UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY

SCHOOL OF ENGINEERING & TECHNOLOGY

Vision

To achieve excellence in engineering education, empower students to be technically competent professionals and entrepreneurs with strong ethical values so as to significantly contribute as agents for universal development and societal transformation

Mission

To provide affordable quality education at par with global standards of academia and serve society with harmonious social diversity

To encourage new ideas and inculcate an entrepreneurial attitude amongst the students, and provide a robust research ecosystem

To practice and encourage high standards of professional ethics and accountability among students

Bachelor of Technology in Computer Science & Engineering

Program Outcomes (POs)

PO1	**Engineering knowledge:** Acquire strong fundamental knowledge of computer science and engineering along with mathematics.
PO2	**Problem analysis:** Ability to identify, formulate & analyse requirements of a problem to provide sustainable solution which are in coherence with the local/regional/national or global needs and feasibility
PO3	**Design/development of solutions:** Design solution for complex problems, which incorporate components and processes, which are sustainable and reusable.
PO4	**Conduct investigation of complex problems:** Develop skills to synthesize research-based knowledge in the design, interpretation, analysis and synthesis of data for providing solutions to complex problems
PO5	**Modern tool usage:** Possess programming skills in different contemporary programming languages and use different development tools. Be able to select the appropriate tool/programing language/platform and understand the limitations of the same while implementing the solution.
PO6	**The Engineer and Society:** To apply skills for social causes at the local, regional, national and global level and work towards sustainable solutions. Apply reasoning informed by the contextual knowledge to access social, legal and cultural issues.
PO7	**Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environment contexts
PO8	**Ethics:** To understand contemporary legal, social & ethical issues in computing.
PO9	**Individual and Teamwork:** Posses Flexibility to adapt to a team environment. To be able to work as an individual or as a member or a team leader in multidisciplinary team organizations.
PO10	**Communication:** To be able to present and communicate precisely and effectively. Be able to comprehend and write effective reports and design documents and presentations professionally and be able to perceive and give clear instructions.
PO11	**Project management and finance:** Demonstrate knowledge and understanding of engineering and management principles and apply to work in the capacity of a member/leader in the team to manage projects
PO12	**Life-long learning:** To have passion for acquiring technical advancements in the field of computer science and engineering and apply new technology for solving local/regional/national or global problems

Program Specific Outcomes (PSOs)

PSO-1	To be able to understand problem, think of best suitable approach to solve the problem, develop and evaluate effective solutions as per the local/ regional/ national/ global requirements and availability of resources/ technologies.
PSO-2	To be able excel in contemporary technologies being adopted by the industry and academia for providing sustainable solutions
PSO-3	To be able to excel in various programming/ project competitions and technological challenges laid by professional bodies

Program Educational Outcomes (PEOs)

PEO-1	To make the students ready for successful career leading to higher education/ industry and to apply expertise in solving global problems.
PEO-2	To empower students achieve personal and professional success with awareness and commitment to their ethical and social responsibilities, both as individuals and in team environments.
PEO-3	To encourage students maintain and improve their technical competence through lifelong learning.

Curricular Components

Category of courses	Credits offered
Basic Science Core	**27**
Engineering Science Core	**25**
Humanities and Social Science Core	**17**
Departmental Core	**68**
Departmental Electives	**16**
Open Electives	**20/25**
Projects and Seminars	**12**
Total	**185/190**

Semester-wise Course Structure

1st Year - Semester I

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MTH-S101	Mathematics-I	3	1	0	4
2.	PHY-S101	Physics-I	3	1	3	5
3.	TCA-S101	Engineering Drawing	0	2	4	5
4.	ISC-S101	Programing in C & Unix	3	0	3	5
5.	HSS-S101	Communicative English	3	1	0	4
6.	UHV-S101	Universal Human Values –I (SIP)	0	0	0	0
		Total	**12**	**5**	**10**	**23**

1st Year - Semester II

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MTH-S102	Mathematics-II	3	1	0	4
2.	PHY-S102	Physics-II	3	1	3	5
3.	CHM-S101	Chemistry-I	3	0	3	5
4.	ESC-S101	Basic Electrical & Electronics Engg.	3	1	3	5
5.	TCA-S102	Workshop Concepts	1	1	3	5
		Total	**13**	**4**	**12**	**24**

2nd Year - Semester III

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MTH-S201	Mathematics-III	3	1	0	4
2.	ESC-S201	Engineering Mechanics	3	1	0	4
3.	ESC-S202	Thermodynamics	3	1	0	4
4.	CSE-S201	Data Structure	3	0	3	5
5.	CSE-S202	Digital Electronics & Logic Design	3	0	2	4
6.	CSE-SST201	Internship-1	0	0	2	1
7.	UHV-S201	Universal Human Values-II	2	1	0	3
		Total	**17**	**4**	**7**	**25**

2nd Year - Semester IV

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HSS-S401	Industrial Economics	3	1	0	4
2.	CSE-S204	Object Oriented Programing (Using Java)	3	0	3	5
3.	CSE-S205	Computer Organization	3	1	0	4
4.	CSE-S206	Operating Systems	3	2	0	5
5.	MTH-S301	Discrete Mathematics	3	1	0	4
6.	EVS-S101	Environmental Science	2	0	0	2
		Total	**17**	**5**	**3**	**24**

3rd Year - Semester V

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CSE-S301	Database Management System	3	0	3	5
2.	CSE-S302	Design and Analysis of Algorithms	3	1	0	4
3.	CSE-S303	Microprocessor	3	0	2	4
4.	CSE-S304	Theory of Computation	3	1	0	4
5.	MTH-S501/ MTH-S502	Mathematics Elective	MOOCS Course			4/5
6.	CSE-SST301	Internship-2	0	0	2	1
		Total	**12**	**2**	**7**	**22/23**

3rd Year - Semester VI

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CSE-S305	Compiler Design	3	2	0	5
2.	CSE-S306	Computer Networks	3	2	0	5
3.	CSE-S307	Software Engineering	3	1	0	4
4.	HSS-S301	Professional Communication	1	1	1	2
5.	MTH-S503/ MTH-S5504	Mathematics Elective	MOOCS Course			4
6.	CSE-S5--	Departmental Elective	3	1/0	0/3	4/5
		Total	**13**	**6**	**4**	**24/25**

4th Year - Semester VII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	HSS-S201	Industrial Management	3	0	0	4
2.	CSE-S401	Computer Graphics	3	1	3	5
3.	CSE-SST-S401	Summer Training	0	0	3	2
4.	PRT-S401	B.Tech. Project-1	0	0	6	4
5.	CSE-S5--	Departmental Elective	3	1	0	4
6.	CSE-S5--/	Departmental Elective/ Open Elective	3	1	0	4
		Total	**12**	**3**	**12**	**23**

4th Year - Semester VIII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	CSE-S5--	Departmental Elective	3	1	0	4
2.	CSE-S5--	Departmental Elective	3	1	0	4
3.	CSE-S5--/	Departmental Elective/ Open Elective	3	1	0	4
4.	CSE-S5--/	Departmental Elective/ Humanities Elective	3	1	0	4
5.	PRT-S402	B.Tech. Project -II	0	0	6	4
		Total	**12**	**4**	**18**	**20**

Total Credits – 185/187

Detailed Syllabus

Course Code: MTH-S101 **Breakup: 3 –1 – 0 – 4**
Course Name: Mathematics-I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Test the convergence & divergence of infinite series
CO2	Understand concepts of limit, continuity and differentiability of function of two variables
CO3	Find the maxima and minima of multivariable functions
CO4	Evaluate multiple integrals, concepts of beta & gamma functions
CO5	Apply the concepts of gradient, divergence and curl to formulate engineering problems

Course Details:

Unit-I
Sequences & Series: Definition, Monotonic sequences, Bounded sequences, Convergent and Divergent Sequences Infinite series, Oscillating and Geometric series and their Convergence, n^{th} Term test, Integral test, Comparison Test, Limit Comparison test, Ratio test, Root test, Alternating series, Absolute and Conditional convergence, Leibnitz test.

Unit II
Differential Calculus: Limit Continuity and differentiability of functions of two variables, Euler's theorem for homogeneous equations, Tangent plane and normal. Change of variables, chain rule, Jacobians, Taylor's Theorem for two variables, Extrema of functions of two or more variables, Lagrange's method of undetermined multipliers**.**

Unit III
Integral Calculus: Review of curve tracing, Double and Triple integrals, Change of order of integration. Change of variables. Gamma and Beta functions, Dirichlet's integral; Applications of Multiple integrals such as surface area, volumes

Unit –IV
Vector Calculus: Differentiation of vectors, gradient, divergence, curl and their physical meaning; Identities involving gradient, divergence and curl Line and surface integrals Green's, Gauss and Stroke's theorem and their applications

Unit–V
Probability and Statistics: Concept of probability, random variable and distribution function: discrete and continuous, Binomial, Poisson and Normal Distributions.

Text and Reference Books:

1. C.L.Liu : Discrete Mathematics, , McGraw Hill, 2nd Edition, 1985.
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India, 1985.
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975

Course Code: PHY-S101 **Breakup: 3 –1 – 3 – 5**
Course Name: Physics-I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the behaviour of Physical bodies
CO2	Understand the basic concepts related to the motion of all the objects around us in our daily life
CO3	Gain the foundation for applications in various applied fields in science and technology
CO4	Understand the concepts of vectors, laws of motion, momentum, energy, rotational motion, central force field, gravitation, collision and special theory of relativity
CO5	Empower the students to develop the skill of organizing the theoretical knowledge and experimental observations into a coherent understanding

Course Details: (Theory)

Unit 1
Revision of vectors, vector differentiation, ordinary derivatives of vectors, space curves continuity and differentiability, partial derivatives of vectors, gradient, divergence, curl, vector differentiation and their geometrical interpretation, various coordinate systems: polar coordinate, orthogonal curvilinear coordinate system, unit vectors and tangent vectors in curvilinear systems, special orthogonal curvilinear coordinate system, cylindrical coordinate system and spherical polar coordinate systems.

Unit 2
Inertial and non-inertial frames, fictitious force, Coriolis force, Newton's laws of motion and its applications, friction, conservative and non-conservative force, work energy theorem, conservation of linear momentum and energy, variable mass system (Rocket motion), simple harmonic motion, small oscillation, equilibrium, condition for stability of equilibrium, energy diagram, small oscillation in a bound system, working of Teetertoy.

Unit 3
Concept of centre of mass and calculation of center of mass for different objects, system of particles and collision, conditions for elastic and inelastic collision, collision in center of mass frame, rigid body kinematics, rotational motion, moment of inertia, theorems on moment of inertia, calculation of moment of inertia of bodies of different shapes.

Unit 4
Central force field, properties of central force field, inverse square law force, gravitational field and potential; Kepler's laws of planetary motion and its application
Wave mechanics, wave particle duality, De-Broglie matter wave, Schrodinger wave equations (time dependent and time independent), uncertainty principle and its applications

Unit 5
Frame of reference, Galilean transformation, Michelson-Morley experiment, postulates of special theory of relativity, Lorentz transformations, Length contraction, time dilation, velocity addition theorem, variation of mass with velocity, Einstein's mass energy relation, relativistic relation between energy and momentum, rest mass of photon.

Text and Reference Books:

1. Vector Analysis by M. R. Spiegel, Schaum's Outlines, 2021
2. Introduction to Mechanics: R. D. Kleppner and J. Kolenkow, Cambridge University Press, 2nd edition, 2014
3. A textbook of Mechanics by J. C. Upadhyay,Ram Prasas Publications; 1st edition, 2017

4. Mechanics by D. S. Mathur, S. Chand; New edition, 2000
5. Theory & Problems of Theoretical Mechanics by M. R. Spiegel, Schaum's Outline Series, 2017
6. Introduction to Special Theory of Relativity by Robert Resnick, Wiley, 1st edition 2007.
7. Concept of physics (Part-I) by H. C. Verma, Bharti Bhawan Publisher, 2022.
8. Quantum Mechanics by L.I. Schiff, McGraw-Hill Education (India) Pvt Limited, 2017.
9. A Textbook of Quantum Mechanics by P.M. Mathews and K. Venkatesan, McGraw-Hill Education (India) Pvt Limited, 2010.
10. Introduction to Quantum Mechanics by D.J.Griffiths, 3E, Cambridge University Press, 2018.

Course outcomes (CO): At the end of the lab course, the student will be able to:

CO1	Perform basic experiments related to mechanics
CO2	Be familiar with various measuring instruments and also would learn the importance of accuracy of measurements.

Course Details: (Practical)

1. Graphical Analysis (Ref. UIET Laboratory Manual)
2. Trajectory of projectile (Ref. UIET Laboratory Manual) Apparatus Used (Trajectory Apparatus, Metal Balls, Channels, Vernier Callipers, Carbon & Graph Paper)
3. Moment of Inertia of Bicycle wheel (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Bicycle Wheel, Masses, Thread, Stopwatch, Meter Scale, Vernier Callipers)
4. Spring Oscillations (Ref. UIET Laboratory Manual) Apparatus Used (Spring Oscillation Apparatus, Stop Watch, Masses)
5. Coupled Pendulum (Ref. UIET Laboratory Manual) Apparatus Used (Coupled Pendulum Setup, Stop Watch, Scale)
6. Bifilar Suspension System (Ref. UIET Laboratory Manual) Apparatus Used (Bifilar Suspension System Setup, Stop Watch, Masses)
7. Frequency of AC Mains by Melde's Method (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Electrical Vibrator, String, Pulley, Small Pan, Weight Box & Physical Balance)
8. Kater's (Reversible) Pendulum (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Kater's Pendulum, Stop Watch)
9. Inertia Table (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Inertia Table, Stop Watch, Vernier Callipers, Split Disc, Balancing Weights, and Given Body (Disc))
10. Moment of Inertia of Flywheel (Ref. Book by J. C. Upadhyay and UIET Laboratory Manual) Apparatus used (Fly wheel, weight hanger, slotted weights, stop watch, metre scale)

Course Code: TCA-S101 **Breakup: 0 –2 – 4 – 5**
Course Name: Engineering Drawing

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basics of engineering graphics
CO2	Develop skills to prepare basic engineering drawings
CO3	Understand the concept of projection and acquire visualization skills
CO4	Gain imaginative skills to understand section of solids and developments of surfaces

Course Details:

Introduction-Drawing instruments and their uses, BIS conventions, lettering dimensioning and free-hand practicing

Orthographic projections: Lines, planes and surfaces of objects, Sectional views, Auxiliary views, Space geometry: lines and planes, True lengths and shapes, Properties of parallelism, Perpendicularity and intersections of lines and planes, Simple intersections of solids and development of lateral simple solids

Isometric Projections: Introduction isometric scale, isometric projection of simple plane figures, isometric projection of tetrahedron, hexahedron(cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combinations of solids.

Introduction to computer graphics: Some problems on above topics on computer graphics.

Text and Reference Books:

1. Narayana,K.L. & Kannaiah,P. "Engg.Graphics". Tata McGraw Hill, New Delhi (2012).
2. Bhatt,N.D. (2014) "Elementary Engg. Drawing" Charotar Book stall. Anand.
3. Lakshminarayanan ,V and Vaish Wannar , R. S. "Engg.Graphics".Jain Brothers , New Delhi (2006).
4. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
5. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

Course Code: ISC – S101 **Breakup: 3 – 0 – 3 – 5**
Course Name: Programming & Computing(C & UNIX)

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Recollect various programming constructs and to develop C programs
CO2	Understand the fundamentals of C programming
CO3	Choose the right data representation formats based on the requirements of the problem
CO4	Implement different Operations on arrays, functions, pointers, structures, unions and files

Course Details:
Basic concepts of Computers, Basic UNIX Concepts and Vi - Editor
Introduction to C: Basic Programming concepts, Program structure in C, Variables and Constants, Data types, Conditional statements, control statements, Functions, Arrays, Structures, Introduction to pointers and Introduction to File Systems.

Text Books and References:

1. Programming in C, Schaum Series, 3rd edition, BPB Publication, Byron S. Gottfried
2. The 'C' Programming, Denis Ritchi, Second edition, PHI, 1988
3. Mastering C, Venugopal, Second edition, TMH, 2006
4. Let Us C, Yashavant Kanetkar, 18th Edition, BPB, 2021
5. Programming in ANSI C, Balaguruswami, Eighth Edition, TMH, 2019

Computer Programming Lab:

Learning OS Commands
Practice of all Internal and External DOS Commands, Writing simple batch programs, Exposure to Windows environment, Practice of UNIX commands and Vi editor, Writing simple shell script
C Programming:
Practicing programs to get exposure to basic data types, algebraic expressions, Conditional statements, Input Output Formatting, Control structures, arrays, functions, structures, pointers and basic file handling

Course Code: HSS-S101 **Breakup: 3 –1 – 0 – 4**
Course Name: Professional Communication

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Enhance their communication skills for tackling the professional challenges of a diverse workplace
CO2	Learn effective writing skills and be able to write clear technical reports
CO3	Improve their verbal and non-verbal communication
CO4	Be fluent orally in the use of the nuances of the English language
CO5	Learn good interpersonal skills and be proficient with the soft skills required for national and global placements

Course Details:

Unit -1 Basics of Technical Communication

Technical Communication**:** features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; Flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group); Importance of technical communication; Barriers to Communication.

Unit - II Constituents of Technical Written Communication

Words and Phrases: Word formation. Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; Requisites of Sentence Construction: Paragraph Development: Techniques and Methods - Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation- various steps.

Unit - III Forms of Technical Communication
Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Job application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports; Technical Proposal; Parts; Types; Writing of Proposal; Significance; Technical Paper, Project. Dissertation and Thesis Writing: Features, Methods & Writing.

Unit - IV Presentation Strategies

Defining Purpose; Audience & Locale; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Space; Setting Nuances of Voice Dynamics; Time-Dimension.

Unit - V Value- Based Text Readings
Following essays form the suggested text book with emphasis on Mechanics of writing,
The Aims of Science and the Humanities by M.E. Prior
The Language of Literature and Science by A.Huxley
Man and Nature by J.Bronowski
The Mother of the Sciences by A.J.Bahm
Science and Survival by Barry Commoner
Humanistic and Scientific Approaches to Human Activity by Moody E. Prior
The Effect of Scientific Temper on Man by Bertrand Russell.

Text and Reference Books:

1. V.N. Arora and Laxmi Chandra, Improve Your Writing ed. Oxford Univ. Press, New Delhi
2. Meenakshi Raman & Sangeeta Sharma, Technical Communication – Principles and Practices, Oxford Univ. Press 2007, New Delhi.
3. Barun K. Mitra, Effective Technical Communication, Oxford Univ. Press, 2006, New Delhi

4. R.C. Sharma & Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill & Co. Ltd., New Delhi.
5. M.Rosen Blum, How to Build Better Vocabulary, Bloomsbury Pub. London.
6. Norman Lewis, Word Power Made Easy, W.R. Goyal Pub. & Distributors, Delhi.
7. Krishna Mohan, Developing Communication Skills Meera Banerji-Macmillan India Ltd. Delhi.
8. L.U.B. Pandey & R.P. Singh, Manual of Practical Communication, A.I.T.B.S. Publications India Ltd.; Krishan Nagar, Delhi.

Course Code: MTH-S102 **Breakup: 3 –1 – 0 – 4**
Course Name: Mathematics-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Solve the consistent system of linear equations
CO2	Determine the power series expansion of a given function
CO3	Solve arbitrary order linear differential equations with constant coefficients
CO4	Apply Laplace transforms to solve physical problems arising in engineering
CO5	Find eigen values, eigen vectors & diagonalize a matrix
CO6	Understand concept of vector space & linear transformation

Course Details:

Unit–I
Matrix Algebra: Elementary operations and their use in finding Rank, Inverse of a matrix and solution of system of linear equations. Orthogonal, Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, Normal & Unitary matrices and their elementary properties

Unit–II
Vector Space, Linear transformation, Linear dependent and linear independent, Eigen-values and Eigenvectors of a matrix, Cayley-Hamilton theorem, Diagonalization of a matrix

Unit-III
Ordinary Differential Equations of second order: Solution of linear differential equations with Constant coefficients. Euler-Cauchy equations, Solution of second order differential equations by changing dependent and independent variables; Method of variation of parameters, Introduction to series solution method, Frobenious Methods

Unit- IV
Ordinary differential equations of higher orders: Matrix method

Unit-V
Laplace Transform: Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of derivatives and integrals. Convolution theorem, Initial and final value theorem; Laplace transform of periodic functions, error functions, Heaviside unit step function and Dirac delta function. Applications of Laplace transform.

Text and Reference Books:

1. C.L.Liu : Discrete Mathematics, , McGraw Hill, 2nd Edition, 1985.
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India, 1985.
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975.

Course Code: PHY-S102 **Breakup: 3 –1 – 3 –5**
Course Name: Physics-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	understand the vector integration which they can apply in electricity and magnetism
CO2	Understand the concepts of wave optics such as the phenomena of interference, diffraction and polarization of light
CO3	Understand the concepts of electrostatics, magnetostatics, electromagnetic induction, Maxwell's equations and electromagnetic waves
CO4	Apply the concepts of physics in the engineering courses

Course Details: (Theory)

Unit 1
Vector integration, Stokes' theorem, divergence theorem, electrostatics: Coulomb's law, superposition of electric forces, electric flux, Gauss's law, electric field, potential, calculation of electric fields due to different charge distribution, gradient and curl of electric field, electric dipoles and multipoles, potential energy of a dipole placed in external electric field, Laplace's equation, Poisson's equation.

Unit 2
Magnetostatics, motion of charge in electric and magnetic field, Lorentz force, magnetic flux, torque on a current coil in uniform magnetic field, magnetic dipole, potential energy of a magnetic dipole, Biot-Savart law, Ampere's law, calculation of magnetic field due to different current distribution, divergence and curl of magnetic field.

Unit 3
Electromagnetic induction, Faraday's law, Lenz's law, self-induction, mutual induction, growth and decay of current in L-R circuit, electromagnetic waves, displacement current, Maxwell's equations in free space and matter, verification of Faraday's law of electromagnetic induction and Ampere's law in vacuum by using plane electromagnetic waves and derivation of velocity of light (c) in terms of permittivity and permeability of free space, Poynting vectors, Poynting theorem.

Unit 4
Coherent sources, Interference, Fresnel's biprism, interference in uniform and wedge shaped thin films, necessity of extended source, Newton's rings and its applications, Fresnel and Fraunhofer diffraction at single slit and double slits, absent spectra, diffraction grating, spectra with grating, dispersive power, resolving power of grating, Rayleigh's criterion of resolution

Unit 5
Dispersion of light, angular dispersion, dispersive power, irrational dispersion, angular and chromatic dispersion, deviation without dispersion, dispersion without deviation, polarization of light, Fresnel's theory of optical activity and polarimeter, fundamental idea of optical fiber, types of fibers.

Text and References Books:

1. Introduction to Electrodynamics by D.J. Griffiths, 3E, Prentice-Hall of India Private Limited, 2002.
2. Vector Analysis by M. R. Spiegel, Schaum's Outlines, 2021
3. Optics by Ajoy Ghatak, McGraw Hill Education (India) Private Limited, 7th Edition,2020
4. A textbook of Optics by Subrahmanyam, Brijlal and Avadhanulu, Schand; 23rd Rev.

Edition. 2006.
5. Classical electrodynamics by J. D. Jackson,Wiley, 3rd edition, 1998.
6. Concept of Modern Physics by Aurthur Beiser, McGraw-Hill Education,6th Edition 2021.
7. Introduction to fiber optics by Ajoy Ghatak and K. Tyagrajan, 1E, Cambridge University Press, 2012.

Course Name: Physics Lab-II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Gain practical knowledge about electricity and magnetism and measurements such as resistance, voltage, current etc
CO2	Gain experimental knowledge of interference, diffraction and polarization of light and measurement of the wavelengths of the monochromatic light with the help of Newton's ring experiment, Fresnel's biprism experiment, etc.
CO3	Understand the concept of semiconductor physics through the four probe experiment
CO4	Gain knowledge about the various optical devices: prism, grating, spectrometer.
CO5	Understand the basic concept of modern physics through the determination of Planck's constant

Course Details: (Practical)

1. Newton's Ring (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Traveling Microscope, Support for Glass Plate inclined at 450 to the Vertical, Short Focus Convex Lens, Sodium Lamp, Plano Convex Lens, An Optically Plane Glass Plate)

2. Prism Spectrometer (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Spectrometer, Glass Prism, Reading Lens, Mercury Lamp)

3. Plane Transmission Grating (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Spectrometer, Diffraction Grating, Mercury Lamp)

4. Ballistic Galvanometer (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Ballistic Galvanometer, Morse key, Damping key, Condenser, Rheostat, Volt Meter, Storage Battery, Connection Wires)

5. Carey Foster's Bridge (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Carey Foster's Bridge, Laclanche cell, Resistance Box, Galvanometer, Plug Key, Copper Strip)

6. Fresnel's Biprism (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Sodium Lamp, Biprism, Convex Lens, Optical Bench with Four Uprights)

7. Variation of Magnetic Field (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Stewart and Gee type Tangent Galvanometer, Storage Battery, Commutator, Ammeter, Rheostat, One way Plug Key, Connection Wires)

8. Polarimeter (Ref. Book by K. K. Dey, B. N. Dutta) Apparatus Used (Sodium Lamp, Polarimeter, Physical Balance)

9. Planck's Constant (Ref. Book by S.K. Gupta and UIET Laboratory Manual) Apparatus Used (Power supply, photocell, connecting wires)

10. Energy Band Gap by Four Probe Method (Ref. Book by S.K. Gupta and UIET Laboratory Manual) Apparatus Used (An experimental kit)

Course Code: CHM – S101 **Breakup: 3 –0 – 3 – 5**
Course Name: Chemistry - I

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concept related to atoms and molecules, chemical bonding coordinate compounds and its applications
CO2	Concept of chemical kinetics, electrochemistry, photochemistry and their applications
CO3	Understand the concept of spectroscopy and its applications in various fields
CO4	Understand the basics of stereochemistry, organic reactions and its mechanism for various types of reactions
CO5	Various experiments helps the student to learn the basics of experiments to apply in day today life as well as in industry

Course Details: (Theory)

UNIT-I - Atoms and Molecules:
Need for wave mechanical picture of atomic structure [Photoelectric effect, de Broglie concept of matter waves], Derivation of Schrodinger wave equation [as an example particle moving in uni-dimensional potential well]
Chemical Bonding - Orbital concepts in bonding, V.B. and M.O. theory, M.O. diagrams, Intermolecular interactions

UNIT-II - Reaction Dynamics:
Order, Molecularity, Rate law, Integrated rate equations, Methods of determining of order of reaction, Complex reaction kinetics- chain reactions and reversible reactions in detail, Catalysis and enzyme catalysis

UNIT-III - Electrochemistry:
Arrhenius theory of electrolytic dissociation, Transport number, Kohlrausch's law, Solubility product, Redox reaction, Electrochemical and concentration cells.

UNIT-IV- Stereochemistry:
Introduction, Chirality, Enantiomers, Diastereomers, Projection formula of a tetrahedral carbon, Geometrical isomerism, Conformers

UNIT- V- Application of Spectroscopic Techniques:
Basic working principle on measurement technique: IR, UV visible spectroscopy and NMR

UNIT-VI - Organic Reactions:
Concepts Electron displacement effects, Organic intermediates, Types of reactions [addition, elimination and substitution reactions]

UNIT-VII - Photochemistry:
Principles of photo chemistry, Photoexcitation of organic molecules, Jablonski diagram, Laws of photochemistry and quantum yield, some examples of photochemical reactions, Chemistry of vision and other applications of photochemistry

UNIT-VIII - Transition Metal Chemistry:
Structure of coordination compounds corresponding to coordination number up to 6, Types of ligands, chelation, Isomerism [geometrical, optical, ionization, linkage and coordination], Theories of bonding in coordination compounds- crystal field theory, Valence bond theory.

Text and Reference Books:

Physical Chemistry-

1. Physical Chemistry, P. Atkins and J De Paul, International student edition , 8th edition, Oxford University Press, (2006)
2. Principles of physical chemistry, B. R. Puri, L.R. Sharma and M.S. Pathania, Shoban Lal Nagin Chand and Co., Jalandhar, 43 edition, Vishal Publishing ***Co***. (2017)

Organic Chemistry-

1. Organic Chemistry, R. T. Morrison and R.N. Boyd, 6th edition, Prentice hall of India (P) Ltd. New Delhi (2016)
2. A Textbook of Organic Chemistry, Arun Bahl and B.S. Bahl, S., 22th edition, S.Chand Publishers, New Delhi (2019)

3.Inorganic Chemistry-

1. Concise Inorganic chemistry, J.D. Lee, 5th edition, (1997).
2. Inorganic Chemistry, J.E. Huyee, E.A. Keiter and R.L. Keiter. 4th edition, Prentice Hall, Upper Saddle River,(2017)

Engineering Chemistry-

1. Engineering chemistry , Shashi Chawala, Dhanpat Rai & Co.(2013)
2. Engineering chemistry , P. C.Jain and Monika Jain. 16th edition, Dhanpat Rai Publishing Company **(**2015)

Course Name: Chemistry Lab- I

Course Details: (Practical)

1. To estimate the strength of the given unknown solution of Mohr's salt (Ferrous ammonium sulphate (FeSO4.(NH4)SO4.6H2O) using KMnO4 solution as an intermediate.
2. To prepare a sample of p-nitroacetanilide.
3. To prepare a sample of Aspirin.
4. Preparation of Tris (Thiourea) Copper (I) sulphate.
5. Preparation of Hexaamine Nickel (II) chloride [Ni(NH3)6]Cl2.
6. Estimation of commercial caustic soda: Determination of the amounts of sodium carbonate and sodium hydroxide present together in the given commercial caustic soda.
7. Estimation of calcium ions present in tap water.
8. To determine the partition coefficient of acetic acid between n-butanol and water.
9. To study the photochemical reduction of a ferric salt (Blue printing).
10. To determine the viscosity of a given liquid room temperature using Ostwald's viscometer.
11. To separate Ag(I), Hg (I) and Pb(II) ions by paper chromatography and calculate their RF values.
12. Understanding reaction kinetics and calculating the rate and order of a reaction.
13. To study the kinetics of first order reaction (methyl acetate hydrolysis catalysed by o.5 N HCl solution).

Course Code: ESC-S101 **Breakup: 3 –1 – 3 – 5**
Course Name: Basic Electrical & Electronics Engineering

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Predict the behaviour of any electrical and magnetic circuits
CO2	Formulate and solve complex AC, DC circuits
CO3	Realize the requirement of transformers in transmission and distribution of electric power and other applications
CO4	Have knowledge of some basic electronic components and circuits
CO5	Understand the basics of diode and transistor circuits
CO6	Understand the working of some I C based circuits
CO7	Study logic gates and their usage in digital circuits

Course Details: (Theory)

Unit – I

Sinusoidal steady state circuit analysis, voltage, current, sinusoidal & phaser presentation single phase AC circuit – behavior of resistance, inductance & capacitance & their combination, impedance concept of power, power factor; Series & parallel resonance – band width & quality factor, Three phase circuits – phase voltage & current, line & phase quantities, phasor diagram, balanced & unbalanced loads, Measurement of R, L, and C.

Unit –II

Network Theory: Network theorems – Thevenin's, Norton, maximum power transfer theorem, star delta transformation, circuit theory concept – mesh & nodal analysis.

Unit – III

Magnetic circuit concepts: self-inductance, magnetic coupling analysis of single tuned & double tuned circuit involving mutual inductance, introduction to transformer.

Unit – IV

Basic Instruments, electrical measurement – measurement of voltage , current , power & energy, voltmeters& ammeter , wattmeter , energy meter , three phase power measurement , electronics instrument –multimeter, CRO(analog & digital),An overview of voltage regulator.

Unit – V

Introduction to basic electronics devices – junction diode, BJT, amplifier, op-amps & instrumentation amplifier with mathematical operation

Number System: Introduction to binary, octal, decimal & hexadecimal systems, representation of negative, numbers, 1's, 2's, 9's, 10's complement and their arithmetic.

Text and Reference Books:

Text Books

1. Edward Hughe "Electrical and Electronic Technology", 10th Edition, Pearson Education Asia, 2019.
2. P. Kothari, I J Nagrath, "Electric Machines", 5th Edition, Tata McGraw Hill, 2017.
3. P. Malvino, "Electronic Principles", 7th Edition, Tata McGraw Hill, 2007.
4. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) 23Rev Ed Edition, S. Chand Publishing.2020

Reference Books

1. S. K. Bhattcharya, "Basic Electrical and Electronics Engineering", Pearson, 2012.

2. Vincent Del Toro, “Electrical Engineering Fundamentals”, Prentice Hall of India Private Limited, 2nd Edition, 2003.
3. David Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.
4. Michael Tooley A., “Electronic circuits: Fundamentals and Applications”, 3rd Edition, Elsevier Limited, 2006.

Course Name: Basic Electrical & Electronics Engineering Lab
Course Details: (Practical)

1. Familiarization with the Electronic Instruments.
2. Familiarization with electronic components and Bread board.
3. To verify the Thevenin theorem.
4. To verify the Superposition theorem.
5. Measurement of voltage and frequency with CRO.
6. To study half wave rectifier.
7. To study full wave bridge rectifier.
8. To study full wave bridge rectifier with filter.
9. To study and verify the truth table of different logic gates using digital IC.
10. To study different type of transformer and there operation.
11. To study basic wiring and design a switchboard/extension board.
12. To study the polarity test of a single phase transformer.
13. To study the open & short circuit test of a transformer and calibration losses.
14. To study the load test and efficiency of a single phase transformer.

Course Code: TCA-S102 **Breakup: 1 –1 – 3 – 5**
Course Name: Workshop Concepts

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the design and applications of different machine tools and their operations
CO2	Gain basic knowledge of casting processes and their applications
CO3	Recognize the different types metal forming process and their operations
CO4	Understand and appreciate the basic fabrication processes such as welding
CO5	Have knowledge about modern trends in manufacturing, unconventional machining processes and automation

Course Details: (Theory)

Historical perspectives and Classification of Manufacturing processes

Machining: Basic principles of lathe machine & operations performed on it. Basic description of machines & operations of shaper-planer, drilling, milling, grinding Unconventional machining processes, Machine tools.

Casting processes: Pattern & allowances, Moulding sands & its desirable properties. Mould making with the use of a core Gating system, Casting defects & remedies, Cupola furnace, Die-casting & its uses

Metal forming: Basic metal forming operations & uses of such as-forging, rolling, wire& tube drawing/making & extrusion, & its products/applications, presswork & die & punch assembly, cutting & forming, its application; Hot working vs Cold working;

Powder metallurgy: powder metallurgy process &its applications, plastic-products manufacturing, galvanizing & electroplating.

Welding: Importance & basic concepts of welding, classification of welding processes, Gas welding, types of flames, Electric arc welding. Resistance welding, Soldering & brazing and its uses,

Modern trends in manufacturing, Automation, Introduction to NC/ CNC /DNC, FMS, CAD/CAM, CIM and factory of future

Course Name: Workshop Practice

Course Details: (Practical)

1. Foundry (1turn)

2. Welding (3 turns)
   (a) Gas Welding (1turn)
   (b) Arc Welding(2 urns)
      i. Lap Joint (1 turn)
      ii. Butt Joint (1 turn)

3. M/C Shop (4 Turns)

4. Fitting & Sheet Metal Work (1 turn+1turn)

5. Carpentry Shop (1turn)

6. Black-smithy shop (1turn)

Text and Reference Books:

1. Chapman,W A J & Arnold ,E "Workshop Technology,1972 ; vol. I,II&III" Viva Low Priced Student Edition.
2. Raghuwanshi,B S "Workshop Technology ,2015; vol. I&II" Dhanpat Rai & Sons
3. Chaudhary, Hajra "Elements of Workshop Technology, 2008 ; vol. I&II" Media Promoters & Publishers.

Course Code: MTH-S201 **Breakup: 3 –1 – 0 – 4**
Course Name: Mathematics - III

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Obtain the Fourier series expansion of a given function
CO2	Apply Fourier transform for solving Boundary Value Problems
CO3	Determine the solution of linear partial differential equations (PDE) by variable Lagrange's method & some nonlinear PDEs
CO4	Understand and use of complex variable & analyticity
CO5	Expand a function of Laurent series
CO6	Evaluation of real integrals using residues

Course Details:

Unit – I
Function of a Complex variable: Complex numbers- power and roots, limits, continuity and derivative of functions of complex variable, Analytic functions, Cauchy - Reimann equations, Harmonic function, Harmonic conjugate of analytic function and methods of finding it, Complex Exponential, Trigonometric, Hyperbolic and Logarithm function.

Unit – II
Complex Integration: Line integral in complex plane(definite and indefinite), Cauchy's Integral theorem, Cauchy's Integral formula, Derivatives of analytic functions, Cauchy's Inequality, Liouville's theorem, Morera's theorem, Power series representation of analytic function and radius of convergence, Taylor's and Laurent's series, singularities, Residue theorem, Evaluation of real integrals, Improper Integrals of rational functions.

Unit-III
Fourier series: Trigonometric Fourier series and its convergence. Fourier series of even and odd functions, Fourier half-range series; Parseval`s identity, Complex form of Fourier series;

Unit-IV
Fourier Transforms: Fourier integrals, Fourier sine and cosine integrals, Fourier transform, Fourier sine and cosine transforms and their elementary properties, Convolution theorem, Application of Fourier transforms to BVP

Unit-V
Partial Differential Equations: Formation of first and second order partial differential equations. Solution of first order partial differential equations: Lagrange`s equation, Four standard forms of non-linear first order equations.

Text and Reference Books:

1. C.L.Liu : Discrete Mathematics, , McGraw Hill, 2nd Edition, 1985.
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. J.L.Mott, A.Kandel and T.P.Baker : Discrete mathematical structures For computer scientists & Mathematicians , Prentice–Hall India, 1985.
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY, 1975.

Course Code: ESC-S201 **Breakup: 3 –1 – 0 – 4**
Course Name: Engineering Mechanics

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the fundamentals of engineering mechanics and their applications
CO2	Gain knowledge of various types of motion related to body
CO3	Understand the basic concepts of friction and application of friction
CO4	Identify appropriate structural system for studying a given problem and isolate it from its environment
CO5	Carry out kinematic and kinetic analyses for particles and systems of particles
CO6	Apply the principles of mechanics to practical engineering problems

Course Details:

General Coplanar force systems: Basic concepts, Law of motions, principle of transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, simplest resultant of two dimensional concurrent & non-concurrent force systems, free body diagrams, equilibrium & its equations, applications

Trusses & Cables: Introductions, simple truss & solutions of simple truss, method of joints & method of sections.

Friction: Introduction, Laws of coulomb friction, equilibrium of bodies involving dry friction, belt friction, applications.

Centre of gravity, centroid, Moment of Inertia: Centroid of plane, curve, area, volume & composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principal moment inertia, mass moment of inertia of circulating, disc, cylinder, sphere and cone about their axis of symmetry.

Beams: Introductions, shear force and bending moment, differential equations for equilibrium, shear force & bending moments diagrams for statically determinate beams.

Kinematics of rigid body: Introduction, plane motion of rigid bodies, velocity & acceleration under translation & rotational motion, Relative velocity, projectile motion.

Kinetics of rigid bodies: Introduction, force, mass & acceleration, work & energy, impulse & momentum, D'Alembert principles & dynamic equilibrium, Virtual work.

Text and Reference Books:

1. Beer F.P. & Johnston ,F.R. " Mechanics For Engineers" 11th edition 2017, McGraw Hill.
2. Shames, I.H. " Engg. Mechanics" 4th edition2005 , P H I.
3. Meriam , J. L. " Statics" 7th edition 2011, J. Wiley.
4. Meriam , J. L. " Dynamics" 7th edition 2011, J. Wiley.

Course Code: ESC-S202 **Breakup: 3 –1 – 0 – 4**
Course Name: Basic Thermodynamics (CHE)

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Use thermodynamic terminology correctly and explain fundamental thermodynamic properties
CO2	Derive and discuss the zeroth, first, second, and third laws of thermodynamics
CO3	Apply the first and second laws of thermodynamics to chemical processes and calculate efficiency
CO4	Solve problems using the properties and relationships of thermodynamic fluids.
CO5	Analyze the behaviour of flow and non-flow processes using mass and energy balances
CO6	Analyze basic thermodynamic cycles

Course Details:

Introduction: Definition and scope of thermodynamics, macroscopic and microscopic viewpoint, system, properties, processes and cycles, homogeneous and heterogeneous systems, thermodynamic equilibrium, quasi-static process, phases of a substance, unit systems, specific volume, pressure.

Temperature: Zeroth law of thermodynamics, measurement of temperature, different temperature scales.

Properties of pure substances: Pure substance, p-v diagram, p-T diagram, T-s diagram, h-s diagram or Mollier diagram, quality or dryness fraction, steam table.

Energy and its transfer: Energy, different forms of energy, energy transfer by heat, energy transfer by work, different forms of work transfer - pdV work or displacement work, shaft work, flow work, etc., pdV work in various quasi-static processes, specific heat and latent heat.

First Law of Thermodynamics: Energy balance, energy conversion efficiency, energy analysis of open and closed systems, PMM1.

Second Law of Thermodynamics: Cyclic heat engine, thermal reservoirs, Kelvin-Planck statement, Clausius' statement, refrigerator and heat pump, equivalence of Kelvin-Planck and Clausius' statement, PMM2, conditions for reversibility, Carnot cycle, Carnot's theorem, corollary of Carnot's theorem, absolute thermodynamic temperature scale, efficiency of the reversible heat engine.

Entropy: Clausius' theorem, temperature-entropy plot, Clausius inequality, entropy change in an irreversible process, entropy principle, entropy generation in a closed and open system, entropy and direction, entropy and disorder.

Availability: Available energy, available energy in a cycle, quality of energy, law of degradation of energy, maximum work in a reversible process, second law efficiency.

Thermodynamic relations: Maxwell's equations, TdS equations, Joule-Kelvin effect, Clausius-Clapeyron equation, Gibbs phase rule for non-reactive system.

Power and refrigeration cycles: Simple steam power cycle, Rankine cycle, comparison of Rankine and Carnot cycles, characteristics of an ideal working fluid in vapour power cycles. Carnot gas power cycle, Refrigeration cycle – reversed heat engine cycle, vapour compression refrigeration cycle, components in a vapour compression plant, refrigerants.

Text and Reference Books:

1. P K Nag, Engineering Thermodynamics, Sixth edition, McGraw Hill Education, Delhi (2017).
2. Y A Cengel, M A Boles, M Kanoglu, Thermodynamics An Engineering Approach, Ninth edition, McGraw Hill Education, Delhi (2019).
3. Y V C Rao, An Introduction to Thermodynamics, Universities Press, Hyderabad (2003).

Course Code: **CSE - S201** **Breakup: 3 – 0 – 3 – 5**
Course Name: **Data Structure**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Learn the basic types for data structure, implementation and application.
CO2	Know the strength and weakness of different data structures.
CO3	Use the appropriate data structure in context of solution of given problem.
CO4	Develop programming skills, which require to solve given problem.

Course Details:

Basic concepts and notations, Mathematical background, Revision of arrays and pointers, Recursion and implementation of Recursion

Stacks and Queues: Sequential representation of stacks and queues

Lists: List representation techniques, Dynamics Storage allocation, Representation of stacks and queues using linked list, operations on linked list, Introduction to Doubly linked list.

Sorting Algorithms: Insertion sort, Bubble sort, Quick sort, Merge sort, Heap sort, Shell sort, Time and Space complexity of sorting algorithms

Tables: Searching sequential tables, Index sequential searching, Hash tables, Heaps.

Trees: Definition and basic concepts, Linked tree representations, Binary tree traversal algorithms,(Preorder, Inorder, Postorder), Binary search tree, Insertion and Deletion in Binary search tree, Multiway search trees, B trees, B+ tree and their applications, Digital search trees and Trie structure.

Graphs: Introduction to Graphs, Implementation of Graphs, Depth first search, Breadth first search.
Introduction to External Sorting

Text Books and References:

1. Data Structure Using C and C++, Y. Langsam, M.J. Augenstein and A.M. Tenenbaum, , Second Edition, Pearson education, 2002.
2. Data Structures with C (Schaum's Outline Series), Seymour Lipschutz, McGraw Hill, first edition, 2017
3. Data Structures Using C, Aaron M. Tenenbaum, McGraw Hill, first edition, 1989

Data Structures Lab

Write Program in C / C++ for following:

1. Array implementation of Stack, Queue, Circular Queue
2. Linked list implementation using Dynamic memory Allocation, deletions and insertions, Linked Implementation of Stack, Queue, Circular Queue
3. Implementation of Tree Structures, Binary Tree, Tree Traversals, Binary Search Tree, Insertion and Deletion in BST, Simple implementation of Multiway search trees
4. Implementation of Searching and Sorting Algorithms
5. Graph Implementation, BFS, DFS.

Course Code: **CSE - S202** **Breakup: 3 – 0 – 2 – 4**
Course Name: **Digital Electronics and Logic Design**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Convert different type of codes and number systems which are used in digital communication and computer systems.
CO2	Employ the codes and number systems converting circuits and Compare different types of logic families which are the basic unit of different types of logic gates in the domain of economy, performance and efficiency.
CO3	Analyze different types of digital electronic circuit using various mapping and logical tools and know the techniques to prepare the most simplified circuit using various mapping and mathematical methods.
CO4	Design different types of with and without memory element digital electronic circuits for particular operation, within the realm of economic, performance, efficiency, user friendly and environmental constraints.

Course Details:

Basic Concepts and Boolean Algebra
Number system and conversions, Boolean algebra and simplification, Minimum and maximum expansion, sum of products and product of sums, Minimization of Boolean functions, Karnaugh map Quine Mc Cluskey method, Prime implications and essential prime implicants.

Logic Gates and Gate Networks
Logic gates of different families circuits characteristics and comparisons tri-state gates, Multilevel gates networks, NAND and OR implementation use of alternate gate symbols, mixed logic and polarity indication, multiple output networks.

Combinational Logic Circuits
Problem formation and design of combinational circuits, Adder/Subtractor, Encoder/Decoder, MUX/DEMUX, Code converters and comparators, Design using standard IC's, Programmable Logic devices, ROM, PAL, PLA and PGAs, Design using PLDs.

Sequential Logic Circuits
Flip-Flops, SR, JK, D and T triggering, Master Slave Flip flops, Synchronous and Asynchronous, Analysis of clocked sequential circuits, State diagram, State table, Design of sequential circuits, counters, shift registers and sequence generation and detection.
Synchronous And An Asynchronous State Machines
State minimization, State assignment, Incomplete specified state machines, Fundamental mode and pulse mode sequential circuits, Hazards, Essential Hazards, Design of hazard free networks, VHDL.

Text Books and References:

1. Charles H. Roth, Jr., Fundamentals of Logic Design, Jaico Publ. House, 6th Edition, 2009
2. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 1979
3. William I. Fletcher, An Engineering Approach to Digital Design, PHI, 1979
4. Alan B. Marcovitz, Introduction to Logic Design, McGraw Hill, 3rd edition 2009

Digital Electronics and Logic Design Lab

Verification of All logic Gates, Other Gate implementation using Universal Gates NAND / NOR, Implementation of Adder / Subtractor using Basic gates , Bread-board implementation of various flip-flops, Bread-board implementation of counters & shift registers, Adder/ Subtractor operation using IC7483 4 bit/ 8 bit, Demultiplexer / Decoder operation using IC-74138, Modulo N counter using programmable counter 74190.

Course Code: UHV-S201 **Breakup: 2 –1 – 0 – 3**
Course Name: Universal Human Values - II

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the significance of value inputs in a classroom and start applying them in their life and profession.
CO2	Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
CO3	Understand the role of a human being in ensuring harmony in society and nature.
CO4	Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Course Details:
UNIT I: Introduction to Value Education
Value Education, Definition, Concept and Need for Value Education.
The Content and Process of Value Education
Basic Guidelines for Value Education
Self exploration as a means of Value Education
Happiness and Prosperity as parts of Value Education

UNIT II: Harmony in the Human Being
Human Being is more than just the Body
Harmony of the Self ('I') with the Body
Understanding Myself as Co-existence of the Self and the Body
Understanding Needs of the Self and the needs of the Body
Understanding the activities in the Self and the activities in the Body

UNIT III: Harmony in the Family and Society and Harmony in the Nature
Family as a basic unit of Human Interaction and Values in Relationships
The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love
Comprehensive Human Goal: The Five Dimensions of Human Endeavour.
Harmony in Nature: The Four Orders in Nature.
The Holistic Perception of Harmony in Existence

UNIT IV: Social Ethics
The Basics for Ethical Human Conduct
Defects in Ethical Human Conduct
Holistic Alternative and Universal Order
Universal Human Order and Ethical Conduct
Human Rights violation and Social Disparities

UNIT V: Professional Ethics
Value based Life and Profession.
Professional Ethics and Right Understanding
Competence in Professional Ethics
Issues in Professional Ethics – The Current Scenario
Vision for Holistic Technologies, Production System and Management Models

Text and Reference Books:

1. R.R. Gaur., R, Sangal. G.P Bagaria., A Foundation Course in Value Education, Excel Books, (2009).
2. R.R. Gaur., R, Sangal. G.P Bagaria, Teachers Manual for A Foundation Course in Human Values and Professional Ethics Excel Books, (2009).
3. A.N. Tripathy, Human Values, New Age International Publishers, (2003)
4. A. Nagaraj, JeevanVidya: EkParichaya, JeevanVidyaPrakashan, Amarkantak, (1999)
5. M.K. Gandhi, My Experiemnts with Truth, Maple Classics (2011)
6. I.C. Sharma, Ethical Philosophy of India, Nagin & Co Julundhar
7. Cecile Andrews, – Slow is Beautiful (2006)

Course Code: HSS-S401 **Breakup: 3 –1 – 0 – 4**
Course Name: Industrial Economics

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Have sufficient knowledge about demand and supply problems
CO2	Understand concepts of production and cost analysis
CO3	Use of microeconomic tools in problem solving
CO4	Utilisation of limited resources in meeting the rising demand in the market

Course Details:

UNIT-1
Meaning, definition and scope of economics, Basic concepts of demand and supply, Market equilibrium, Ceiling price and floor price.

UNIT-2
Price elasticity of demand: Factors affecting price elasticity of demand, Calculation, Relation between marginal revenue, demand and price elasticity, Income elasticity of demand and Cross elasticity of demand, Indifference curves, Budget Line

UNIT-3
Production and Cost analysis: Basic concepts, Production in the short- run and long-run, cost analysis
Finding the optimal combination of inputs, Returns to scale

UNIT-4
Market: Characteristics of perfect completion, Profit maximisation in short-run and long-run
Firms with market power: Measurement and determinants of market power, Profit maximisation under monopoly: output and pricing decisions, Price discrimination, capturing consumer surplus, Strategic decision making in oligopoly markets

UNIT-5
National income: Concepts, Sources, Measurement, Difficulties, circular flow of income
Inflation: Cost-push and Demand-pull inflation, Effects and control of inflation, Business cycle, Functions of RBI, GST

Text and References Books:

1. Economics by Paul. A. Samuelson, McGraw-Hill; Twentieth edition, 2019
2. Managerial Economics by Christopher R. Thomas, S. Charles Maurice, Sumit Sarkar, McGraw Hill Education; 9th edition, 2010
3. Financial Management by J. V. Vaishampayan, New Royal Book Company; 1st edition, 2015
4. Micro Economics by A. Koutsoyannis, Palgrave Macmillan; 2nd edition, 1979

Course Code: **CSE-S204** **Breakup:** **3 – 0 – 3 – 5**
Course Name: **Object Oriented Programming Using Java**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basic concepts of Procedure–Oriented Programming and object-oriented programming.
CO2	Achieve the Knowledge of developing simple java programs.
CO3	Develop computer programs to solve real world problems.
CO4	Design simple GUI interfaces to interact with users, using Applets and swings.
CO5	Achieve Knowledge of multi-threading and to comprehend the event-handling techniques.

Course Details:

Basic Concepts : Object, Class, Inheritance, Instant, Instant variable, Attribute, Encapsulation, Information hiding, Multiple Inheritance, Typing, Dynamic typing, Object analysis, Object oriented issues

Some advance topics: Classes Packages, interface, string handling etc., Java Applets & Application Programming in Java: Variables, Simple I/O, file I/O, Class data types, derived classes, Functions, function overloading, Overloading operators, Abstract classes. Class inheritance, Inter lace. Multiple Inheritance, Templates, Java Library.

Text Books and References:

1. Java: The Complete Reference, Herbert Schildt, McGraw Hill, Twelfth Edition, 2021
2. Java 2 Unleashed, Stephen Potts, Alex Pestrikov, Sams Publishing; 6th edition 2002

Object Oriented Programming Lab

1. Programming illustrating the use of classes and objects
2. Programming illustrating the use of functions and parameter passing
3. Programs illustrating overloading of various operators
Ex:Binary operators, Unary operators, New and delete operators etc.
3.Programs illustrating the use of following functions:
4.Programs to create singly and doubly linked lists and perform insertion and deletion
5.Programs illustrating various forms of inheritance: Ex. Single, Multiple, multilevel inheritance etc.
6.Programs on abstract class and derived classes
7.Programs illustrating the use of virtual functions.
8.Write programs illustrating the console I/O operations.
9.Write Programs illustrating how exceptions are handled (cx: division-by-zero, overf1ow and Underflow in stacks etc.

Course Code: **CSE-S205** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Computer Organization**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Explain the basics of organizational and architectural issues of a digital computer and Classify and compute the performance of machines, Machine Instructions.
CO2	Describe various data transfer techniques in digital computer and the I/O interfaces.
CO3	Analyze the performance of various classes of Memories, build large memories using small memories for better performance and analyse arithmetic for ALU implementation
CO4	Describe the basics of hardwired and micro-programmed control of the CPU, pipelined architectures , Hazards and Superscalar Operations

Course Details:

Brief review of digital logic, Boolean algebra, flip flops, etc.
Data Representation: Integer representation-- number systems (binary, octal, Decimal, Hexadecimal), 1's and 2's Complements, Floating point numbers - - IE standard, normalization.

Computer Arithmetic: Half adder, Full adder, ripple carry and carry look-ahead adders, Multipliers - - Booth's algorithm. Processor Organization, Registers, Instruction cycle, ALU design, Instruction set of a processor, types of operands, types of operations, addressing modes, instruction formats.
Memory: RAM, ROM, DRAM Vs SRAM, Organization of memory cells inside a memory chip, Interfacing of memory with processor; Cache memory - mapping function emplacement algorithm, Write policy.
Input Output Organization: Program controlled, Interrupt driven (priority interrupts Daisy chaining), Direct memory access.
Control Unit: Micro–operations - - hardwired implementation, Micro -programming.
Computer Peripheral Organization: Keyboard, Monitor, Hard disk, CD-ROMs, Printers, etc.

Text Books and References :

1. V.C. Hamacher, Z.G. Vranesic and S.G.Zaky, Computer Organization, Fourth Edition, McGraw Hill, 1996.
2. Computer Organization & Architecture, Stallings, Eleventh Edition, Pearson, 2022
3. Computer Organization & Design, David A Paterson and John L. hennery, fifth edition, Morgan Kaufmann,
4. Computer System & Architecture, Morris Mano, TMH,,Third edition, 2007

Course Code: **CSE-S206** **Breakup:** **3 – 2 – 0 – 5**
Course Name: **Operating System**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understands the different services provided by Operating System at different level.
CO2	They learn real life applications of Operating System in every field
CO3	Understands the use of different process scheduling algorithm and synchronization techniques to avoid deadlock.
CO4	They will learn different memory management techniques like paging, segmentation and demand paging etc

Course Details:

Introduction and history of operating system
Process Management: Process Synchronization and mutual exclusion, Two process solution and Dekker's algorithm, semaphores monitors, Examples (Producer – consumer, reader-writer, dining philosophers, etc.)

CPU Scheduling: Multiprogramming and time sharing, Scheduling approaches (shortest–job–first, first–in– first–out, Round Robin, etc.)

Deadlock: Modeling, detection and recovery, prevention and avoidance.

Interprocess communication: Shared memory, message passing pipes.

Input/ output: Devices controllers and device drivers, disk scheduling, other devices

Memory Management: with and without swapping, virtual memory- paging and segmentation, page replacement algorithm, Implementation.

File System: FS services, Disk source management, Directory and data structure .Security, Protection, Access right.

Text Books and References:

1. Operating system concepts, A.Silberschatz and P.B. Galvin, , Wiley, 8th edition, 2017
2. Schaum's Outline of Operating Systems, J. Archer Harris, McGraw-Hill Education, 2001
3. Modern Operating Systems, Andrew Tanenbaum, Pearson; 4th edition 2014
4. Operating Systems Concepts And Design, Milan Milenkovic, McGraw Hill Education; 2nd edition 2001
5. Operating Systems: Internals and Design Principles, William Stallings, Pearson, 9th edition, 2018
6. Operating Systems : A Design-Oriented Approach, Charles Crowley, McGraw Hill Education, 2017

Course Code: MTH-S301 **Breakup: 3 – 1 – 0 – 4**
Course Name: Discrete Mathematics

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Analyze logical propositions via truth tables.
CO2	Prove mathematical theorems using mathematical induction.
CO3	Understand sets and perform operations and algebra on sets
CO4	Determine properties of relations, identify equivalence and partial order relations, sketch relations
CO5	Identify functions and determine their properties
CO6	Define graphs, digraphs and trees, and identify their main properties
CO7	Evaluate combinations and permutations on sets

Course Details:

Unit-I
Logic: Introduction to formal logic, Formulae of prepositional logic, Truth tables, Tautology, Satisfiability, Contradiction, Normal and principle normal forms, Completeness. Theory of inference. Predicate calculus: Quantifiers, Inference Theory of predicate logic, Validity, Consistency and Completeness.

Unit-II
Sets, Operations on sets, Ordered pairs, Recursive definitions, Relations and Functions, Equivalence relations, Composition of relations, Closures, Partially ordered sets, Hasse Diagram's,
Lattices (Definition and some properties).

Unit-III
Algebraic Structures : Definition, Semi groups, Groups, Subgroups, Abelian groups, Cyclic groups.

Unit-IV
Graph Theory: Incidence, Degrees, Walks, Paths, Circuits, Charactarization theorems, Connectedness, Euler graphs, Hamiltonian graphs, Travelling salesman problem, Shortest distance algorithm (Djkstra's), Trees, Binary trees, Spanning trees, Spanning tree algorithms Kruksal's and Prim's .
Unit-V
Introduction to Combinatorics: Counting techniques, pigeon–hole principle, Mathematical induction, Strong induction , Permutations and Combination.

Unit-VI
Generating functions, Recurrence relations and their solutions.

Text Books and Reference :

1. Elements of Discrete Mathematics: A Computer Oriented Approach, C Liu (Author), D. Mohapatra, McGraw Hill Education, 4th edition 2017
2. B.Kolman, R.C.Busby, and S.C.Ross, Discrete mathematical structures, 5/e, Prentice Hall, 2004
3. Discrete mathematical structures For computer scientists & Mathematicians , J.L.Mott, A.Kandel and T.P.Baker, Pearson Education India, 2nd edition, 2015
4. J.P.Trembley, R. Manohar, Discrete mathematical structures with applications to computer science, McGraw –Hill, Inc. New York, NY,1975

Course Code: EVS-S101 **Breakup: 2 –0 – 0 – 2**
Course Name: Environmental Science

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concepts and definitions associated with ecosystems, environmental pollution and its causes
CO2	Gain knowledge to analyse problems and suggest alternatives and new methods to manage natural resources
CO3	Understand how to Redesign, Recreate & Restore the ecosystems
CO4	Understand the legal aspects and the role of government in environment protection

Course Details:

UNIT-I
Scope and Importance of environmental studies, Need for public awareness, Segments of environment, biodiversities: Genetic diversity, Species diversity, Ecosystem diversity, Landscape diversity, Causes of pollution and detrimental effects.

UNIT-II
Eco systems- Types of systems, energy flow in an ecosystem, Balanced ecosystem,
Human activities- Food, shelter, economic and social security, Effects of human activities on environment- Agriculture, housing, Industry, mining and transportation activities, Basics of Environmental Impact Assessment, Sustainable Development.

UNIT-III
Types of natural resources: Water resources-Availability and quality aspects, Water borne diseases, Fluoride problems in portable water, Mineral resources, Food resources, Land resources, Forest Wealth, Material cycles- Carbon, Nitrogen and Sulphur cycle.

UNIT-IV
Energy- Different types of energy (Renewable and Non-renewable), Convectional and non-conventional energy-sources Electromagnetic radiation, Hydro Electric, Fossil fuel based, Nuclear, Solar, Biomass and Bio-gas, Hydrogen as an alternative future source of energy

UNIT-V
Environmental pollution and their effects, Water pollution, Land pollution, Noise pollution, public Health aspects, Air pollution. Current environmental issues of importance and their impact on environment: Population Growth, Climate change and global warming effect, Urbanization, Automobile pollution, Acid rain, Ozone layer depletion.

UNIT-VI
Preventive measures and control of pollution, Air and Water pollution control, Sold waste management, Case studies.

UNIT-VII
Role of Government in environment protection, Legal Aspects, Initiatives and protection Acts, public awareness, Initiatives by Non-governmental Organizations (NGOs), Role of IT services, Disaster management.

UNIT-VIII
Field work/ Activities/ Visit
Text and References Books:

1. Environmental Studies- Benny Joseph, TATA Mcgaw Hill publication, Third edition, 2017.
2. Environmental Studies- Dr. D.L. Manjunath, pearson Education, 2022.

3. Environmental Studies- R. Rajgopalan, Oxford publication.
4. Environmental Science and Technology- M. Anji Reddy, BS publication.
5. Principles of Environmental Science and Engineering- P. Venugopalan Rao, Prentice Hall of India, 2006.
6. Environmental Science and Engineering- Meenakshi, Prentice Hall of India, 2005.

Course Code: **CSE-S301** **Breakup:** **3 – 0 – 3 – 5**

Course Name: **Database Management Systems**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Describe the fundamental elements of relational database management systems
CO2	Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
CO3	Design ER-models to represent simple database application scenarios
CO4	Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
CO5	Improve the database design by normalization.
CO6	Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

Course Details:

Introduction:

- Database-System Applications
- Purpose of Database Systems
- File processing disadvantages
- View of Data
- Data Abstraction
- Data Models
- Database Languages
- Relational Databases
- DBMS Architecture

Introduction to the Relational Model

- Structure of Relational Databases
- Database Schema
- Attributes and Keys
- Schema Diagrams

Introduction to SQL

- SQL Data Definition
- Basic Structure of SQL Queries
- Basic Operations
- Set Operations
- Null Values
- Aggregate Functions
- Nested Subqueries

The Relational Algebra

The Tuple Relational Calculus

The Domain Relational Calculus

Functional Dependencies

- Extraneous Attribute
- Left irreducible FD
- Prime/non-prime attributes
- Logically Implied FD
- Closure of a FD
- Rules for logical inference of FD
- Algorithm to determine closure of a FD set
- Canonical Cover of a FD
- Algorithm to determine Canonical Cover of a FD set
- Algorithm to determine closure of an attribute set under FD set

Relational Database Design

- Features of Good Relational Designs
- Atomic Domains and First Normal Form
- Decomposition Using Functional Dependencies

Modification of the Database

Database Design and the E-R Model

Overview of the Design Process

The Entity-Relationship Model

Constraints

Removing Redundant Attributes in Entity Sets

Entity-Relationship Diagrams

Reduction to Relational Schemas

Entity-Relationship Design Issues

Lossless Join Decomposition

Dependency preserving Decomposition

Normalization

Introduction to Concurrency Control

Introduction to Transaction Management

Reference Books

1. Database System Concepts, Abraham Silberschatz), Henry F. Korth, S. Sudarshanl, McGraw Hill; 7th edition, 2021
2. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education; Third edition 2014
3. Fundamentals of Database Systems, Elmasri Ramez , Navathe Shamkant, Pearson Education; Seventh edition 2017

DBMS Lab

1. Creating tables for various relations (in SQL)
2. Implementing the queries in SQL for
   a) Insertion
   b) Retrival (Implement all the operation like Union, Intersect, Minus, in, exist, aggregate functions (Min.,Max…) etc…
   c) Updation d) Deletion
3. Creating Views
4. Writing Assertions
5. Writing Triggers
6. Implementing Operations on relations (tables) using PI/SQL
7. Creating FORMS
8. Generating REPORTS.

Course Code: **CSE-S302** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Design and Analysis of Algorithms**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Ability to decide the appropriate data type and data structure for a given problem
CO2	Ability to select the best algorithm to solve a problem by considering various problem characteristics, such as the data size, the type of operations, etc
CO3	Ability to compare algorithms with respect to time and space complexity

Course Details:

Notion of algorithm, Big Oh, Small–oh, Theta and Omega notations, Space and Time complexities of an algorithm
Sorting and Order Statistics: Revision of complexity analysis of different sorting algorithms and introduction to recurrence relations

Introduction: A first problem: Stable matching

Graph Algorithms: Breadth First search, Depth First search, single source shortest paths, minimum spanning trees, all pair shortest paths, Traveling sales person problem
Fundamental design paradigms:
Divide and Conquer: Mergesort, Binary search, Quick sort, Matrix multiplication,etc
Greedy methods: Shortest path algorithms, fractional knapsack problem, task scheduling problem etc.

Dynamic Programming: 0/1 knapsack problem, Longest common subsequence, Matrix chain multiplication, etc.

Network Flow: The maximum flow problem and Ford Fulkerson algorithm, maximum flows and minimum cuts in a network

Theory of NP completeness: Polynomial time, NP complete problems, concept of reducibility. Measure of approximation: ratio bound and relative error, Polynomial time approximation scheme.

Text Books and References:

1. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Galgotia, 2011
2. Algorithm Desig, Jon Kleinberg, Pearson Education India; 1st edition, 2013
3. Introduction to Algorithms, Charles E. Leiserson, Thomas H. Cormen, MIT Press; 4th edition 2022
4. Computer Algorithms: Introduction To Design And Analysis, Sara Baase and Van Gelder, Pearson Education,2000
5. Design & Analysis of Computer Algorithms, AHO, Pearson Education India; 1st edition 2002

Course Code: CSE-S303 **Breakup: 3 – 0 – 2 – 4**
Course Name: Microprocessor

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Assess and solve basic binary math operations using the microprocessor and explain the microprocessor's and Microcontroller's internal architecture and its operation within the area of manufacturing and performance.
CO2	Apply knowledge and demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller
CO3	Compare accepted standards and guidelines to select appropriate Microprocessor (8085) and Microcontroller to meet specified performance requirements
CO4	Analyze assembly language programs; select appropriate assemble into machine a cross assembler utility of a microprocessor and microcontroller.

Course Details:

Introduction to microprocessor, Microprocessor Computer and assembly language, Microprocessor
Architecture (8085) & Memory interfacing, Interfacing I/O Device, 8085 assemble language programming, Programming technique with 8085 Instruction set.

Counters & Delays, Stack & Subroutines, Code conversion, BCD Arithmetic & 16 bit data operations.
Interrupts, D/A & A/D converters, Programmable Interface Device (8155, 8355, 8279, 8255, 8254, 8259) DNA Controller, Serial I/O & Data Communication, Microprocessor application & future aspects of Microprocessor Technology.Introduction to 8086

Text Books and References:

1. Douglas V. Hall , Microprocessor & Interfacing Programming & Hardware,2nd Edition. 1991
2. B.Ram – Fundamentals & Microprocessors & Microcomputer, Dhanpat Rai Publications, 2008
3. Ramesh S. Gaonkar – Microprocessor Architecture, Programming & Application with 8085, Pearson; 4th edition, 1998
4. C with Assembly Language, Steven Holzner, bpb, 1990
5. Uffenback–Microcomputers & Microprocessors (8080, 8085 & Z-80) Interfacing & Troubleshooting, Pearson; 3rd edition, 1999

Microprocessor Lab

1. 8 bit Addition,16-bit addition
2. 8 bit Subtraction, 16 bit Subtraction
3. BCD Addition and Subtraction
4. Sorting the n numbers in ascending & descending order.
5. Sum of squares of n numbers, sum of cubes of n numbers
6. Arithmetic average of n numbers.
7. Programs using subroutines
8. 8 bit counter with 5ms Delay.
9. Interfacing of switch and display
10. Other related programs

Course Code: CSE – S304 **Breakup: 3 – 1 – 0 – 4**
Course Name: Theory of Computation

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Design Finite Automata machines for given problems.
CO2	Analyze a given Finite Automata machine and find out its Language.
CO3	Design Pushdown Automata machine for given CF language(s).
CO4	Generate the strings/sentences of a given context-free languages using its grammar.
CO5	Design Turing machines for given any computational problem.

Course Details:

Model of Computation
Classification, Properties and equivalence's
Regular languages models:
finite state machine (deterministic and non – deterministic). Regular grammars, regular expression, Equivalence of deterministic and non – deterministic machines, Properties: closure, decidability, minimization of automata, iteration theorems.

Context – free languages models:
Context – free grammars, simplification if CFGs, Chomsky normal form , Greibach normal form. Pushdown Automata, and their equivalence with context free languages, Properties closure, iteration theorems, parsing.

Recursive and recursively innumerable sets models:
Turing machines, computable languages and function, Modification of Turing machines, Restricted Turning machines equivalents to the basic model, grammars recursive function , and their equivalence Church's thesis, Properties: closure, decidability, undecidability/ non – computability, notion of reductions.

Text Books and References:

1. J.E. Hopcroft and J.D.Ullman & Motwani Introduction to Automata Theory, Language and Computation,3rd edition Addision wesley, 2007.
2. Peterlinz – An Introduction to formal Language & automata (Narosa Publication House), 6th edition, Jones & Bartlett, 2016
3. Theory of Computer Science: Automata, Languages and Computation, Mishra K.L.P, Prentice Hall India Learning Private Limited, 3rd edition, 2006
4. Introduction to Computer Theory, Daniel I.A. Cohen, Wiley; Second edition 2007
5. Theory of Computation (TMH), John Martin, McGraw Hill Education; 3rd edition 2007
6. Introduction to Theory of Computation, Michael Sipser, 2nd Edition, Thomson course technology, 2014

Course Code: **MTH-S501** **Breakup:** **3 – 0 – 3– 5**
Course Name: **Numerical Methods**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Apply Numerical analysis which has enormous application in the field of Science and some fields of Engineering.
CO2	Familiar with finite precision computation
CO3	Familiar with numerical solutions of nonlinear equations in a single variable.
CO4	Familiar with numerical integration and differentiation, numerical solution of ordinary differential equations.
CO5	Familiar with calculation and interpretation of errors in numerical method.

Course Details:

Unit I: Errors, Finding zeroes of transcendental and polynomial equation using Bisection method, Regula- falsi method and Newton- Raphson method, Rate of convergence of above methods.

Unit II: Interpolation: Finite differences, difference tables, Newton's forward and backward interpolation , Lagrange's and Newton's divided difference formula for unequal intervals.

Unit III: Solution of system of linear equations: Gauss- Elimination method, Gauss Jordan method, Gauss- Seidal method, Crout method.

Unit IV: Numerical differentiation, Numerical integration , Trapezoidal , Simpson's one third and three- eight rules.

Unit V: Solution of ordinary differential (first order, second order and simultaneous) equations by Euler's, Picard's and fourth-order Runge- Kutta mehthods.

Lab Work: Programming in C/ C++. One three hour lab per week . At east two programs from each chapter should be done .

Text Books and Reference :

1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House, 2002.
2. Devi Prasad, An introduction to Numerical Analysis, Narosa Publication house, New Delhi 2006.
3. T. Veerajan & T. Ramchandrandran, Theory & Problems in Numerical Methods, TMH, New Delhi,2004

Course Code: **MTH-S502** **Breakup: 3 – 1 – 0 – 4**
Course Name: **Operations Research**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimization problems.
CO3	Use mathematical software to solve the proposed models.
CO4	Develop a report that describes the model and the solving technique, analyze the results
CO5	Propose recommendations in language understandable to the decision-making processes in Management Engineering.

Course Details:

UNIT- I

Introduction: Uses, scope and applications of operations research.

Linear Programming: Mathematical formulation of Linear programming problems. Solution of LPP by Graphical method, Simplex method, Duality in Linear Programming Problem, Dual Simplex method, Sensitivity analysis.

UNIT-II

Transportation Problems:Various methods for finding initial basic feasible solution and optimal solution .

Assignment Problems: Hungarian method for solving assignment problems.

Sequencing problem: Basic assumptions, n- jobs on two machine, n- jobs on three machines, two jobs on three machines.

UNIT-III

Game Theory: Two persons zero sum game, pure and mixed strategy games, saddle point, solutions of a game with or without saddle point ,dominance rule, different methods of solving (Algebraic, Graphical, Linear programming).

Inventory Control Models: Deterministic EOQ inventory models.

UNIT-IV

Network Models: Minimal spanning tree algorithm, Shortest route problem, Maximal flow model.

Project Management: Phases of project management, guidelines for network construction, CPM and PERT.

Text Books and Reference :

1. Wayne L. Winston,"Operations Research" Thomson Learning,2003.
2. Hamdy H. Taha, "Operations Research-An Introduction" Pearson Education,2003.
3. R. Panneer Seevam, "Operations Research" PHI Learning, 2008.
4. V.K.Khanna, "Total Quality Management" New Age International, 2008.
5. Kanti swroop , Manmohan and Gupta-operations research , sultan chand & sons new delhi.
6. V.K.Kapoor- operations Research, S.Chand,4th Edition

Course Code: **CSE-S305** **Breakup:** **3 – 2 – 0 – 5**
Course Name: **Compiler Design**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand fundamentals of compiler and identify the relationships among different phases of the compiler.
CO2	Understand the application of finite state machines, recursive descent, production rules, parsing, and language semantics.
CO3	Analyze & implement required module, which may include front-end, back-end, and a small set of middle-end optimizations
CO4	Use modern tools and technologies for designing new compiler.

Course Details:

Compiler Structure: Analysis – Synthesis model of compilation, various phases of a compiler, Tool based approach to compiler construction.

Lexical Analysis: Interface with input, parser and symbol table, Token, lexeme and patterns. Difficulties in lexical analysis. Error reporting. Implementation, Regular definition, Transition Diagrams, Lex.

Syntax Analysis: CFGs, Ambiguity, associativity, precedence, top down parsing, recursive descent parsing, transformation on the grammars predictive parsing , bottom up parsing, operator precedence grammars, LR parsers (SLR.LALR, LR), YACC.

Syntax Directed definition: Inherited and synthesized attributes, dependency graph, Evaluation order, bottom up and top down evaluation of attributes, L- and s-attributes definition.

Type checking: type system, type expression, structural and name equivalence of types, type conversion, overloaded function and operators, polymorphic function.
Run time system: Storage organization, activation tree activation record parameter passing, symbol table, dynamic storage allocation.

Intermediate code generation: Intermediate representation translation of declaration, assignments, control flow Boolean expressions and procedure calls. Implementation issues.

Code generation and Instruction selection: Basic block and flow graph register allocation, code generation, dag representation of program, code generation from DAGs, peephole optimization.

Text Book and References:

1. A.V. Aho, R. Sethi and J.D. Ullman, Compilers: Principle Techniques and Tools, Addition- Wesley 2007, 2nd edition.
2. Steven Muchnick – Advance Compiler Design Implementation (Elsevier India), 2008
3. Theory and Practice of Compiler Writing, Jean Paul Trembla, Paul Gordon Sorenson, McGraw-Hill Inc.,US, 1985
4. Compiler Design in C, Holub (Author), Allen, Prentice Hall India Learning Private Limited, 1992

Course Code: **CSE-S306** **Breakup:** **3 – 2 – 0 – 5**
Course Name: **Computer Networks**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Recognize the technological trends of Computer Networking.
CO2	Discuss the key technological components of the Network.
CO3	Evaluate the challenges in building networks and solutions to those

Course Details:

Introduction: history and development of computer networks, Local area networks, Metropolitan area
networks, wide area networks, networks topology ISO/OSI seven layer architecture, connectionless versus connection oriented.

Data Communication: Data encoding and transmission ,data link control, Multiplexing, packet switching, LAN Architecture, LAN Systems(Ethernet, Token Ring), Network devices switches, Gateways , Routers

Physical Layer: transmission media, analog transmission, digital transmission.

Data link layer: framing error detection and correction, stop-and wait protocol, sliding window protocols, HSLC protocol.

MAC Layer: Aloha protocols, CSMA/CD: Ethernet, token ring, token bus Logical link control, Bridges and switches, FDDI, fast Ethernet, FDM, TDM.

Network layer: Virtual circuit, datagrams, Routing Algorithms shortest path, distance vector, link state routing, flooding, hierarchical routing, congestion control algorithms. Internetworking tunneling, Encapsulation , Fragmentation. Multicasting, Inter network protocols (IP) – header structure, addresses, option, etc. Routing protocols, (Example : RIP, HELLO, OSPF, BGP)classless Inter- domain routi9ng other protocols, ICMP,ARP, RARP, BOOTP, DHCP.

Asynchronous Transfer mode (ATM); cell format, connection setup, switching, quality –of – services, ATM adaptation layers.

Text Book and References:

1. Computer Networks, S. Tanenbaum, Pearson Education India; Sixth edition, 2022
2. Data and Computer Communication, Stallings William, Pearson Education; Tenth edition, 2017
3. Data Communications and Networking with TCPIP Protocol Suite, Behrouz A. Forouzan, 6/e, McGraw Hill Education (India) Private Limited, 2022
4. Unix Network Programming Volume 1, Steavens/ Bill Fenner / Rudoff, Vol. 1, Pearson Education India; 3rd edition, 2015
5. Computer Networks: A Systems Approach, Peterson, Elsevier, Fifth edition 2011

Course Code: CSE-S307 **Breakup: 3 – 1 – 0 – 4**
Course Name: Software Engineering.

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Basic knowledge and understanding of the analysis and design of complex systems
CO2	Ability to apply software engineering principles and techniques.
CO3	Ability to develop, maintain and evaluate large-scale software systems
CO4	To produce efficient, reliable, robust and cost-effective software solutions, applying professional ethics.
CO5	Ability to perform independent research and analysis.
CO6	To communicate and coordinate competently by listening, speaking, reading and writing English for technical and general purposes.
CO7	Ability to work as an effective member or leader of software engineering teams.

Course Details:

1. Software and Software Engineering
2. Software Process a Generic View
3. Software Process Models
4. Requirements Engineering
5. Project Management Concepts
6. Software Process, Project and Product Metrics
7. Metrics for Design Model
8. Estimation for Software Projects
9. Analysis Concepts and Modeling
10. Software Testing

Reference Books

1. Software Engineering: A Practitioner's Approach, Bruce R. Maxim (Author), Roger S. Pressman, McGraw Hill Education; Eighth edition, 2019
2. Integrated approach to software engineering, Pankaj Jalote, Narosa, 2005
3. Software Engineering: A Precise Approach, Pankaj Jalote, Wiley, 2010
4. Fundamentals of Software Engineering, Rajib Mall, PHI Learning; 5th edition, 2018
5. Sommerville – S/W Engineering, Pearson Education; First edition, 2020

Course Code: **HSS-S301** **Breakup:** **1 – 1 – 1 – 2**
Course Name: **Professional Communication**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Plan, draft, revise, and edit documents for use in professional settings
CO2	Adapt writing to different audiences, purposes, and contexts
CO3	Synthesize and report on the professional and technical literature in the field
CO4	Write in a clear, coherent, and direct style appropriate for engineering communication
CO5	Understand and employ common documents in engineering writing, including proposals, failure
CO6	Analyses technical descriptions, research reports, and professional correspondence
CO7	Avoid plagiarism search, evaluate, and cite primary and secondary sources
CO8	Format documents in IEEE, the formatting style used in engineering communication

Course Details:

Unit 1- Presentation Techniques
- Meaning and importance of presentation technique
- Use of presentation techniques in everyday life
- Presentation skills required for business organization
- Types of business presentations-meetings, seminars, Conferences

Unit 2-Oral presentations
- Effective oral presentation techniques
- Tips for good oral delivery; debates, elocution, impromptu speeches
- Levels and models of organizational Communication
- Interviews-types of interviews
- Group discussions

Unit 3- Written communication
- Style and tone of writing business messages and Documents.
- Writing for websites, internet e-mails and short messages
- Applications, letters, memos
- Proposals and report writing

Unit 4 - Nonverbal presentations
- Nonverbal communication techniques
- Business manners, ethics and personality development
- Audio/visual presentations, power point presentations
- Art of delivery

Unit 5- Literary concepts
- Stories, essays, comprehension
- Reading techniques-skimming and scanning methods
- Listening skills

Recommended Books:

1. "Business Communication Today", Bove'e, Thill and Schatzman: Pearson Education(Singapore),2003
2. "Business Communication-a framework of success", H.Dan O'Hair, James S.O'Rourke and Mary John O' Hair: South Western College Publishing 2001.
3. "Basic Business Communication", Raymond V.Lesikar, Marie E.Flatley: Tata McGraw Hill Publishing Company Ltd., 2002.

Course Code: **MTH-S503** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Graph Theory**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basics of graph theory and their various properties
CO2	Model problems using graphs and to solve these problems algorithmically.
CO3	Apply graph theory concepts to solve real world applications like routing, TSP/traffic control, etc.
CO4	Optimize the solutions to real problems like transport problems etc.,

Course Details:

Unit –I

Graphs, Sub graphs, Some basic properties, Different types of graphs (Regular, Bipartite, Induced, Quotient etc) walks, paths & circuits, connected graphs, disconnected graphs and its components, Euler graphs and its properties, Fluery's algorithms and Chinese postman problem Operation on graphs, Hamiltonian graphs and its properties, Hamiltonian paths and circuits, the traveling sales man problem. Shortest distance algorithms (Dijkstra's) .

Unit –II

Cuts sets and cut vertices, some properties, all cut sets in a graph, fundamental circuits and cut sets , connectivity and separability , Rank, Nullity of a graph.

Digraphs : Definition, Types of Digraphs, Digraphs and Binary relations, Directed path and connectedness, Euler Digraphs.

Unit- III

Trees and its characterization, Distance, Height, Diameters, Radius of a tree, Weighted Tree, Rooted and Binary trees, Spanning trees , Weighted spanning tree , Minimum weight spanning tree algorithms prim's and Kruskal's. Chords, Branches, Fundamental circuits.

Unit –IV

Matrix representation of graphs : Incidence, Adjacency, Circuit, Cut-set and Path matrices and their properties. Matrix representation of Digraphs (Adjacency matrix).

Unit –V

Planarity: Planer graphs, Regions, Euler formula, Kuratowski two graphs, Characterization of planarity, detection of planarity, Thickness and Crossings number of a graph.

Colouring of graphs: Vertex colouring , Edge colouring, Five colour Theorem, Chromatic number, chromatic polynomials, Methods of finding the chromatic polynomial, Chromatic partitioning, Independence number and Covering number.

Matchings , Maximal matching, Augmenting path, Hall's marriage problem

Unit -VI

Enumeration : counting labelled and unlabelled graphs and trees. Cycle index, Figure counting series, Configuration counting series, Polya's Theorem(without Proof). Application to simple and multiple graphs with at most two edges between vertices.

Transportation networks : Network flows, Max flow-Min cut Theorem.

Text Books and Reference :

1. Deo, N, Graph theory with applications to Engineering and Computer Science, PHI
2. V. Balakrishnan, Schaum's Outline of Graph Theory, TMH

3. Robin J. Wilson, Introduction to Graph Theory, Pearson Education Limited; 5th edition 2010
4. Harary, F, Graph Theory, Narosa Publishing House 2001
5. Geir Agnarsson, Graph Theory: Modeling, Applications and Algorithms, Pearson Education India; 1st edition 2008
6. Bondy and Murthy: Graph theory and application. Elsevier Science Ltd 1976

Course Code: **MTH-S504** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Probability & Statistics**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Acquaintance: with various methods of collecting data and get familiar with some elementary methods of data viz. Measures of central tendency, dispersion, skewness and kurtosis and to interpret them.
CO2	Understanding: the basic concepts of probability and to find probabilities of various events.
CO3	Understand: types of random variables, concepts of conditional probability and ability to distinguish between univariate and bivariate probability distributions; transformation of continuous random variable and its application.
CO4	Knowledge of characteristics of random variables such as expectation, variance and also to compute various generating functions.

Course Details:

UNIT – I

Introduction of random variables, types of random variables, Probability density function, Joint Distribution Functions, Necessary and Sufficient conditions for independence of random variables, central Limit Theorem.

UNIT – II

Correlation & Regression; Bivariate population, Method of least squares for curve fitting, Meaning of correlation & regression, Coefficient of Correlation, rank correlation, lines of regression properties of regression coefficients.

UNIT – III

Estimation Theory; Methods of Estimation, Unbiased, Consistent, Maximum likelihood estimators, Minimum Variance, Unbiased Estimators.

UNIT – IV

Testing of Hypotheses; Simple and Composite Hypotheses, Two types of error, Power of a test, Neyman pearson Lemma for most powerful Tests, Application of the Lemma, Various tests of significance for the mean and variance based on t,F & Z distribution, Contingency tables and x2 – tests. Confidence Interval Estimation.

Text Books and Reference

1. Applied Statistics and Probability for Engineers, Douglas C. Montgomery (Author), George C. Runger, Wiley; Sixth edition, 2016
2. Probability and Statistics for Engineering and the Sciences, Jay L. Devore, Cengage India Private Limited, 9th edition, 2020

Course Code: **HSS-S201** **Breakup:** **3 – 0 – 0 – 4**
Course Name: **Industrial Management**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Choose, prepare, interpret and use cost estimates as a basis for the different situations in an industrial company
CO2	Interpret financial statements and other financial reports of industrial companies, including the income statement, the balance sheet, the cash flow statement, key measures, budget and sustainalbility analysis in these
CO3	Explain how the industrial company can be organised and managed
CO4	Explain the industrial company's value creating processes, how the company can price it's products and how the company works in it's environment.

Course Details:

Introduction to Industrial management, Brief history of industries in India, Brief definition of management, organization and administration. Characteristics of management, Principle of management, Function of management like, planning, organization, direction, co-ordination etc.

Level of management, skills of management, inter relation between skills and levels of management, scientific management, Introduction to Schools of Management thoughts, introduction to organization, study of basic type of organization for ex. Line and staff organization, project organization, metrics organization, Informal organization, Introduction to industrial Psychology, Motivation theory and study of Maxlow, Need, Hierarchy Theory, Planned Location, Planned Layout. Study of different forms of layout like line layout, process layout, product layout, combinational layout, sixth position layout etc.

Objective of planned layout, introduction to material management, scope of material management, study of inventory control method, introduction to different types of inventory control techniques, introduction to work study, motion study etc, introduction to conflict management.

Text Book and References:

1. Khanna O.P. : Industrial Engineering, Dhanpat Rai Publications 2018
2. Industrial Engineering and Management, Divya Zindani Kaushik Kumar, Dreamtech Press 2020
3. Mahajan : Industrial and Process Management, Dhanpat Rai & Co. (P) Limited 2015

Course Code: **CSE-S401** **Breakup:** **3 – 1 – 3 – 5**
Course Name: **Computer Graphics**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basics of computer graphics, different graphics systems and applications of computer graphics
CO2	Discuss various algorithms for scan conversion and filling of basic objects and their comparative analysis
CO3	Use of geometric transformations on graphics objects and their application in composite form
CO4	Extract scene with different clipping methods and its transformation to graphics display device
CO5	Explore projections and visible surface detection techniques for display of 3D scene on 2D screen.
CO6	Render projected objects to naturalize the scene in 2D view and use of illumination models for this

Course Details:

Introduction: Areas of Graphics, What is Computer Graphics, Video Display Devices, Fundamental problem in geometry.
Line drawing algorithm, Circle and Ellipse generating algorithms, Polynomial and Spline curves, Filling (Boundary fill, Flood fill etc.), Attributes of lines, Curves, Filling, Characters, etc.
Geometric Manipulation:
Transformation (Translation, Rotation, Scaling, Reflection etc), Matrix representation, Homogeneous coordinate systems
Two dimensional viewing: Viewing coordinate reference frame, line clipping, polygon clipping Elementary 3D Graphics: Plane projection, Perspective, Orthographic projection, Surface vendering, Hidden lines Removal, Vanishing points, Specification of 3D view.
3D Transformations : Rotation, Scaling, Shearing, Translation, Reflection.

Visibility: Image and Object precision, z-buffer algorithm, Area-based algorithm.

Text Book and References:

1. Hill – Computer Graphics using openGL, Pearson; 3rd edition 2007
2. Foley, Feiner & Hughes – Computer Graphics Principles & Practices in C (Addision wesley)
3. Computer Graphics C Version, Hearn, Pearson Education India; 2nd edition 2002
4. Procedural Elements of Computer Graphics, David Rogers, McGraw Hill Education; 2nd edition 2017
5. Yashwant Kanetkar – Computer Graphics Programming in C, BPB, 1998

Computer Graphics Lab

1. Implementation of line generation using slope's method, DDA and Bresenham's algorithms.
2. Implementation of circle generation using Mid-point method and Bresenham's algorithms.
3. Implementation of ellipse generation using Mid-point method.
4. Implementation of polygon filling using Flood-fill, Boundary –fill and scan line

algorithms.

5. Implementation of 2-D transformation: Translation, Scaling, rotation, Mirror Reflection and sharing (write a menu driven program).
6. Implementation of line clipping using Cohen-Sutherland algorithm and Bisection Method.
7. Implementation of Polygon clipping using Sutherland-Hodgeman algorithms.
8. Implementation of 3-D geometric transformations: Translation, Scaling and rotation.
9. Implementation of curve generation using Interpolation methods.
10. Implementation of Curve generation using B-spline and Bezier curves.
11. Implementation of any one of back face removal algorithm (such that depth-buffer algorithm, Painter's algorithm, Warnock's algorithm, Scan line algorithm) Departmental Elective Courses

Course Code: **CSE-S501** **Breakup:3– 1 – 0 – 4**
Course Name: **Digital Image Processing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Review the fundamental concepts of a digital image processing system
CO2	Analyse images in the frequency domain using various transforms
CO3	Evaluate the techniques for image enhancement and image restoration.
CO4	Categorize various compression techniques
CO5	Interpret Image compression standards
CO6	Interpret image segmentation and representation techniques

Course Details:

UNIT-I

The image model and image acquisition image shape, sampling, intensify images, color images, range images, image capture, scanners.

UNIT-II

Statistical and spatial operations Grey Level transformations, histogram equilization, multi image operations. Spatially dependent transformations, templates and convolution window operations, Directional smoothing, other smoothing techniques.

UNIT-III

Segmentation and Edge detection region operations, Basic edge detection, second order detection, crack edge detection edge following, gradient operators, compass & laplace operators.

UNIT-IV

Morphological and other area operations, basic morphological operations, opening and closing operations, area operations morphological transforms.

UNIT-V

Image compression: Types and requirements, statistical compression, spatial compression, contour coding, quantizing compression.

Text Books and References:

1. Andrion Low-Introductory computer Vision and Image Processing MCGraw Hill International Edition, 1991
2. Digital Image Processing, Rafael Gonzalez , Richard Woods, Pearson; 4th edition 2017)

Course Code: **CSE-S502** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Digital Signal Processing.**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Discrete-time signal and system types, convolution sum, impulse and frequency response concepts for linear, time-invariant (LTI) systems, difference equation realization of LTI systems and discrete-time Fourier transform and basic properties of these
CO2	Understand periodic sampling of analog signals and the relation between Fourier transforms of the sampled analog signal and the resulting discrete-time signal
CO3	Understand and apply z and inverse z transform, region of convergence concepts and their properties, performs simple transform calculations, understand the system function concept with its relations to impulse and frequency responses
CO4	Understand the basic properties of system functions and frequency responses of LTI systems, minimum-phase, all-pass and linear-phase systems.
CO5	Understand signal flow graph and block diagram representations of difference equations that realize digital filters: (i) Learns direct forms 1 and 2 for IIR filter realization. (ii) Learns direct form for FIR filter realization.Understands definitions and basic properties of forward and inverse discrete Fourier transform and their computation by fast algorithms

Course Details:

Discrete Time Signals and Systems:
Analysis of discrete time linear shift invariant systems - Convolution sum- Discrete-time systems described by difference equations- Implementation of discrete time systems - Z-transform and system analysis.
Discrete time Fourier transform (DTFT): DFT and properties - computation of DFT and IDFT using Fast Fourier Transform (FFT), radix-2 DIT and DIF algorithms

Structures for FIR systems: direct, cascade, frequency sampling and lattice structures - Structures for IIR systems: direct, cascade, parallel and lattice structures- Representation of numbers - Quantization of filter coefficients - Round-off effects in digital filters.

Digital Filters: Design of linear phase FIR filters using window methods, frequency sampling method - Design of IIR filters from analog filters, Frequency transformation.

Application: Multirate Digital Signal Processing, Sampling rate conversion – Sub-band coding of speech signals - Musical sound processing.

Text Books and References:

1. John G.Proakis and Dimitris G.Manolakis, “Digital Signal Processing Principles Algorithms and Applications, 4th edition, Prentice Hall of India Pvt.Ltd. 2007.
2. Sanjit K. Mitra, “Digital Signal Processing – A Computer based Approach”, Tata McGraw Hill 4th Edition, 2010.
3. Alan Oppenheim V., Ronald Schafer W., “Discrete Time Signal Processing”, Pearson Education India Pvt Ltd., New Delhi, 2002.
4. Anil K. Jain – Fundamental of Digital image Processing, Pearson, 1988

Course Code: **CSE-S503** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Parallel Processing**
Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the basic construction and use of parallel computers,
CO2	Use of the terminology for how one measures the performance of parallel algorithms and parallel computers
CO3	Develop computer programs for different types of parallel computers
CO4	Optimize sequential code for fastest possible execution
CO5	Analyze sequential programs and determine if they are worthwhile to parallelize
CO6	Develop, analyze, and implement algorithms for parallel computers. This applies both to computers with shared memory and with distributed memory

Course Details:

Introduction to Parallel Processing:
Supercomputers and grand challenge problems, Modern Parallel Computers, Data Dependence Graph, Data Parallelism, Functional Parallelism, Pipelining and Data Clustering.

Interconnection Networks:
Switch Network Topologies, Direct and Indirect Network Topology, Bus, Star, Ring, Mesh, Tree, Binary Tree Network, Hyper Tree Network, Hybrid, Hypercube, Perfect Shuffle Network, Torus and Butterfly Network.

Performance Analysis:
Introduction, Execution Time, Speedup, Linear and Superlinear Speedup, Efficacy and Efficiency, Amdahl's Law and Amdahl Effect, Gustafson-Barsis's Law, Minsky's Conjecture, The Karp-Flatt Metric, The Isoefficiency Metric, Isoefficiency Relation, Cost and Scalability.

Parallel Computational Models:
Flynn's Taxonomy, PRAM, EREW, CREW, ERCW, CRCW, Simulating CRCW, CREW and EREW, PRAM algorithms.

Introduction to Parallel Algorithms:
Parallel Programming Models, PVM, MPI Paradigms, Parallel Programming Language, Brent's Theorem, Simple parallel programs in MPI environments, Parallel algorithms on network, Addition of Matrices, Multiplication of Matrices.

Text Books and References:

1. Hwang and Briggs, advance Computer Architecture and Parallel Processing, McGraw Hill Education 2017
2. Crichlow, Introduction to Distributed and Parallel Computing, Prentice-Hall 1987
3. M.J.Quinn, Designing Efficient Algorithms for Parallel Computers, McGraw-Hill College; First Edition 1987
4. V.Rajaraman, Elements of Parallel Computing, Prentice-Hall of India.
5. Joseph JA JA, Introduction to Parallel Algorithms, Addison Wesley.
6. S.G.Akl, The Design and Analysis of Parallel Algorithms, Prentice Hall; First Edition 1989

Course Code: **CSE-S504** **Breakup:** **3 – 1 – 3 – 5**
Course Name: **Advance Java Programming**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Develop appropriate data model and database scheme
CO2	Create and test prototypes
CO3	Develop Structure
CO4	Identify major subsystems and interfaces
CO5	Validate design scheme and models
CO6	Implement Program

Course Details:

Introduction to Java- Architecture of Java, Data types, arrays, Classes Packages, interface, string handling etc.
Introduction to HTML Java Applets & application Exception Handling in Java I/O in Java Multithreaded Programming in Java Networking in Java
Bust Handling in Java
AWT controls, Layout Manager and Menus Introduction to Java Beans, Servlets
Introduction to Java Database Connectivity JDBC) and Remote Method Invocation (RMI)

Text Books and References:

1. The complete Reference – Java 2 (Latest Edition) by Patrick Naughton & Herbert Schildt, McGraw Hill; 12th edition 2021
2. Java 2 Plateform Unleashed, Jamie Jaworski, Sams; Book and CD-ROM edition 1999
3. Java Collection – John Zukowski (Apress), 2001
4. Java Swing – Loy & Cole, O'Reilly Media; 2nd edition, 2002
5. Mastering Enterprise JavaBeans and the Java 2 Platform, Enterprise Edition, wiley, 1999
6. Advanced Programming for Java 2, Calvin Austin (Author), Monica Pawlan Addison Wesley 2000

Course Code: **CSE-S505** **Breakup:3 – 1 – 0– 4**
Course Name: **Distributed Processing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To provide hardware and software issues in modern distributed systems.
CO2	To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
CO3	To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.
CO4	To know about Shared Memory Techniques.
CO5	Have Sufficient knowledge about file access
CO6	Have knowledge of Synchronization and Deadlock

Course Details:

Introduction
Introductory Concept of Process, Concurrent Process, Synchronization Problems like Dining Philosopher, Producer Consumer, Readers writers problem, Process Deadlocks, Deadlock Vs Starvation, Models of Deadlocks, Model of Resources, Graph Theoretic Model of State, Necessary & sufficient condition for deadlock, Introduction of Distributed Processing , Issues in Distributed systems, Global knowledge, naming, scalability, Compatibility, Process Synchronization, Security issues.

Theoretical Foundation for Distributed Systems: Limitation of Distributed System, absence of global clock, shared memory, Logical Clocks, Lamports & Vectors logical Clocks, casual ordering of messages, global state, termination detection

Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion algorithm, Token Based and non token based algorithm, performance metric for distributed mutual exclusion Algorithms

Distributed Deadlock Detection: System model, resource vs communication deadlocks, dead lock prevention, avoidance, detection & Resolution, Centralised deadlock detection, distributed dead lock detection, path pushing algorithm, Edge chasing algorithm

Agreement Protocols: Introduction, System Model, Classification of Agreement Problem, Byzantine Agreement Problem Consensus Problem, Interactive Consistency Problem, Solution to Byzantine Agreement Problem Application of Agreement Protocol, Atomic Commit in Distributed Database System

Distributed Resource Management: Distributed File System, Mechanism for building distributed file system, Mounting caching Hints Bulk Data Transfer, Encryption , Design Issues , Naming & Naming Resolution, Caches on Disk or Main Memory, Writing Policy, Distributed Shared Memory, Architecture & Motivation, Algorithms for Implementing Distributed Shared Memory, Client Server, Migration, Read Application full Replication Algorithms, Memory Coherence protocols.
Advanced issues in Distributed System: Distributed Scheduling , issues in load distribution, Component of load distributing algorithm, stability Performance comparison, task migration, Introduction to Fault Tolerance, Data Security Encryption , Distributed resource management, Multiprocessing Operating System, Database

Operating system
Distributed Algorithms: Introduction to Communication protocols, Balanced Sliding Window Protocol, Routing Algorithm Destination based routing, APSP Problem, Deadlock Free Packet Switching, Introduction to Wave Traversal Algorithms, Election Algorithms.

Text Books & References:

1. Mukesh Singhal &Niranjan Shivaratri "Advanced Concepts in Operating System" McGraw Hill Education, 2017
2. Tel , Gerald, "Introduction to Distributed Algorithm" Cambridge University Press; 2nd edition 2000
3. Distributed Systems: Concepts and Design, Coulouris, Pearson Education India; 4th edition 2008
4. Distributed Systems, Andrew S Tanenbaum (Author), Maarten Van Steen, Maarten Van Steen 2023

Course Code: **CSE-S506** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **VLSI Design**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
CO2	Understand chip level issues and need of testability.
CO3	Design analog & digital CMOS circuits for specified applications

Course Details:

Basic MOS Transistor
Enhancement mode & Depletion mode – Fabrication (NMOS, PMOS, CMOS, BiCMOS) Technology – NMOS transistor current equation – Second order effects – MOS Transistor Model.

NMOS & CMOS Inverter and Gates
NMOS & CMOS inverter – Determination of pull up / pull down ratios – Stick diagram – lamda based rules– Super buffers, BiCMOS & steering logic.

Sub System Design and Layout
Structured design of combinational circuits – Dynamic CMOS & clocking – Tally circuits – (NAND- NAND, NOR-NOR and AOI logic) – EXOR structure – Multiplexer structures – Barrel shifter.

Design Of Combinational Elements and Regular Array Logic
NMOS PLA – Programmable Logic Devices - Finite State Machine PLA – Introduction to FPGA.

VHDL Programming
RTL Design – Combinational logic – Types – Operators – Packages – Sequential circuit – Sub-programs – Test benches. (Examples: address, counters, flipflops, FSM, Multiplexers / Demltiplexers).

Text Books & References:

1. D.A.Pucknell, K.Eshraghian, ‘Basic VLSI Design’, 3rd Edition, Prentice Hall of India, New Delhi, 2011.
2. Eugene D.Fabricius, ‘Introduction to VLSI Design’, Tata McGraw Hill, 1990.
3. N.H.Weste, ‘Principles of CMOS VLSI Design’, Pearson Eduction, India, 2002.
4. Charles H.Roth, ‘Fundamentals of Logic Design’, Jaico Publishing House, 1992.
5. Zainalatsedin Navabi, ‘VHDL Analysis and Modelling of Digital Systems’, 2nd Edition, Tata McGraw Hill, 1998.
6. Douglas Perry, ‘VHDL Programming by example’, Tata McGraw Hill, 4th Edition, 2002.

Course Code: CSE-S507 **Breakup: 3 – 1 – 0 – 4**
Course Name: Advanced Computer Networks

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	To identify and discuss the concepts underlying IPv6 protocol, and their main characteristics and functionality
CO2	To understand the principles and functionality of mobile IP, explaining its concretization in IPv6; to understand the needs of optimization of the mobility mechanisms and description of some extensions that aim to reduce handover latency and requirements from terminals;
CO3	To recognize the need for service integration and discuss how it can be accomplished;
CO4	To explain and exemplify current QoS architectures and mechanisms, and the QoS support challenges in future networks;
CO5	To understand and explain the design issues in transport services w.r.t. applications and services requirements

Course Details:
Revision of Computer Networks, Seven Layer Architecture, TCP/IP Suite of protocols etc.
Transport Layer: Flow and error control, multiplexing, establishing and releasing a connection, Transmission control protocol – header, services, connection management, convention control, sliding window and timers. User datagram protocol, Domain name services.

Unix network programming, socket abstraction client – server architecture.

Session presentation, application layers, Example protocols: Email (SMTP) Telnet, FTP, etc.

Internet security: firewalls. Network managements: SNMP.

IPV6: IPV6 Versus IPV4, Structure of IPV6 Protocol : general header structure , extension headers , IPV6 addressing : Types , notation, prefix notation , unicast, anycast , multicast addresses etc.

Security in IPV6: Basic Security Requirement and techniques, open security issues in current internet, IPSec frame work Quality of service in IPV6

ICMPV6: error messages, neighbor discovery, Auto configuration, path MTU discovery.

Wireless networks: Overview of 802.11 networks, 802.11 MAC, wired Equivalent privacy, Wireless communication technology: FHSS, DSSS, CDMA etc.

Mobility networks: Mobile IP, security related issues

Text Books and References:

All books used in the computer network
1. 802.11 wireless networks : The definitive guide, Mathew S. Gast, O'relly,2nd edition 2005

2. Wireless communication & networks: William Stallings, Pearson; 1st edition 2015
3. IPV6 Essentials , Silvia Hagen ,O'Reilly Media; 3rd edition 2014
4. TCP/IP Clearly Explained, Peter Loshin, Morgan Kaufmann; 4th edition 2003
5. Mobile IP design , Principle & Practices , Charles Perkin, Bobby Woolf, Sherman R. Alpert, Prentice Hall; First Edition 1998

Course Code: **CSE – S508** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Natural Language Processing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Apply the computational knowledge for Natural Language Processing to understand the properties of natural languages, its algorithms for processing linguistic information in various tasks such as Machine translation, Information extraction and retrieval, and Speech Technology to solve global problems related to NLP.
CO2	Understand the concepts of linguistic foundations that underlie natural language processing, which would provide the knowledge for building components of NLP systems.
CO3	Discover the capabilities, analyze them and explore the limitations of current natural language technologies, and some of the algorithms and techniques that underline these technologies to take up various research challenges in the field
CO4	Demonstrate the concepts of morphology, syntactic analysis, semantic interpretation and pragmatics of the language, and understanding them to apply in different research areas

Course Details:

Introduction to Natural Language Understanding
Linguistic Background: Outline of English Syntax

Knowledge Representation and Reasoning: A Representation Based on FOPC

Grammars and Parsing: Grammars and Sentence Structure, What Makes a Good Grammar, A Top-Down parser, Bottom-Up Chart Parser, Transition Network Grammars, Top-Down Chart Parsing, Finite State Models and Morphological Processing, Grammars and Logic Programming

Features and Augmented Grammars: Feature Systems and Augmented Grammars, Augmented Transition Networks

Grammars for Natural Language: Auxiliary Verbs and Verb Phrases, Movement Phenomena in Language, Toward Efficient Parsing, Human Preferences in Parsing

Encoding Uncertainty: Shift-Reduce Parsers, A Deterministic Parser, Techniques for Efficient Encoding of Ambiguity

Ambiguity Resolution: Statistical Methods, Basic Probability Theory, Estimating Probabilities, Part of Speech Tagging, Obtaining Lexical Probabilities, Probabilistic Context Free Grammars

Semantics and Logical form: Semantics and Logical form, Word senses and ambiguity, Encoding ambiguity in the logical form, Verbs and states in logical Form, Thematic roles

Text Books & References:

1. James Allen, Natural Language Understanding, Pearson; 2nd edition 1994
2. Jurafsky & Martin – Speech & Language Processors, Prentice Hall; 2nd edition 2008

Course Code: **CSE – S509** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Soft Computing (Neural Networks, fuzzy logic and Genetic algorithms)**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Learn about Neural Network, Fuzzy Logic and Genetic Algorithms, which are the major building blocks of an Intelligent Systems
CO2	Develop intelligent systems leveraging the paradigm of soft computing techniques.
CO3	Implement, evaluate and compare solutions by various soft computing approaches for finding the optimal solutions
CO4	Design hybrid system to revise the principles of soft computing in various applications

Course Details:

Neural network
Basic Concepts of Neural Network, Models of artificial Neural network, Characteristics of Neural Networks Network Architectures, Artificial Intelligence and Neural Networks

Leaning Processes
Introduction, Error-Correction Learning, Memory-Based Learning, Hebbian Learning, Competitive Learning,Boltzmann Learning, Credit Assignment Problem, Learning with a Teacher, Learning Tasks, Statistical Nature of the Learning Process, Statistical Learning Theory, Probably Approximately Correct Model of Learning

Single Layer Perceptrons
Adaptive Filitering Problem, Unconstrained Optimization Techniques, Linear Least-Squares Filters, Learning Curves, Learning Rate Annealing Techniques, Perceptron, Perceptron Convergence Theorem

Multi Layer Perceptrons
Some Preliminiaries, Back-Propagation Algorithm, Summary of the Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Output Representation and Decision Rule, Computer Experiment, Feature Detection, Back-Propagation and Differentiation

Fuzzy Logic
Fuzzy Set Theory: Fuzzy verses crisp , crisp sets , Fuzzy sets, Crisp relations, Fuzzy relations Fuzzy systems: Crisp logic, predicate logic , fuzzy logic , fuzzy rule based system , De fuzzification systems , applications

Genetic Algorithms
Fundamental of genetic algorithm ,Genetic algorithms , basic concept of genetic algorithm , creation of rings, working principal , encoding, fitness function, reproduction
Genetic Modeling:
Inheritance operators, cross over , inversion and deletion , mutation operation, bitwise operators, bitwise operators used in genetic algorithm , generational cycle, convergence of genetic algorithm.

Text Books and references :
1. Neural Networks, Fuzzy Logic, And Genetic Algorithms : Synthesis And

Applications, S. Rajasekaran (Author), G. A. Vijayalakshmi Pai, PHI, 2013
2. Introduction to neural network James A. Anderson, MIT Press 1995
3. Introduction to genetic algorithm by Melanie Mitchell, MIT Press 1996
4. Genetic algorithm by Goldberg , Addison Wesley; 13th ed. edition 1989

Course Code: **CSE-S510** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Cryptography and Network Security**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Provide security of the data over the network.
CO2	Do research in the emerging areas of cryptography and network security
CO3	Implement various networking protocols
CO4	Protect any network from the threats in the world, applying professional ethics

Course Details:

Unit I:
Introduction to security attacks and mechanisms, Introduction to cryptology.
Conventional Encryption: Convention encryption model, Classical encryption techniques – substitution ciphers & transposition ciphers, cryptanalysis,
stereography, stream & block ciphers.
Modern Block Ciphers: Block ciphers principles, Shannon's theory of confusion and diffusion, fiestal structure, Data Encryption Standards (DES), Strength of DES, Differential & Linear Cryptanalysis of DES, Block Cipher modes of Operation, Triple DES, IDEA encryption and decryption. Strength of IDEA, Confidentiality using conventional encryption, traffic confidentiality, key distribution, random number generation.

Unit II:
Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's & Euler's Theorem, primarily testing, Euclid's Algorithm, Chinese remainder theorem, Discrete algorithms.
Principles of Public-Key cryptosystems, RSA algorithm, Security of RSA, Key management, Diffle- Hellman key exchange algorithm, Introductory idea of Elliptic curve cryptography, Elganal encryption.

Unit III:
Message authentication and hash functions: Authentication requirements, Authentication functions, message authentication codes, hash function, birthday attacks, security of hash function. & MACS, MD5 message digest algorithm, Secure Hash Algorithm (SHA).
Digital signatures: Digital signatures, Authentication protocol, digital signature standard (DSS), proof of digital signature algorithm.

Unit IV:
Authentication Application: Kerberos & X.509, directory authentication service, electronic mail security- Pretty Good Privacy (PGP), S7 MIME.

Unit V:
IP Security: Architecture, Authentication Header, Encapsulating security payloads, combining security associations, Key management.
Web security: Secure Socket Layer & Transport security, Secure electronic Transaction (SET). System security: Intruders, Viruses and related threads, Firewall design principles, trusted systems.

Text Books and References:

1. William Stallings, "Cryptography and Network Security: Priciples and Practice", Prentice Hall, New Jersey,5th edition 2010
2. Johannes A. Buchmann, Introduction to Cryptography", Springer- Verlag,2nd edition 2004.
3. Bruce Schneier, Practical Cryptography, Pearson Education India

Course Code: **CSE-S511** **Breakup: 3 – 1 – 0 – 4**
Course Name: **Adv. Database Management System**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Apply advanced database design principles
CO2	Implement advanced transaction management and concurrency control
CO3	Analyze and solve complex database problems
CO4	Understand concepts of data recovery process

Course Details:

Data storage and querying
- Overview of Physical Storage Media
- RAID
- File Organization
- Organization of Records in Files
- Data-Dictionary Storage

Indexing and Hashing
- Basic Concepts
- Ordered Indices
- B+-Tree Index Files
- Static Hashing
- Dynamic Hashing
- Bitmap Indices

Query Processing and Query Optimization
- Measures of Query Cost
- Selection Operation
- Sorting
- Join and other Operation
- Evaluation of Expressions
- Transformation of Relational Expressions
- Estimating Statistics of Expression Results
- Choice of Evaluation Plans

Transactions
- Transaction Concept
- Storage Structure
- Transaction Atomicity and Durability
- Transaction Isolation
- Serializability
- Recoverability
- Test for Serializability

Concurrency Control
- Lock-Based Protocols
- Deadlock Handling
- Multiple Granularity
- Timestamp-Based Protocols
- Validation-Based Protocols
- Multi-Version Schemes
- Snapshot Isolation

Recovery System
- Failure Classification
- Recovery Algorithm

Case studies of various DBMS

Introduction to Distributed Databases

Reference Books

1. Database System Concepts, Abraham Silberschatz), Henry F. Korth, S. Sudarshanl, McGraw Hill; 7th edition, 2021
2. Database Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education; Third edition 2014
3. Fundamentals of Database Systems, Elmasri Ramez , Navathe Shamkant, Pearson Education; Seventh edition 2017

Course Code: CSE-S512 **Breakup: 3 – 1 – 0 – 4**
Course Name: Computational Geometry

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Analyze randomized algorithms for small domain problems
CO2	Use line-point duality to develop efficient algorithms.
CO3	Apply geometric techniques to real-world problems in graphics
CO4	Solve linear programs geometrically.

Course Details:

Convex hulls:
construction in 2d and 3d, lower bounds; Triangulations: polygon triangulations, representations, point-set triangulations, planar graphs; Voronoi diagrams: construction and applications, variants; Delayney triangulations: divideand- conquer, flip and incremental algorithms, duality of Voronoi diagrams, min-max angle properties;

Geometric searching:
pointlocation, fractional cascading, linear programming with prune and search, finger trees, concatenable queues, segment trees, interval trees;

Visibility:
algorithms for weak and strong visibility, visibility with reflections, art-gallery problems; Arrangements of lines: arrangements of hyperplanes, zone theorems, many-faces complexity and algorithms;

Combinatorial geometry:
Ham-sandwich cuts, Helly's theorems, k-sets, polytopes and hierarchies, polytopes and linear progarmming in d-dimensions, complexity of the union of convex sets, simply connected sets and visible regions; Sweep techniques: plane sweep for segment intersections, Fortune's sweep for Voronoi diagrams, topological sweep for line arrangements;

Randomization in computational geometry: algorithms, techniques for counting; Robust geometric computing; Applications of computational geometry.

Textbooks and Refrences

1. M. de Berg, M. van Kreveld, Mark Overmars & Otfried Schwarzkopf, "Computational Geometry: Algorithms and Applications," Second Edition, Springer-Verlag, 2000. ISBN: 3-540-65620-0.
2. Computational Geometry (An Introduction), by Franco P Preparata and Michael Shamos, Springer- Verlag, 1985.
3. Computational Geometry In C (Second Edition), by Joseph O'Rourke, Cambridge University Press, 1998.

Course Code: **CSE-S513** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Computer Vision**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Identify basic terminology, theories and models in the field of Computer Vision.
CO2	Analyze different methods of Computer Vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.
CO3	Use and apply appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation.
CO4	Assess which methods to use for solving a given problem, and analyze the accuracy of the methods.
CO5	Design of Computer Vision system for a specific problem.

Course Details:

Image Formation Models
Monocular imaging system, Orthographic & Perspective Projection , Camera model and Camera calibration. Binocular imaging systems.

Image Processing and Feature Extraction
Image representations (continuous and discrete), Edge detection.

Motion Estimation
Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.

Shape Representation and Segmentation
Deformable curves and surfaces, Snakes and active contours, Level set representations Fourier and wavelet descriptors, Medial representations, Multiresolution analysis.

Object recognition
Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal component analysis, Shape priors for recognition.

Text Books and References:

1. Computer Vision - A modern approach, by D. Forsyth and J. Ponce, Prentice Hall,2003
2. Robot Vision, by B. K. P. Horn, MIT Press 1986
3. Introductory Techniques for 3D Computer Vision, by E. Trucco and A. Verri, Publisher: Prentice Hall.
4. Computer Vision: Algorithms and Applications, Richard Szeliski, Springer; 2011th edition, 2010
5. Modern Computer Vision with PyTorch: Explore deep learning concepts and implement over 50 real-world image applications, V Kishore Ayyadevara (Author), Yeshwanth Reddy, Packt Publishing Limited, 2020

Course Code: **CSE-S514** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Embedded Systems**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems.
CO2	Learn to develop the hardware for embedded system application based on the processors.
CO3	Explore the features of the microcontrollers and provide appropriate solutions for any embedded application.
CO4	Analyze the embedded systems' specification and develop software programs.
CO5	Incorporate suitable microcontroller along with appropriate interfacing circuits and implement the same for an application with software programs

Course Details:

Introduction
Introduction to embedded systems – hardware and software components – types – examples – characteristics
– challenges in Embedded computing system design – embedded system design processes.
Architecture of Embedded System
Hardware components – SOC – Processors – CPU – Types of memory – Memory management – I/O devices and interfacing – Software components – Interpreter – Compiler – Assembler – Cross Assembler – RTOS – Languages for embedded applications – Hardware and software architecture. Examples: Cellphone, Smartcard, Digital Thermometer.
OS for Embedded Systems
Introduction to real time theory – Operating System Services – Real time Operating System Concepts – Basic design using a RTOS – Underground tank monitoring system.

Performance Issues of an Embedded System
CPU performance – CPU Power Consumption – Analysis and Optimization of CPU Power Consumption program execution time – Analysis and optimization of energy and power – Analysis of program size – Hardware accelerators.
Design Examples
Personal Digital Assistants – Set Top Boxes – Ink Jet Printers – Telephone PBX. Introduction to Micro C/OS-II operating system and its uses.

Text Books and References:

1. Wayne Wolf, (2001). "Computer as Components – Principles of Embedded Computing System Design", Harcourt India Pvt Ltd.,
2. David E Simon, (2004) "An Embedded Software Primer", Pearson Education,
3. Raj Kamal, (2003) "Embedded Systems – Architecture, Programming and Design", Tata McGraw Hill,.
4. Sriram V Iyer, Pankaj Gupta, (2004) "Embedded Realtime Systems Programming", Tata McGraw Hill,
5. K.V.K.K. Prasad, (2004) "Embedded/Realtime Systems: Concepts, Design and Programming", Dreamtech Press,.

Course Code: **CSE-S515** **Breakup:** **3 – 1 –0 – 4**
Course Name: **Web Technology**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Students are able to develop a dynamic webpage by the use of java script and DHTML
CO2	Students will be able to write a well formed / valid XML document
CO3	Students will be able to connect a java program to a DBMS and perform insert, update and delete operations on DBMS table
CO4	Students will be able to write a server side java application called Servlet to catch form data sent from client, process it and store it on database
CO5	Students will be able to write a server side java application called JSP to catch form data sent from client and store it on database, applying professional ethics

Course Details:

Introduction and Web Development Strategies
History of Web, Protocols governing Web, Creating Websites for individual and Corporate World, Cyber Laws, Web Applications, Writing Web Projects, Identification of Objects, Target ,Users, Web Team, Planning and Process Development.

HTML, XML and Scripting
List, Tables, Images, Forms, Frames, CSS Document type definition, XML schemes, Object Models, Presenting XML, Using XML Processors: DOM and SAX, Introduction to Java Script, Object in Java Script, Dynamic HTML with Java Script.

Java Beans and Web Servers
Introduction to Java Beans, Advantage, Properties, BDK, Introduction to EJB, Java Beans API. Introduction to Servelets, Lifecycle, JSDK, Servlet API, Servlet Packages: HTTP package, Working with Http request and response, Security Issues.

JSP
Introduction to JSP, JSP processing, JSP Application Design, Tomcat Server, Implicit JSP objects, Conditional Processing, Declaring variables and methods, Error Handling and Debugging, Sharing data between JSP pages- Sharing Session and Application Data.

Database Connectivity Database Programming using JDBC, Studying Javax.sql.*package, accessing a database from a JSP page, Application-specific Database Action, Developing Java Beans in a JSP page, Introduction to Struts framework.

Text Books and References:

1. Collaborative Web Development: Strategies and Best Practices for Web Teams, Jessica Burdman, Addison Wesley 1999
2. Chris Bates, “Web Programing Building Internet Applications”, John Wiley & Sons Inc; 3rd edition 2006
3. Joel Sklar , “Principal of web Design” Cengage; 5th edition 2012
4. Core Java: An Integrated Approach, R. Nageswara Rao, Dreamtech Press 2016
5. Herbert Schieldt, The Complete Reference:Java, McGraw Hill; Standard Edition 2022
6. Hans Bergsten, “Java Server Pages”, O′Reilly; 1st edition 2001

Course Code: **CSE-S516** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Bioinformatics Concepts: A computer Science Perspective**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
CO2	Get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
CO3	Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics
CO4	Explain about the methods to characterize and manage the different types of Biological data
CO5	Classify different types of Biological Databases.
CO6	Understand the basics of sequence alignment and analysis
CO7	Overview about biological macromolecular structures and structure prediction methods.

Course Details:

Unit 1: Cell Structure and function of cell, Introduction of DNA, RNA, Protein, Carbohydrate and Lipids,
Structure of Protein (primary, secondary Tertiary and quaternary), Gene and non coding RNA. Protein folding and function, Nucleic acid-Protein interaction. Enzymes: details of enzyme nomenclature and classification; units of enzyme activity; coenzymes and metal cofactors; temperature and pH effects; Michaelis-Menten kinetics; Inhibitors and activators; active site and catalytic mechanisms; covalent and non-covalent regulations; isoenzymes; osmolytes and intracellular modulation of enzymes.

Unit 2: Biological Databases both protein and Nucleotide, Sequence similarity search program and Algorithm , Pairwise and Multiple sequence Alignment program, Shannon Entropy, BLAST Algorithm , FASTA Algorithm, Protein Substitution Matrix (BLOSUM and PAM), Nucleotide Substitution Matrix, Profile, Heuristic based approach
Unit 3: Computational representations of molecular biological data storage techniques: databases (flat, relational and object oriented), and controlled vocabularies, general data retrieval techniques: indices, Boolean search, fuzzy search and neighboring, application to biological data warehouses.
Unit 4: Hidden Markov Model and their application for profile analysis, Genetic Algorithm and its use in Structure Prediction of biomolecules , Nussinov algorithm for RNA secondary structure prediction, SOM, Cluster Analysis :Nearest neighbour search ,Search using stem numbers ,Search using text signatures, Phylogenetic Analysis Tools: Maximum Likelihood, Parsimony methods, Distance methods, Model Comparison.

Text Books and References:

1. Fundamentals of Biochemistry, D., Voet, Voet, J.G. & Pratt, C. W. (John Wiley & Sons, 2 edition, 2006)
2. Computational Molecular Biology: An Algorithmic Approach, Pavel Pevzner (MIT Press, 2000)
3. An Introduction to Bioinformatics Algorithms, Neil C. Jones (The MIT Press 2004)

4. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids, Richard Durbin, Sean R. Eddy , Anders Krogh, Graeme Mitchison (Cambridge University Press 1998)
5. Bioinformatics: Sequence and Genome Analysis, David W. Mount (Cold Spring Harbor Laboratory Press 2001
6. Statistical methods in bioinformatics: an introduction, Ewens, W. J. & Grant, G. R., (New York. Springer, 2001

Course Code: **CSE – S517** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Wireless & Mobile Computing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Demonstrate knowledge on : cellular concepts like frequency reuse, fading, equalization, CDMA.
CO2	Demonstrate knowledge hand-off and interface and apply the concept to calculate link budget using path loss model.
CO3	Demonstrate knowledge equalization and different diversity techniques.
CO4	Apply the concept of GSM in real time applications.
CO5	Compare different multiple access techniques in mobile communication.
CO6	Study applications of different types of MANET's Algorithm.

Course Details:

Introduction:
History of wireless communication, Cellular Telephone system, Mobile & Wireless devices, GSM, CDMA standards, Mobile services.

Wireless Transmission:
Frequencies for radio Transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation.

Modern Wireless Communication System:
2G Cellular networks, 3G wireless networks, WLL, WLANs, Bluetooth & Personal Area Network.

The Cellular Concept:
Frequency Reuse, channel assignment strategies, Handoff strategies, Interference & system capacity, improving coverage & capacity.

Mobile Radio Propagation: (Large Scale Path Loss):
Introduction to radio wave propagation, free space propagation model, Relating power to electric field, Three basic propagation mechanisms, Reflection, Ground reflection.

Small Scale Fading & Multipath: Small scale multipath propagation, Impulse response model of a multipath channel, small scale multipath measurements, parameters of mobile multipath channels.

Wireless Networking:
Introduction, Difference b/w fixed & wireless telephone networks, Development of Wireless Networking, Traffic Routing in wireless networks, CCS, ISDN.

Speech coding:
Introduction, characteristics of speech signals, Quantization Techniques, ADPCM, Frequency Domain Coding of Speech, Vocoders.

Text Books and References:
1. Wireless Communication –Theodore . S. Rappaport, (PHI 2002),2nd edition
2. Mobile Communication - Jochen Schiller, Adison Wisley, 2nd Edition 2003

Course Code: **CSE – S518** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Artificial Intelligence**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
CO4	Demonstrate proficiency-developing applications in an 'AI language', expert system shell, or data-mining tool.
CO5	Demonstrate proficiency in applying scientific method to models of machine learning, apply AI to solve global problems

Course Details:

Introduction:
Introduction to AI, Foundations of AI, History of AI, Concept of AI techniques, the underlying assumptions, the state of art

Intelligent agents:
Agents and Behavior, The concept of rationality, Agent Architecture

Problem solving:
Problems, problem space and search – Formulating problems, Designing the problems as state space search, Issues in the design of search programs

Uninformed Search Techniques: Breadth first, Depth first, Depth limited, Iterative deepening, bidirectional, etc
Heuristic/Informed Search Techniques:
Generate and test, Best first search, A* search, Memory bounded heuristic search, Hill climbing search, Simulated annealing search, local beam search, genetic algorithms

Constraint Satisfaction Problem, Means End Analysis Adversial Search: Optimal decitions in games, Minmax algorithm, Alpha Beta Pruning

Knowledge Representation – knowledge representation issues, the predicate calculus representing knowledge using rules, symbolic reasoning, uncertainty, Probabilistic reasoning.
Languages and programming technique for AI:
An Introduction to PROLOG or LISP

Text Books and References:

1. S.J. Russell and P. Norvig , Artificial intelligence : A Modern Approach , Pearson; 3rd edition 2010
2. Elaine Rich and Kaven Knight – Artificial Intellegence McGraw Hill Education; 3rd edition, 2017
3. Introduction to Artificial Intelligence, Mariusz Flasiński, Springer, 1st ed. 2016
5. Introduction to Artificial Intelligence, Patterson, Pearson, 2015

Course Code: **CSE – S519** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Advance Computer Architecture**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Interpret the performance of a processor based on metrics such as execution time, cycles per instruction (CPI), Instruction count etc
CO2	Predict the challenges of realizing different kinds of parallelism (such as instruction, data, thread, core level) and leverage them for performance advancement
CO3	Apply the concept of memory hierarchy for efficient memory design and virtual memory to overcome the memory wall
CO4	Explore emerging computing trends, computing platforms, and design trade-offs Teaching Methodology: Depends on the Instructor(s)

Course Details:

Review of pipelining, example of some pipelining in modern processors, Pipeline hazards, data hazards,
control hazards, techniques to handle hazards. Performance improvement with pipelines and effect of hazards on the performance.

Vector processor – use and effectiveness, memory to memory vector architectures vector register architecture. Vector length and stride issues. Compiler effectiveness in vectorization. Example of modern vector processors. Single instruction multiple data stream (SIMD) architecture, array processors, comparison with vector processors, example of array processors such as MMX technology.

Advance pipeline techniques, instruction level parallelism, basic instruction scheduling to avoid conflicts, dynamics scheduling, effect of loop unrolling. Branch prediction and their effectiveness in reducing control stalls, multiple issue of instruction compiler support for exploiting instruction level parallelism, issues of cache design.

Memory hierarchy. Cache Introduction, technique to reduce cache misses, techniques to reduce cache penalties, techniques to reduce cache hit times. Effect of main memory bandwidth, effect of bus width memory access time virtual memory etc.

RISC architectures, addressing modes, instruction formats, effect of simplification, on the performance example processors such as MIPS, PA-RISC, SPARC, PowerPC etc.

MIMD Multiprocessors. Centralized shared memory architectures, distributed shared memory architecture, synchronization and memory consistency models, message passing architectures, compiler issues. Dataflow architectures.

Interconnection networks: World wide parallel processing projects, Architecture of multiprocessor and multicomputer machines like hypercube, MMS, mesh CM*, CMP Iliac IV, Monsoon machine, dataflow architecture CM machine, teraflop computers.

Text Book and References:

1. Kai. Hwang, Advance computer architecture, MacGraw Hill, 1993.

2. Schaum's Outline of Computer Architecture, Nick Carter, McGraw-Hill Education 2002
3. Structured Computer Organization, Tanenbaum, Pearson Education India; Sixth edition 2016
4. Parallel Computer Architecture: A Hardware/Software Approach (The Morgan Kaufmann Series in Computer Architecture and Design), Anoop Gupta (Author), David Culler (Author), J.P. Singh, Morgan Kaufmann Publishers In 1998
5. Advance computer architecture, Amit Mishra, S.K. Kataria & Sons; 2012th edition 2012

Course Code: **CSE – S520** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Machine Learning**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Appreciate the importance of visualization in the data analytics solution
CO2	Apply structured thinking to unstructured problems
CO3	Understand a very broad collection of machine learning algorithms and problems
CO4	Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theory
CO5	Develop an appreciation for what is involved in learning from data.

Course Details:
Introduction: Introduction to machine learning, supervised learning, unsupervised learning Reinforcement learning.

Revision: Basics of Probability Theory, Basics of Linear Algebra and Statistical Decision Theory.

Supervised learning:
Linear regression: Linear Regression, Linear discriminant analysis, Polynomial Regression. Ridge Regression, Lasso Regression. Parameter Estimation: Least Square, Least Mean Square, Gradient Descent.

Classification: Two class classification, Multi-class classification, Concept of Loss functions for classification

Classification algorithms:
Logistic Regression: Introduction. to Logistic Regression, Types of Logistic Regression, Regression Models, Binary Logistic Regression Model, Multinomial Logistic Regression Model, Naive Bayes: Bayes Theorem, The Naive Bayes' Classifier.
Decision trees, Regression trees, Stopping criteria &pruning.
SVM:SVM—formulation,interpretation&analysis,SVMsforlinearlynon-separabledata,SVM kernels. SVM hinge loss formulation.
Artificial Neural Networks: Concept of Perceptron & Parameter Estimation, Early artificial neural network models , Feed forward networks, Recurrent Networks. Concept of Back propogation, Initialization, training & validation, Maximum Likelihood estimate.
Unsupervised learning:
Clustering: Partitional clustering, Hierarchical clustering, K- Means, II- NN, Dimensionality reduction, BIRCH algorithm.
Association Mining: Frequent Itemset Mining, Apriori algorithm, FP-growth algorithm.

Evaluation Measures & Hypothesis Testing: Evaluation measures, Bootstrapping & cross validation, 2 class evaluation measures, The ROC curve.

Introduction to Advance Topics: Recommendation systems, Deep learning etc.

Text Book and References:

1. Tom M. Mitchell : "Machine Learning", 2013.
2. Hal Daume III: "A Course in Machine Learning, 2012.
3. Christopher M. Bishop, "" Pattern Recognition and Machine Learning", 2010.

4. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach : "Deep Learning", 2017.

Course Code: **CSE-S521** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Data Mining and Data Warehousing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand data mining principles and techniques: Introduce DM as a cutting edge business intelligence method and acquaint the students with the DM techniques for building competitive advantage through proactive analysis, predictive modelling, and identifying new trends and behaviours. Learning objectives include:
CO2	Building basic terminology.
CO3	Learning how to gather and analyse large sets of data to gain useful business understanding
CO4	Learning how to produce a quantitative analysis report/memo with the necessary information to make decisions
CO5	Describing and demonstrating basic data mining algorithms, methods, and tools
CO6	Identifying business applications of data mining
CO7	Overview of the developing areas - web mining, text mining, and ethical aspects of data mining

Course Details:

Unit I:

Data Warehousing: Need for data warehousing , Basic elements of data warehousing, Data Mart, Data Warehouse Architecture, extract and load Process, Clean and Transform data, Star ,Snowflake and Galaxy Schemas for Multidimensional databases, Fact and dimension data, Partitioning Strategy-Horizontal and Vertical Partitioning.

Unit II:

Data Warehouse and OLAP technology, Multidimensional data models and different OLAP Operations, OLAP Server: ROLAP, MOLAP, Data Warehouse implementation ,Efficient Computation of Data Cubes, Processing of OLAP queries, Indexing data.

Unit III:

Data Mining: Data Preprocessing ,Data Integration and Transformation, Data Reduction, Discretizaion and Concept Hierarchy Generation , Basics of data mining, Data mining techniques, KDP (Knowledge Discovery Process), Application and Challenges of Data Mining, Introduction of Web Structure Mining, Web Usage Mining, Spatial Mining, Text Mining, Security Issue, Privacy Issue, Ethical Issue.

Unit IV:

Mining Association Rules in Large Databases: Association Rule Mining, Single-Dimensional Boolean Association Rules, Multi-Level Association Rule, Apriori Algorithm, Fp-Growth Algorithm, Time series mining association rules, latest trends in association rules mining.

Unit V:

Classification and Clustering Distance Measures, Types of Clustering, K-Means Algorithm,Decision Tree Induction, Bayesian Classification, Association Rule Based, Other Classification Methods, Prediction, Classifier Accuracy, Categorization of methods, Partitioning methods, Outlier Analysis.

Text Books and References:

1. Data Mining: Concepts and Techniques, A volume in The Morgan Kaufmann Series in Data Management Systems, Third Edition, 2012
2. P.Ponnian, "Data Warehousing Fundamentals", John Wiley & Sons Inc; 2nd edition 2010
3. M.H.Dunham, "Data Mining Introductory & Advanced Topics", Pearson Education.
4. Ralph Kimball, "The Data Warehouse Lifecycle Tool Kit", John Wiley.
5. M.Berry , G.Linoff, "Master in Data Mining", Wiley; 3rd edition 2008
6. W.H.Inmon, "Building the Data Ware houses", Wiley; 4th edition 2005
7. E.G. Mallach , "The Decision Support & Data Warehouse Systems", McGraw-Hill Education 2000
8. Data Warehousing in the Real World: A practical guide for building Decision Support Systems, D. Murray, Addison-Wesley; 1st edition 1997
9. David Hand, Heikki Manila, Padhraic Symth, "Principles of Data Mining", PHI 2004..
10. Alex Bezon, Stephen J.Smith, "Data Warehousing, Data Mining & OLAP", McGraw Hill Education 1 July 2017

Course Code: **CSE-S522** **Breakup:** **3 – 1– 0 – 4**
Course Name: **Multi-core architectures**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Identify the limitations of Instruction-level parallelism and the need for multicore architectures
CO2	Define fundamental concepts of parallel programming and its design issues
CO3	Solve the issues related to multiprocessing and suggest solutions
CO4	Make out the salient features of different multicore architectures and how they exploit parallelism
CO5	Demonstrate the role of OpenMP and programming concept

Course Details:

Introduction to multi-core architectures, issues involved into writing code for multi-core architectures, how to develop programs for these architectures, program optimizations techniques.
OpenMP and other message passing libraries, threads, mutex etc.

Introduction to parallel computers:
Instruction level parallelism (ILP) vs. thread level parallelism (TLP); Performance issues: Brief introduction to cache hierarchy and communication latency; Shared memory multiprocessors: General architectures and the problem of cache coherence.

Synchronization primitives:
Atomic primitives; locks: TTS, ticket, array; barriers: central and tree; performance implications in shared memory programs.

Chip multiprocessors:
Why CMP (Moore's law, wire delay); shared L2 vs. tiled CMP; core complexity; power/performance; Snoopy coherence: invalidate vs. update, MSI, MESI, MOESI, MOSI; performance trade-offs; pipelined snoopy bus design; Memory consistency models: SC, PC, TSO, PSO, WO/WC, RC; Chip multiprocessor case studies: Intel Montecito and dual-core Pentium4, IBM Power4, Sun Niagara.

Introduction to optimization:
Overview of parallelization; Shared memory programming, introduction to OpenMP; Dataflow analysis, pointer analysis, alias analysis; Data dependence analysis, solving data dependence equations (integer linear programming problem); Loop optimizations; Memory hierarchy issues in code optimization; Operating System issues for multiprocessing Need for pre-emptive OS.

Scheduling Techniques:
Usual OS scheduling techniques, Threads, Distributed scheduler, Multiprocessor scheduling, Gang scheduling; Communication between processes, Message boxes, Shared memory; Sharing issues and Synchronization, Sharing memory and other structures, Sharing I/O devices, Distributed Semaphores, monitors,spin-locks,

Text Books and References:

1. Computer Architecture: A Quantitative Approach (The Morgan Kaufmann Series in

Computer Architecture and Design), John L. Hennessy (Author), David A. Patterson, Morgan Kaufmann; 6th edition 2017

2. Parallel Computer Architecture: A Hardware/Software Approach (The Morgan Kaufmann Series in Computer Architecture and Design), Anoop Gupta (Author), David Culler (Author), J.P. Singh, Morgan Kaufmann Publishers, 1998
3. Kai hwang, Advance computer architecture. Mac Graw Hill 1993

Course Code: **CSE – S523** **Breakup : 3 – 1 – 0 – 4**
Course Name: **Cloud Computing**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Ability to understand various service delivery models of a cloud computing architecture.
CO2	Evaluate the ways in which the cloud can be programmed and deployed
CO3	Understanding cloud service providers
CO4	Analyzing the Infrastructure as a Service in Cloud computing
CO5	Apply cloud programming and software environments in different systems

Course Details:

Overview of cloud computing: What is a cloud, Definition of cloud, Definition of cloud, characteristics of cloud, Why use clouds, How clouds are changing, How clouds are changing, Driving factors towards cloud, Comparing grid with cloud and other computing systems, workload patterns for the cloud, "Big Data", IT as a service.
Cloud Computing Concepts: Concepts of cloud computing, Cloud computing leverage the Internet, Positioning cloud to a grid infrastructure, Elasticity and scalability, Virtulazation, Characteristics of virtualization, Benefits of virtualization, Virtualization in cloud computing, Hypervisors, Multitenancy, Types of tenancy, Application programming interfaces (API), Billing and metering of services, Economies of scale, Management, tooling, and automation in cloud computing. Management, Desktops in the Cloud, Security.
Cloud service delivery: Cloud service, Cloud service model architectures, Infrastructure as a service (IaaS) architecture, Infrastructure as a service (IaaS) details, Platform as a service (PaaS) architecture, Platform as a service (PaaS) details, Platform as a service (PaaS), Examples of SaaS applications, Trade-off in cost to install versus, Common cloud management platform reference architecture Architecture overview diagram, Common cloud management platform, cloud deployment scenarios Cloud deployment models, Public clouds, Hybrid clouds, Community, Virtual private clouds, Vertical and special purpose. Migration paths for cloud, Selection criteria for cloud deployment.
Security in cloud computing: Cloud security reference model, How security gets integrated, cloud security, Understanding security risks, Principal security dangers to cloud computing, Virtualization and multitenancy, Internal security breaches, Data corruption or loss, User account and service hijacking Steps to reduce cloud security breaches, Steps to reduce cloud security breaches, Reducing cloud security, identity management; Detection and forensics, Identity management Detection and Identity management, Benefits of identity, Encryption techiniques, Encryption & Encrypting data, Symmetric key encryption, Asymmetric key encryption, Digital signature, What is SSL? IBM Smart Cloud, Amazon Web Services, Google Cloud platform, Windows Azure platform, Acomparison of Cloud Computing Platforms, Common building Books.

Text Books and References:

1. Raj Kumar Buyya, James Broberg, Andrezei M Goscinski, Cloud Computing Principles and paradigms 2011
2. Michael Miller, Cloud Computing 2008
3. Judith Hurwith, Robin Bllor, Marcia Kaufman, Fern Halper, Cloud Computing for dummies, 2009
4. Anthony T Velte, Toby J Velte and Robert Elsenpeter, Cloud Computing A Practical Approach, McGraw Hill, 2010.
5. Barrie Sosinksky, Cloud Computing Bible, Wiley, 2011.6. Borko Furht, Armando Escalante (Editors), Handbook of Cloud Computing, Springer, 2010.

Course Code: **CSE-S524** **Breakup:** **3 – 0 – 3 – 5**
Course Name: **Python Programming**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Interpret the fundamental Python syntax and semantics and be fluent in the use of Python control flow statements.
CO2	Express proficiency in the handling of strings and functions
CO3	Determine the methods to create and manipulate Python programs by utilizing the data structures like lists, dictionaries, tuples and sets
CO4	Identify the commonly used operations involving file systems and regular expressions.
CO5	Articulate the Object-Oriented Programming concepts such as encapsulation, inheritance and polymorphism as used in Python

Course Details:

Introduction to Python Programming.

Installing Python: Python IDE, basic syntax, interactive shell, editing , saving, and running a script, the concept of data types.

Basics: Variables, Python Operators: Arithmetic, Comparison. Assignment, Bitwise, etc. Control flow statements: If, If Else, Break & Continue, For Loop and While Loop.

Implementation of OOPs Paradise: Class, object, inheritance, operator overloading, exceptional handling.

Python Data types: List, tuples, dictionary, set.

Implementation of basic data structure: Stack, queue, link list, binary search tree.
Introduction to some libraries: NumPy, matplotlib, pandas, Jupiter notebook , Scikit learn etc.

Text Books and References:

1. John M. Sewart, “Python for Scientist”, Cambridge University Press; 2nd edition, 2017.
2. Reema Thareja, “Python Programming” Oxford University Press; First edition, 2017.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python“ Addison-Wesley Professional; 1st edition, 2015
4. Mark Litz, “ Learning Python”,O’ Reilly, 2013
5. Mark Pilgrim, “Dive into Python”, Apress; 2nd ed. Edition, 2009
6. James L. Young, “Python made Simple and Practical”, Createspace Independent Pub, 2017
7. Y. Daniel Liang “Introduction to Programming using Python” Pearson Education; First edition, 2017

Course Code: **CSE-S526** **Breakup:** **3 – 1 – 0- 4**
Course Name: **Deep Learning**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the main fundamentals that drive Deep Learning
CO2	Be able to build, train and apply fully connected deep neural networks
CO3	Know how to implement efficient CNN or RNN.
CO4	Understand the key features in a neural network's architecture

Course Details:

Introduction: History of Neural network, an overview of Linear models, Hebbian learning Processing units: Perceptrons (classification), Limitations of Linear nets and Perceptrons, Activation functions, Error functions.
Neural Network : Neural network architecture, Multi-layer neural network, Practical advice, Optimization, Bias-variance dilemma, Overfitting, Inductive bias,
Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and Optimization.
Conditional Random Fields: Linear chain, partition function, Markov network, belief propagation, Training CRFs, Hidden Markov Model, Entropy.
Deep Learning: Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.
Probabilistic Neural Network: Hopfield Net, Boltzman machine, RBMs, Sigmoid net, Autoencoders.
Deep Learning research: Object recognition, sparse coding, computer vision, natural language processing.
Deep Learning Tools: Caffe, Tlieano, Torch.

Text Books and References:

1. Goodfel1ow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016..
2. Bishop, C. ,M., Pattern Recognition and Machine Learning, Springer, 2006.
3. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
4. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education,
5. Ravindran, K. M. Ragsdell , and G. V. Reklaitis , ENGINEERING OPTIMIZATION: Methods and Applications , John Wiley & Sons, Inc. , 2016

Course Code: **CSE - S527** **Breakup: 3 – 1 – 0 – 4**
Course Name: **Geographic Information System**

Course outcomes (CO): At the end of the course, the student will be able to:

CO1	Understand the concepts of Photogrammetry and compute the heights of objects
CO2	Understand the principles of aerial and satellite remote sensing, Able to comprehend the
CO3	Energy interactions with earth surface features, spectral properties of water bodies.
CO4	Understand the basic concept of GIS and its applications, know different types of data
CO5	Understand the basic concept of GIS and its applications, know different types of data
CO6	representation in GIS
CO7	Understand and Develop models for GIS spatial Analysis and will be able to know what the questions that GIS can answer are
CO8	Apply knowledge of GIS software and able to work with GIS software in various application fields
CO9	Illustrate spatial and non-spatial data features in GIS and understand the map projections and coordinates systems
CO10	Apply knowledge of GIS and understand the integration of Remote Sensing and GIS

Course Details:

FUNDAMENTALS OF GIS:

Introduction to GIS – Basic spatial concepts – Goordinate Systems – GIS and Information Systems – Definitions - History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open sources software – Types of data – Spatial. Attribute datatypes of attributes – scales/ levels of measurements.

SPATIAL DATA MODELS:

Database Structures – Relational, Object Oriented – Entities – ER diagram – data models conceptual, logical and physical models – spatial data models – Raster Data Structures – Roster Data Compression – Vector Data Structures – Raster vs Vector Models – TIN and GRID data models.

DATA INPUT AND TOPOLOGY:

Scanner – Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input Digitiser Datum Projection and reprojection – Coordinate Transformation – Topology – Adjacency, connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data linking – Linking External Databases – GPS Data Integration.

Text Books and References:

1. Kang-Tsung Chang, “Introduction to Geographic Information Systems”, 2nd Edition, MeGraw Hill Publishing, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju. “An Introduction Geographical Information Systems, 2nd Edition, Pearson Education. 2007.

3. Lo Albert C.P. Yeung K.W. Concepts and Techniques of Geographic Information Systems, Prentice Hall of India Publishers, 2006.