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
(Specialization in Artificial Intelligence)

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	**17**
Humanities and Social Science Core	**11**
Departmental Core	**79**
Departmental Electives	**8**
Open Electives	**4**
Projects and Seminars	**24**
Total	**170**

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-S102	Workshop Concepts	1	1	3	5
4	CHM-S101	Chemistry-I	3	0	3	5
5	ESC-S101	Basic Electrical & Electronics Engg.	3	1	3	5
6.	UHV-S101	Universal Human Values –I (SIP)	0	0	0	0
		Total	**13**	**4**	**12**	**24**

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.	ISC-S101	Programing in C & Unix	3	0	3	5
4.	TCA-S101	Engineering Drawing	0	2	4	5
5.	HSS-S101	Communicative English	3	1	0	4
		Total	**12**	**5**	**10**	**23**

2nd Year - Semester III

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MTH-S201	Mathematics-III	3	1	0	4
2	CSE-S207	Object Oriented Programing with Python	3	0	3	5
3	CSE-S202	Digital Electronics & Logic Design	3	0	2	4
4	MTH-S301	Discrete Mathematics	3	1	0	4
5	UHV-S201	Universal Human Values-II	2	1	0	3
6.	CSE-SST201	Internship-1	0	0	2	1
		Total	**14**	**3**	**5**	**21**

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-S208	Data Structure using Python	3	0	3	5
3	CSE-S206	Operating Systems	3	2	0	5
4	MTH-S504	Probability & Statistics	3	1	0	4
5	CSE-S205	Computer Organization	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-S518	Artificial Intelligence	3	1	0	4
4	CSE-S304	Theory of Computation	3	1	0	4
5	CSE-S308	Introduction to Data Science	3	0	2	4
6.	CSE-SST301	Internship-2	0	0	2	1
		Total	**15**	**3**	**5**	**22**

3rd Year - Semester VI

Sl. No.	Course Code	Course Title	L	T	P	Credits
1	CSE-S511	Adv. Database Management System	3	0	3	5
2	CSE-S306	Computer Networks	3	2	0	5
3	CSE-S307	Software Engineering	3	1	0	4
4	CAP-S101	Capstone Project	0	0	2	2
5	CSE-S520	Machine Learning	3	1	0	4
		Total	**12**	**4**	**5**	**20**

4th Year - Semester VII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1	CSE-S513	Computer Vision	3	1	0	4
2	SST-S401	Summer Training	0	0	3	2
3	MRT-S401	Minor Project	0	0	6	4
4	CSE-S526	Deep Learning	3	1	0	4
5	CSE-S5--	Departmental Elective	3	1	0	4
6	CSE-S5--	Departmental Elective	3	1	0	4
		Total	**12**	**4**	**9**	**22**

4th Year - Semester VIII

Sl. No.	Course Code	Course Title	L	T	P	Credits
1.	MRT-S402	Major Project				16
		Total				**16**

Total Credits – 172

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-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: 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)

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.
1 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: 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:

2. Introduction to Electrodynamics by D.J. Griffiths, 3E, Prentice-Hall of India Private Limited, 2002.
3. Vector Analysis by M. R. Spiegel, Schaum's Outlines, 2021
4. Optics by Ajoy Ghatak, McGraw Hill Education (India) Private Limited, 7th Edition,2020
5. A textbook of Optics by Subrahmanyam, Brijlal and Avadhanulu, Schand; 23rd Rev. Edition. 2006.
6. Classical electrodynamics by J. D. Jackson,Wiley, 3rd edition, 1998.
7. Concept of Modern Physics by Aurthur Beiser, McGraw-Hill Education,6th Edition 2021.
8. 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: 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, 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: 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: 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-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: **CSE- S207** **Breakup:** **3 – 0 – 3 – 5**
Course Name: **Object Oriented Programming with Python**

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

CO1	Setup python to develop simple applications.
CO2	Make use of the python programming language to construct basic programs.
CO3	Knowhow to use collections such as list, tuple, range, dictionary and sets.
CO4	Make use of functions, classes and objects from those classes.
CO5	Understand the concepts of inheritance and polymorphism for code reusability and extensibility.
CO6	Write robust code using exception handling.
CO7	Create and animate a variety of shapes and develop an application with graphical user interface (GUI).
CO8	Extend the knowledge of python programming to build successful career in software development.

Course Details:
Introduction: The Programming Cycle for Python , Python IDE, Interacting with Python Programs , Elements of Python, Type Conversion.
Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.
Conditionals: Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation.
Loops: Purpose and working of loops , While loop including its working, For Loop , Nested Loops , Break and Continue.
Function: Parts of A Function , Execution of A Function , Keyword and Default Arguments ,Scope Rules. Strings : Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings.
Python Data Structure : Tuples , Unpacking Sequences , Lists , Mutable Sequences , List Comprehension , Sets , Dictionaries
Higher Order Functions: Treat functions as first class Objects , Lambda Expressions
Sieve of Eratosthenes: generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes.
File I/O : File input and output operations in Python Programming , Exceptions and Assertions, Modules : Introduction , Importing Modules , Abstract Data Types : Abstract data types and ADT interface in Python Programming.
Classes : Class definition and other operations in the classes , Special Methods (such as _init_,_str_, comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.Iterators & Recursion: Recursive Fibonacci , Tower Of Hanoi
Search : Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time Sorting & Merging: Selection Sort , Merge List , Merge Sort , Higher Order Sort

Text books:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘, 2nd edition, Updated for Python 3, Shroff/O‘Reilly Publishers, 2016
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘,

Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015. 6.Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
7. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition, 2013.
8. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

Object Oriented Programming with Python Lab

1. To write a python program that takes in command line arguments as input and print the number of arguments.
2. To write a python program to perform Matrix Multiplication.
3. To write a python program to compute the GCD of two numbers.
4. To write a python program to find the most frequent words in a text file.
5. To write a python program find the square root of a number (Newton’s method).
6. To write a python program exponentiation (power of a number).
7. To write a python program find the maximum of a list of numbers.
8. To write a python program linear search.
9. To write a python program Binary search.
10. To write a python program selection sort.
11. To write a python program Insertion sort.
12. To write a python program merge sort.
13. To write a python program first n prime numbers.
14. To write a python program simulate bouncing ball in Pygam

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
2. Morris Mano, Digital Logic and Computer Design, Prentice Hall of India, 1979
3. William I. Fletcher, An Engineering Approach to Digital Design, PHI
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: 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. C.L.Liu : Discrete Mathematics, 4th edition, 2017
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: 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-S208 **Breakup: 3 – 0 – 3 – 5**
Course Name: Data Structure Using Python

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

CO1	**Differentiate static and dynamic memory allocation techniques**
CO2	**Implement various operations on linear and non-linear data structures**
CO3	**Analyze and implement different searching and sorting techniques**
CO4	**Identity the appropriate data structure to solve a given problem**
CO5	**Compute time complexities of different algorithms**

Course Details:
Informal introduction to programmin, algorithms and data structures viagcd, Downloading and installing Python, gcd in Python: variables, operations, control flow - assignments, condition-als, loops, functions, Python: types, expressions, strings, lists, tuples, Python memory model: names, mutable and immutable values, List operations: slices etc Binary search, Inductive function denitions: numerical and structural induction, Elementary inductive sorting: selection and insertion sort, In-place sorting

Basic algorithmic analysis: input size, asymptotic complexity, O() notation, Arrays vs lists, Merge sort, Quicksort, Stable sorting, Dictionaries, More on Python functions: optional arguments, default values, Passing functions as arguments, Higher order functions on lists: map, lter, list comprehension

Exception handling, Basic input/output, Handling files, String processing, Backtracking: N Queens, recording all solutions, Scope in Python: local, global, nonlocal names, Nested functions, Data structures: stack, queue, Heaps.

Abstract datatypes, Classes and objects in Python, "Linked" lists: find, insert, delete, Binary search trees: find, insert, delete, Height-balanced binary search trees, Effcient evaluation of recursive denitions: memorization, Dynamic programming: examples, Other programming languages: C and manual memory management, Other programming paradigms: functional programming

Text and Reference Books:

1. Reema Thareja, “Python Programming Using Problem Solving Approach”, Oxford University Press 2018.
2. Anurag Gupta, G.P. Biswas, “Python Programming: Problem Solving, Packages and Libraries”, McGrawHill, 2020.
3. Allen B. Downey, “Think Python: How to Think Like a Computer Scientist”, Shroff/O'Reilly; Second edition, 2016
4. Updated for Python 3, Shroff/O'Reilly Publishers, 2016
5. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2", Network Theory Ltd., 2011.
6. John V Guttag, “Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
7. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach”, Pearson India Education Services Pvt. Ltd., 2016

Data Structures Lab

Write Program in Python 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-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-S504 **Breakup: 3 – 1 – 0 – 4**
Course Name: Probability and 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:
Probability: Sample Space , Events , Counting Sample Points ,Probability of an Event , Additive Rules , Conditional Probability, Independence and Product Rules , Bayes' Rule Random Variables and Probability Distributions , Concept of a Random Variable , Discrete Probability Distributions , Continuous Probability Distributions ,Joint Probability Distributions.

Mathematical Expectation : Mean of a Random Variable , Variance and Covariance of Random Variables , Means and Variances of Linear Combinations of Random Variables , Chebyshev's Theorem, Some Discrete Probability Distributions :Introduction and Motivation , Binomial and Multinomial Distributions,Hypergeometric Distribution, Negative Binomial and Geometric Distributions , Poisson Distribution and the Poisson Process .

Some Continuous Probability Distributions : Continuous Uniform Distribution , Normal Distribution , Areas under the Normal Curve , Applications of the Normal Distribution , Normal Approximation to the Binomial , Gamma and Exponential Distributions , Chi-Squared Distribution, Sampling Distributions and More Graphical Tools : Random Sampling and Sampling Distributions , Some Important Statistics , Sampling Distributions , Sampling Distribution of Means and the Central Limit Theorem , Sampling Distribution of S2 , t-Distribution , F-Distribution.

One- and Two-Sample Estimation Problems: Introduction , Statistical Inference , Classical Methods of Estimation , Single Sample: Estimating the Mean , Standard Error of a Point Estimate , Prediction Intervals , Tolerance Limits , Single Sample: Estimating the Variance, One- and Two-Sample Tests of Hypotheses : Statistical Hypotheses: General Concepts , Testing a Statistical Hypothesis , The Use of P-Values for Decision Making in Testing Hypotheses , Single Sample: Tests Concerning a Single Mean.

Text and Reference Books:
1. Probability and Statistics for Engineers and Scientists, 9/E, by Walpole, Myers, Myers, Ye, Pearson 2012

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: 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

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

Nested Subqueries

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

Dependencies

Lossless Join Decomposition

Dependency preserving Decomposition

Normalization

Introduction to Concurrency Control

Introduction to Transaction Management

Text and References 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-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 – 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: **CSE- S308** **Breakup:** **3 – 0 – 2 – 4**
Course Name: **Introduction to Data Science**

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

CO1	Develop relevant programming abilities.
CO2	Demonstrate proficiency with statistical analysis of data.
CO3	Develop the ability to build and assess data-based models.
CO4	Execute statistical analyses with professional statistical software.
CO5	Demonstrate skill in data management.

Course Details:

Fundamentals of Data Manipulation with Python: Introduction to Specialization,Introduction to the Course, The Coursera Jupyter Notebook System, Python Functions, Python Types and Sequences, Python More on Strings, Python Demonstration: Reading and Writing CSV files, Python Dates and Times, Advanced Python Objects, map(), Advanced Python Lambda and List Comprehensions, Numerical Python Library (NumPy), Manipulating Text with Regular Expression

Basic Data Processing with Pandas:
Introduction to Pandas, The Series Data Structure, Querying a Series, DataFrame Data Structure, DataFrame Indexing and Loading, Querying a DataFrame, Indexing Dataframes, Missing Values

More Data Processing with Pandas:
Understanding of the python pandas library by learning how to merge DataFrames, generate summary tables, group data into logical pieces, and manipulate dates. Understanding of scales of data, and discuss issues with creating metrics for analysis. Merging Dataframes, Pandas Idioms, Group by, Scales, Pivot Table, Date/Time Functionality
Principles of Information Visualization:
Matplotlib Architecture, Basic Plotting with Matplotlib, Scatterplots, Line Plots, Bar Charts
Charting Fundamentals:
Subplots, Histograms, Box Plots, Heatmaps, Animation

Text Books and References:

1. Practical Statistics for Data Scientists, Bruce and Andrew Bruce, O′Reilly; 2nd edition, 2020
2. Introduction to Probability – By Joseph K. Blitzstein and Jessica Hwang, Chapman and Hall/CRC; 1st edition, 2014
3. Python for Data Analysis – By Wes McKinney, O′Reilly; 2nd edition, 2017
4. The Elements of Statistical Learning — Data Mining, Inference, and Prediction, by Trevor Hastie, Robert Tibshirani, Jerome Friedman, Springer-Verlag New York Inc, 9th printing 2017 edition
5. The Art of Data Science — A Guide for Anyone Who Works With Data, by Roger D. Peng and Elizabeth Matsui, Lulu.com, 2016

Course Code: **CSE-S511** **Breakup: 3 – 0 – 3 – 5**
Course Name: **Adv. Database Management System**

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

CO1	Identify advance database concepts and database models.
CO2	Apply and analyse various terms related to transaction management in centralized and distributed database
CO3	Produce data modelling and database development process for object –oriented DBMS.
CO4	Analyse and Implement the concept of object- relational database in development of various real time software.
CO5	Examine the issues related to multimedia and mobile database performance.

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

Text and 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-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.
ata 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

Text Book and References:

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: **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-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	Analyse 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

Computer Vision 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)

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 to TensorFlow : Computational Graph, Key highlights, Creating a Graph, Regression example, Gradient Descent, TensorBoard, Modularity, Sharing Variables,Keras Perceptrons: What is a Perceptron, XOR Gate

Activation Functions : Sigmoid,ReLU, Hyperbolic Fns, Softmax Artificial Neural Networks : Introduction, Perceptron Training Rule, Gradient Descent Rule

Gradient Descent and Backpropagation: Gradient Descent, Stochastic Gradient Descent, Backpropagation, Some problems in ANN

Optimization and Regularization : Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters

Introduction to Convolutional Neural Networks: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications Introduction to Recurrent Neural Networks: Introduction to RNNs, Unfolded RNNs, Seq2Seq RNNs, LSTM, RNN applications

Deep Learning applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics

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-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, 2nd 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-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-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:

Introduction introduction to cloud computing – definition of cloud – evolution of cloud computing – underlying principles of parallel and distributed computing – cloud characteristics – elasticity in cloud – on-demand provisioning.

cloud enabling technologies service oriented architecture – rest and systems of systems – web services – publish-subscribe model – basics of virtualization – types of virtualization – implementation levels of virtualization – virtualization structures – tools and mechanisms – virtualization of cpu – memory – i/o devices – virtualization support and disaster recovery.

cloud architecture, services and storage layered cloud architecture design – nist cloud computing reference architecture – public, private and hybrid clouds – laas – paas – saas – architectural design challenges – cloud storage – storageas-a-service – advantages of cloud storage – cloud storage providers – s3.

resource management and security in cloud inter cloud resource management – resource provisioning and resource provisioning methods – global exchange of cloud resources – security overview – cloud security challenges – software-as-aservice security – security governance – virtual machine security – iam – security standards.

Cloud technologies and advancements hadoop – mapreduce – virtual box — google app engine – programming environment for google app engine — open stack – federation in the cloud – four levels of federation – federated services and applications – future of federation.

Text Books and References:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

Course Code: **CSE-S525** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Internet of Things**

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

CO1	Explain the definition and usage of the term "Internet of Things" in different contexts
CO2	Understand the key components that make up an iot system
CO3	Differentiate between the levels of the iot stack and be familiar with the key technologies and protocols employed at each layer of the stack
CO4	Apply the knowledge and skills acquired during the course to build and test a complete, working iot system involving prototyping, programming and data analysis
CO5	Understand where the iot concept fits within the broader ICT industry and possible future trends
CO6	Appreciate the role of big data, cloud computing and data analytics in a typical iot system

Course Details:

Module I: IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

Module II:IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Module III: IOT ARCHITECTURE - IoT Open source architecture (OIC) - OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Module IV: WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.

Module V: IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Text Books and References:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition,• VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to• ConnectingEverything", 1st Edition, Apress Publications, 2013
3. CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011

Course Code: **CSE-S530** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Text Analytics**

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

CO1	Explain the text analytics framework
CO2	Analyse various sources of text data.
CO3	Measure machine learning model performance with appropriate metrics.
CO4	Interpret the results, gain insights, and recommend possible actions from analytics performed on text data.

Course Details:

Introduction to text mining: Roots of text mining - Information extraction and text mining - Development of enabling technology in text mining - Sentiment analysis and opinion mining. Definition - Business challenges addressed: information organization and access - Discovery of patterns.

Text analytics: Text analytics and text mining - Future of text mining - Practice areas of text analytics - Finding the appropriate solution to a problem - Visualizing the domains of text analytics.

Clustering: Text Capturing, sorting, sifting, stemming and matching – word cloud, wordless and beyond –Clustering document using words – sentiment and counting

Predictive model: Word regression – Classification that grow on trees: CHAID and CART applications – Bayes Nets.

Applications and tools: Application of text mining - Case study – Limitations of Google analytics.

Text Books and References:

1. Gary Miner John Elder IV, Robert Nisbet, DursunDelen, Thomas Hill, Andrew Fast, “Practical Text Mining and Statistical Analysis for Non structured Text Data Applications”,1st Edition, Academic Press, ISBN9780123869791, 2012.

2. Steven Struhl,”Practical Text Analytics: Interpreting text and unstructured data for business intelligence”, ISBN : 0749474025, 2015.

Course Code: **CSE-S509** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **SOFT COMPUTING**

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 Networks (Introduction & Architecture), Neuron, Nerve structure and synapse, artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks. Various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propogation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications. Fuzzy Logic-I (Introduction):Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory and operations,Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.
Fuzzy Logic –II (Fuzzy Membership, Rules) Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzificataions, Fuzzy Controller, Industrial applications.
Genetic Algorithm(GA) : Basic concepts, working principle, procedures of GA, flow chart of GA, Genetic representations, (encoding) Initialization and selection, Genetic operators, Mutation, Generational Cycle, applications.

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-S531** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Time Series Data Analysis (Natural Language Processing + Speech recognition)**

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

CO1	**Demonstrate advanced understanding of the concepts of time series and their application to health, climate, finance and other areas.**
CO2	**Demonstrate an advanced understanding the underlying concepts in the time series and frequency domains.**
CO3	**Apply ideas to real time series data and interpret outcomes of analyses.**

Course Details:

Basic Concepts: Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts; Short-Time Fourier Transform, Filter-Bank and LPC Methods.

Speech Analysis, Speech Modeling, Speech Recognition and Speech Synthesis
Linguistic Background, Knowledge Representation and Reasoning
Grammars and Parsing, Features and Augmented Grammars, Grammars for Natural Language, Encoding Uncertainty, Ambiguity Resolution and Semantics and Logical form

Text Books and references :

1. Lawrence Rabinerand Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003. 2.
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition”, Pearson Education. Pearson Education India; 2nd edition, 2013
3. Steven W. Smith, “The Scientist and Engineer’s Guide to Digital Signal Processing”, California Technical Pub; 1st edition, 1997
4. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson Education, Pearson Prentice Hall, 2001
5. Claudio Becchetti and Lucio Prina Ricotti, “Speech Recognition”, John Wiley and Sons, 1999.
6. Ben gold and Nelson Morgan, “Speech and audio signal processing”, processing and perception of speech and music, Wiley- India Edition, 2006 Edition.
7. James Allen, Natural Language Understanding, Pearson; 2nd edition, 1994
8. Jurafsky & Martin – Speech & Language Processors, Pearson; 2nd edition, 2008

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 in face of 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:

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

3. Wireless communication & networks: William Stallings, Pearson; 1st edition 2015
4. IPV6 Essentials , Silvia Hagen ,O'Reilly Media; 3rd edition 2014
5. TCP/IP Clearly Explained, Peter Loshin, Morgan Kaufmann; 4th edition 2003
6. 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 – S529** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **AI in Network Security**

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

CO1	Discuss the cyber security threat landscape, professional ethics in cyber security applications
CO2	Describe the artificial intelligence techniques commonly used in cyber security applications, such as classification, clustering and anomaly detection techniques.
CO3	Explain the capabilities and limitations of machine learning techniques for security applications including the types of threats that can and cannot be handled by them.
CO4	Decide which artificial intelligence tools are appropriate for dealing with certain security threats to organisations and reason about the level of protection afforded by the tools.
CO5	Apply classification technology to develop a threat detection system by collecting appropriate training data and training appropriate classifiers.
CO6	Apply clustering and anomaly detection techniques to identify anomalous behaviour in log data

Course Details:

- Introduction to network security
- Classical Machine-Learning Paradigms for Data Mining
- Supervised Learning for Misuse/Signature Detection
- Machine Learning for Anomaly Detection
- Machine Learning for Hybrid Detection
- Machine Learning for Profiling Network Traffic
- Emerging Challenges in Cybersecurity

Text Books & References:

1. Data Mining and Machine Learning in Cybersecurity, by Sumeet Dua, Xian Du, Released April 2016, Publisher(s): Auerbach Publications
2. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Nina Godbole and Sunit Belpure, , Wiley
3. Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives , B. B. Gupta, D. P. Agrawal, Haoxiang Wang, , CRC Press, 2018
4. Hands-On Machine Learning for Cybersecurity, by Soma Halder, Sinan Ozdemir, Released December 2018, Publisher(s): Packt Publishing,
5. Machine Learning In Cybersecurity A Complete Guide – 2019, by Gerardus Blokdyk

Course Code: **CSE – S528** **Breakup:** **3 – 1 – 0 – 4**
Course Name: **Nature Inspired Algorithms**

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

CO1	Understand the strengths, weaknesses and appropriateness of nature-inspired algorithms
CO2	Apply nature-inspired algorithms to optimization, design and learning problems.
CO3	Understand fundamental concepts of NP-hardness and computational complexity.
CO4	Prove algorithm convergence rates using probabilistic arguments.
CO5	Analyse search space structure using statistical and information theoretic measures, and explain its impact on algorithm behaviour and output.

Course Details:

Unit I - Introduction:
From Nature to Nature Computing , Philosophy , Three Branches: A Brief Overview, Individuals, Entities and agents - Parallelism and Distributivity Interactivity ,AdaptationFeedback-Self-Organization-Complexity, Emergence and ,Bottom-up Vs Top-Down- Determination, Chaos and Fractals.
UNIT II - Computing Inspired by Nature:
Evolutionary Computing, Hill Climbing and Simulated Annealing, Darwin's Dangerous Idea, Genetics Principles, Standard Evolutionary Algorithm -Genetic Algorithms, Reproduction-Crossover, Mutation, Evolutionary Programming, Genetic Programming
Unit Iii - Swarm Intelligence:
Introduction - Ant Colonies, Ant Foraging Behavior, Ant Colony Optimization, SACO and scope of ACO algorithms, Ant Colony Algorithm (ACA), Swarm Robotics, Foraging for food, Social Adaptation of Knowledge, Particle Swarm Optimization (PSO)
Unit Iv - Immunocomputing:
Introduction- Immune System, Physiology and main components, Pattern Recognition and Binding , Immune Network Theory- Danger Theory, Evaluation Interaction Immune Algorithms , Introduction – Genetic algorithms , Bone Marrow Models , Forest's Algorithm, Artificial Immune Networks

Text Books & References:

1. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
4. Marco Dorrigo, Thomas Stutzle,” Ant Colony Optimization”, PHI,2005