operation and construction of single-phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation; Synchronous Generators covering, Principle of operation; Types and constructional features; EMF equation.

UNIT III: DC Machines

Working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics and applications.

UNIT-IV: Three Phase Induction Motors

Concept of rotating magnetic field; Principle of operation, types and constructional features; Slip and its

significance; Applications of squirrel cage and slip ring motors; Necessity of a starter, star-delta starter.

UNIT V: Sources of Electrical Power

Introduction to Wind, Solar, Fuel cell, Tidal, Geothermal, Hydroelectric, Thermal-steam, diesel, gas, nuclear power plants; Concept of cogeneration, and distributed generation.

Text Books:

1. AICTE's Prescribed Textbook: Basic Electrical Engineering, Khanna Book Publishing
2. Ritu Sahdev (2022), Basic Electrical Engineering, Khanna Book Publishing.
3. Nagrath I.J. and D. P. Kothari (2001), Basic Electrical Engineering, Tata McGraw Hill.

References:

1. Hayt and Kimberly, Engineering Circuit Analysis, Tata McGraw Hill.
2. Kulshreshtha D.C. (2009), Basic Electrical Engineering, Tata McGraw Hill.
3. Rajendra Prasad (2009), Fundamentals of Electrical Engineering, Prentice Hall, India Hughes
4. Mittel & Mittal, Basic Electrical Engineering, Tata McGraw Hill.

ASHE106-- Basic Electrical Engineering Lab

Basic Electrical Engineering Laboratory [L : 0; T:0 ; P : 2 (1 credit)]

List of experiments/demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments–voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (nonsinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary sides. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super-synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Engineering Graphics & Design

COURSE CODE: ASHE104	COURSE NAME:	L	T	P	C
	Engineering Graphics & Design	1	0	4	3

Category of Course: Engineering Science Courses

Course Objectives:

The objective of this Course is to provide the basic knowledge about Engineering Drawing. Detailed concepts are given in projections, technical drawing, dimensioning, and specifications, so useful for a student in preparing for an engineering career.

Course Outcomes:

After the completion of the course, the learner will be able to

1. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. Use the techniques, skills, and modern engineering tools necessary for engineering practice.
3. Describe engineering design and its place in society.
4. Discuss the visual aspects of engineering design.
5. Use engineering graphics standards.
6. Illustrate solid modelling.
7. Use computer-aided geometric design.
8. Design creating working drawings.
9. Inspect engineering communication.

Course Contents:

Traditional Engineering Graphics: Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics: Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

Unit I: Introduction to Engineering Drawing Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Orthographic Projections Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Unit II: Projections of Regular Solids

Covering those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Sections and Sectional Views of Right Angular Solids

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism,

Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)..

Unit III: Isometric Projections

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Viewsand Vice-versa, Conventions;

Unit IV: Orthographic Projections of Points

Orthographic Projections of Points: Introduction to drawing standards, creation of 2D environment using CAD software, principles of orthographic projections, projections of points in all the four quadrants.

Unit V: Transformation of Projections

Conversion of Isometric Views to Orthographic Views.

Conversion of orthographic views to isometric views – simple objects. Plan and elevation of simple buildings with dimensions.

Text Books:

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

Design Thinking

COURSE CODE: ASHH107	COURSE NAME:	L	T	P	C
	Design Thinking	0	0	2	1
Category of Course: Humanities and Social Sciences including Management courses					
Pre-requisite: None					
Course Objectives: The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.					
Course Outcomes: Student will able to 1. Compare and classify the various learning styles and memory techniques and Apply them in their engineering education 2. Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products 3. Develop new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products 4. Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development 5. Perceive individual differences and its impact on everyday decisions and further Create a better customer experience					

Course Contents:

Unit I: An Insight to Learning

Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques, Understanding Emotions, Experience & Expression, Assessing Empathy, Application with Peers

Unit II: Basics of Design Thinking

Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype,Test

Unit III: Being Ingenious & Fixing Problem
Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving, Understanding Individual differences & Uniqueness

Unit IV: Process of Product Design
Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design

Unit V: Prototyping & Testing
What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing

Text Books/ References:

As provided by the course instructor

IDEA Lab Workshop

COURSE CODE: ASHA108	COURSE NAME:	L	T	P	C
	IDEA Lab Workshop	2	0	4	0
Category of Course: Audit Course					
Pre-requisite: None					

Course Objectives:

The objective of Idea Lab is to make engineering graduates more imaginative and creative in critical thinking, problem solving, design thinking, collaboration, communication, lifelong learning etc. In addition, it will help them

1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. To learn useful mechanical and electronic fabrication processes.
3. To learn necessary skills to build useful and standalone system/ project with enclosures.
4. To learn necessary skills to create print and electronic documentation for the system/project

Course Outcomes:

Upon completion of this laboratory course, students will be able to

1. Study and practice on machine tools and their operations
2. Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
3. Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiselling.

Course Contents:

Unit I:

Introduction to basic hand tools - Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits,

Unit II:

Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly, Concept of Lab aboard a Box.

Unit III:

3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab

Unit IV:
Discussion and implementation of a mini project.

Unit V:
Documentation of the mini project (Report and video).

List of Lab activities and experiments:

1. Machining of 3D geometry on soft material such as soft wood or modelling wax.
2. 2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
3. Familiarity and use of welding equipment.
4. Familiarity and use of normal and wood lathe.
5. Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

Text Books:

1. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.

References

1. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top- Selling Product Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
2. Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
3. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
4. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
5. Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703
6. Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
7. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
8. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.
9. Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 : 978-1484200773
10. Venu vinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
11. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

Semester-II

Chemistry-I (Theory and Lab)

COURSE CODE:	COURSE NAME:	L	T	P	C
i) ASHC151 ii) ASHC156	i) Chemistry-I	3	1	0	4
	ii) Chemistry-I Lab	0	0	2	1

Category of course: Basic Science Course

Course Objectives:

1. To understand the basic concepts of bonding and shapes of atoms, molecules and solids.
2. To understand the concepts of crystal field theory of transition metal ions.
3. To understand the basic concepts of different spectroscopic techniques and its applications in emerging fields.
4. To study the interaction forces of gases and potential energy surfaces of molecules.
5. To study the different thermodynamic functions.
6. To study the basic concepts of oxidation and reduction
7. To study the different properties of periodic table.
8. To understand the phenomenon of isomerism and optical activity.
9. To study different types of organic reactions.
10. Chemistry lab will provide students with the first-hand experience of verifying various theoretical concepts learnt in theory courses.

Course Outcomes: This course will enable the students to.

1. Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalize bulk properties and processes using thermodynamic considerations.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques and will help in identifying different organic molecules.
4. Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5. Learnt the different types of organic reactions.
6. Apply basic knowledge of chemistry to solve real-world problems.
8. Estimate rate constants of reactions from concentration of reactants/products as a function of time.
9. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc
10. Synthesize a small drug molecule and analyse a salt sample

Chemistry-I [L:3; T:1; P:0 (4 credits)]

Course Contents:

UNIT I: Atomic and molecular structure

Schrodinger equation. Particle in a box solutions and its applications, Hydrogen atom wave functions and its plots to explore their spatial variations. Equations for atomic and molecular orbitals. Molecular orbitals and energy level diagrams of diatomic molecules, butadiene and benzene. Aromaticity. Crystal field theory of transition metal ions and magnetic properties. Band structure of solids and the role of doping on band structures.

UNIT II: Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

UNIT III: Intermolecular forces, potential energy surfaces and chemical equilibria

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, and H2F and trajectories on these surfaces. Thermodynamic functions: energy, entropy and free energy. Cell potentials, emf, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Ellingham diagrams.

UNIT-IV: Periodic properties

Effective nuclear charge, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers, hard soft acids and bases.

UNIT-V: Stereochemistry, organic reactions and synthesis of drug molecule

Representations of 3 dimensional structures, Isomerism in organic molecules and transition metal compounds, optical activity, absolute configurations and conformational analysis. Introduction to organic reactions. Synthesis of a commonly used drug molecule.

Suggested Text Books

(i) University chemistry, by B. H. Mahan

(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane

(iii) Fundamentals of Molecular Spectroscopy, by C. N. Banwell

(iv) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

(v) Physical Chemistry by P. W. Atkins

(vi) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5^{th} Edition

Chemistry-I Lab [L:0; T:0; P:2 (1 credit)]

Experiments from the following:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary viscometers to demonstrate the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Mathematics-II (Probability and Statistics)

COURSE CODE:	COURSE NAME:	L	T	P	C
ASHB152	Mathematics-II (Probability and Statistics)	3	1	0	4
Category of course: Basic Science Courses					
Pre-requisites: Basic knowledge of +2 level probability and statistics					
Course Objectives: 1. To make the students familiar with the basics of probability theory. 2. To explain the use of continuous and discrete probability distributions in all branches of engineering. 3. To develop the tools of basic statistics, applied statistics in connection with engineering purpose.					
Course Outcomes: At the end of the course the students will be able to learn the basics of Probabilityand Statistics and apply them to solve engineering problems.					

Course Contents:

Unit I: Basic Probability

Probability spaces, conditional probability, independence; theorem of total probability and Bayes' theorem.

Unit II: Random variables

Discrete random variables, continuous random variables, independent random variables, mean and variance of random variables, distribution functions and densities.

Unit III: Discrete Probability Distributions

Binomial and Poisson distributions, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials; Correlation coefficient.

Unit IV: Continuous Probability Distributions

Normal, exponential and gamma distributions with their properties.

Unit V: Basic and Applied Statistics

Measures of Central tendency, Test of significance. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves

Text Books:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006. (Unit- I-V)
2. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002. (Unit- I-V)

References:

1. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.
2. N.P. Bali and M. Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

Programming for Problem Solving (Theory and Lab)

COURSE CODE:	COURSE NAME:	L	T	P	C
i) ASHE153 ii) ASHE157	**i)Programming for Problem Solving**	3	0	0	3
	ii) Programming for Problem Solving Lab	0	0	4	2
Category of course: Engineering Science Courses					
Course Objectives: 1. To learn the fundamentals of computers. 2. To understand the various steps in program development. 3. To learn the syntax and semantics of C programming language. 4. To learn the usage of structured programming approach in solving problems. 5. To understated and formulate algorithm for programming script 6. To analyze the output based on the given input variables					
Course Outcomes: The student will learn 1. To formulate simple algorithms for arithmetic and logical problems. 2. To translate the algorithms to programs (in C language). 3. To test and execute the programs and correct syntax and logical errors. 4. To implement conditional branching, iteration and recursion. 5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach. 6. To use arrays, pointers and structures to formulate algorithms and programs. 7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems. 8. To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.					

UNIT I:

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.).

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples.

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

UNIT II:
Arithmetic expressions and precedence.

Conditional Branching and Loops, Writing and evaluation of conditionals and consequent branching, Iteration and loops.

Arrays (1-D, 2-D), Character arrays and Strings.

UNIT III:

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required).

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

UNIT IV:

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Structures, Defining structures and Array of Structures

UNIT V:
Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling (only if time is available, otherwise should be done as part of the lab)

ASH-ESC-157 Programming for problem Solving Lab
Laboratory - Programming for Problem Solving [L : 0; T:0 ; P : 4 (2credits)]

[The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.]

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value:
Lab 7: Simple functions
Tutorial 8 &9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems
Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions
Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures
Tutorial 12: File handling:
Lab 12: File operations

Suggested Text/ Reference Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
(iii) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

English

COURSE CODE: ASHH154	COURSE NAME:	L	T	P	C
	English	2	0	2	3
Category of Course: Humanities and Social Sciences including Management courses					
Pre-requisites: The learners should have the basic knowledge of English to understand the class lecture.					
Course Objectives: 1. To provide learning environment to practice listening, speaking, reading and writing skills. 2. To assist the students to carry on the tasks and activities through guided instructions and materials. 3. To effectively integrate English language learning with employability skills and training. 4. To provide hands-on experience through group and individual presentations.					
Course Outcomes: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.					

Course Contents:

Unit I: Vocabulary Building

1.1 The concept of Word Formation
1.2 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.3 Synonyms, antonyms, and standard abbreviations.
1.4 Parts of Speech

Unit II: Basic Writing Skills

2.1 Interchange of Sentences
2.2 Use of phrases and clauses in sentences
2.3 Framing Questions
2.4 Narration

Unit III: Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Prepositions
3.4 Redundancies

Unit IV: Writing Skill

4.1 Writing short passage
4.2 Writing reports based on visuals
4.3 Writing instructions with clarity

Unit V: Oral Communication

5.1 Conversations in common everyday situations

5.2 Polite expression and their usage

5.3 Giving opinion; giving feedback

5.4 Communication at Workplace

5.5 Listening Comprehension

Text Books:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Technical Communication: Principles and Practice. Meenakshi Raman. Oxford University Press

References:

1. Remedial English Grammar. F.T. Wood. Macmillan.2007
2. On Writing Well. William Zinsser. Harper Resource Book. 2001
3. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
4. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
5. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Universal Human Values

COURSE CODE: ASHH155	COURSE NAME:	L	T	P	C
	Universal Human Values	2	1	0	3

Category of Course: Humanities and Social Sciences including Management courses

Course Objectives:

1. To help the students appreciate the essential complementarily between 'VALUES' and
2. 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
3. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
4. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.
5. To provide a much-needed orientational input in value education to the young enquiring minds.

Course Outcomes:

By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society). It is hoped that they would be able to apply what they have learnt to their own self in different day-today settings in real life, at least a beginning would be made in this direction. Therefore, the course and further follow up is expected to positively impact common graduate attributes like:

1. Holistic vision of life
2. Socially responsible behaviour
3. Environmentally responsible work
4. Ethical human conduct
5. Having Competence and Capabilities for Maintaining Health and Hygiene
6. Appreciation and aspiration for excellence (merit) and gratitude for all

Course Contents:

Unit I: Introduction to Value Education
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Understanding Value Education
Self-exploration as the Process for Value Education
Continuous Happiness and Prosperity – the Basic Human Aspirations
Happiness and Prosperity – Current Scenario Method to Fulfil the Basic Human Aspirations

Unit II: Harmony in the Human Being
Understanding Human being as the Co-existence of the Self and the Body
Distinguishing between the Needs of the Self and the BodyThe Body as an Instrument of the Self
Understanding Harmony in the Self
Harmony of the Self with the Body
Programme to ensure self-regulation and Health

Unit III: Harmony in the Family and Society
Harmony in the Family – the Basic Unit of Human Interaction
'Trust' – the Foundational Value in Relationship
'Respect' – as the Right Evaluation
Other Feelings, Justice in Human-to-Human Relationship
Understanding Harmony in the Society
Vision for the Universal Human Order

Unit IV: Harmony in the Nature/Existence
Understanding Harmony in the Nature
Interconnectedness, self-regulation and Mutual Fulfilment among the Four
Orders of Nature
Realizing Existence as Co-existence at All Levels
The Holistic Perception of Harmony in Existence

Unit V: Implications of the Holistic Understanding – a Look at Professional Ethics
Natural Acceptance of Human Values
Definitiveness of (Ethical) Human Conduct
A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Competence in Professional Ethics
Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Strategies for Transition towards Value-based Life and Profession

Text Books:

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

Workshop/Manufacturing Practices

COURSE CODE: ASHE158	COURSE NAME:	L	T	P	C
	Workshop/Manufacturing Practices	1	0	4	3

Category of Course: Engineering Science Courses

Course Objectives:

1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To have a study and hands-on-exercise on plumbing and carpentry components.
3. To have a practice on gas welding, foundry operations and fitting
4. To have a study on measurement of electrical quantities, energy and resistance to earth.
5. To have a practice on soldering

Course Outcomes:

Upon completion of this course, the students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Upon completion of this laboratory course, students will be able:

1. To fabricate components with their own hands.
2. To relate practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. To design small devices of their interest by assembling different components

Course Contents:

Module I: Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
Module II: CNC machining, Additive manufacturing.
Module III: Fitting operations & power tools.
Module VI: Carpentry.
Module V: Plastic moulding, glass cutting.
Module VI: Metal casting.
Module VII: Welding (arc welding & gas welding), brazing.

Practicals:

1. Machine shop
2. Fitting shop
3. Carpentry
4. Welding shop (Arc welding + Gas welding)

5. Casting
6. Smithy
7. Plastic moulding & Glass Cutting

Text Books :

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai**.**

References:

1. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
2. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
3. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
4. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE CODE: ASHA159	COURSE NAME:	L	T	P	C
	Sports and Yoga	2	0	0	0

Category of Course: Audit Course

Pre-requisite: None

Course Objectives:

1. To make the students understand the importance of sound health and fitness principles as they relate to better health.
2. To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
3. To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury.
4. To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Outcomes:

On successful completion of the course the students will be able:

1. To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
2. To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.
3. To learn breathing exercises and healthy fitness activities
4. To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
5. To perform yoga movements in various combination and forms.
6. To assess current personal fitness levels.
7. To identify opportModuleies for participation in yoga and sports activities.
8. To develop understanding of health-related fitness components: cardiorespiratory endurance, flexibility and body composition etc.
9. To improve personal fitness through participation in sports and yogic activities.
10. To develop understanding of psychological problems associated with the age and lifestyle.
11. To demonstrate an understanding of sound nutritional practices as related to health and physical performance.
12. To assess yoga activities in terms of fitness value.
13. To identify and apply injury prevention principles related to yoga and physical fitness activities.
14. To understand and correctly apply biomechanical and physiological principles elated to exercise and training

Course Contents:

Unit I:

Module I: Introduction to Physical Education

Meaning & definition of Physical Education

Aims & Objectives of Physical Education Changing trends in Physical Education

Module II: Olympic Movement

Ancient & Modern Olympics (Summer & Winter)

Olympic Symbols, Ideals, Objectives & Values

Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

Unit II:

Module III: Physical Fitness, Wellness & Lifestyle
Meaning & Importance of Physical Fitness & Wellness

Components of Physical fitness
Components of Health related fitness

Components of wellness
Preventing Health Threats through Lifestyle Change

Concept of Positive Lifestyle
Module IV: Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga
Define Anatomy, Physiology & Its Importance

Effect of exercise on the functioning of Various Body Systems. (Circulatory System,

Respiratory System, Neuro-Muscular System etc.) Module V:
Kinesiology, Biomechanics & Sports
Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports

Newton's Law of Motion & its application in sports.
Friction and its effects in Sports.

Unit III:

Module VI: Postures

Meaning and Concept of Postures.
Causes of Bad Posture.

Advantages & disadvantages of weight training.
Concept & advantages of Correct Posture.

Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.

Corrective Measures for Postural Deformities

Module VII: Yoga

Meaning & Importance of Yoga

Elements of Yoga
Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas

Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
Relaxation Techniques for improving concentration - Yog-nidra
Module VIII: Yoga & Lifestyle

Asanas as preventive measures.

Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.

Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.

Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.

Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.

Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

Unit IV:

Module IX: Training and Planning in Sports
Meaning of Training

Warming up and limbering down
Skill, Technique & Style

Meaning and Objectives of Planning.
Tournament – Knock-Out, League/Round Robin & Combination.
Module X: Psychology & Sports

Definition & Importance of Psychology in Physical Edu. & Sports
Define & Differentiate Between Growth & Development
Adolescent Problems & Their Management Emotion: Concept, Type & Controlling of emotions Meaning, Concept & Types of Aggressions in Sports. Psychological benefits of exercise.

Anxiety & Fear and its effects on Sports Performance. Motivation, its type & techniques.
Understanding Stress & Coping Strategies.
Module XI: Doping
Meaning and Concept of Doping
Prohibited Substances & Methods
Side Effects of Prohibited Substances

Unit V:

Module XII: Sports Medicine

First Aid – Definition, Aims & Objectives.
Sports injuries: Classification, Causes & Prevention.

Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

Module XIII: Sports / Games

Following subtopics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.

History of the Game/Sport.
Latest General Rules of the Game/Sport.
Specifications of Play Fields and Related Sports Equipment. Important Tournaments and Venues.
Sports Personalities.
Proper Sports Gear and its Importance.

Text Books:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga by B.K.S. Iyengar.

Semester-III

Discrete Mathematics

Course Code	CSE201
Course Name	Discrete Mathematics
Category of Course	Professional core courses (PC)
Credits	3L:1T: 0 P C:4
Pre-Requisites	Elementary algebra and arithmetic

Course Objectives

Throughout the course, students will be expected to demonstrate their understanding of Discrete Mathematics by being able to do each of the following:

- Use mathematically correct terminology and notation.
- Apply logical reasoning to solve a variety of problems.
- Understand discrete mathematical structures.
- Formulate and solve graph problems

Syllabus

UNIT I	Hours = 40
Sets and Relation Set Basics, Venn Diagram, counting principles, Inclusion and Exclusion principle, pigeon-hole principle, Induction, Mathematical Induction. **Relations** Groups, Monodies, Types of relation, Diagraphs, Inductive form of relations, Congruence relations on Semi groups. Partially Ordered Set, Lattices,Recursion and Recurrence Relation: Basic idea.	8
UNIT II	
Functions and Algebraic Structures Functions types, mapping in functions, commutative diagrams, Monotone functions, Sequence and discrete function. Generating functions and applications, Rings, Subrings, morphism of rings, ideals and quotient rings. Euclidean domains. Integral domains and fields. **Boolean Algebra** Direct product, Morphisms. Boolean sub-algebra. Boolean Rings. Applications of Boolean algebra in logic circuits and switching functions.	8
UNIT III **Recursion and Recurrence Relation** Basic idea, Sequence and discrete function. Generating functions and	8

applications. **Propositional Logic** Syntax, Semantics, Validity and Satisfiability, Basic Connectives and Truth Tables, Logical Equivalence: The Laws of Logic, Logical Implication, Rules of Inference, The use of Quantifiers. Proof Techniques: Some Terminology, Proof Methods and Strategies, Forward Proof, Proof by Contradiction, Proof by Contraposition, Proof of Necessity and Sufficiency.	
UNIT IV	
Introduction to Graph Theory and Trees Graphs, Digraphs, Isomorphism, Walks, Paths, Circuits, Shortest Path Problem, Dijkstra's Algorithm, Trees, Properties of Trees, Cotrees and Fundamental Circuits.	8
UNIT V	
Graph Theoretic Algorithms and Applications: Shortest Spanning Trees - Kruskal's Algorithm, Prims Algorithm, DFS, BFS, Cut Sets, Fundamental Cut Sets and Cut Vertices, Planar and Dual Graphs, Graph Coloring, Metric Representation of Graphs, Networks, Flow Augmenting Path, Ford-Fulkerson Algorithm for Maximum Flow.	8

Text Books:

1. *Kolman, Busby and Ross, "Discrete mathematical structures" (6th Ed.) PHI, 2009.*
2. *Kenneth H. Rosen: Discrete Mathematics and its Applications, 7th Edition, McGraw Hill, 2011.*
3. *Deo N., "Graph Theory with Applications to Engineering and Computer Science", PHI, 2004.*
4. *C L Liu and D P Mohapatra, Elements of Discrete Mathematics A Computer Oriented Approach, 3rd Edition by, Tata McGraw – Hill*

Reference books:

1. *R. Balakrishnan and K. Ranganathan," A Text book of Graph Theory" (2nd Ed.), MH,2013.*
2. *Tremblay and Manohar, Discrete mathematical structures with applications to computer science, McGraw Hill, 2001.*
3. *Tremblay and Manohar, Discrete mathematical structures with applications to computer science, McGraw Hill, 2001.*

Course Outcomes:

- For a given logic sentence express it in terms of predicates, quantifiers, and logical connectives.
- For a given a problem, derive the solution using deductive logic and prove the solution based on logical inference.
- For a given a mathematical problem, classify its algebraic structure.
- Evaluate Boolean functions and simplify expressions using the properties of Boolean algebra.
- Develop the given problem as graph networks and solve with techniques of graph

Signals and Systems

Course Code	CSE202
Course Name	Signals and Systems
Category of Course	Engineering Science courses (EC)
Credits	3L:0T: 0 P C: 3
Pre-Requisites	NIL

Course Objectives

- To make the students understand the physical meaning of signals, systems and its various classifications.
- The students will be able to correlate the concept of the subject with the real life phenomenon.

Syllabus

UNIT I	**Hours=40**
Introduction to signals and systems Definition of Signals, Basic Signals, Classification of Signals, Operations on Signals, Definition of Systems, System Properties: Linearity: Superposition and Homogeneity, Shift-Invariance, Causality, Stability, LTI Systems and its Properties, Convolution.	8
UNIT II	
Fourier analysis of Signals Introduction, Fourier Series representation of Continuous Time (CT) Periodic Signals, Convergence of the Fourier series, Properties of CT Fourier series, Fourier series representation of Discrete Time (DT)periodic signals and its Properties. Fourier Transform of aperiodic signals in CT and DT, Properties of Fourier Transform, Basic idea of Discrete Fourier Transform.	8
UNIT III	
Laplace Transform Introduction, Region of Convergence and its properties, Poles and Zeros of system, Properties of LT, Inverse Laplace Transform, Analysis and Characterization of LTI systems using Laplace Transform.	8
UNIT IV	

DT conversion from CT State-space analysis, The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.	6
UNIT V	
Z -Transform Introduction, Region of Convergence and its properties, Properties of Z-Transform, Inverse Z-Transform, Analysis and Characterization of LTI systems using Z-Transform. Initial and Final theorem of Z-Transform, Application of Signals and Systems in communication, filtering etc.	6

Text Books/ Reference Books*:*

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall,1983.
1. 4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
2. 5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
3. 9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.

Course outcomes:

At the end of this course students will

1. Have better understanding of signals and Systems.
2. Be able to represent continuous and discrete systems in time and frequency domain using different transforms.
3. Be able to state about the stability of a given system.
4. Have better understanding of sampling and reconstruction of a sign

Data Structure

Course Code	CSE203
Course Name	Data Structure
Category of Course	Professional core courses (PC)
Credits	3L:0T: 0 P C: 3
Pre-Requisites	Any computer language preferably C (Desirable)

Course Objectives

- To impart the basic concepts of data structures and algorithms.
- To understand concepts about searching and sorting techniques
- To understand basic concepts about stacks, queues, lists, trees and graphs.
- To enable them to write algorithms for solving problems with the help of fundamental data Structures.

Syllabus

UNIT I	Hours = 36
Fundamentals: Basic Terminologies: Elementary Data Organizations; Time and Space analysis of Algorithms: Time Complexity, Space complexity, Order Notations. Recursion - Design of recursive algorithms, Searching: Linear Search and Binary Search Techniques and their complexity analysis.	8
UNIT II	
Stacks and Queues ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	9
UNIT III	
Linked Lists Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.	6
UNIT IV	
Trees Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis**.**	6

UNIT V	
Sorting and Hashing Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. **Graph** Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	7

Text Books:

1. *S.K. Srivastava and Deepali Srivastava," Data Structure through C in depth", BPB Publications,2004.*
2. *Ellis Horowitz, SartajSahni ,S A Freed"Fundamentals of Data Structures in C (Second Edition)"Universities Press; Second edition (2008)*

Reference Books:

1. *Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Pearson; 1 edition (30 October 1995)*
2. *"How to Solve it by Computer", 2nd Impression by R.G. Dromey, Pearson Education*

Course Outcomes

- For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
- For a given Search problem (Linear Search and Binary Search) student will able to implement it.
- For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
- Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
- Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity.

Digital Electronics

Course Code	CSE204
Course Name	Digital Electronics
Category of Course	Engineering Science courses (EC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	Fundamental knowledge of electronics and electrical circuits.

Course Objectives

- Introduce students to the Digital Systems, learn about number systems, Boolean algebra and logic gates.
- Students learn about the representation, manipulation, and minimization of Boolean functions.
- Students should be able to learn how to design combinational and sequential circuits.
- Students should be able to understand the concept of finite state machines, state minimization, and algorithmic state machines.
- Learn about analysis and synthesis of asynchronous circuits.

Syllabus

UNIT I	Hours = 40
Fundamentals of Digital Systems and Number Systems ***Introduction:*** Need of Digital Systems, Digital Vs Analog Systems, Logic Levels and Pulse Waveforms, Elements & Functions of Digital Logic, and Benefits of Digital Systems. ***Number Systems:*** Systematic way to represent and manipulate number systems, Signed and Unsigned number representation, Binary arithmetic, BCD, Gray-Code, XS-3 code representation, Error Detection and Correction code.	6
UNIT II	
Logic Gates, Logic families to implement gates, Boolean Algebra *Logic Gates:* Binary Logic, Importance of Moore's Law, Introduction of Logic gates. *Logic families:* DTL, TTL, ECL, MOS, CMOS etc. and their operation, design, and specifications. *Boolean Algebra or Switching Algebra:* Basic concept of Boolean algebra, Basic Laws and Properties of Boolean algebra, Definition of Boolean Functions and their properties, Boolean Function representation, manipulation and minimization (by algebraic method, Karnaugh Map method, Quine-McCLUSKY method).	8
UNIT III	
Combinational Logic and Threshold Logic Design ***Combinational Logic Design:***Introduction of combinational circuits, and design procedure of combinational circuit modules, Binary Adder-Subtractor, Decimal Adder, Comparator, Decoder, Encoder, Multiplexer, De-Multiplexer, Parity generator. ***Threshold Logic Design:***Basic concept of threshold logic and importance, Threshold element and construction of threshold gate, Boolean function realization using threshold gate, Synthesis of threshold function.	10
UNIT IV	

Sequential Logic Design ***Introduction:***Basic concept of memory elements like Latches and Flip-Flops, Design of Latches, Notion of Clock, Design of Flip-Flops, Clocking and Timing. ***Synthesis of Synchronous Sequential Circuits:*** Combinational Vs Sequential Circuits, Finite State Machine (FSM), Model of Synchronous Sequential Machine, State transition diagram and State table, Examples of Synchronous Sequential Circuits design methodology. ***Design of Registers and Counters:*** Different variations of Registers and their design, Design of asynchronous and synchronous counters. Design of Asynchronous sequential Circuits.	10
UNIT V	
Analog-to-Digital (A/D), Digital-to Analog Conversion (D/A), Memory devices ***A/D, D/A Conversion:*** Basic concept D/A Conversion, Different types of D/A converters and conversion techniques. *Memory devices:* RAM, ROM, EPROM, EEPROM.	6

Text Books:

1. *Digital Design, 4th Edition, M. Morris Mano and Michael D. Ciletti, published by Pearson Education, Inc., Copyright © 2007.*
2. *Fundamental of Digital Circuits, 4th Edition, A. Anand Kumar, published by PHI Learning Private Limited, Copyright © 2016.*

Reference Books:

1. *Modern Digital Electronics, 4th Edition, R P Jain, published by TMH, Copyright © 2010, 2003, 1997, 1984.*
2. *Switching and Finite Automata Theory, 3rd Edition, ZviKohavi and Niraj K. Jha, published by Cambridge University Press, Copyright © 2010.*

Course Outcomes

- Students Will Be Able To Explain The Concept Of Digital Systems, Number Systems Which Helps Digital Representation Of Information.
- Students Will Be Able To Explain The Basic Logic Operation Of NOT, AND, OR, NAND, NOR, X-OR, X-NOR.
- Students Will Be Capable Of Understanding The Different Type Of Logic Families Like DTL, TTL, ECL, MOS, CMOS, Etc., And Their Operation, Design, And Specification.
- Students Will Be Able To Interpret The Boolean Algebra Expressions, Logic Functions, Circuits, And Truth Tables. Also, Learn The Minimization Techniques Of Boolean Algebra Expressions.
- Students Will Be Able To Design The Combinational Circuits And Analyze The Computer Software Application. Also, Learn The Detail Concept And Synthesis Approaches Of Threshold Logic.
- Students Will Be Able To Understand The Detail Concept Of Memory Elements Like Latches And Edge-Triggered Flip-Flops.
- Students Will Be Able To Design The Synchronous Sequential Circuit, And Also Able To Implement The Computer Software Application.
- Students Will Be Able To Understand The Concept Of Registers, Counters And Their Applications In Digital Circuits. Moreover, Students Will Be Gain Knowledge Of The Detail Designing Procedure Of Asynchronous Sequential Circuits.
- Students will be able to model and analyze the A/D and D/A conversion technique. Also, able to understand the different types of memory devices.

Mathematics -III

Course Code	ASHB201
Course Name	Mathematics III (Calculus, Differential Equations and Algebraic Structures)
Category of Course	Basic Science courses (BC)
Credits	2L:0T: 0 P C:2
Pre-Requisites	Basic knowledge of single variable calculus and differential equations.

Course Objectives:

1. To present the effective mathematical tools for the solutions of differential equations that model physical processes.
2. To introduce the tools of different multivariable calculus and algebraic structures that are used in the modeling of various engineering problems**.**

Course Outcome:

At the end of the course the students should be able to

1. Understand the basics of ordinary differential equations and their engineering applications.
2. Get familiar with the concept of sequences, series, multivariable calculus and algebraic structures and their applications

Course Contents:

Unit 1: Sequences and Series

Convergence of sequence and series, tests for convergence; Power series, Taylor's series.

Unit 2: Multivariable Calculus

Limit, continuity and partial derivatives, directional derivatives, total derivative.

Unit 3: First order ordinary differential equations

Exact, linear and Bernoulli's equations, Euler's equations,

Unit 4: Ordinary differential equations of higher degree and higher orders

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit 5: Algebraic Structures

Algebraic structures with one binary operation – semigroup, monoid and group. Cosets, Lagrange's theorem, normal subgroup.

Text books:

1. G. B. Thomas and R .L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002. (Unit-I,II)
2. S. L. Ross, Differential Equations, 3rdEd., Wiley India, 1984. (Unit_III,IV)
3. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997. (Unit-V)

References:

1. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
2. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
3. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.

Humanities I

Course Code	ASHH202
Course Name	Humanities I (Effective Technical Communications)
Category of Course	Humanities and Social Science including the Management Course (HC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	The learners should have the basic knowledge of grammar to write correct sentences.

Course Objectives:

Considering the significance of English language as a tool for academic and professional communication, the course aims to develop and enhance the linguistic and communicative competence of the learners. This course aims to train the B.Tech students in basic principles of communication and language by developing their LSRW skills, namely listening, speaking, reading and writing skills, and thereby, improving their proficiency in oral and written communication in English. During the course, the learners will be exposed to various forms of professional communication

Course Outcomes:

At the successful completion of the course, students will be able to understand

1. How communication works and why it is important
2. Methods for speaking and presenting with confidence
3. How to share views in a professional setting
4. Techniques for writing professional business documents
5. How to interact in one-on-one or group meetings

Course Contents:

Unit I: Introduction to Technical Communication
Differences between technical and literary style; Principles of technical writing; Different kinds of technical documents; Organization; Writing introduction and conclusion.

Unit II: Organizing principles of sentences in a paragraph
Topic Sentence; Support Sentence; Closing Sentence; Recognizing incoherence and logical sequencing of sentences; Importance of proper punctuation.

Unit III: Creating coherence and clarity
Avoiding ambiguity; Hedging; Transition and Signal words.

Unit IV: Use of appropriate diction
Technical writing style and language; Using specific and formal words; Economy with words

Unit V: Oral Communication
Public speaking; Group discussion; Formal presentation; Interviews;Impromptu Speech.

Text Books:

1. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
2. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.

References:

1. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
2. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003.
3. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004.

Data Structures Lab

Course Code	CSE205
Course Name	Data Structure Lab
Category of Course	Professional core courses (PC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	NIL

Course Objectives

- Identify, formulate, review research literature, and analyze complex engineering problems
- Design solutions for complex engineering problems and design system components or processes that meet the specified needs
- Create, select, and apply appropriate data structures for different problems

Experiments:

1. Create a dynamic array.
2. Implement pointer operations.
3. Implement binary search.
4. Create Singly Linked list and doubly linked list and perform: a) Insertion, b) Deletion, c) Display.
5. Implement stack using array and linked list.
6. Implement queue and circular queue using array and linked list.
7. Perform the following operations for stack & queue: a) Insertion, b) Deletion, c) Display.
8. Write a C program that uses Stack operations: a) To convert a given infix expression into its postfix Equivalent, b) Evaluate postfix expression, c) Check for balanced parenthesis.
9. Implement the following: a) Binary Search Tree and its traversal, b) Graph traversal algorithms.
10. Implement the following sorting algorithms: a) Insertion, b) Selection c) Bubble, d) Merge, e) Quick.

Course Outcomes

- Demonstrate knowledge and understanding of the problem and the nature of solution.
- Gain hands-on experience and apply the principles of data structures.
- Apply reasoning informed by the appropriate knowledge to assess different problem.

Digital Electronics Lab

Course Code	CSE206
Course Name	Digital Electronics Lab
Category of Course	Engineering Science courses (EC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	Fundamental knowledge of electronics and basic C programming skill

Course Objectives

- Introduce students to the Digital Systems, learn about number systems, Boolean algebra and logic gates.
- Students learn about the representation, manipulation, and minimization of Boolean functions.
- Students should be able to learn how to design combinational and sequential circuits through Hardware programming design using Verilog/VHDL.
- Students should be able to understand the detail circuit structure and their behaviours with the help of software application.
- Students should be able to learn about the details behaviour of combinational and sequential circuit through Hardware programming Language.

Experiments:

1. Introduction to Verilog/VHDL language.
2. Design of all basic and Universal gates using Verilog /VHDL.
3. Design of XOR and XNOR gate using VHDL.
4. Design of Full -adder and Full -Subtractor using VHDL.
5. Design of 4-bit Parallel Adder-Subtractor using VHDL.
6. Design of 4:1 Multiplexer using VHDL.
7. Design of 1:4 De-multiplexer using VHDL.
8. Design of 8 X 3 Encoder using VHDL.
9. Design of 3X8 Decoder using VHDL.
10. Design of Priority Encoder using VHDL.
11. Design of 4-bit array multiplier using VHDL.
12. Design of S-R Flip-Flop using VHDL.
13. Design of D Flip-Flop using VHDL.
14. Design of J-K/T Flip-Flop using VHDL.
15. Design of Master-Slave Flip-Flop.
16. Design of mod-10 synchronous counter.
17. Design ripple counter/ twisted ring counter.

Text Books:

1. *Digital Design, 4th Edition, M. Morris Mano and Michael D. Ciletti, published by Pearson Education, Inc., Copyright © 2007.*
2. *Fundamental of Digital Circuits, 4th Edition, A. Anand Kumar, published by PHI Learning Private Limited, Copyright © 2016.*
3. *VHDL programming by Example, 4th Edition, Douglas L. Perry, Published by McGraw-Hill, Copyright © 2012.*

Course Outcomes

- Students will be able to design the combinational and sequential circuit, and also able to implement the computer software application.
- Students will be able to explain the details behaviour of the varieties of digital circuits.

IT Workshop I (Web Technology)

Course Code	CSE207
Course Name	IT Workshop I (Web Technology)
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	

Course Objectives

Experiments:

Text Books:

Course Outcomes

Semester-IV

Software Engineering

Course Code	CSE251
Course Name	Software Engineering
Category of Course	Professional Core courses (PC)
Credits	3L:1T: 0 P C:4
Pre-Requisites	NIL

Course Objectives:

- To discuss the process for developing large software.
- To analyse and model a particular system.
- To develop alternative solutions for the system.
- To implement, test and validate a systems design.

Syllabus

UNIT I	Hours =40
System Analysis & Design Overview, Business System Concept, System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model, Function Point Analysis (FPA).	8
UNIT II	
System Requirement Specification and System analysis DFD, Data Dictionary, ER diagram, Process Organization & Interactions. System Design- Problem Partitioning, Top-Down & Bottom-Up design; **Decision tree** Decision table and structured English; Functional vs. Object- Oriented approach.	8
UNIT III	
Coding & Documentation Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.	8
UNIT IV	
Testing Levels of Testing, White & Black box testing, Integration Testing, structural testing Test case Specification, Reliability Assessment, Validation & Verification Metrics, and Monitoring& Control.	8
UNIT V	
Software Project Management Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. CASE TOOLS: Concepts, use and application. Software reliability	8

and quality management.	

Text Books:

1. *Rajib Mall, Fundamentals of Software Engineering. 3ed, PHI.*

Reference Books:

1. *R. G. Pressman, Software Engineering, TMH.*
2. *Behforooz, Software Engineering Fundamentals, OUP*

Course Outcomes:

- Discuss the process for developing large software.
- Analyze and model a particular system.
- Develop alternative solutions for the system.
- Implement, test and validate a systems design.

Object Oriented Programming

Course Code	CSE252
Course Name	Object Oriented Programming
Category of Course	Professional Core courses (PC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	Data Structures and Algorithms (Desirable)

COURSE OBJECTIVES

- Introduce students to the Object Oriented Programming paradigm.
- To familiarize students to use standard tools and techniques for software development, using object oriented approach
- Students should be able to understand fundamental concepts of OOP to solve different problems of varied nature
- To introduce event driven GUI applications using Java

Syllabus

UNIT I	
Introduction to Java and Object oriented Concepts: Need of OOP, History & Evolution, Concepts, and Benefits of OOP. Overview and characteristics of Java, Java program Compilation and Execution Process Organization of the Java Virtual Machine, JVM as an interpreter and emulator.	
UNIT II	
Data Abstraction & Inheritance: Data Types & Literals Variables, Arrays, Arithmetic Operators, Logical Operators, Control of Flow, Classes and Instances, Class Member Modifiers Inheritance concept, Inheritance basics, Member access, Constructors, Creating Multilevel hierarchy, super uses, using final with inheritance, Interfaces- defining an interface, implementing interfaces, Nested interfaces, applying interfaces, variables in interfaces and extending interfaces.	
UNIT III	
Polymorphism, Exceptions & Packages : Polymorphism-ad hoc polymorphism, pure polymorphism, method overriding, abstract classes, Object class, Anonymous inner class, wrapper class. Exception Handling: Try Throw, Catch, Throwing an Exception, Catching an Exception, Re-throwing an Exception, Exception specifications, Defining a Package, CLASSPATH, Access protection, importing packages.	
UNIT IV	
Multithreading & Collection Framework Threads Life Cycle: Creating Threads, Thread Priority, Blocked States, Extending Thread Class, Runnable Interface, Starting Threads. Collections overview, Collection Interfaces, The Collection classes- Array List, Linked List, Hash Set, Tree Set, Priority Queue, Array Deque.	
UNIT V	
Files and I/O Streams: The Stream classes-Byte streams and Character streams, Reading console Input and	

Writing Console Output, File class, Reading and writing Files. GUI: Swings/JavaFx.	

Text Books:

1. *Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH*
2. *Ivor Horton's Beginning Java 2 SDK – Wrox Publication*
3. *E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH*

Reference books:

1. *R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING*
2. *Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson*

COURSE OUTCOMES

- Specify simple abstract data types and design implementations, using abstraction functions to document them.
- Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
- Name and apply some common object-oriented design patterns and give examples of their use.
- Design applications with an event-driven graphical user interface

Database Management Systems

Course Code	CSE253
Course Name	Database Management Systems
Category of Course	Professional core courses (PC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	Basic Professional Course

Course Objectives:

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
- To understand and use data manipulation language to query, update, and manage a database
- To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Syllabus

UNIT I	Hours=40
Database system architecture 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.	8
UNIT II	
Relational query languages Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. **Relational database design** Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. **Query processing and optimization** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	8
UNIT III	
Storage strategies Indices, B-trees, hashing. **Transaction processing** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database	8

recovery.	
UNIT IV	
Database Security Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	8
UNIT V	
Advanced topics Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	8

Text Books:

1. *"Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.*

Reference Books:

1. *"Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.*
2. *"Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education*
3. *"Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley*

Course Outcomes:

- For a given query write relational algebra expressions for that query and optimize the developed expressions.
- For a given specification of the requirement design the databases using E_R method and normalization.
- For a given specification construct the SQL queries for Open source and Commercial DBMS MYSQL, ORACLE, and DB2.
- For a given query optimize its execution using Query optimization algorithms
- For a given transaction-processing system, determine the transaction atomicity, consistency, isolation, and durability.
- Implement the isolation property, including locking, time stamping based on concurrency control and Serializability of scheduling.

Computer Organization & Architecture

Course Code	CSE254
Course Name	Computer Organization & Architecture
Category of Course	Professional core courses (PC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	Digital logic Design

Course Objectives:

The student should be made to:

- Gives a view of computer system from user's perspective.
- Types of instructions.

Syllabus

UNIT I	Hours=40
Introduction to Computer System Representation of basic information, Computer types, Different functional units of computer, operational concept. Computer Organization and Computer Architecture and its difference. Performance of a Computer. Memory locations and addressing-Byte addressability-Big endian and little endian assignment-word alignment. Addressing modes and MIPS addressing. MIPS registers and instruction types. Operations of the Computer Hardware, Operands of the Computer Hardware. Representing Instructions in the Computer, Logical Operations, Instructions for Making Decisions, Supporting Procedures in Computer Hardware.	10
UNIT II	
ALU Design High speed adder and subtractions design: ripple carry Adder/subsctractor, Carry look ahead adder/ substractor design, Multiplexer design, AND, OR, SLT, OVERFLOW design. Design of 8-bit ALU for Adder/Sub/AND/OR/RLL/RLR. Multiplier Design: multiplication of positive numbers-Signed operand multiplication and Booth algorithm-Fast multiplier design-Carry Save addition of Summands. Integer Division. Floating point numbers and operation.	9
UNIT III	
Memory System Basic concept of memory, Semiconductor RAM memories-Read only memories. Speed size cost, cache memories, performance consideration virtual memory, memory management requirement, and secondary storage.	8
UNIT IV	
Data Path Design And Control Design	7

Hardwired controlled and micro programmed control. MIPS Data path design for Rtype,I-type and J-Type of Instructions and its hardwired control design.	
UNIT V	
Pipeline An Overview of Pipelining, Pipelined Data path and Control ,Data Hazards: Forwarding versus Stalling, Control Hazards	6

Text Books:

1. John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.

Reference books:

1. Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition, 2000. 2. Sima D, Fountain T and KacsukP,"Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.

Course Outcomes

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

- Evaluate performance of different architectures with respect to various parameters.
- Study about different hazards and its resolution.
- Analyze performance of different ILP techniques.
- Identify cache and memory related issues in multi-processors.

Management I

Course Code	ASHH251
Course Name	Management I (Organizational Behaviour)
Category of Course	Humanities and Social Science including the Management Course (HC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	None

Course Objectives:

The objective of the course is to orient the engineering students with the concepts and practical implications of Behaviour, personality and attitude of individuals and groups in organization.

Course Outcomes:

After the completion of the course

1. The students will acquire the skills of understanding individual and group behavior, culture, attitude and personality.
2. The students will gain the knowledge of organizational behavior

Course Contents:

Unit I:

Organizational Behaviour- Concept and Emergence of OB Concept; Historical Background- Hawthorne Studies, Psychological foundations; Models of Organisational Behaviour, Challenges and Opportunities for Organizational Behavior; Ethics and Organizational Behaviour.

Unit II:

Individual Behavior: Personality, Learning, Values and Attitudes, Perception, Learning Behaviorist, cognitive and social learning; Stress at work. Management's assumptions about people- McGregor's Theory X and Theory Y.

Unit III:

Motivation - Maslow's Need Hierarchy, Herzberg's Two Factors Theory, Vroom's Expectancy Theory; Theoryof Intrinsic Motivation by Ken Thomas; Work –Designing for creating motivating Jobs.

Unit IV:

Inter-personal Behaviour: Interpersonal communication and Feedback, Feedback utilization; Transactional Analysis (TA); Johari Window. Group Behaviour: Group Dynamics, Cohesiveness and Productivity; Group Decision Making; Organizational Politics.

Unit V:

Leadership- Concept and Styles; Fielder's Contingency Model; Leadership Effectiveness; Sources, patterns, levels, and types of conflict; Traditional and modern approaches to conflict; Functional and dysfunctional conflicts; Resolution of conflict. Organizational change- resistance and management

Text Books:

1. Robbins, Stephen P. and Timothy A. Judge: Organisational Behaviour. Prentice -Hall, New Delhi.
2. Aswathappa, K: Organisation Behaviour. Himalaya Publishing House, New Delhi.

Reference books:

1. Singh, K: Organizational Behaviour: Text and Cases. Pearson.
2. Pareek, U. and Khanna, S: Understanding Organizational Behaviour. Oxford University Press.
3. Sharma, R. A: Organisational Theory and Behaviour. Tata McGraw -Hill Publishing Co. Ltd.
4. Sekaran, Uma: Organisational Behaviour: Text and Cases. Tata McGraw-Hill Publishing Co. Ltd.
5. Singh, B. P. and T. N. Chhabra: Organisation Theory and Behaviour. DhanpatRai and Co. P. Ltd., New Delhi; 2000.

Environmental Science

Course Code	ASH252
Course Name	Environmental Science
Category of Course	Mandatory Courses (MC)
Credits	2L:0T: 0 P C:0
Pre-Requisites	

Course Objectives:

- We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these enthuses. There is a direct application of this wisdom even in modern times.
- Idea of an activity-based course on environment protection is to sensitize the students on the above issues through following two type of activities.

Syllabus

UNIT I	
Multidisciplinary nature of environmental studies Definition, scope and importance need for public awareness. Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.	
UNIT II	
Ecosystems • Concept of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
UNIT III	

Biodiversity and its conservation • Introduction – Definition: genetic, species and ecosystem diversity. • Biogeographical classification of India • Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values• Biodiversity at global, National and local levels. • India as a mega- diversity nation • Hot-sports of biodiversity. • Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. • Endangered and endemic species of India •Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.	
UNIT IV	
Environmental Pollution Definition • Cause, effects and control measures of :- a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards • Solid waste Management : Causes, effects and control measures of urban and industrial wastes. • Role of an individual in prevention of pollution. • Pollution case studies. • Disaster management: floods, earthquake, cyclone and landslides.	
UNIT V	
Social Issues and the Environment • From Unsustainable to Sustainable development • Urban problems related to energy • Water conservation, rain water harvesting, watershed management • Resettlement and rehabilitation of people; its problems and concerns. Case Studies • Environmental ethics: Issues and possible solutions. • Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies. • Wasteland reclamation. • Consumerism and waste products. • Environment Protection Act. • Air (Prevention and Control of Pollution) Act. • Water (Prevention and control of Pollution) Act • Wildlife Protection Act • Forest Conservation Act • Issues involved in enforcement of environmental legislation. • Public awareness.	

Text/Reference Books:

1. A Textbook of Environmental Studies, D K Asthana, S Chand Publishing
2. Fundamental Concepts in Environmental Studies, D. D. Mishra S Chand Publishing
3. Environmental, R.Rajagopalan, OUP India
4. Introduction to Environmental Engineering and Science, Gilbert M. Masters, Wendell P. El 3rd Edition Pearson
5. Principles of Environmental Science: Inquiry & Applications - Inquiry and Applications Cunningham William, Mcgrawhill

Course Outcomes:

(a) Awareness Activities:

i) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
ii) Slogan making event
iii) Poster making event
iv) Cycle rally
v) Lectures from experts

(b) Actual Activities:

i) Plantation
ii) Gifting a tree to see its full growth
iii) Cleanliness drive
iv) Drive for segregation of waste
v) To live some big environmentalist for a week or so to understand his work
vi) To work in kitchen garden for mess
vii) To know about the different varieties of plants
viii) Shutting down the fans and ACs of the campus for an hour or so

Object Oriented Programming Lab

Course Code	CSE255
Course Name	Object Oriented Programming Lab
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	NIL

Course Objectives

Upon successful completion of this Lab the student will be able to:

- To familiarize students to use standard tools and techniques for software development, using object oriented approach
- Students should be able to understand fundamental concepts of OOP to solve different problems of varied nature based on Encapsulation, Inheritance and polymorphism

Experiments:

Programs related to the topics as mentioned in the object-oriented programming syllabus.

Course Outcomes

- Demonstrate knowledge and understanding of the problem and the nature of solution
- Gain hands-on experience and apply the principles of OOP
- Apply reasoning informed by the appropriate knowledge to assess different problem using OOP principles

Database Management Systems Lab

Course Code	CSE256
Course Name	Database Management Systems Lab
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4 P C:2

Course Objectives:

- To provide a sound introduction to the creation of problem statements from real life situations.
- To give a good formal foundation on the relational model of data and usage of Relational Algebra.
- To introduce the concepts of basic SQL as a universal Database language.
- To enhance knowledge to advanced SQL topics like embedded SQL, procedures connectivity through JDBC.
- To enable the design of an efficient database using normalization concepts.
- To enable students to be create indexes for databases for efficient retrieval.
- To enable the student to experiment different transaction concept practically.
- To provide a introduction to Use of host language interface with embedded SQL.

Experiments:

1. Creating table, inserting data, updating table data, data record deletion, viewing data, modifying table structure, renaming and destroying table.

2. Arithmetic, logical operator, range searching, pattern matching, numeric function- scalar & group functions, string functions, Date function, table conversion functions.

3. Grouping data, join, sub-queries, union, intersection, minus clause, indexing, view, granting and revoking permissions.

4. Null value concept, primary key, and foreign key, unique, creating constraints, creating Indexes.

5. Introduction to PL/SQL – data type, branching, looping, simple problem solving using PL/SQL, Transaction concepts –commit, rollback, save point, introduction to cursor, parameterized cursor, locking.

6. Stored procedure and functions, package, trigger.

7. Use of host language interface with embedded SQL.

8. Use of user interfaces and report generation utilities typically available with RDBMS products.

Text Books:

1. *"Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.*
2. *"Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe, Pearson Education*

Reference Books:

1. *"Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.*

2. *"Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley*

Course Outcomes

- Construct problem definition statements for real life applications and implement a database for the same.
- Design conceptual models of a database using ER modeling for real life applications and also construct queries in Relational Algebra.
- Create and populate a RDBMS, using SQL.
- Write queries in SQLto retrieve any type of information from a data base.
- Analyze and apply concepts of normalization to design an optimal database.
- Analyze and apply concepts of transactions.
- Practically learn the concept of user interfaces and report generation utilities of RDBMS products.

Computer Organization and Architecture Lab

Course Code	CSE257
Course Name	Computer Organization and Architecture Lab
Category of Course	Professional Core courses
Credits	0L:0T: 4 P C:2
Pre-Requisites	Digital Electronics Theory And Lab, Computer Architecture And Organization Theory

Course Objectives:

- Study of different component of PC and its working.
- Design and simulation of simple processor.

Experiments:

1. Recognize various components of PC and its dismantling and assembling detail study of motherboard and microprocessor.
2. Study of SMPS and printer.
3. Familiarization with the process of storing and viewing the contents of memory as well as registers; Study of prewritten programs on trainer kit using the basic instruction set (data transfer, Load/Store, Arithmetic, Logical); Assignments based on above.
4. Design and simulation of ALU (32-bit).
5. Design and simulation of 32-bit simple single cycle processor.
6. Design and simulation of 32-bit simple pipelined processor.
7. Programming using kit/simulator for: table look up, Copying a block of memory, Shifting a block of memory, Packing and unpacking of BCD numbers, Addition of BCD numbers, Binary to ASCII conversion, String Matching, Multiplication using Booth's Algorithm.
8. Program using subroutine calls and IN/OUT instructions using 8255 PPI on the trainer kit eg, subroutine for delay, reading switch state & glowing LEDs accordingly, finding out the frequency of a pulse train etc.

Text Books:

1. *R. Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085".*
2. *David A. Patterson and John L. Hennessey, "Computer organization and design", Morgan Kauffman / Elsevier, Fifth edition, 2014.*

Reference books:

1. *K. Ayala, "The 8051 Microcontroller".*

2. *Yu-Cheng Liu and Glenn A. Gibson, "Microcomputer Systems: The 8086/8088 Family".*
3. *J. Uffenberk, "Microcomputers and microprocessors".*
4. *D.V. Hall and SSSP Rad, "Microprocessors and Interfacing".*
5. *V.CarlHamacher, Zvonko G. Varanesic and Safat G. Zaky, "Computer Organisation", VI th edition, McGraw-Hill Inc, 2012.*
6. *John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 1998.*

Course Outcomes

The students will able to:

- Develop assembly language programs for problem solving using software interrupts and various assembler directives.
- Implement interfacing of various I/O devices to the microprocessor/microcontroller through assembly language programming.
- Study of different component of PC and its working.
- Design and simulation of simple processor

**Students have to undergo a mandatory 4 weeks (at least) summer training after this semester and it will be included in the curriculum of next semester (CSE308).

Semester-V

Design and Analysis of Algorithms

Course Code	CSE301
Course Name	Design and Analysis of Algorithms
Category of Course	Professional Core courses (PC)
Credits	3L:1T: 0 P C:4
Pre-Requisites	Basic knowledge of introductory courses on mathematics, Programming, and Data Structures.

Course Objectives:

- Introduce students to the basic concept of algorithms in computing, analyzing algorithms, and designing algorithms.
- Students learn about the asymptotic notation of algorithms.
- Students should be able to write correctness of proofs for algorithms. Also, able to analyze the efficiency of algorithms based on asymptotic complexity.
- Students should be able to demonstrate different modeling of problem-solving like a graph, data structures, decomposing the problem.
- Learn about the different techniques of algorithms like divide-and-conquer, greedy, dynamic programming.
- Students will be able to synthesize efficient algorithms in a given engineering problem.

Syllabus

UNIT I	Hours = 40
Introduction of Algorithms Introduction, Motivation, the role of algorithms in computing. **Analyzing of algorithms** Model of Computation like RAM, TM, etc., space and time complexity, asymptotic notation, functions, and running time are applied in well-known algorithms like heap sort, search algorithms, etc. **Designing algorithms** Definition of recursion, use, and limitation, Examples of Towers Hanoi, Tail recursion, etc., an overview of designing techniques.	10
UNIT II	
Divide and Conquer Basic concept, element of dynamic programming, use, Examples- Quick sort, Merge sort, Binary search, the maximum-subarray problem, Strassen's algorithm for matrix multiplication, etc., Methods for solving recurrences. **Dynamic Programming** Basic concept, use, Examples- matrix-chain multiplication, All pair shortest paths, Single-source shortest path, Longest common subsequence Traveling Salesman problem etc.	8

Branch and Bound Basic concept, Least cost search, use, Example- The 15-puzzle problem, 0/1 knapsack problem, Traveling salesman problem etc.	
UNIT III	
Backtracking method Basic concept, use, Examples- 8-Queens problem, Graph coloring problem, Hamiltonian, knapsack problem, etc. **Greedy Method** Basic concept, use, Examples- Knapsack problem, Job sequencing with deadlines, Huffman Coding, Matroids, task-scheduling problems, minimum spanning tree (Prim's and Kruskal's algorithms). **Lower Bound Theory** Comparison trees based on searching, sorting, and selection, Lower Bound techniques through reduction.	8
UNIT IV	
Disjoint Set manipulation Set manipulation algorithm like UNION-FIND, union by rank, Path. **Graph Algorithms** Properties of graphs and graph traversal algorithms: BFS and DFS, Minimum Spanning Trees, Graph traversal Shortest Path problems, Maximum Flow problems etc.	7
UNIT V	
NP-Completeness Notion of NP-completeness: P class, NP-hard class, NP-complete class, Circuit Satisfiability problem, Clique Decision Problem, etc. **Approximation Algorithms** Necessity of approximation scheme, performance guarantee, Polynomial time approximation schemes: 0/1 knapsack problem, Traveling-salesman problem, Vertexcover Problem.	7

Text Books:

1. *Introduction to Algorithms,3rd Edition, T H. Cormen, C E. Leiserson, R L. Rivest, and Clifford Stein, published by PHI Learning Private Limited (Original edition published by the MIT Press, Cambridge, MA, USA), Copyright © 2011.*
2. *Fundamental of Compter Algorithms, 2nd Edition, E. Horowitz, S. Sahni, and S. Rajasekaran, published by Universities Press (India) Private Limited, Copyright © 2008, 2010.*

Reference Books:

1. *Algorithm Design, 1st Edition, Jon Kleinberg, and Eva Tardos, published by Pearson Education Limited, Copyright © 2014.*
2. *Algorithms, 1st Edition, S. Dasgupta, C. Papadimitriou, and U. Vazirani, published by McGraw-Hill Education, Copyright © 2008.*

Course Outcomes:

- Students will be able to apply the concept and design strategies to algorithm design.
- Students will be able to analyze the efficiency of algorithms based on space and time complexity theory.
- Students will be capable of understanding the different type algorithm design techniques, and also learned the concept of which design technique is more suited for finding the solution of a given problem.
- Students will be able to synthesize the efficient algorithm in a given engineering problem.

Theory of Computation

Course Code	CSE302
Course Name	Theory of Computation
Category of Course	Professional Core Courses (PC)
Credits	3L:1T: 0P C:4
Pre-Requisites	Calculus, Data Structures and Algorithms

Course Objectives:

- To understand problem classification and problem solving by machines.
- To study computing machines by describing, classifying and comparing different types of computational models.
- Understand various Computing models like Finite State Machine, Pushdown Automata, and Turing Machine.
- Be aware of Decidability and Un-decidability of various problems.
- Learn types of grammars.

Syllabus

UNIT I	Hours = 40
Introduction to Finite Automata Introduction: Alphabet, languages and grammars. Production rules and derivation of languages. Chomsky hierarchy of languages. Regular expressions, regular languages, applications, Regular grammars, Finite Automata- DFA and NFA, conversion of NFA to DFA, NFA with null move, conversion of NFA with Null move to DFA without Null move, Equivalence of DFA and NFA, Finite Automat with output- Mealy Machine and Moore Machine, Conversion to one machine to another.	8
UNIT II	
Regular expressions and languages Basic of Regular expressions, Basic Operation on RE- Kleene's theorem, Identities of RE, The Arden's theorem, Construction of Finite Automata from RE, NFA to DFA conversion using ε-Closure method, Construction of Regular Grammar from RE, Construction of FA from Regular Grammar, Closure and decision properties of regular sets. Pumping lemma of regular sets. Minimization of finite automata.	8
UNIT III	
Context-Free Grammars and languages Definitions of Context free Grammar-Backus Naur Form (BNF), Derivation and Parse Tree, Applications of context free grammars, Ambiguity in CFG. Simplification of CFG-Removal of Useless Symbols, Unit Production and Null Production. Left and right linear grammars, Equivalence of Left and right linear grammars. Normal FormChomsky and Greibach normal forms, Closure properties of context free languages. Pumping lemma, Ogden's lemma.	8

UNIT IV	
Push Down Automata and Turning Machines: Introduction to Push Down Automata, Acceptance by a PDA, Deterministic Push Down Automata and Non-deterministic Automata. Two-stack PDA, Construction of PDA from CFG and Construction of CFG equivalent to PDA. Turing machines-Transitional representation, Conversion of RE to TM, Twostack and TM, Turing machines and Variation of Turing machine model, Turing computability, Type 0 languages. Church Turing hypothesis. TM languages, Unrestricted grammar.	8
UNIT V	
Unsolvable Problems and computational complexity Recursive and recursively enumerable sets and its properties, Universal languages, Reducibility and Undecidable problems, Rice Theorem, Post Correspondence problem and modified PCP. Types of computational complexity- Time and space complexity, The Classes P, NP. P=NP? – The million Dollar question, NPcomplete, NP-Hard.	8

Text Books:

1. *John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, Introduction to Automata Theory, Languages and Computation", 3rd Edition, Pearson Education Publ.,2008.*
2. *John C Martin, "Introduction to Languages and the Theory of Computation", Fouth Edition, Tata McGraw Hill Publishing Company, 2011.*

Reference books:

1. *PoonamSinha,Sunita, A Saxena,"Theory of Computation", Laxmi Publication,2014.*
2. *H. R. Lewis and C. H. Papadimitriou,"Elements of the Theory of Computation",(2nd Ed.), Prentice Hall, Englewood Cliffs,2005.*

Course Outcomes:

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

- Design Finite State Machine, Pushdown Automata, and Turing Machine.
- To write mathematical expressions for the formal languages.
- Explain the Decidability or Undecidability of various problems.
- Students will apply this basic knowledge of Theory of Computation in the computer field to solve computational problems and in the field of compiler also.

Operating System

Course Code	CSE303
Course Name	Operating System
Category of Course	Professional Core courses (PC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	

Course Objectives:

- To learn the mechanisms of OS to handle processes and threads and their communication.
- To learn the mechanisms involved in memory management in contemporary OS.
- To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols.
- To know the components and management aspects of concurrency management.
- To learn to implement simple OS mechanisms.

Syllabus

UNIT I	Hours=40
Introduction 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.	8
UNIT II	
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, **Process Scheduling** 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.	8
UNIT III	
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.	8
UNIT IV	
Deadlocks Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and **Deadlock Avoidance:** Banker's algorithm, Deadlock detection and Recovery.	8

UNIT V	
I/O Hardware 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	8

Text Books:

1. *Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.*
2. *Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India*

Reference books:

1. *Create processes and threads.*
2. *Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.*
3. *For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.*
4. *Design and implement file management system.*
5. *For a given I/O devices and OS (specify) develop the I/O management functions in OS*
6. *As part of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.*

Course Outcomes:

- The skill that a student will acquire.
- The knowledge (Theoretical/applied/both) the student will gain.

Computer Networks

Course Code	CSE304
Course Name	Computer Networks
Category of Course	Professional Core courses
Credits	3L:0T: 0 P C:3
Pre-Requisites	Data Structures and Algorithms (Desirable)

Course Objectives

- To develop an understanding of modern network architectures from a design and Performance perspective.
- To introduce the students to the major concepts involved in Wide-Area Networks (WANs), Local Area Networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming.
- To provide a WLAN measurement ideas.

Syllabus

UNIT I	Hours = 40
Data communication Components 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.	9
UNIT II	
Data Link Layer and Medium Access Sub Layer 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/CD, CDMA/CA.	9
UNIT III	10
Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.	
UNIT IV	
Transport Layer: 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.	6

UNIT V	
Application Layer Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	6

Text Books:

1. *Data Communication and Networking, 4th Edition, Behrouz A. Forouzan, McGraw-Hill.*
2. *Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.*

Reference Books:

1. *Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition. 2. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.*
2. *TCP/IP Illustrated, Volume 1, W. Richard Stevens, and Addison-Wesley, United States of America.*

Course Outcomes:

- Explain the functions of the different layer of the OSI Protocol.
- Draw the functional block diagram of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) describe the function of each block.
- For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component For a given problem related TCP/IP protocol develop the network programming.
- Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools. Note: The syllabus is taken from AICTE syllabus.

Management II

Course Code	ASHH301
Course Name	Management II (Project Management)
Category of Course	Humanities and Social Science including the Management Course (HC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	

Course Objectives:

The objectives of this course are to:

1. Make the learners understand the concepts of Project Management for planning to execution of projects.
2. Make them understand the feasibility analysis in Project Management and network analysis tools for cost and time estimation.
3. Enable them to comprehend the fundamentals of Contract Administration, Costing and Budgeting.
4. Make them capable to analyze, apply and appreciate contemporary project management tools and methodologies in Indian context.

Course Outcomes:

On completion of this course, the learners will be able to:

1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses – Market, Technical, Financial and Economic. Execution Control.
3. Analyze the learning and understand techniques for Project planning, scheduling and Execution Control
4. Apply the risk management plan and analyze the role of stakeholders.
5. Understand the contract management, Project Procurement, Service level Agreements and productivity.
6. 6. Understand the How Subcontract Administration and Control are practiced in the industry.

Course Contents:

Unit I: Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.

Unit II: Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management, Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks.

Unit III: Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.

Unit IV: Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management.

Unit V: Post-Project Analysis.

Text Books:

1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, PrenticeHall, India
2. Horald Kerzner, Project Management: A Systemic Approach to Planning, Schedulingand Controlling, CBSPublishers, 2002.
3. John M Nicholas, Project Management for Business and Technology: Principles and Practice, Prentice Hall, India,2002.

References:

1. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. Ibdia
2. S. Choudhury, Project Scheduling and Monitoring in Practice.
3. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.
4. N. J. Smith (Ed), Project Management, Blackwell Publishing, 2002.
5. Robert K. Wysocki, Robert Back Jr. and David B. Crane, Effective Project Management, John Wiley, 2002.
6. Jack R Meredith and Samuel J Mantel, Project Management: A Managerial Approach, John Wiley, 2000.

Constitution of India

Course Code	ASHA304
Course Name	Essence of Indian Knowledge Tradition
Category of Course	Mandatory Courses (MC)
Credits	2L: 0T: 0 P C: 0
Pre-Requisites	

Syllabus

UNIT I	
The Constitution - Introduction • The History of the Making of the Indian Constitution Preamble and the Basic Structure, and its interpretation • Fundamental Rights and Duties and their interpretation • State Policy Principles	
UNIT II	
Union Government • Structure of the Indian Union • President – Role and Power • Prime Minister and Council of Ministers • Lok Sabha and Rajya Sabha	
UNIT III	
State Government • Governor – Role and Power • Chief Minister and Council of Ministers • State Secretariat	
UNIT IV	
Local Administration • District Administration • Municipal Corporation • Zila Panchayat	
UNIT V	
Election Commission • Role and Functioning • Chief Election Commissioner • State Election Commission	

Text Books/Reference Books:

1. Ethics and Politics Indian Constitution, Rajeev Bhargava , Oxford University Press, New Delhi, 2008
2. The Constitution of India, B.L. Fadia , Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India , DD Basu , Lexis Nexis; Twenty-Third 2018 edition

Essence of Indian Knowledge Tradition

Course Code	ASHA304
Course Name	Essence of Indian Knowledge Tradition
Category of Course	Mandatory Courses (MC)
Credits	2L: 0T: 0 P C: 0
Pre-Requisites	

Course Objective:
The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.

Syllabus

UNIT I	
Introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view	
UNIT II	
Basic principles of Yoga Holistic health care system	
UNIT III	
Indian philosophical traditions,	
UNIT IV	
Indian linguistic Tradition (Phonology, morphology, syntax and semantics)	
UNIT V	
Indian artistic tradition	

Text Books/Reference Books:

1. V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
2. Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
3. V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
4. S.C. Chaterjee & D.M. Datta, An Introduction to Indian Philosophy, University of Calcutta, 1984

Operating Systems Lab

Course Code	CSE305
Course Name	Operating system Lab
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	NIL

Course Objectives

- This lab complements the operating systems course. Students will gain practical experience with designing and implementing concepts of operating systems such as system calls, CPU scheduling, process management, memory management, file systems and deadlock handling using C language in Linux environment.

Experiments:

1. Overview of Shell scripting and shell programming.
2. Write a C program to simulate the following non-preemptive CPU Scheduling algorithms to find turnaround time and waiting time. a) FCFS b) SJF c) Round Robin (pre-emptive) d) Priority Scheduling.
3. Write a C program to simulate Bankers algorithm for the purpose of deadlock avoidance.
4. Write a C program to simulate Peterson's software solution for Race condition.
5. Write a C program to simulate the following contiguous memory allocation techniques: a) Worst-fit, b) Best-fit and c) First-fit.
6. Write a C program to simulate page replacement algorithms a) FIFO, b) LRU and c) LFU.
7. Write a C program to simulate the following file organization techniques: a) Single level directory, b) Two level directory and c) Hierarchical.

Course Outcomes:

Upon the completion of Operating Systems practical course, the student will be able to:

- Understand and implement basic services and functionalities of the operating system using system Calls.
- Use modern operating system calls and synchronization libraries in software/ hardware interfaces.
- Understand the benefits of thread over process and implement synchronized programs using Multithreading concepts.
- Analyze and simulate CPU Scheduling Algorithms like FCFS, Round Robin, SJF, and Priority.
- Implement memory management schemes and page replacement schemes.
- Simulate file allocation and organization techniques.
- Understand the concepts of deadlock in operating systems and implement them in multiprogramming System.

Computer Networks Lab

Course Code	CSE306
Course Name	Computer Networks Lab
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4P C:2
Pre-Requisites	C/C++ Programming

Course Objectives:

- To introduce Network related commands and configuration files in Linux Operating System..
- To introduce tools for Network Simulation
- To introduce Socket programming for client server application

Experiments

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of data link layer flow control techniques.
3. Study of Socket Programming and Client – Server model.
4. Write a socket Program for Echo/Ping/Talk commands.
5. Simulate different routing protocols like RIP, OSPF, and EIGRP.
6. Simulate other protocols like NAT, VLAN, and ACL etc.
7. Implement Encryption and decryption.

Text Books/ Reference Books:

1. *TCP/IP Illustrated, Volume 1, W. Richard Stevens, and Addison-Wesley, United States of America.*

Course Outcomes:

- Use network related commands and configuration files in Linux Operating System**.**
- For a given problem related TCP/IP protocol develop the network programming.
- Configure different protocols using open source available software and tools.
- Analyze network traffic using network monitoring tools.

IT Workshop II (Python)

Course Code	CSE307
Course Name	IT Workshop II (Python)
Category of Course	Professional Core courses (PC)
Credits	1L:0T: 4P C:3
Pre-Requisites	Basic Programming Knowledge

Course Objectives:

- Understand the programming basics (operations, control structures, data types, etc.)
- Readily use the Python programming language
- Apply various data types and control structure
- Understand class inheritance and polymorphism
- Understand the object-oriented program design and development
- Understand and begin to implement code

Syllabus

UNIT I	Hours =40
Introduction Relationship between computers and programs, Basic principles of computers, File systems, Using the Python interpreter, Introduction to binary computation.	8
UNIT II	
Data Types And Control Structures Operators (unary, arithmetic, etc.), Data types, variables, expressions, and statements, Assignment statements, Strings and string operations, Control Structures: loops and decision.	8
UNIT III	
Modularization And Classes Standard modules, Packages, Defining Classes, Defining functions, Functions and arguments (signature).	8
UNIT IV	
Exceptions And Data Structures Data Structures (array, List, Dictionary), Error processing, Exception Raising and Handling.	8

UNIT V	
Object Oriented Design Programming types, Object Oriented Programming, Object Oriented Design, Inheritance and Polymorphism	8

Text Books:

1. *Starting Out with Python plus MyProgramming Lab with Pearson eText --Access Card Package (3rd Edition) Tony Gaddis ISBN-13: 978-0133862256*

Reference Books:

1. *Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material*
2. *Python Programming using problem solving Approach by ReemaThareja, OxfordUniversity, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173*

Course Outcomes

After completion of course, students would be able to:

- Students can use Python interactively
- Students can demonstrate understanding of the role of testing in scientific computing, and write unit tests in Python.
- Students can write code in Python to perform mathematical calculations and scientific simulations.

Summer Training

Course Code	CSE308
Course Name	Summer Training (Min 4 weeks)
Category of Course	Mandatory Course, Summer Training (MC)
Credits	0L:0T: 0 P C:0

Students have to undergo mandatory summer training at least for 4 weeks in reputed academic institutions/government institutions/industry in the summer vacation and they are required to submit the project report (if any) and training certificate mandatorily.

Semester-VI

Research Methods in Computer Science

Course Code	CSE351
Course Name	Research Methods in Computer Science
Category of Course	Engineering Core courses (EC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	

Course Objectives:

- To know the basics of how research problems are defined, research methods are adopted and/or developed, research is undertaken, and how research results are communicated to the peers.
- To know the research methods specific to the field of computer science.

Syllabus

UNIT I	Hours = 40
Underpinnings of Research Introduction: Novelty, Originality, Organized Method of Investigation, and Communication of Problem, Data, Method, and Results for Peer Group Verification; Paradigm and paradigm shift. Types of Research: Theoretical, Empirical, Experimental, and Design and Characterization of New Materials, Components, Processes, and Systems. Broad Objectives of Research: Problem-oriented Defining Problems and Problem Issues, Analysing Data, Predicting, and Designing; Technique-oriented-Improving Performance and Expanding Scope. Modes of Inquiry and Inquiring Systems: Hypothetico-deductive and Empirical-inductive modes; Scientific Method; and Inquiring Systems of Locke, Kant, Leibnitz, Hegel, and Singer. Continuum of Connections among Facts, Data, Laws, Hypotheses, Theory, Models, and Experiments; Criteria of a Theory Research Topic, Problem, Questions, Objectives, and Scope Methodology, Methods, Tools, and Techniques Research Ethics, Plagiarism, and Their Prevention	8
UNIT II	
Measurement, Data, and Analytics Structured and Unstructured Data, Scales of Measurement, Population and Sample, Descriptive Statistics, Data Visualization. Probability and Random Variables, Sampling and Estimation, Hypothesis Testing, ANOVA, Correlation, and Regression. Data Analytics: Elements of Association, Clustering, and Classification.	8
UNIT III	

Elements of Theoretical Research Model and Model Building: Classification of Models, Exogenous and Endogenous Variables, Variable Relationships, Model Boundary, and Predictive and Prescriptive Models	8
UNIT IV	
Research Methods for Computer Science Formal Methods: Formal Specification, Algorithm, and Complexity; Building Artefacts: Proof of Performance, Proof of Concept, and Proof of Existence; Process Methodology: Methods for Software Engineering and Human-Computer Interaction, Cognitive Processes, Interactive Games, Social Networks, and Web Analytics.	8
UNIT V	
Research Documentation Elements of Preparing a Paper and a Project report: Title, Abstract, Keywords, Acknowledgements, Symbols and Abbreviations, Introduction, Literature Review, Materials and Methods, Graphical and Tabular Presentation, Results and Discussion, Conclusion, Scope for Future Work, Citations and List of References, and Appendixes.	8

Text Books:

Kothari, C. R. and G. Garg (2019), Research Methodology: Methods and Techniques, Fourth Multi-Colour Edition, New Age International Publishers.

Course Outcomes:

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

1. Know and understand the basics and fundamentals of research problems, research methods, research work and its communication to the peers.
2. Understand the research methods specific to the field of computer science.

Machine Learning

Course Code	CSE352
Course Name	Machine Learning
Category of Course	Professional Core Courses (PC)
Credits	3L: 0T: 0P C:3
Pre-Requisites	Probability and Linear Algebra; Basic programming skills preferably in python

Course Objectives:

- To impart the basic concepts of machine learning and algorithms.
- To understand concepts about supervised and unsupervised learning.
- To understand basic concepts about deep learning and learning theory.
- To enable them to understand issues related to the application of machine learning Algorithms.

Syllabus

UNIT I	Hours = 36
Fundamentals Introduction, Different Types of Learning, Hypothesis Space and Inductive Bias, Evaluation and Cross-Validation, Linear Regression Introduction to Decision Trees Learning Decision Tree, Overfitting.	8
UNIT II	
Supervised learning Supervised learning setup, LMS, Logistic regression, Perceptron, Exponential family, Generative learning algorithms, Gaussian discriminant analysis, Naive Bayes, Support vector machines.	9
UNIT III	
Learning Theory Model selection and feature selection, Ensemble methods: Bagging, boosting, Evaluating and debugging learning algorithms;. Bias/variance tradeoff, Union and Chernoff/Hoeffding bounds, VC dimension, Worst case (online) learning. .	6
UNIT IV	
Unsupervised learning Clustering K-means, EM. Mixture of Gaussians, Factor analysis, PCA (Principal components analysis), ICA (Independent components analysis).	6

UNIT V	
Reinforcement learning and control MDPs. Bellman equations, Value iteration and policy iteration, Linear quadratic regulation (LQR), LQG, Q-learning. Value function, approximation, Policy search. Reinforce. POMDPs.	7

Text Books:

1. *EthemAlpaydin, Introduction to Machine Learning, 3rd Edition, PHI, 2015.*
2. *Tom M. Mitchell, Machine Learning, McGraw Hill Education; First edition (1 July 2017).*

Reference Books:

1. *T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Second Edition 2009.*
2. *Christopher Bishop.Pattern Recognition and Machine LearningSpringer; 2011 edition (15 February 2010).*

Course Outcomes:

For a given problem student will able to analyze and implement the solution using:

- Linear regression.
- Logistic regression, decision trees, k-nearest neighbor.
- Bayesian learning and the naïve Bayes algorithm.
- Support vector machines and kernels.
- Neural networks to determine and justify the correctness.
- For a given problem student will able to analyze.
- Hypothesis space, overfitting, bias and variance.
- Tradeoffs between representational power and learnability.
- Evaluation strategies and cross-validation and feature reduction methods.

Compiler Design

Course Code	CSE353
Course Name	Compiler Design
Category of Course	Professional Core courses (PC)
Credits	3L:0T: 0 P C:3
Pre-Requisites	Theory of Computation

Course Objectives:

- To understand and list the different stages in the process of compilation.
- Identify different methods of lexical analysis.
- Design top-down and bottom-up parsers.
- Identify synthesized and inherited attributes.
- Develop syntax directed translation schemes.
- Develop algorithms to generate code for a target machine.

Syllabus

UNIT I	Hours = 40
Introduction to Compliers Overview of the Translation Process, A Simple Compiler, Difference between interpreter, assembler and compiler. Overview and use of linker and loader, types of Compiler, Analysis of the Source Program, The Phases of a Compiler, Cousins of the Compiler, The Grouping of Phases ,The Structure of a Compiler. Applications of Compiler Technology. **Lexical Analysis** The Role of the Lexical Analyzer, Specification and recognition of Tokens, The Lexical-Analyzer Generator Lex.	8
UNIT II	
Syntax Analysis Context-free language and grammar, push-down automata, LL(1) grammar and topdown parsing, operator grammar, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison).	8
UNIT III	
Syntax-Directed Translation Attribute grammar, syntax directed definition, evaluation and flow of attribute in a syntax tree. **Symbol Table** Structure, Symbol attributes and management.	8
UNIT IV	

Run-time environment Procedure activation, parameter passing, value return, memory allocation, and scope. **Intermediate Code Generation** Translation of different language features, different types of intermediate forms.	8
UNIT V	
Code Improvement (optimization) Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc. Register allocation and target code generation.	8

Text Books:

1. *Alfred V. Aho, Ravi Sethi, Monica S. Lam and J.D. Ullman, "Compilers: Principles, Techniques and Tools",(2nd Ed.),Pearson Education Ltd.,2007.*
2. *Alfred V. Aho and J.D. Ullman, "Principles of Compiler Design", Narosa Publication,2002*

Reference Books:

1. *Andrew W. Appel, "Modern Compiler Implementation in C/Java", Cambridge University Press,2003.*
2. *K. D. Cooper and L. Torczon "Engineering a Compiler"(2nd Ed.),Morga Kaufmann,2011..*

Course Outcomes:

- For a given grammar specification develop the lexical analyser.
- For a given parser specification design top-down and bottom-up parsers.
- Develop syntax directed translation schemes.
- Develop algorithms to generate code for a target machine.

Elective-I

Course Code	CSE354
Course Name	Elective-I (Name to be chosen from list of elective courses of CSE department)
Category of Course	Professional Elective courses (PE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Elective-II

Course Code	CSE355
Course Name	Elective-II (Name to be chosen from list of elective courses of CSE department)
Category of Course	Professional Elective courses (PE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Machine Learning Lab

Course Code	CSE356
Course Name	Machine Learning Lab
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	As applicable

Experiments:

Programs related to the topics as mentioned in the machine learning syllabus.

Compiler Design Lab

Course Code	CSE357
Course Name	Compiler Design Lab
Category of Course	Professional Core courses (PC)
Credits	0L:0T: 4 P C:2
Pre-Requisites	NIL

Course Objectives:

- To understand and implement the principles, techniques, and also available tools used in compiler construction process. This will enable the students to work in the development phase of new computer languages in industry.

Experiments

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines.
2. Write a C program to identify whether a given line is a comment or not
3. Write a C program to test whether a given identifier is valid or not.
4. Write a C program to simulate lexical analyzer for validating operators
5. To Study about Lexical Analyzer Generator(LEX) and Flex(Fast Lexical Analyzer)
6. Create a Lexer to take input from text file and count no of characters, no. of lines & number of words.
7. Design Predictive Parser for the given language.
8. Design a LALR bottom up parser for the given language.
9. Convert the BNF rules into Yacc form and write code to generate abstract syntax tree.
10. A program to generate machine code from the abstract syntax tree generated by the parser.

Text Books/ Reference Books:

1. Modern compiler implementation in C, Andrew w.Appel, Revised Edn, Cambridge University Press
2. Principles of Compiler Design. – A.V Aho, J.D Ullman ; Pearson Education.
3. lex&yacc , -John R Levine, Tony Mason, Doug Brown; O'reilly.
4. Compiler Construction,- LOUDEN, Thomson.
5. Engineering a compiler – Cooper& Linda, Elsevier 6. Modern Compiler Design – Dick Grune,Henry E.Bal, Cariel TH Jacobs, Wiley Dreatech

Course Outcomes:

Upon the completion of Compiler Design practical course, the student will be able to:

- Understand the working of lex and yacc compiler for debugging of programs.
- Understand and define the role of lexical analyzer, use of regular expression and transition diagrams.
- Understand and use Context free grammar, and parse tree construction.
- Learn & use the new tools and technologies used for designing a compiler.
- Develop program for solving parser problems.

Project-I

Course Code	CSE358
Course Name	Project-I
Category of Course	Project (PR)
Credits	0L:0T: 6 P C:3
Pre-Requisites	As applicable

**Students have to undergo a mandatory 6 weeks (at least) Internship training after this semester and it will be included in the curriculum of next semester (CSE404).

Semester-VII

Cryptography& Network Security

Course Code	CSE401
Course Name	Cryptography & Network Security
Category of Course	Professional Elective Courses (PE)
Credits	3L:0T: 0P C:3
Pre-Requisites	Computer Networks, Discrete Mathematics

Course Objectives:

Students will try to learn:

- The concepts of classical encryption techniques and concepts of finite fields and number theory.
- And explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
- And explore the design issues and working principles of various authentication Protocols.
- And explore various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.
- The ability to use existing cryptographic utilities to build programs for secure communication.
- The concepts of cryptographic utilities and authentication mechanisms to design secure applications.

Syllabus

UNIT I	Hours = 40
Introduction and Mathematical Foundations Overview on Modern Cryptography, Ciphers and Secret Messages, Security Attacks and Services. Number Theory, Probability and Information Theory, Mathematical Tools for Cryptography: Substitutions and Permutations, Modular Arithmetic, Euclid's Algorithm, Finite Fields, Polynomial Arithmetic, Discrete Logarithms. Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems.	8
UNIT II	

Conventional and Modern Symmetric Encryption Algorithms Theory of Block Cipher Design, Feistel Cipher Network Structures, DES and Triple DES, Modes of Operation (ECB, CBC, OFB, CFB), Strength (or Not) of DES. Modern Symmetric Encryption Algorithms: IDEA, CAST, Blowfish, Twofish, RC2, RC5, Rijndael (AES), Key Distribution. Stream Ciphers and Pseudo Random Numbers: Pseudo random sequences, Linear Congruential Generators, Cryptographic Generators, Design of Stream Cipher, One Time Pad, and Cryptanalysis of Symmetric Key Ciphers.	8
UNIT III	
Public Key Cryptography, Hashes and Message Digests Prime Numbers and Testing for Primality, Factoring Large Numbers, RSA, DiffieHellman, ElGamal, Key Exchange Algorithms, Public-Key Cryptography Standards. Hashes and Message Digests: Message Authentication, MD5, SHA, RIPEMD, HMAC, Cryptanalysis of Asymmetric Key Ciphers, Modern Trends in Asymmetric Key Cryptography.	8
UNIT IV	
Digital Signatures, Certificates, User Authentication Digital Signature Standard (DSS and DSA), Security Handshake Pitfalls, Elliptic Curve Cryptosystems. Authentication of Systems: Kerberos V4 and V5, X.509 Authentication Service. Digital Watermarking and Steganography.	8
UNIT V	
Network Security Secret Sharing Schemes, Network Protocols, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure/Multipurpose Internet Mail Extensions (S/MIME), Intruders and Viruses, Intrusion Detection Systems: Host Based and Network Based IDS, Honey pots. Firewalls, IPSEC, Private networks access security (L2F, PPTP, and L2TP), Web Security, privilege management infrastructure (PMI) and Access Control, security in e-commerce, smart cards.	8

Text Books:

1. *William Stallings, Cryptography and Network Security, Principles and Practice, 7th Edition, Pearson Education, 2017.*
2. *Schneier, Bruce, John Wiley & Sons, "Applied cryptography: protocols, algorithms, and source code in C" (20th Anniversary Ed.), 2015.*

Reference Books:

1. *Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill.*
2. *Mollin, Richard A. "An introduction to cryptography."(2nd Ed.) CRC Press, 2006.*

Course Outcomes:

- Identify information security goals, classical encryption techniques and acquirefundamental knowledge on the concepts of finite fields and number theory.
- Understand, compare and apply different encryption and decryption techniques to solveproblems related to confidentiality and authentication
- Apply the knowledge of cryptographic checksums and evaluate the performance ofdifferent message digest algorithms for verifying the integrity of varying message sizes**.**
- Apply different digital signature algorithms to achieve authentication and create secureapplications.

- Apply network security basics, analyze different attacks on networks and evaluate theperformance of firewalls and security protocols like SSL, IPSec, and PGP.
- Apply the knowledge of cryptographic utilities and authentication mechanisms todesign secure application

Elective-III

Course Code	CSE402
Course Name	Elective III (Name to be chosen from list of elective courses of CSE department)
Category of Course	Professional Elective courses (PE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Open Elective-I

Course Code	
Course Name	Will be provided by other offering department(s) or from MOOC course
Category of Course	Open Elective courses (OE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Internship

Course Code	CSE404
Course Name	Internship (6-8 Weeks)
Category of Course	Project (PR)
Credits	0L:0T: 0 P:4 C:2

Students have to undergo mandatory Internship training at least for 6-8 weeks in reputed academic institutions/government institutions/industry in the summer vacation after 6th semester and evaluation shall be done on the basis of seminar presentation and submission of project report and certificate.

Project-II

Course Code	CSE405
Course Name	Project-II
Category of Course	Project (PR)
Credits	0L:0T: 8P C:4
Pre-Requisites	As applicable

Semester-VIII

Elective-IV

Course Code	CSE451
Course Name	Elective IV(Name to be chosen from list of elective courses of CSE department)
Category of Course	Professional Elective courses (PE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Open Elective-II

Course Code	
Course Name	Name to be chosen from list of elective courses provided by other offering department(s) or from MOOC course
Category of Course	Open Elective courses (OE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Open Elective-III

Course Code	
Course Name	Name to be chosen from list of elective courses provided by other offering department(s) or from MOOC course
Category of Course	Open Elective courses (OE)
Credits	3L:0T: 0 P C:3
Pre-Requisites	As applicable

Project-III

Course Code	CSE454
Course Name	Project-III
Category of Course	Project (PR)
Credits	0L:0T: 12P C:6
Pre-Requisites	As applicable

Grand Viva

Course Code	CSE455
Course Name	Grand Viva
Category of Course	Project (PR)
Credits	0L:0T: 0P C:2
Pre-Requisites	As applicable

List of Electives

Artificial Intelligence

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Artificial Intelligence
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives

- To study the basic concepts of artificial intelligence and its architecture.
- To study the basic concept of artificial intelligence, knowledge, and knowledge base.
- To understand the concept and architecture of expert system.
- To study expert system tools and build the expert system using software shell.

Syllabus

UNIT I	Hours=40
Introduction To Artificial Intelligence Overview of AI, definition and importance of knowledge, knowledge based systems, representation of knowledge, knowledge organization, knowledge manipulation, acquisition of knowledge.	8
UNIT II	
Introduction To Expert Systems Features of expert systems, knowledge engineering, basic expert system terminology, human experts and artificial experts, algorithmic and	8

heuristic methods, difference between conventional programs and expert systems, Architecture of expert systems.	
UNIT III	
Knowledge Representation Rule based methods, rule execution, forward chaining and backward chaining, knowledge representation using semantic nets, structure of semantic nets, Frame-based methods.	8
UNIT IV	
Expert System Tools Types of tools for expert system building, system building aids, support facilities, debugging aids, I/O facilities, explanation facilities, knowledge base editors, stages in the development of expert system tools, procedure oriented methods, object-oriented methods, logic-based methods, access oriented methods.	8
UNIT V	
Expert Systems Building an Expert System – Development phases in expert system building, development constraints, reliability, maintainability, examples of expert systems, and difficulties in development of expert systems.	8

Text Books:

1. *Donald A. Waterman, "A Guide to Expert Systems", Pearson*
2. *Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", Pearson Education, 2007.*

Reference Books:

1. *Kevin Night, Elaine Rich, Nair B., "Artificial Intelligence (SIE)", McGraw Hill 2008.*
2. *Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.*
3. *Stuart Russel, Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.*

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.
- Students will demonstrate the skills of development of expert system for industrial problems.
- Students will know the design pre-requisites and design procedure of expert system.
- Students will understand the concept of fuzzy logic and will try to implement in project work

Neural Networks

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Neural Network
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- To study Artificial Neural Networks and its applications in the field of computation.
- To study basics of Biological Neural Network and Artificial Neural Network.
- To study different methods of representing ANN.
- To study various architectures of ANN and applications of ANN.
- To understand pattern classification and pattern recognition techniques.

Syllabus

UNIT I	Hours =40
Introduction Features, structure and working of Biological Neural Network. Computing Comparison of BNN and ANN, History of neural network research, characteristics of neural networks terminology, models of neuron McCulloch – Pitts model.	8
UNIT II	
Neural Net For Pattern Classification Hebbs net, Perceptron, Adaline model, Basic learning laws, Topology of Neural network architecture, Backpropagation neural net – Architecture, Delta Learning Rule algorithm – applications.	8
UNIT III	
Neural Nets Based On Competition Kohonen Neural Network –Applications, Learning Vector QuantizationApplications, Counter Propagation Network- Applications.	8
UNIT IV	
Pattern Association Hetero-associative memory neural network applications, Auto-associative net, Iterative Auto-associative net- Bidirectional Associative MemoryApplications.	8

UNIT V	
Adaptive Resonance Theory &Neocognitron Motivation, Architecture, Operation- Algorithm, applications- Neocognitron: Architecture, Algorithm, Applications.	8

Text Books:

1. *LaureneV. Fausett, "Fundamentals of Neural Networks-Architectures, Algorithms and Applications", Pearson Education, 2011*
2. *B. Yegnanarayana, "Artificial neural Networks", PHI, 2007.*

Reference Books:

1. *James. A. Freeman and David.M.Skapura, "Neural Networks Algorithms, Applications and Programming Techniques ", Pearson Education, Sixth Reprint, 2011.*
2. *Simon Haykin, "Neural Networks and Learning Methods", PHI Learning Pvt. Ltd., 2011.*

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.
- Students will demonstrate the skills of development of neural net based intelligent system for industrial problems.
- Students will know the design pre-requisites and design procedure of intelligent system.
- Students will understand the concept of pattern classification and pattern association and will try to implement in project work.

Deep Learning

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Deep Learning
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Machine learning/Soft computing/Neural Networks

Course Objectives:

- To study deep learning and its applications in the field of computation.
- To study the basics of neural network and deep learning.
- To study the concepts of gradient descent, Singular Value Decomposition.
- To study various architectures of CNN.
- To understand RNN and its architectures.

Syllabus

UNIT I:	Hours=40
History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Perceptrons, Multilayer Perceptrons (MLPs), FeedForward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam, Eigenvalues and eigenvectors. Principal Component Analysis (PCA) and its interpretations, Singular Value Decomposition.	8
UNIT II:	
Autoencoders and relation to PCA, Regularization in autoencoders, Denoisingautoencoders, Sparse autoencoders, Contractive autoencoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.	8
UNIT III:	
Greedy Layerwise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization. Learning Vectorial Representations Of Words.	8
UNIT IV:	
Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks.	8

UNIT V:	
Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, GRU, LSTMs Encoder Decoder Models, Attention Mechanism, Attention over images	8

Text Books:

1. *Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", MIT Press, http://www.deeplearningbook.org*
2. *"Deep Learning Tutorial", LISA lab, University of Montreal, 2015 http://deeplearning.net/tutorial/deeplearning.pdf*

Reference Books:

1. *Li Deng and Dong Yu, "Deep Learning: Methods and Applications ",https://www.microsoft.com/enus/research/wp-content/uploads/2016/02/DeepLearning-NowPublishing-Vol7-SIG-039.pdf.*
2. *Francois Chollet, "Deep Learning with Python", Manning Publishing Co, 2018, https://tanthiamhuat.files.wordpress.com/2018/03/deeplearningwithpython.pdf.*

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.
- Students will demonstrate the skills of development of neural net based intelligent system for industrial problems.
- Students will know the design pre-requisites and design procedure of intelligent system.
- Students will understand the concept of pattern classification and pattern association and will try to implement in project work.

Soft Computing

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Soft Computing
Category of Course	Professional Elective Courses/ Open Elective courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- To introduce concept of soft computing techniques and applications.
- To introduce basics of genetic algorithms and their applications in optimization problem.
- To introduce the concepts of fuzzy sets, fuzzy logic and its application.
- To familiarize with tools and techniques of Soft Computing.
- To develop skills for solving problems in different application domain using Soft Computing Techniques.

UNIT – I	**Hours=40**
Introduction To Soft Computing And Neural Networks Evolution ofComputing: Soft Computing Constituents, Hard Computing, From Conventional AI to Computational Intelligence: Machine Learning Basics, Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks: Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks.	8
UNIT – II	
Fuzzy Logic Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions, Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	8
UNIT – III	
Genetic Algorithms And Optimizations Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning: Machine Learning Approach to Knowledge Acquisition. Single and multi-/many objective optimizations.	8
UNIT – IV	
MATLAB/Python Lib Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic.	8
UNIT – V	
Recent Trends Recent Trends in deep learning, various classifiers, neural networks and genetic	8

algorithm. Implementation of recently proposed soft computing techniques.	

Text Books:

1. *Neuro-Fuzzy and Soft computing: A Computational Approach to Learning and Machine IntelligenceJang, Sun, Mizutani, Pearson Education (2004)*
2. *Principles of Soft Computing – S.N. Sivanandam and S. N. Deepa, Wiley India Pvt Limited (2011).*

Reference Books:

1. *Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications – S. Rajasekaran and G.A Vijayalakshmipai, Prentice-Hall of India Pvt Limited (2006)*
2. *Fuzzy Set Theory: Foundations and Applications- George J. Klir, Ute St. Clair, Bo Yuan, Prentice Hall(1997).*
3. *Neural Networks: Algorithms, Applications and Programming Techniques- Freeman J.A. & D.M.*

Course Outcomes:

- Understanding of the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- Apply Genetic Algorithm to solve single objective and multiobjective optimization problems.
- Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems.
- Apply neural networks to pattern classification and regression problems.
- Effectively use existing software tools to solve real problems using a soft computing approach.
- Develop some familiarity with current research problems and research methods in Soft Computing Techniques.

Speech and Natural Language Processing

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Speech and natural Language Processing
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Basic Programming Skills General Understanding Of Statistics

Course Objectives:

- This course introduces the fundamental concepts and techniques of natural language processing (NLP). It provides the understanding of the computational properties of natural languages and the algorithms for processing linguistic information. The course will introduce both linguistic (knowledge-based) and statistical approaches to NLP, illustrate the use of NLP techniques and tools in a variety of application areas, and provide insight into many open research problems.

Syllabus

UNIT I	Hours=40
Introduction Introduction to NLP, challenges of NLP , Phases in natural language processing, applications Language Modeling: Grammar-based LM, Statistical LM Regular Expression, Finite State Automata, Morphology and Finite State Transducers, N-grams, Smoothing, HMM and Speech Recognition: Speech Recognition Architecture, Overview of HMM. Evaluation of language models.	4
UNIT II	
Word Classes and Part-of-Speech Tagging English word classes, Targets for English, Part of speech Tagging, Rule Based part of speech Tagging, Stochastic part of speech Tagging,HMM,Transformation Based Tagging. Handling of unknown words, named entities, multi word expressions. **Context Free Grammars for English** Constituency, Context Free rules and Trees, Sentence level construction, The Noun Phrase, Coordination, Agreement, The verb phrase and sub-categorization. Parsing with context free grammars: Basic Top down Parser, and Bottom-up parsing, the early Algorithm, Finite state parsing method. **Features and Unifications** Feature structures, Unification of Features Structures, Features Structures in the grammar, Implementing Unification. **Lexicalized and probabilistic parsing** Probabilistic context free grammars, problems with probabilistic context free grammars, probabilistic lexicalized GFG.	8
UNIT III	

Semantics Representing Meaning Meaning structure of language, First order predicate calculus, linguistically relevant concept, Related Re-presentational approaches, Alternative approaches to meaning. **Semantic Analysis** Syntax driven semantic analysis, Attachment of Fragment of English,. Robust Semantic Analysis.	8
Lexical Semantics Relation among lexemes and their senses, Internal Structure of words. WordNet, Word Sense Disambiguation- Selectional restriction, machine learning approaches, dictionary based approaches.	
UNIT IV	
Pragmatics Discourse Reference resolution, Text Coherence, Discourse Structure, constraints on co-reference algorithm for pronoun resolution Psycholinguistics Studies of reference and coherence. Natural Language generation: Introduction to language generation, Architecture for generation, , Discourse planning.	8
UNIT V	
Applications of NLP Introduction to corpus elements in balanced corpus, TreeBank, PropBank, WordNet, VerbNet etc. stemmers and lemmatiser, Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, Machine Translation– Overview.	8

Text and Reference Books:

1. *Jurafsky, Dan and Martin, James, Speech and Language Processing, Second Edition, Prentice Hall, 2008. Tanveer Siddiqui, U.S. Tiwary, ―Natural Language Processing and Information Retrieval, Oxford University Press, 2008.*
2. *Allen, James, Natural Language Understanding, Second Edition, Benjamin/Cumming, 1995.*
3. *Manning, Christopher and Heinrich, Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.*
4. *Richard M Reese, ―Natural Language Processing with Java, OReilly Media, 2015.*
5. *NitinIndurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.*

Course Outcomes:

- Understand core algorithms and data structures used in NLP.
- Apply these mathematical models and algorithms in applications in software design and implementation for NLP.
- Develop NLP components, such as n-gram language models stemmer, part-of-speech taggers.
- Evaluate the merits of use of different statistical approaches fordifferent types NLP tasks.
- Implement a simple NLP systems.

Data Mining

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Data Mining
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Basic Programming Skills General Understanding Of Statistics

Course Objectives:

- To introduce data warehousing and mining techniques.
- Be acquainted with the tools and techniques used for Knowledge Discovery in Databases.

Syllabus

UNIT I	Hours = 40
Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Integration of a Data Mining System with a Data Warehouse; Data Preprocessing.	7
UNIT II	
Mining Frequent Patterns, Associations and Correlations; Mining Methods; Mining various Kinds of Association Rules; Correlation Analysis, Constraint Based Association Mining, Classification and Prediction, Basic Concepts, Decision Tree Induction; Bayesian Classification; Rule Based Classification; Classification by Back propagation, Support Vector Machines, Associative Classification; Lazy Learners; Other Classification Methods; Prediction; Cluster Analysis – Types of Data in Cluster Analysis.	8
UNIT III	8
Cluster Analysis; Types of Data; Categorization of Major Clustering Methods, Kmeans, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid Based Methods, Model-Based Clustering Methods; Clustering High Dimensional Data, Constraint, Based Cluster Analysis, Outlier Analysis, Data Mining Applications.	
UNIT IV	
Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, and Similarity search in Time-series analysis.	8

UNIT V	
Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;	9

Text Books:

1. *JiaweiHan , M Kamber and J Pei " Data Mining Concepts and Techniques", Third Edition, Elsevier Publication, 2011.*
2. *Pang-Ning Tan, Michael Steinbach and Vipin Kumar "Introduction to Data Mining", Pearson Education, 2007*

Reference Books:

1. *Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.*
2. *G.K. Gupta – Introduction to Data Mining with case Studies, PHI, New Delhi – 2006.*
3. *A. Berson& S.J. Smith – Data Warehousing Data Mining, COLAP, TMH, New Delhi,2004*

Course Outcomes:

After completion of course, students would be:

- Apply data mining techniques and methods to large data sets.
- Use data mining tools.
- Compare and contrast the various classifiers.

Internet of Things

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Internet of Things
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Computer Networks

Course Objectives:

- Able to understand the application areas of IOT.
- Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks.
- Able to understand building blocks of Internet of Things and characteristics.

Syllabus

UNIT I	Hours = 40
Introduction and Applications Smart transportation, smart cities, smart living, smart energy, smart health, and smart learning. Examples of research areas include for instance: Self-Adaptive Systems, Cyber Physical Systems, Systems of Systems, Software Architectures and Connectors, Software Interoperability, Big Data and Big Data Mining, Privacy and Security.	8
UNIT II	
IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. **Real-World Design Constraints** Introduction, Technical Design constraints hardware, Data representation and visualization, Interaction and remote control.	8
UNIT III	
Industrial Automation Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial **Building Automation** Introduction, Case study: phase one-commercial building automation today, Case study: phase two- commercial building automation in the future.	8
UNIT IV	
Hardware Platforms and Energy Consumption, Operating Systems, Time Synchronization, Positioning and Localization, Medium Access Control, Topology and Coverage Control, Routing: Transport Protocols, Network	8

Security, Middleware, Databases	
UNIT V	
IOT Physical Devices & Endpoints What is an IOT Device, Exemplary Device Board, Linux on Raspberry, Interface and Programming & IOT Device Recent trends in sensor network and IOT architecture, Automation in Industrial aspect of IOT.	8

Text/ Reference Books:

1. *Mandler, B., Barja, J., MitreCampista, M.E., Cagáňová, D., Chaouchi, H., Zeadally, S., Badra, M., Giordano, S., Fazio, M., Somov, A., Vieriu, R.-L., Internet of Things. IoT Infrastructures, Springer International Publishing, 2015*
2. *ArshdeepBahga, Vijay Madisetti "Internet of Things - A Hands-on Approach", Universities Press, First Edition, 2015*
3. *David Hanes, Gonzalo Salgueiro, and Patrick Grossetete,IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things,CISCO Press,2017.*

Course Outcomes:

- Identify requirements from emerging WSN applications on WSN platforms, Communication systems, protocols and middleware.
- Understand, compare and evaluate communication and network protocols used in WSNs.
- To develop prototypes for domain specific IoTs.
- To customize real time data for IoT applications.

Mobile Computing

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Mobile Computing
Category of Course	Professional Elective Courses/Open Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Computer Networks

Course Objectives:

- To study the specifications and functionalities of various protocols/standards of mobile networks.
- To learn about the concepts and principles of mobile computing.
- To explore both theoretical and practical issues of mobile computing.
- To develop skills of finding solutions and building software for mobile computing applications.

Syllabus

UNIT I	Hours = 36
Introduction Challenges in mobile computing**,** Description of cellular system, Frequency Reuse, Co-channel and Adjacent channel interference, Propagation Models for Wireless Networks, Multipath Effects in Mobile Communication, channel allocation, Handoff, types of handoffs; location management.	9
UNIT II	
Evolution of Modern Mobile Wireless Communication System First Generation Wireless Networks, Second Generation (2G) Wireless Cellular Networks, Major 2G standards, GSM: Architecture and Protocols ,2.5G Wireless Networks, The General Packet Radio Services: (GPRS), Overview of CDMA systems: IS-95 Networks.	10
UNIT III	
3G Mobile Networks, Cellular WLAN Integration, Introduction to 4G, WiMAX, LTE, Mobile IP, Mobile TCP.	10
UNIT IV	
Support for mobility File systems, World Wide web, Wireless application protocol, Mobile operating systems, Mobile agents, Satellite Systems, Global Positioning System.	3
UNIT V	

Mobile Ad- hoc Network (MANET) Layered architecture of MANET, Ad hoc network routing protocols, MAC and Transport layer issues of MANET, Introduction to Wireless Sensor Network ,Wireless Mesh Network , VANET	4

Text Books/ Reference Books:

1. *P.K. Pattnaik, Rajib Mall, "Fundamentals Of Mobile Computing", PHI, 2015.*
2. *D.P. Agrawal and Q.A. Zeng, "Introduction to Wireless and Mobile Systems",3rd edition, Thomson Learning, 2010.*
3. *J. Schiller, "Mobile Communications", 2nd edition, Pearson Education, 2012.*

Course Outcomes:

- Have a good understanding of how the underlying wireless and mobile communication networks work, their technical features, and what kinds of applications they can support.
- Identify the important issues of developing mobile computing systems and applications.
- Develop mobile computing applications by analyzing their characteristics and requirements, selecting the appropriate computing models and software architectures, and applying standard programming languages and tools.
- Organize and manage software built for deployment and demonstration.

Social Network Analysis

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Social Network Analysis
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Wireless Networks(Desirable)

Course Objectives:

- Students will be able to understand and formulate research questions relevant to social network analysis.
- Students will understand the sources, advantages, and disadvantages of alternative types of social network data.
- Students will be able to describe a social network and compare attributes across different social networks.
- Students will understand theoretical and empirical issues in current research on social network analysis.

Syllabus

UNIT I	Hours =40
Introduction Introduction to social network mining. Illustration of various social network mining tasks with real-world examples. Introduction to Semantic Web: Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Social Network analysis: Development of Social Network Analysis – Key concepts and measures in network analysis – Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities – Web-based networks – Applications of Social Network Analysis.	8
UNIT II	
Modelling, Aggregating And Knowledge Representation Ontology and their role in the Semantic Web: Ontology-based knowledge Representation – Ontology languages for the Semantic Web: Resource Description Framework – Web Ontology Language – Modelling and aggregating social network data: State-of-the-art in network data representation – Ontological representation of social individuals – Ontological representation of social relationships – Aggregating and reasoning with social network data – Advanced representations.	9
UNIT III	
Extraction And Mining Communities In Web Social Networks Extracting evolution of Web Community from a Series of Web Archive – Detecting communities in social networks – Definition of community – Evaluating communities – Methods for community detection and mining – Applications of community mining algorithms – Tools for detecting communities social network infrastructures and communities – Decentralized online social networks – Multi-Relational characterization of	9

dynamic social network communities.	
UNIT IV	
Predicting Human Behaviour And Privacy Issues Understanding and predicting human behaviour for social communities – User data management – Inference and Distribution – Enabling new human experiences – Reality mining – Context – Awareness – Privacy in onlinesocial networks – Trust in online environment – Trust models based on subjective logic – Trust network analysis – Trust transitivity analysis – Combining trust and reputation – Trust derivation based on trust comparisons – Attack spectrum and countermeasures.	8
UNIT V	
Visualization And Applications Of Social Networks Graph theory – Centrality – Clustering – Node-Edge Diagrams – Matrix representation – Visualizing online social networks, Visualizing social networks with matrix-based representations – Matrix and Node-Link Diagrams – Hybrid representations – Applications – Cover networks – Community welfare – Collaboration networks – Co-Citation networks.	6

Text Books:

1. *Peter Mika, —Social Networks and the Semantic Web, First Edition, Springer 2007.*
2. *BorkoFurht, —Handbook of Social Network Technologies and Applications, 1st Edition, Springer, 2010.*

Reference Books:

1. *GuandongXu ,Yanchun Zhang and Lin Li,-Web Mining and Social Networking – Techniques and applications, First Edition, Springer, 2011.*
2. *Dion Goh and Schubert Foo,-Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively, IGI Global Snippet, 2008.*

Courses outcomes:

- Understand the basic concepts of social networks.
- Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks.
- Implement mining algorithms for social networks.
- Perform mining on large social networks and illustrate the results.

Data Analytics

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Data Analytics
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Data Structure, Statistics Data Mining

Course Objectives:

The Student should be made to:

- Be exposed to big data.
- Learn the different ways of Data Analysis.
- Be familiar with data streams.
- Learn the mining and clustering.
- Be familiar with the visualization.

Syllabus

UNIT I	Hours=34
Introduction to Big data Introduction to Big Data Platform – Challenges of conventional systems - Web data – Evolution of Analytic scalability, analytic processes and tools, Analysis vs. reporting - Modern data analytic tools, **Statistical concepts** Sampling distributions, resampling, statistical inference, and prediction error.	6
UNIT II	
Data analysis Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, and Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics - Rule induction - Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks. **Fuzzy logic** Extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.	9
UNIT III **Mining data streams:** Introduction to Streams Concepts – Stream data model and architecture - Stream Computing, Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a window – Decaying window - Real-time Analytics Platform (RTAP) applications - case studies - real time sentiment analysis, stock market predictions.	6

UNIT IV **Frequent item sets and clustering** Mining Frequent item sets - Market based model – Apriori Algorithm – Handling large data sets in Main memory – Limited Pass algorithm – Counting frequent item sets in a stream – Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS – Frequent pattern based clustering methods – Clustering in non-Euclidean space – Clustering for streams and Parallelism.	7
UNIT V	
Frameworks and visualization MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed file systems – Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications.	6

Text Books:

1. *Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses*
2. *Montgomery, Douglas C. and Runger, George C. (2014) Applied Statistics and Probability for Engineers, 6th edition, John Wiley & Sons, Inc (ISBN- 978-1118539712)* Reference books:

1. *Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.*
2. *AnandRajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.*
3. *P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of*
4. *Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.*
5. *Eric Sammer, "Hadoop Operations", O'Reilley, 2012.*

Course Outcomes:

After completion of course, students would be:

- Demonstrate understanding of hypotheses testing for samples to solve engineering problems.
- Perform linear and multiple linear regression analyses.
- Demonstrate ability to design and analysis of single-factor experiments.
- Demonstrate ability to do design of experiments with several factors.
- Describe big data and use cases from selected business domains.
- Explain NoSQL big data management.
- Install, configure, and run Hadoop and HDFS.
- Perform map-reduce analytics using Hadoop.
- Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

Image Processing

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Image Processing
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- To become familiar with digital image fundamentals.
- Be exposed to simple image processing techniques.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- Learn to represent image in form of features.

Syllabus

UNIT I	Hours = 40
Digital Image Fundamentals Steps in Digital Image Processing, Components, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Relationships between pixels, neighborhood, adjacency, connectivity, distance measures, Color image fundamentals, RGB, HSI models.	8
UNIT II	
Image Enhancements **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, Homomorphic filtering, Color image enhancement.	8
UNIT III	
Image Restoration Image Restoration, degradation model, Properties, Noise models, Mean Filters, Order Statistics, Adaptive filters, Band reject Filters, Band pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener filtering.	8
UNIT IV	

Image Segmentation and Color Image Processing Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation, Region growing, Region splitting and merging, Morphological processing, erosion and dilation, Segmentation by morphological watersheds, basic concepts, Dam construction, Watershed segmentation algorithm. Color models, RGB, YUV, HSI; Color transformations, formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.	8
UNIT V	
Wavelets and Morphological Image Processing Uncertainty principles of Fourier Transform, Time frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Sub band filter banks, wavelet packets. Erosion and Dilation, Opening and Closing, The Hit-or-Miss Operation, Some Basic Morphological Algorithms, Boundary Extraction, Extraction of Connected Components, Convex Hull, Thinning and Thickening.	8

Text Books:

1. *Rafael C. Gonzalez, Richard E. Woods,Digital Image Processing Pearson, Third Edition, 2010.*
2. *Anil K. Jain,Fundamentals of Digital Image Processing Pearson, 2002.*

Reference Books:

1. *Kenneth R. Castleman,Digital Image Processing Pearson, 2006.*
2. *Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,Digital Image Processing using MATLAB Pearson Education, Inc., 2011.*
3. *D,E. Dudgeon and RM. Mersereau,Multidimensional Digital Signal Processing Prentice Hall Professional Technical Reference, 1990.*
4. *William K. Pratt,Digital Image Processing John Wiley, New York, 2002.*
5. *Milan Sonka et al Image processing, analysis and machine vision Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.*

Course Outcomes:

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

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

Computer Graphics

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Computer Graphics
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Analytic Geometry, Linear Algebra, Basic Programming

Course Objectives:

- Gain knowledge about graphics hardware devices and software used.
- Understand the two-dimensional graphics and their transformations.
- Understand the three-dimensional graphics and their transformations.
- Appreciate illumination and color models.
- Be familiar with understand clipping techniques. Provide an understanding of mapping from a world coordinates to device coordinates, clipping, and projections.
- To be able to discuss the application of computer graphics concepts in the development of computer games, information visualization, and business applications.
- To comprehend and analyze the fundamentals of animation, virtual reality, underlying technologies, principles, and applications.

Syllabus

UNIT I	Hours=40
Introduction to Computer Graphics & Graphics Systems Overview of computer graphics & its uses, Classification, characteristics & components & applications of computer graphics, Representing pictures, Basic Terminologies: Pixel, Resolution & its different types, Dots, Dot Pitch, Aspect ratio; Raster scan display: Refresh rate & Interlacing, Retrace, CRT, Shadow mask, Aperture grill, Bit planes, Color depth, Color palette, Frame buffer, Video controller, General architecture of Raster Scan display, Active & Passive graphics devices, Computer graphics software.	8
UNIT II	
Scan Conversion Points & lines, Line drawing algorithms: DDA algorithm, Advantages & Disadvantages; Bresenham's line algorithm; Circle generation algorithm: Basic concepts, DDA circle drawing algorithm, Midpoint circle drawing algorithm, Brsenham's circle drawing algorithm; Ellipse generation algorithm: Basic concepts, Midpoint ellipse generation algorithm; Aliasing, Antialiasing, Methods of antialiasing.	8

UNIT III **Polygon Filling algorithms and Transformation** Inside & Outside test of polygon: Even-Odd method, Winding number method; Polygon filling algorithms: Scan line polygon, Scan line seed fill algorithm, Boundary fill algorithm, Flood fill algorithm. **Basic transformations** Translation, rotation, scaling, reflection, shear; Transformation between coordinate systems; Homogeneous coordinates & Combined transformations; Inverse transformation: Rotation about an arbitrary point, General fixed-point scaling, Reflection through an arbitrary line.	8
UNIT IV	
Viewing and Clipping Viewing transformation, Viewing pipeline, Window to viewport co-ordinate transformation; Clipping: Point clipping, Line clipping -- Cohen-Sutherland algorithm, Liang-Barsky algorithm, Polygon clipping – Sutherland-Hodgeman algorithm, WeilerAtherton algorithm; Text clipping. 3D transformation and Projection: **3D transformations** Translation, rotation, scaling, reflection & shearing. Rotation about an axis parallel to a coordinate axis, Rotation about an arbitrary axis in space, reflection through an arbitrary plane; 3D Projection: Parallel projection – Orthographic, Axonometric, Oblique; Perspective projection – transformation matrix, vanishing points, Single-point, Two-point, Three-point perspective transformation.	8
UNIT V	
Curves, Hidden Surfaces, Color and Shading Models Curve generation algorithm- DDA method, approximation method, Spline representation, Continuity, Piecewise Cubic Spline, Bezier curves – Cubic Bezier, Mid-point Bezier, Bspline curves; Depth comparison, Z-buffer algorithm, Back faces detection, BSP tree method, Painter's algorithm, Scan-line algorithm; Hidden line elimination method, wire frame methods; Introduction, Modeling Light Intensities and Sources, Diffuse Reflection, Lambert's Cosine Law, Specular Reflection, Half-toning, Color Models - RGB Color, CMY Color.	8

Text Books:

1. *Computer Graphics Multimedia and Animation, Malay K. Pakhira, 2nd Ed., PHI Learning Pvt. Ltd.*
2. *D. P. Mukherjee, Fundamentals of Computer Graphics & Multimedia, Prentice Hall.*
3. *D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, McGraw Hill.*

Reference Books:

1. *D. Hearn and M. P. Baker, Computer Graphics (C version), Prentice Hall.*
2. *J. F. K Buford., Multimedia Systems, Pearson Education.*
3. *P. K. Andleigh and K. Thakrar, Multimedia Systems Design, Pearson Education India*
4. *S. Harrington, Computer Graphics: A programming Approach, McGraw Hill.*
5. *V. Dam; F. H. John; J. D. Foley; S. K. Feiner, Computer Graphics principles and practice, Pearson Education.*

6. *W. M. Newman and R. F. Sproull, Principles of Interactive computer Graphics, McGraw Hill.*
7. *M. E. Cook, Principles of Interactive Multimedia, McGraw Hill.*
8. *Mukhopadhyay and A. Chattopadhyay, Introduction to Computer Graphics and Multimedia, Vikas Publishing House*.

Course Outcomes:

- Design two-dimensional graphics.
- Apply two dimensional transformations.
- Design three-dimensional graphics.
- Apply three dimensional transformations.
- Apply Illumination and color models.
- Apply clipping techniques to graphics.
- Design animation sequences.

Computational Complexity

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Computational Complexity
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Data Structure, Algorithm, Theory of Computation

Course Objectives:

The Student should be made to:

- Learn the main computational complexity classes, their underlying models of computation, and relationships.
- Understand the concept of reductions and its role in classifying problems by their computational complexity.
- Be able to show using reductions that a problem is NP-complete.
- Be familiar with the concepts of randomized, approximation, and parallel algorithms and aware of the related complexity classes.

Syllabus

UNIT I	Hours=40
Introduction Easy and hard problems. Algorithms and complexity. Turing machines: Models of computation. Multi-tape deterministic and non-deterministic Turing machines. Decision problems.	4
UNIT II	
The Halting Problem and Undecidable Languages Counting and diagonalization. Tape reduction. Universal Turing machine. Undecidability of halting. Reductions. Rice's theorem. Deterministic Complexity Classes: DTIME[t]. Linear Speed-up Theorem. P Time. Polynomial reducibility. Polytime algorithms: 2-satisfiability, 2-colourability.	6
UNIT III	
NP and NP-completeness Non-deterministic Turing machines. NTIME[t]. NP. Polynomial time verification. NPcompleteness. Cook-Levin Theorem. Polynomial transformations: 3- satisfiability, clique, colourability, Hamilton cycle, partition problems. Pseudo-polynomial time. Strong NP-completeness. Knapsack. NP-hardness.	6

UNIT IV **Space complexity and hierarchy theorems** DSPACE[s]. Linear Space Compression Theorem. PSPACE, NPSPACE. PSPACE = NPSPACE. PSPACE-completeness. Quantified Boolean Formula problem is PSPACE-complete. L, NL and NL- completeness. NL=coNL. Hierarchy theorems.	10
UNIT V	
Randomized Complexity The classes BPP, RP, ZPP. Interactive proof systems: IP = PSPACE.	6
UNIT VI	
Optimization and approximation Combinatorial optimization problems. Relative error. Bin-packing problem. Polynomial and fully polynomial approximation schemes. Vertex cover, traveling salesman problem, minimum partition.	8

Text Books:

1. *Sanjeev Arora and Boaz Barak, Computational Complexity: A Modern Approach, Cambridge University Press,2009.*
2. *Sanjeev Arora, et al, Complexity Theory: A Modern Approach, Cambridge University Press, 1st edition, 2009.*

Reference Books:

1. *Allen Downey, Think Complexity: Science and Modeling, O'Reilly Media, 2nd Edition, 2018*
2. *OdedGoldreich, P, NP, and NP-Completeness: The Basics of Computational Complexity, Cambridge University Press, 1st edition, 2010*
3. *Neil Deaton Jones, Computability and Complexity: From a Programming Perspective, The MIT Press, 2007*
4. *Goldreich, Computational Complexity: A Conceptual Perspective, Cambridge University Press, 1st edition, 2008)*

Course Outcomes:

- Students will be able to formulate computational models with resource constraints, and be able to describe relationships between these models.
- Students will be able to analyze computational problems from a complexity perspective, and so locate them within the complexity landscape.
- Students will be able to apply mathematical skills and knowledge from earlier years (e.g., from logic and discrete mathematics) to concrete problems in computational complexity.
- Students will gain an appreciation of the broader importance of fundamental problems in computer science, such as the P vs. NP problem.

Basic Programming Concept

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Basic Programming Concept
Category of Course	Open Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- The objective of this course is to provide fundamentals of Computer Systems and problem-solving techniques using C language programming.

Syllabus

UNIT I	Hours=40
Introduction to Computer Computer system concepts, characteristics of computer, generations and types of computer, components of computer system, Booting process, classification of digital computer system, organization of computers. Input and Output devices, Storage devices.	8
UNIT II	
Introduction to Computer Languages System software, application software, firmware, Programming languages classification: machine language, assembly language & high-level language. Evolution of programming languages: first generation, second generation, third generation & fourth generation languages, Language translator: Compiler, Interpreter, and Assembler. Operating System - Definition, Job, Objective and evolution of operating system, Types of operating systems.	8
UNIT III	
Programming Fundamentals Software development life cycle and structured programming, Flowchart and Algorithms, Introduction to C programming, basic programming using input and output operators and expressions, programming using if and if-else, Programming using looping-for, while, do-while; use of switch and break.	8

UNIT IV	
Storage Class, Preprocessors, Arrays based Programming and Modular Programming Defining and processing 1-d and 2-d arrays for problem solving. Defining and calling a function, modular programming using functions, passing arguments and arrays to functions, functions of void and returning values.	8
UNIT V	
Programming using Strings & Structures and Files Defining and processing string as array of character, use of null char, defining and processing structures, passing strings and structures to functions. Input and Output Files.	8

Text Books:

1. *Yashavant P. Kanetkar, Let Us C, Fifth Edition.*
2. *EBalaguruswamy, Programming with C, Tata McGraw Hill, 2015.*

Reference Books:

1. *Byron S. Gottfried, Programming with C Language, Schaum Series, Tata McGraw Hill, 2015.*
2. *Kernighan & Richie, C Programming, Prentice Hall of India, 2002.*

Course Outcomes

- Learn fundamental knowledge of computer hardware and number systems.
- Learn basic terminology used in computer programming.
- Develop ability to write, compile and debug programs in C language.
- Design programs involving decision structures, loops and functions.
- Understand the dynamics of memory by the use of pointers.
- Learn the basic concepts of object-oriented programming paradigm.

Software Engineering

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Software Engineering
Category of Course	Open Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- **To discuss the process for developing large software.**
- **To analyse and model a particular system.**
- **To develop alternative solutions for the system.**
- **To implement, test and validate a systems design.**

Syllabus

UNIT I	Hours =40
Overview of System Analysis & Design , Business System Concept, System Development Life Cycle, Waterfall Model , Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model, Function Point Analysis(FPA).	8
UNIT II	
System Requirement Specification, System analysis- DFD, Data Dictionary, ER diagram, Process Organization & Interactions. System Design- Problem Partitioning, Top-Down & Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	8
UNIT III	
Coding & Documentation- Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation.	8
UNIT IV	
Testing- Levels of Testing, White & Black box testing, Integration Testing, structural testing Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.	8

UNIT V	
Software Project Management- Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring. CASE TOOLS: Concepts, use and application. Software reliability and quality management.	8

Text Books:

1. RajibMall, Fundamentals of Software Engineering. 3ed, PHI.

Reference Books:

1. *R. G. Pressman, Software Engineering, TMH.*
2. *Behforooz, Software Engineering Fundamentals, OUP.*

Course Outcomes:

- Discuss the process for developing large software.
- Analyse and model a particular system.
- Develop alternative solutions for the system.
- Implement, test and validate a systems design.

Embedded Systems

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Embedded Computing Systems
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- To understand and design embedded systems and real-time systems.
- To identify the unique characteristics of real-time systems.
- To explain the general structure of a real-time system.
- To define the unique design problems and challenges of real-time systems.
- To apply real-time systems design techniques to various software programs.

Syllabus

UNIT I	Hours =38
Hardware Concepts Application and characteristics of embedded systems, Overview of Processors and hardware units in an embedded system, General purpose processors, Microcontrollers:8051, Application- Specific Circuits (ASICs), ASIP, FPGA, ARMbased System on a Chip (SoC), Network on Chip (NoC), Levels of hardware modelling, Verilog, Sensors, A/D-D/A converters, Actuators.	8
UNIT II	
Interfacing using RS-232, UART, USB, I2C, CAN bus, Flexray, SRAM and DRAM, Flash memory.	6
UNIT III	
Real-Time Operating Systems Real-Time Task Scheduling: Some important concepts, Types of real-time tasks and their characteristics, Task scheduling, Clock-Driven scheduling, Hybrid schedulers, Event-Driven scheduling, Earliest Deadline First (EDF) scheduling, Rate monotonic algorithm (RMA).	8
UNIT IV	
Commercial Real-time operating systems Time services, Features of a Real-time operating system, Unix-based Real-time operating systems, POSIX-RT, A survey of contemporary Real- time operating systems,	8

Microkernel based systems, Benchmarking real-time systems.	
UNIT V	
Embedded Application Development UML 2.0, State charts, General language characteristics, MISRA C, Hardware/Software Co- design, Hardware/software partitioning, Testing embedded systems, Design for testability and Self-test.	8

Text Books:

1. Embedded Systems Design – A Unified Hardware /Software Introduction, by Frank Vahid and Tony Givargis,John Wiley (2001).

2. An Embedded Software Primer, by David E.Simon, Pearson Education Asia (1999).

Reference Books:

1. Wayne Wolf, Computers as Components; Principles of Embedded Computing System Design – Harcourt India, Morgan Kaufman Publishers (2000).

Course Outcomes:

- Understand and design embedded systems and real-time systems.
- Identify the unique characteristics of real-time systems.
- Explain the general structure of a real-time system.
- Define the unique design problems and challenges of real-time systems.
- Apply real-time systems design techniques to various software programs.

Advanced Operating System

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Advanced Operating Systems
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Operating Systems

Course Objectives:

- To Understand the working of a distributed Operating system.
- To understand the issues in designing a distributed Operating System.
- To understand the synchronization primitives of interaction of distributed Operating System.
- To understand the construct and functioning of Distributed shared – memory and Deadlock management in distributed environment.
- To understand the various failure modes of the system and failure recovery in a distributed environment.

Syllabus

UNIT I	Hours =40
Distributed Systems Architectures of Distributed Systems, System Architecture types, Issues in distributed operating systems, Communication networks, Communication primitives. Concept of a Process, Concurrent Processes, The Critical Section Problem, Other Synchronization Problems, Language Mechanisms for Synchronization, Axiomatic Verification of Parallel Programs.	8
UNIT II	
Theoretical Foundations Inherent limitations of a distributed system, Lamport's logical clocks, Vector clocks, Casual ordering of messages, Global state, Cuts of a distributed computation, Termination detection. Distributed Mutual Exclusion, Introduction, The classification of mutual exclusion and associated algorithms, A comparative performance analysis.	8
UNIT III	
Distributed Deadlock Detection Introduction, Deadlock handling strategies in distributed systems, Issues in deadlock detection and resolution, Control organizations for distributed deadlock detection, Centralized and distributed deadlock detection algorithms, Hierarchical deadlock detection algorithms. Agreement protocols, Introduction-the system model, a classification of agreement problems, Solutions to the Byzantine agreement problem, Applications of agreement algorithms. **Distributed resource management** Introduction, Architecture, Mechanism for building distributed file	8

systems, Design issues, Log structured file systems.	
UNIT IV	
Distributed shared memory Architecture, Algorithms for implementing DSM, Memory coherence and protocols, Design issues. Distributed Scheduling, Introduction, Issues in load distributing, Components of a load distributing algorithm, Stability, Load distributing algorithm, Performance comparison, Selecting a suitable load sharing algorithm, Requirements for load distributing, Task migration and associated issues.	6
UNIT V	
Failure Recovery and Fault tolerance Introduction, Basic concepts, Classification of failures, Backward and Forward error recovery, Backward error recovery, Recovery in concurrent systems, Consistent set of check.	6
Check Points Synchronous and asynchronous check pointing and recovery, Check pointing for distributed database systems, Recovery in replicated distributed databases.	4

Text Books:

1. *MukeshSinghal, NiranjanG.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001*

Reference Books:

1. *AndrewS.Tanenbaum, "Modern operating system", PHI, 2003*
2. *Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2003*

Course Outcomes:

- The course will help the students to understand the basic aim and scope of Distributed Operating System.
- The Course will help students in analyzing the various issues in designing a Distributed Operating system and also give insight into various solutions to overcome the issues at hand.
- Deep understanding of deadlock handling and synchronization primitives of various algorithms in distributed environment.
- Understanding of process scheduling and implementation of memory coherence, load balancing, processor to processor interaction.
- Deep understanding of Failure recovery and fault tolerance.

Network on Chip

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Network on Chip
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Computer Networks and Data Communication

Course Objectives:

- To introduce basic interconnection networks and its various uses.
- To introduce popular topologies in Noc.
- To introduce Routing and routing mechanics in Noc.
- To introduce flow control and QoSpremitives in NoC.

Syllabus

UNIT I	Hours=40
Introduction to Interconnection Networks Uses of Interconnection Networks, **Network Basics:**Topology, Routing Flow Control, Router Architecture, Performance of Interconnection Networks.	8
UNIT II	
Topology Basics Channels and Nodes, Direct and Indirect Networks, Cuts and Bisections, Paths, Traffic Patterns, Performance**,** Throughput and Maximum Channel Load, Latency, Path Diversity, Packaging Cost. **Basics of Popular Topologies:** Butterfly Networks, Structure, Performance, Packaging cost, Path diversity, Number of Stages; Torus Networks, Structure, Performance, Packaging cost, Path diversity. Meshes and Express cubes.	8
UNIT III	
Routing Basics Taxonomy of Routing Algorithms, The Routing Relation, Deterministic Routing, Oblivious Routing, Minimal Oblivious Routing, Load Balanced Oblivious Routing, Adaptive Routing, Routing Mechanics.	8

UNIT IV **Flow Control Basics** Resources and Allocation Units, Buffer less Flow Control, Circuit Switching, Buffered Flow Control, Packet-Buffer Flow Control,Flit-Buffer,Flow Control, Buffer Management and Backpressure, Flit-Reservation Flow Control.	8
UNIT V	
Deadlock and Livelock Deadlock, Deadlock Avoidance, Adaptive Routing, Deadlock Recovery, Livelock;Quality of Service, Burstiness and Network, Implementation of Guaranteed Services, Delays, Implementation of Best-Effort Services, Separation of Resources.	8

Text Books:

1. *"Principle and Practices of Interconnection Networks", William J. Dally and brain Towles.Morgankaufmann.*

Reference Books:

1. *"Network – On – Chip: From Implementation to programming Paradigm", Sheng Ma Libo Huang Mingche Lai Wei Shi, Margan Kaufman.*

Course Outcomes:

- In depth analysis of CommercialNoCs.
- Understanding of basic requirements of NoC topologies and various performance factors.
- Understanding how to avoid deadlocks and lovelocks in various choices of routing algorithms present.
- Understanding the QoS requirements.

Information Retrieval

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Information Retrieval
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Any Programming Language (Preferably java) Probability and Linear algebra

Course Objectives:

- To learn and study algorithms which will enable to design, and implement modern information retrieval systems.
- To investigate search evaluation, retrieval feedback, search log mining, and applications in web information management.

Syllabus

UNIT I	Hours = 36
Introduction Introduction, History Of IR, Components Of IR, Issues, Open Source Search Engine Frameworks, The Impact Of The Web On IR, IR Versus Web Search, The Basic Building Blocks Of A Modern Search Engine System, Including Web Crawler, Basic Text Analysis Techniques.	9
UNIT II	
Models of Information Retrieval Inverted Index, Query Processing, Search Result Interface. Boolean And Vector-Space Retrieval Models, Term Weighting, TF-IDF Weighting, Cosine Similarity, Preprocessing, Efficient Processing With Sparse Vectors, Language Model Based IR, Probabilistic IR, Latent Semantic Indexing, Relevance Feedback And Query Expansion.	10
UNIT III	10
Text Mining Information Filtering; Organization And Relevance Feedback, Text Mining, Text Classification And Clustering. **Categorization Algorithms** Naive Bayes; Decision Trees; And Nearest Neighbor. **Clustering Algorithms** Agglomerative Clustering; KMeans; Expectation Maximization (EM).	

UNIT IV	3
Link Analysis Link Analysis, Hubs And Authorities, Page Rank And HITS Algorithms, Searching And Ranking, Relevance Scoring And Ranking For Web.	
UNIT V	4
Similarity and evaluation measures Evaluation Measures, Similarity And Distance Measures, Snippet Generation, Summarization, Question Answering, Cross-Lingual Retrieval, Hadoop& Map Reduce And Modern Search Applications.	

Text Books:

1. *C.Manning,P.Raghavan,and H.Schutze,Introduction toInformationRetrieval,Cambridge University Press, 2008.*
2. *Bruce Croft, Donald Metzler and Trevor Strohman,Search Engines: Information Retrieval in Practice, 1stEditionAddisonWesley, 2009.*
3. *MarkLevene,AnIntroductiontoSearchEnginesandWebNavigation,2nd Edition Wiley.*

Reference Books:

1. *OphirFrieder"InformationRetrieval:AlgorithmsandHeuristics:TheInformation Retrieval Series", 2nd Edition,Springer, 2004.*
2. *ManuKonchady,"BuildingSearchApplications:Lucene,LingPipe",andFirstEdition,GateMustru Publishing, 2008.*

Course Outcomes:

- Recognize underlying technologies of modern information retrieval system.
- Obtain hands-on experience by using existing information retrieval toolkits to set up your own search engines and improving their search accuracy.
- Helps in gaining in-depth understanding of the methods like document text-mining techniques, page-rank etc. and develop your own idea for new solutions for different verticals.

Advanced Java Programming

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Advanced Java Programming
Category of Course	Professional Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	Core Java

COURSE OBJECTIVES

- To impart the basic concepts of Enterprise architecture.
- To understand concepts about CGI and request response model
- To understand basic concepts about Session management
- To enable them to understand issues related to the application of J2EE in real world

Syllabus

UNIT I	Hours =36
Fundamentals: Introduction: Client & server side programming. Enterprise architecture styles: Single tier, 2-tier, 3-tier, n-tier; Relative comparison of the different layers of architectures. MVC Architecture: Explanation, Need, Drawbacks, J2EE WEB SERVICES, Different components & Containers	8
UNIT II	
Servlet: Servlet: Introduction, Advantages over CGI, How it works?, Servlet life cycle, Servlet API (Different interfaces & classes of generic servlet & HTTP servlet), Accessing user information by means of Request & Response, Servlet session management techniques and relative comparison.	9
UNIT III	
Java Server Pages: JSP: Introduction, Comparison between JSP & servlet., Architecture/Life cycle, Different types of JSP architectures and relative comparison.; JSP tags, Directives, Scripting elements, Actions; JSP Implicit objects, Accessing user information using implicit objects. Beans-useBeans, setProperty, getProperty, Session Tracking, User Passing Control and Data Between Pages, Shareing Session and application data.	6
UNIT IV	
Database Connectivity: JDBC: Introduction, Database driver, Different approaches to connect an application to a database server, Establishing a database connection and executing SQL statements, JDBC prepared statements, JDBC data sources.	6
UNIT V	
EJB Introduction: J2EE, JavaBeans- Bean Builder, advantages, Design Patterns, Properties- Simple, Bound, Constrained, BeanInfo interface, Persistence, Customizer, JavaBean API, EJB-Architecture, Usage, Benefits, Beans- Sessions, Stateless, Statefull, Entity and Message	7

driven, Introduction to Struts-Basic Idea.	

Text Books:

1. Uttam K. Roy,"Advanced Java Programming", Oxford University Press., Inc.,2015.
2. Ivor Horton,"Beginning J2EE 1.4", SPD Publication,2008.

Reference books:

Austin and Pawlan,"Advanced Programming for JAVA 2 Platform", Pearson,2000.

COURSE OUTCOMES

- Student will able to implement :
    - Servlet
    - JSP
    - JAVA BEANS
    - EJB
    - STATEFUL SESSIONS
- Following key learning indicators will reflect out of this course for the students
    - Different layers of architecture
    - CGI vs Java Alternatives
    - Lifecycle of servlet and jsp
    - JDBC Connections
    - Implementations of hibernate and struts frameworks

Web and Internet

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Web and Internet
Category of Course	Professional Elective Courses/ Open Elective Courses
Credits	3L: 0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- This course has a practical emphasis on the design and techniques for developing internet-based applications, mainly focusing on web programming.
- Topics include HTML, client-side scripting language (JavaScript), server-side programming (Servlets, JSP, and J2EE), and XML/web services.
- This course will also cover some important topics needed for internet-based application developments, such as Internet architectures and web security.

Syllabus

UNIT I	Hours =40
Internet and World Wide Web Introduction, Internet Addressing, ISP, types of Internet Connections, Introduction to WWW, WEB Browsers, WEB Servers, URLs, HTTP, WEB Applications, Tools for web site creation.	8
UNIT II	
HTML5 Introduction to HTML5, Lists, adding graphics to HTML5 page, creating tables, linking documents, forms, frames, Cascading Style sheets.	7
UNIT III	
Java Script Introduction, programming constructs: variables, operators and expressions, conditional checking, functions and dialog boxes, JavaScript DOM, creating forms, introduction to Cookies, Jquery.	8
UNIT IV	
AJAX Introduction, HTTP Request, XMLHttpRequest, AJAX Server Script. **PHP** Introduction, syntax, statements, operators, PHP and MySQL, PHP and AJAX.	10

UNIT V	
Introduction to ASP.net, J2EE, POJO, Java servlets and JSP.	7

Text Books:

1. *Ivan Bayross, Web Enabled Commercial Application Development using HTML, DHTML, JavaScript, Perl CGI, BPB.*
2. *Steven M. Schafer, HTML, CSS, JavaScript, Perl, Python and PHP, Wiley India Textbooks.*
3. *Stephen Walhter, Kevin Hoffman, Nate Dudek, ASP.NET Unleashed, Pearson Education.*
4. *Paul S. Wang, G. Keller, S. Katila, An Introduction to Web Design + Programming, Cengage Learning.*

Reference Books:

1. *Jeffery C. Jackson, Web Technologies: A Computer Science Perspective, Pearson Education*

Course Outcomes:

After completion of course, students would be able to:

- Write syntactically correct HTTP messages and describe the semantics of common HTTP methods and header fields
- Write a valid standards-conformant HTML document involving a variety of element types, including hyperlinks, images, lists, tables, and forms
- Use CSS to implement a variety of presentation effects in HTML and XML documents, including explicit positioning of elements
- Demonstrate techniques for improving the accessibility of an HTML document, Javascript, ASP.net.

Python

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Python
Category of Course	Open Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Basic Programming Knowledge

Course Objectives:

- Understand the programming basics (operations, control structures, data types, etc.)
- Readily use the Python programming language
- Apply various data types and control structure
- Understand class inheritance and polymorphism
- Understand the object-oriented program design and development
- Understand and begin to implement code

Syllabus

UNIT I	Hours =40
Introduction Relationship between computers and programs, Basic principles of computers, File systems, Using the Python interpreter, Introduction to binary computation.	8
UNIT II	
Data Types And Control Structures Operators (unary, arithmetic, etc.), Data types, variables, expressions, and statements, Assignment statements, Strings and string operations, Control Structures: loops and decision.	8
UNIT III	
Modularization And Classes Standard modules, Packages, Defining Classes, Defining functions, Functions and arguments (signature).	8
UNIT IV	
Exceptions And Data Structures Data Structures (array, List, Dictionary), Error processing, Exception Raising and Handling.	8
UNIT V	
Object Oriented Design Programming types, Object Oriented Programming, Object Oriented Design, Inheritance and Polymorphism	8

Text Books:

1. *Starting Out with Python plus MyProgrammingLab with Pearson eText --Access Card Package (3rd Edition) Tony Gaddis ISBN-13: 978-0133862256*

Reference Books:

3. *Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material*
4. *Python Programming using problem solving Approach by ReemaThareja, OxfordUniversity, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173*

Course Outcomes

After completion of course, students would be able to:

- Students can use Python interactively
- Students can demonstrate understanding of the role of testing in scientific computing, and write unit tests in Python.
- Students can write code in Python to perform mathematical calculations and scientific simulations.

Matlab

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Matlab
Category of Course	Open Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Basic Programming Knowledge

Course Objectives:

- Understand the Matlab Desktop, Command window and the Graph Window.
- Be able to do simple and complex calculation using Matlab.
- Be able to carry out numerical computations and analyses.
- Understand the mathematical concepts upon which numerical methods rely.
- Ensure you can competently use the Matlab programming environment.
- Understand the tools that are essential in solving engineering problems.

Syllabus

UNIT I	Hours=40
Introduction to Matlab Matlab Interactive Sessions, Computing with Matlab, Variables, Arrays, Functions and Files.	6
UNIT II	
Programming Techniques Program Design and Development, Relational Operators and Logical Variables, Logical Operators and Functions, Conditional Statements, Loops, The Switch Structure, Debugging Mat Lab Programs.	8
UNIT III	
Plotting XY- plotting functions, Subplots and Overlay plots, Special Plot types, Interactive plotting, Function Discovery, Regression, 3-D plots.	8
UNIT IV	
Probability and Statistics Interpolation, Statistics, Histogram and probability, The Normal Distribution, Random number Generation.	10
UNIT V	
Symbolic Processing With Matlab Symbolic Expressions and Algebra, Algebraic and Transcendental Equations,	8

Calculus, Symbolic Linear Algebra.	

Text Books:

1. *Introduction to Matlab 7 for Engineers, by William J. Palm III, McGraw Hill 2005.*

Reference Books:

1. *S. J. Chapman. MATLAB Programming for Engineers. Thomson, 2004*
2. *J. Cooper. A MATLAB Companion for Multivariable Calculus. Academic Press, 2001.*

Course Outcomes:

After completion of course, students would be able to:

- Able to use Matlab for interactive computations.
- Familiar with memory and file management in Matlab.
- Able to generate plots and export this for use in reports and presentations.
- Able to use basic flow controls.

Cloud Computing

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Cloud Computing
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Operating Systems, Virtualization Technologies, Networking.

Course Objectives:

- The student will also learn how to apply trust-based security model to real-world security problems**.**
- An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
- Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

Syllabus

UNIT I	Hours=40
Introduction to Cloud Computing, The Evolution of Cloud Computing, Hardware Evolution, Internet Software Evolution, Server Virtualization, Web Services Deliver from the Cloud, Communication-as-a-Service, Infrastructure-as-a-Service, Monitoring-as-a-Service, Platform-as-a-Service, Software-as-a-Service, Building Cloud Network.	8
UNIT II	
Federation in the Cloud, Presence in the Cloud, Privacy and its Relation to Cloud-Based Information Systems, Security in the Cloud, Common Standards in the Cloud, EndUser Access to the Cloud Computing.	7
UNIT III	
Introduction, Advancing towards a Utility Model, Evolving IT infrastructure, Evolving Software Applications, Continuum of Utilities, Standards and Working Groups, Standards Bodies and Working Groups, Service Oriented Architecture, Business Process Execution Language, Interoperability Standards for Data Center Management, Utility Computing Technology, Virtualization, Hyper Threading, Blade Servers, Automated Provisioning, Policy Based Automation, Application Management, Evaluating Utility Management Technology, Virtual Test and development Environment, Data Center Challenges and Solutions, Automating the Data Center.	10

UNIT IV	
Software Utility Application Architecture, Characteristics of an SaaS, Software Utility Applications, Cost Versus Value, Software Application Services Framework, Common Enablers, Conceptual view to Reality, Business Profits, Implementing Database Systems for Multitenant Architecture.	7
UNIT V	
Other Design Considerations, Design of a Web Services Metering Interface, Application Monitoring Implementation, A Design for an Update and Notification Policy, Transforming to Software as a Service, Application Transformation Program, Business Model Scenarios, Virtual Services for Organizations, The Future.	8

Text Books:

1. *Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765,O'Reilly Media, September 2009.*
2. *Bunker and Darren Thomson, "Delivering Utility Computing", 2006, John Wiley & Sons Ltd.*

Reference Books:

1. *John W. Rittinghouse and james F. Ransome, "Cloud Computing Implementation, Management and Security", 2010, CRC Press, Taylor & Francis Group, Boca Raton London New York. [Unit -11 and Unit II].*
2. *Alfredo Mendoza, "Utility Computing Technologies, Standards, and Strategies", Artech House INC, 2007. [Unit -11I to Unit V] 3.George Reese, "Cloud Application Architectures", O'reilly Publications, 2009.*

Course Outcomes:

After completion of course, students would be able to:

- Identify security aspects of each cloud model.
- Develop a risk-management strategy for moving to the Cloud.
- Implement a public cloud instance using a public cloud service provider.
- Apply trust-based security model to different layer.

Quantum Computing

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Quantum Computing
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Linear Algebra Basics

Course Objectives:

- The course will provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing.

Syllabus

UNIT I	Hours =40
Qubit& Quantum States The Qubit, Vector Spaces. Linear Combination of Vectors, Uniqueness of a spanning set, basis & dimensions, inner Products, orthonormality, gram-schmidtorthogonalization, bra-ketformalism, the Cauchyschwarez and triangle Inequalities.	8
UNIT II	
Matrices & Operators Observables, The Pauli Operators, Outer Products, The Closure Relation, Representation of operators using matrices, outer products & matrix representation, matrix representation of operators in two dimensional spaces, Pauli Matrix, Hermitian unitary and normal operator, Eigen values & Eigen Vectors, Spectral Decomposition, Trace of an operator, important properties of Trace, Expectation Value of Operator, Projection Operator, Positive Operators.	8
UNIT III	
Commutator Algebra Heisenberg uncertainty principle, polar decomposition &singular values, Postulates of Quantum Mechanics. Tensor Products: Representing Composite States in Quantum Mechanics, Computing inner products, Tensor products of column vectors, operators and tensor products of Matrices.	8

UNIT IV **Density Operator** Density Operator of Pure & Mix state, Key Properties, Characterizing Mixed State, Practical Trace & Reduce Density Operator, Density Operator & Bloch Vector. Quantum Measurement Theory: Distinguishing Quantum states & Measures, Projective Measurements, Measurement on Composite systems, Generalized Measurements, Positive Operator- Valued Measures	8
UNIT V	
Recent trends in Quantum Computing Research Quantum Computing Applications of soft computing. Quantum Cryptography, Quantum Automata Theory etc.	8

Text Books:

1. *M. A. Nielsen and I. L. Chuang. Quantum Computation and Quantum Information. Cambridge University Press, 2000.*
2. *Quantum Computing Explained By DAVID Mc MAHON*

Reference Books:

1. *Quantum Computing without Magic by ZdzislawMeglicki*
2. *Quantum Computer Science By Marco Lanzagorta, Jeffrey Uhlmann*
3. *. An Introduction to Quantum Computing Phillip Kaye, Raymond Laflamme, Michele Mosca.*

Course Outcomes:

- Knowledge of Vector spaces, Matrices, Quantum state, Density operator and Quantum Measurement theory.
- Application of quantum computing to soft computing and Cryptography.

Advance Computer Architecture

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Advance Computer Architecture
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Computer Organization and Architecture

Course Objectives:

The student should be made to:

- Understand the micro-architectural design of processors.
- Learn about the various techniques used to obtain performance improvement and power savings in current processors.

Syllabus

UNIT I	Hours =40
Pipelining Basic And Intermediate Concept Review of Fundamentals of CPU, Memory and IO, Trends in technology, power, energy and cost, Dependability, Performance Evaluation,Review of Pipelining, Examples of some pipeline in modern processors, pipeline hazards, data hazards, and control hazards. Techniques to handle hazards, performance improvement with pipelines and effect of hazards on the performance.	12
UNIT II	
Instruction Level Parallelism ILP concepts, Pipelining overview, Compiler Techniques for Exposing ILP, Dynamic Branch Prediction, Dynamic Scheduling, Multiple instruction Issue, Hardware Based Speculation, Static scheduling, Multi-threading, Limitations of ILP, Case Studies of Intel core i7 and ARM Cortex A8.	8
UNIT III	
Data-Level Parallelism Vector architecture, SIMD extensions, Graphics Processing Units, Loop level parallelism.	6
UNIT IV	
Thread Level Parallelism Symmetric and Distributed Shared Memory Architectures, Performance Issues, Synchronization, Models of Memory Consistency. **Case studies** Intel i7 Processor, SMT & CMP Processors.	6

UNIT V	
Cache Performance Reducing Cache Miss Penalty and Miss Rate, Reducing Hit Time, Main Memory and Performance, Memory Technology.	8

Text Books:

1. *John L Hennessey and David A Patterson, "Computer Architecture A Quantitative Approach", Morgan Kaufmann/ Elsevier, Fifth Edition, 2012.*

Reference Books:

1. *Kai Hwang and Faye Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition,2000.*
2. *Sima D, Fountain T and Kacsuk P, "Advanced Computer Architectures: A Design Space Approach", Addison Wesley, 2000.*

Course Outcomes:

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

- Evaluate performance of different architectures with respect to various parameters.
- Study about different hazards and its resolution.
- Analyze performance of different ILP techniques.
- Identify cache and memory related issues in multi-processors.

Computational Geometry

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Computational Geometry
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Operating Systems

Course Objectives:

- To provide an account of fundamental concepts of quantitative geometry and
- To discuss graphical techniques of geometric construction with experiments using computers.

Syllabus

UNIT I	Hours =40
Polygon Triangulation Polygons-Jordan Curve Theorem-The Art Gallery Theorem-Fisk's Proof of Sufficiency, Triangulation: theory-Existence of a Diagonal-Properties of Triangulations-Triangulation Dual-3-Coloring Proof. Area of polygon and its theorem. **Polygon Partitioning** Monotone partitioning, Trapezoidalization, Monotone Mountains. Convex partitioning.	12
UNIT II	
Convex Hulls in Two Dimensions Definitions of convexity and convex hulls,Extreme points and Naive algorithms for extreme points-Extreme Edges QuickHull,Graham's Algorithm, Lower Bound, Incremental Algorithm, Divide and Conquer Polyhedra, Regular Polytopes-Euler's Formula. Hull Algorithms-incremental algorithm and complexity, Polyhedral Boundary Representations.	7
UNIT III	
Voronoi Diagrams Applications: Preview, Definitions and Basic Properties, Halfplanes**,** Size of Diagram, Delaunay Triangulations, Properties ofDelaunay Triangulations**,** Properties of Voronoi Diagrams, Algorithms,Applications in Detail-Nearest Neighbors, Largest Empty CircleMinimum Spanning Tree-Traveling Salesperson Problem.	6
UNIT IV	
Arrangements Voronoi Diagrams & Medial Axis, Connection to Convex Hulls, Connection to Arrangements, Combinatorics of Arrangements, Combinatorics of	7

Arrangements, Incremental Algorithm.	
UNIT V	
Duality, Higher-Order Voronoi Diagrams, Applications, Segment-Segment Intersection, Segment-Triangle Intersection.	8

Text Books:

1. *Computational Geometry in C 2nd edition by Joseph O'Rourke(Cambridge university press).*

Reference Books:

1. *Computational Geometry Algorithms and Applications Third Edition, Springer by Mark de Berg · Otfried Cheong Marc van Kreveld · Mark Overmars.*

Course Outcomes:

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

- explain the basic principles and theory of geometric algorithms,
- learn and improve their algorithmic skills
- apply the techniques to specific application domains of interest
- develop their own algorithms for solving geometric problems.

Distributed Systems

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Distributed Systems
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Operating Systems

Course Objectives:

- Introduce students to the general properties, characteristics, and issues of distributed systems. Also, students should be able to understand how modern systems works.
- Students should be able to learn on distributed algorithms and how these algorithms are applied when designing and implementing real systems.
- Students learned about some topics on clock synchronization, coordination algorithms, transactions, and replications.
- Students should be able to understand design and implementation issues on distributed shared memory.
- Students should be able to learn experimental experience in designing and implementing real systems through computer-based assignments.

Syllabus

UNIT I	Hours = 40
Introduction *Background:* Brief definitions of distributed systems, *M*otivation, Examples of distributed Systems, Relation to parallel systems, Message passing systems Vs. Shared memory systems, Execution process for synchronous Vs. asynchronous, Case Study, World Wide Web.	8
UNIT II	
Communications in Distributed Computing Models *System Models:* Architectural models, Interaction model, Failure model, security model. *Inter process communication:* API for the internet protocols, External data representation and Marshaling, Client-Server communication, and Group communication, Message queues, Case study: Interprocess communication in Unix. *Distributed objects and Remote invocation:* Distributed objects, Communication between distributed objects, RequestReply protocols, Remote procedure call, Remote method invocation, Case study: Java RMI.	8
UNIT III **Peer-to-Peer services and File systems** *Peer-to-Peer systems:* Introduction, Napster and its legacy, Peer-to-peer middleware, Routing overlays, Case study: Pastry, Tapestry. *Distributed File systems: Introduction, File service architecture, Andrew file system. Name services:* Introduction, Name services	8

and the Domain Name System, directory services, Case study: The Global Name Service.	
UNIT IV	
Synchronization and Replication *Time and Global States:* Introduction, Clocks, events, and process states, Synchronizing physical clocks, Logical time and logical clocks, Global states. *Coordination and Agreement:* Introduction, Distributed mutual exclusion, Elections, Coordination and agreement in group communication. *Transaction and Concurrency control:* Transactions, Nested transactions, Locks, Optimistic concurrency control, Timestamp ordering. *Distributed Transactions:* Introduction, Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Distributed deadlocks, Transaction recovery, Replication.	8
UNIT V	
Process and Resource Management *Process Management:* Process migration, Features, Mechanism, and Threads: Models, Issues, Implementation. *Resource Management: Introduction, Scheduling Algorithms, Task Assignment Approach, Load Balancing Approach, Load Sharing Approach.*	8

Text Books:

1. *Distributed Systems Concept and Design, 5th Edition, George Coulouris, Jean Dollimore, Tim Kindberg, published by Pearson Education, Copyright © 2012.*

Reference Books:

1. *Distributed Operating Systems: Concepts and Design, Pradeep K Sinha, published by Prentice Hall of India, 2007.*
2. *Distributed computing: principles, algorithms, and systems, Kshemkalyani, Ajay D., and MukeshSinghal, published by Cambridge University Press, 2011.*
3. *Distributed Systems: Principles and Paradigms, 3rd Edition, Tanenbaum A.S., Van Steen M., published by Pearson Education, 2017.*

Course Outcomes:

- Students will be able to apply the concept of distributed systems, techniques, and trends.
- Students will be capable of applying the concept of network virtualization, remote method invocation, and distributed objects.
- Students will be able to understand the peer-to-peer services, distributed file systems, domain name system.
- Students will gain the knowledge of logical clocks, distributed mutual exclusion, distributed deadlocks, concurrency control in distributed transactions, replications.
- Students will be able to capture the knowledge of process and resource management.

Formal Methods for System Verifications

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Formal Methods for System Verifications
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	General knowledge in discrete mathematics, and C/C++ programming skill.

Course Objectives:

- Introduce students to the mathematically proving formally specified properties of computer systems.
- Students will be able to learn on theoretical aspects of specification formalisms and algorithm verifications.
- Students should be able to understand mathematically-based techniques for the specification, development, and verification of software and hardware systems.
- Students will acquire skill in using language for model description and specification of model behaviors in modeling and verification of event-driven systems.

Syllabus

UNIT I	Hours = 40
Introduction to the formal methods and modeling systems *Introduction:* The need for formal methods, Motivation for formal verification, Hardware and software verification, simple verification examples. Modeling systems: Modeling concurrent systems, concurrent systems, Kripke structures, State/configuration of a program or hardware module, Operational semantics and state transition diagrams (finite and infinite-state), Specifying a state transition relation: explicit enumeration and implicit specifications, Constructing a state transition relation from a description of a program or hardware system.	10
UNIT II	
Logical formalism *Propositional logic:* Declarative sentences, Natural deduction, Propositional logic as a formal language, Semantics of propositional logic, Normal forms, SAT solver. *Predicate logic:* The need of predicate logic, predicate logic as a formal language, Proof theory of predicate logic, Semantics of predicate logic, Undecidability of predicate logic. *Temporal logic:* motivation for their use in specifying properties of reactive systems, The computational Tree logic CTL*, Linear-time Temporal Logic (LTL): syntax, semantics and usage in specifying properties of computer systems, Computation-tree Temporal Logic (CTL): syntax, semantics, difference with respect to LTL and usage in specifying properties, Examples of some commonly specified properties in CTL and LTL.	8

UNIT III **Model checking for verification:** *CTL model checking:* CTL model checking using finite Kripke structures: explicit-state algorithms, CTL model checking with fairness, The fixed-point characterization of CTL. *LTL model checking:* LTL model checking using finite Kripke structures: an automatetheoretic technique, Discussion on automate-theoretic LTL model checking, The LTL model-checking algorithm, Reduction of LTL model checking to fair CTL model checking. *CTL* model checking:* The properties of CTL*, LTL and CTL as subset ofCTL*, The expressive power of CTL*. *Study of Verification Tools:* SMV, NuSMV.	8
UNIT IV	
Binary Decision Diagrams, and Symbolic model checking: *Binary Decision Diagrams:* Introduction to Binary Decision Diagram (BDD), and modelling hardware with BDDs, Algorithms for BDD operations, Concept of OBDDs and ROBDDs and operation on ROBDDs. *Symbolic model checking:* Fix point Representations, Symbolic model checking for CTL, Fairness of Symbolic model checking, Symbolic LTL model checking.	7
UNIT V	
Model checking and Automata Theory *Introduction: Automata on finite and infinite words, Model checking using automata, Checking emptiness, Translating LTL into automata, On-the-Fly model checking.*	7

Text Books:

1. *Logic in Computer Science: Modelling and Reasoning about Systems, 2nd Edition , M. Huth and M. Ryan, published by Cambridge University Press, Copyright © 2011 (Reprinted 2007, 2010, 2011).*
2. *Model Checking, E. M. Clarke, O. Grumberg and D. Peled, MIT Press, 1999.*

Reference books:

1. *Higher Order Logic and Hardware Verification, T. F. Melham, published by Cambridge University Press, Print publication year: 1993, online publication date: January, 2010.*
2. *Algorithm Design, 1st Edition, Jon Kleinberg, and Eva Tardos, published by Pearson Education Limited, Copyright © 2014. T. F. Melham, Higher Order Logic and Hardware Verification, Cambridge University Press, 1993.*
3. *The Temporal Logic of Reactive and Concurrent System Specification, Z. Manna and A. Pnueli, SpringerVerlag, 1992.*

Course Outcomes:

- Students will be able to understand formal methods which are applying for Hardware and Software verifications.
- Students will be able to write the formal proofs based on the propositional logic, predicate logic, and temporal logic to verify the hardware circuits and program verifications.
- Students will be capable of writing the formal properties and specifications in computation tree logic (CTL), linear-time temporal logic (LTL).
- Students will be able to verify the systems using CTL and LTL model checking.
- Students will be able to construct and use Binary Decision Diagrams (BDDs) in symbolic model checking.
- Students will be able to understand the model checking using automata and also able to translating LTL into automata.
- Students will be able to learn the verification tools: SMV, PVS.

Operations Research

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Operations Research
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	NIL

Course Objectives:

- The objective of the course is to orient the engineering students with the concepts and practical implications of Operations Research and Optimization Techniques.

Syllabus

UNIT I	Hours =40
Decision Theory, Introduction to Operation Research, Introduction to Linear Programming, Transportation problems, Assignment Problem.	8
UNIT II	
Construction of a Network Diagram, Game Theory, Markov Chains, Waiting Line, Replacement.	8
UNIT III	
Integer Programming, Goal Programming, Dynamic Programming, Applied Queuing Models, Simulation Modeling.	8
UNIT IV	
Forecasting Models, Specific Inventory Models under uncertainty, Linear Programming-Sensitivity Analysis, Large scale linear programming, discrete optimization models.	8
UNIT V	
Network models and Optimization, Non-Linear Programming, Analytical Hierarchy Process, Yield Management and Revenue Optimization.	8

Text Books:

1. *Taha H. A: Operations Research an Introduction. Pearson Education, New Delhi; 2014.*
2. *Sharma J.K:Operations Research .PHI, New Delhi; 2014.*

Reference books:

1. *Bertsimas, D., & Freund, R. M: Data models and decisions: The fundamentals of management science. Dynamic Ideas USA; 2004.*
2. *Srinivasan G: Quantitative Models in Operations and Supply Chain Management. PHI, New Delhi; 2013.*
3. *Rajagopal: Operations Research. Prentice Hall of India Pvt. Ltd., New Delhi; 2013.*
4. *Pai: Operations Research. OXFORD UNIVERSITY PRESS, New Delhi; 2014.*
5. *Bertsimas, D., &Tsitsiklis, J. N: Linear Optimization. Athena Scientific; 2010.*
6. *Powel, S. G., & Baker, K. R: Management Science: The art of modeling with spreadsheets. Wiley US;2009.*

Course Outcomes:

- The students will acquire the skills of Optimization techniques.
- The students will gain the knowledge of applying the concepts of operations research in engineering problems.

Advanced Algorithms

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Advanced Algorithms
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Design and Analysis of Algorithms

Course Objectives:

- Introduce students to the advanced methods of designing and analysis of algorithms in computing.
- Students should be able to select appropriate algorithm techniques for a specific problem.
- Students learn about the different modeling of problem-solving like data structures, graph, decomposing the problem, which is used to solve the advanced algorithmic issues.
- Students should be able to classify the different classes of problems based on their computational difficulties.

Syllabus

UNIT I	Hours= 40
Overview of Design Paradigms *Background:* Motivation, the role of algorithms in computing, Analyzing of algorithms, algorithms like heap sort, search algorithms, etc. *Designing techniques: over*view of Divide and Conquer, Greedy method, Dynamic Programming, Branch and Bound, Backtracking, Graph traversal algorithms.	7
UNIT II	
Matroids, String and Graph Matching *Matroids:* Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. *String Matching:* Introduction to string-matching problem, Naïve algorithm, Rabin Karp, String matching with finite automata, Knuth-Morris-Pratt algorithms and complexity analysis. *Graph Matching:* Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmentingpath.	8
UNIT III	
Max-Flow Problem and Matrix Computation *Flow-Networks:* Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. *Matrix Computations:* Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the timecomplexities	8

of basic matrix operations, LUP-decomposition.	
UNIT IV	
Shortest Path Problems, Modulo Representation of integers/polynomials, Discrete Fourier Transform (DFT): *Shortest Path Problems in Graphs:* Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. *Modulo Representation of integers/polynomials:* Chinese Remainder Theorem, Conversion between base-representation and modulorepresentation. *Discrete Fourier Transform:* DFT and FFT algorithms.	8
UNIT V	
Theory of NP-Hard and NP-Completeness Problems, and Approximation Algorithms: *Theory of NP-Hard and NP-Completeness Problems:* P, NP, and NP-Complete complexity classes, Polynomial-time verification, NP-completeness and reducibility, NP-completeness proofs. *ApproximationAlgorithms:* Notion of NP-completeness: P class, NP-hard class, NP-complete class, Circuit Satisfiability problem, Clique Decision Problem,etc. *Approximation Algorithms: Approximation algorithms for vertex-cover problem, set cover, TSP, knapsack, subset-sum problem etc.*	9

Text Books:

1. *Introduction to Algorithms, 3rd Edition, T H. Cormen, C E. Leiserson, R L. Rivest, and Clifford Stein, published by PHI Learning Private Limited (Original edition published by the MIT Press, Cambridge, MA, USA), Copyright © 2011.*
2. *The Design and Analysis of Computer Algorithms by Aho, Hopcroft, Ullma.*

Reference Books:

1. *Algorithm Design, 1st Edition, Jon Kleinberg, and Eva Tardos, published by Pearson Education Limited, Copyright © 2014.*
2. *Algorithms, 1st Edition, S. Dasgupta, C. Papadimitriou, and U. Vazirani, published by McGraw-Hill Education, Copyright © 2008.*

Course Outcomes:

- Students will be able to apply the concept and design strategies to algorithm design.
- Also, capable of writing the correctness of algorithms systematically.
- Students will be able to choose a suitable data structure for solving the problems, and also design the appropriate algorithms.
- Students will be capable of classifying the different class of problems based on their completeness theorem.
- Students will be able to understand more details in the field of advanced data structures for synthesizing more complicated problems in the field of engineering.

Cybersecurity

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Cybersecurity
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Cryptography and Network Security

Course Objectives:

- Understand the fundamentals of cyberspace and cybersecurity terminology.
- Identify common cyber threats and attack vectors.
- Implement cybersecurity best practices and data protection measures.
- Comprehend the legal and ethical aspects of cybercrime and cybersecurity.
- Analyze real-world cybersecurity incidents and case studies.

Syllabus

UNIT I	Hours= 40
Basic Introduction to Cyberspace and Cybersecurity Introduction to cyberspace and its significance in the modern world Key terminology in cybersecurity (e.g., malware, firewall, penetration testing), Evolution of cybersecurity from its early days to current trends Roles and responsibilities of cybersecurity professionals in organizations Cybersecurity ethics and professional conduct	8
Cybercrime and Cybersecurity Threat Landscape Understanding different types of cyber threats (viruses, worms, ransomware, DDoS attacks), Common cyber-attack vectors (e.g., social engineering, phishing, malware distribution), Analysing the global threat landscape and recent cyber incidents, Case studies of prominent cyber attacks (e.g., WannaCry, Equifax breach), The economics of cybercrime and its impact on businesses and individuals	8
Solutions or Precautions to Resist Cyber Threats and Data Privacy Cybersecurity best practices for individuals and organizations Developing information security policies and procedures Security awareness and training programs, Data privacy principles and regulations (e.g., GDPR, HIPAA), Data encryption and protection measures (e.g., SSL, encryption algorithms)	8
Cybercrime and Cyber Law Cybercrime laws and regulations at the national and international levels Cybercrime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Investigating cybercrimes: digital forensics and evidence collection Case studies of high-profile cybercrime prosecutions Ethical hacking and penetration testing as legal and ethical practices	8
Emerging Trends in Cybersecurity Internet of Things (IoT) security challenges and solutions Cloud security and virtualization best practices Artificial intelligence and machine learning in cybersecurity (e.g., anomaly detection) Blockchain and cryptocurrency security considerations Biometric security technologies and their use in authentication	8

Text Books:

1. *William Stallings, "Cryptography and Network Security: Principles and Practices", 6th Edition, Pearson Education Ltd, 2016.*
2. *Karnika Seth, " Computers, Internet and New Technology Laws" ,Cyber Lawyer and Expert and is The Managing Partner of Seth Associates, Edition*
3. *S.K.Verma, Raman mittal , "Legal dimensions of cyber space" ,Indian Law Institute, New Delhi Indian Institute,2004.*
4. *Thomas Halt, Adam M. Bossler and Kathryn C.Seigfried Spellar, ―Cybercrime and Digital Forensics: An Introduction‖, Routledge Taylor and Francis Group 2017.*

Reference Books:

1. *Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.*
2. *Information Warfare and Security by Dorothy F. Denning, Addison Wesley.*
3. *Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.*

Course Outcomes:

- Apply foundational concepts and terminology in cybersecurity to analyze and address security challenges effectively.
- Evaluate and assess various cyber threats and vulnerabilities systematically, demonstrating the ability to recognize and mitigate security risks.
- Design and implement cybersecurity solutions and strategies to protect data and information systems.
- Comprehend the legal and ethical dimensions of cybersecurity, demonstrating an understanding of relevant laws and regulations.
- Analyze and investigate real-world cyber incidents and case studies, drawing meaningful insights to enhance security measures.

Computer Vision

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Computer Vision
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	Image Processing

Course Objectives:

- Develop a fundamental understanding of Computer Vision concepts and techniques.
- Apply Computer Vision algorithms to solve real-world image and video processing problems.
- Explore advanced topics in Computer Vision, including deep learning-based approaches.
- Analyze and critique state-of-the-art research in Computer Vision.

Syllabus

UNIT I	Hours= 40
Introduction to Computer Vision Overview of Computer Vision and its significance, Image formation and representation (pixels, color models), Image processing fundamentals (filters, histograms, transforms), Image enhancement techniques (contrast adjustment, noise reduction), Introduction to Computer Vision libraries and tools (OpenCV)	8
Feature Detection and Matching Feature extraction and keypoint detection (Harris corner detection, SIFT, SURF), Image descriptors and matching techniques (ORB, BRISK, BRIEF), Object detection and recognition (Haar cascades, template matching), Optical character recognition (OCR) using Tesseract, Hands-on exercises on feature-based image matching	8
Image Segmentation and Object Tracking Image segmentation algorithms (thresholding, region-based, edge-based), Motion estimation and object tracking methods (Lucas-Kanade, Mean-Shift), Video analysis and tracking applications (surveillance, motion detection), Case studies in object tracking using OpenCV, Project: Real-time object tracking and analysis	8
Deep Learning for Computer Vision Introduction to deep learning and neural networks, Convolutional Neural Networks (CNNs) for image analysis, Transfer learning and pre-trained models (VGG, ResNet), Object detection with CNNs (YOLO, Faster R-CNN), Hands-on exercises with deep learning frameworks (TensorFlow, PyTorch)	8
Advanced Topics in Computer Vision 3D computer vision and depth perception, Face recognition and biometric systems, Image-based medical diagnosis and applications (MRI, CT), Emerging trends in Computer Vision research (GANs, generative models)	8

Text Books:

1. *Szeliski R., "Computer Vision: Algorithms and Applications", Springer, 2010.*
2. *Introductory techniques for 3-D computer vision, Trucco, Emanuele & Verri, Alessandro. published by Pearson (1998), ISBN – 0132611082.*
3. *Concise Computer Vision: An Introduction into Theory and Algorithms, Dr. Reinhard Klette, published by Springer Nature; 2014th edition, ISBN: 1447163192.*

Reference Books:

1. *Shapiro L. G. and Stockman G., "Computer Vision", Prentice Hall, 2001.*
2. *Forsyth D. A. and Ponce J., "Computer Vision – A Modern Approach", Second Edition, Pearson Education, 2012.*
3. *Davies E. R., "Machine Vision: Theory, Algorithms, Practicalities", Morgan Kaufmann, 2004.*

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Course Outcomes:

- Students will be able to apply fundamental Computer Vision concepts to solve image and video processing challenges effectively.
- Students will be capable of implementing Computer Vision algorithms for tasks such as feature detection, object recognition, and motion tracking.
- Utilize deep learning techniques in Computer Vision to develop advanced applications.
- Evaluate and critique state-of-the-art research papers and stay current with developments in the field.
- Demonstrate practical competence by successfully applying Computer Vision knowledge to real-world projects and applications.

Digital Forensics

Course Code	Code will be given as per choice in particular semester and paper
Course Name	Digital Forensics
Category of Course	Professional Elective Courses
Credits	3L:0T: 0P C:3
Pre-Requisites	

Course Objectives:

- Understand the principles and methodologies of digital forensics for investigating cybercrimes and incidents.
- Develop proficiency in acquiring and analyzing digital evidence from various devices and sources.
- Apply forensic tools and techniques to recover, preserve, and present digital evidence effectively.
- Explore legal and ethical considerations in digital forensics, including chain of custody and expert witness testimony.

Syllabus

UNIT I	Hours= 40
Introduction to Digital Forensics Introduction to digital forensics and its role in cybercrime investigation, Legal and ethical considerations in digital investigations (chain of custody, expert witness ethics), Overview of the digital forensics process and methodologies, Types of digital evidence and sources (computers, mobile devices, cloud, network logs)	8
Digital Evidence Acquisition Data acquisition methods and strategies (disk imaging, memory capture), Best practices in preserving and securing evidence, Mobile device forensics techniques (smartphones, tablets), Network forensics: capturing and analyzing network traffic	8
Digital Evidence Analysis Data recovery techniques (file system reconstruction, deleted file recovery), File system analysis (NTFS, FAT, ext4, HFS+), Registry analysis and artifact extraction (Windows Registry), Carving data from unallocated space and fragmented files	8
Forensic Tools and Techniques Introduction to digital forensic software and hardware tools (EnCase, FTK, Autopsy), Data validation and verification methods (hashing, checksums), Timeline analysis and reconstruction of digital events, Detecting and analyzing steganography and encryption in digital media	8

Case Studies and Practical Applications Real-world digital forensic investigations and case studies, Analyzing cybercrime cases and incident response scenarios, Preparing for expert witness testimony in court, Emerging trends and challenges in digital forensics (IoT forensics, cloud forensics)	8

Text Books:

1. *Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", Addison Wesley, 2002.*
2. *Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006, ISBN: 0-619-21706-5.*

Reference Books:

1. *Cyber Vacca, J, Computer Forensics, Computer Crime Scene Investigation, 2nd Ed, Charles River Media, 2005, ISBN: 1-58450-389.*

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Course Outcomes:

- Students can apply the principles and methodologies of digital forensics to conduct effective investigations into cybercrimes and incidents.
- Demonstrate proficiency in acquiring and analyzing digital evidence from a variety of devices and data sources.
- Utilize forensic tools and techniques to recover, preserve, and present digital evidence in a legally sound manner.
- Students will be able to understand the legal and ethical considerations in digital forensics, including chain of custody and expert witness responsibilities.
- Students will be able to conduct practical digital forensic investigations, analyze case studies, and communicate findings effectively.