

UNIVERSITY OF LUCKNOW

FACULTY OF ENGINEERING AND TECHNOLOGY

PROGRAME OUTCOMES (POs), PROGRAME SPECIFIC OUTCOMES (PSOs) & COURSE OUTCOMES (COs)

DEPARTMENT OF APPLIED SCIENCE & HUMANITIES

PROGRAMME OUTCOMES (POs)

The Engineering graduates shall demonstrate the following outcomes:

- **PO-1.** The ability to implement strong conceptual knowledge of Physics, Chemistry, Mathematics, Professional Communication, Engineering fundamentals and provide engineering-centric and innovative solutions of complex engineering problems.
- **PO-2.** The ability to identify, formulate, research literature and analyze complex engineering problems reaching substantiated conclusions by using first principles of Physics, Chemistry, Mathematics, Humanities and Engineering Sciences.
- **PO-3.** The ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare, as well as global, cultural, social, environmental and economic factors.
- **PO-4.** The ability to resolve issues of professional and ethical dilemma with sensitivity and address them in the context of organizational development.
- **PO-5.** The ability to function effectively and exhibit decision-making skills, employing analytical and critical thinking ability and augment growth in multidisciplinary settings.
- **PO-6.** The ability to use techniques, skills and modern engineering tools necessary for engineering practice by visualizing and working in laboratory.
- **PO-7.** The ability to communicate effectively at varied professional activities with the engineering community and society at large, such as, being able to comprehend and write effective reports and design documentation, make emphatic presentations, and give and receive clear instruction.
- **PO-8.** The ability to integrate technical, economic, social, cultural and regulatory frameworks for industrial sector planning and resource management by incorporating teamwork.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Upon completion of the programme, the Engineering graduates shall demonstrate the following Programme Specific Outcomes:

- **PSO-1.** To establish a coherent framework of Engineering aptitude in which Applied Sciences & Humanities plays a vital role as it base of all Engineering subjects. Certain topics are essential for every student of Engineering and Technology to pursue, to achieve professional degree with substantial knowledge.
- **PSO-2.** To provide an in-depth understanding of the fundamentals of Applied Science and create a foundation for lifelong learning to facilitate progressive careers in industry, as an entrepreneur and in pursuit of higher studies.

- **PSO-3.** To gather informative relevance about the significance of electrochemistry, molecular orbital theory, nanotechnology, polymer science, water technology, fuels, corrosion science, and spectroscopic techniques.
- **PSO-4.** To develop efficient communication and interpersonal skills, multidisciplinary teamwork and leadership skills which shall enable them to fulfill professional responsibilities and industrial purposes.
- **PSO-5.** To regulate contemporary issues and become ethically upright towards themselves, co-workers, the society and the nation in order to promote peace and harmony.
- **PSO-6.** To analyze stated requirements, use appropriate mathematical models and design necessary optimized algorithmic solutions implemented through desired hardware architecture.
- **PSO-7.** To design and analyze the mathematical models for the problem related to industry and socio-economic world.
- **PSO-8.** To develop algorithm to perform task related to research/training for the industry and education.
- **PSO-9.** To understand theories and concepts of Modern Physics and their application in various micro and macro systems.
- **PSO-10.** To apply software engineering principles and project management skills through synergized teams to cater to the dynamic needs of the industry.
- **PSO-11.** To carry out laboratory experiments taught in Core Theory papers and to understand proper laboratory practices.
- **PSO-12.** To work for sustainable development and comprehend the relationship of biotic and abiotic factors that are related to individual, population, community and ecosystem.

AS 103 Engineering Mathematics - I

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Course Outcomes (COs):

After the completion of the course, students are expected to have the ability to:

- **CO-1.** Use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra, Understand the definitions of Vector Space and its linear Independence, Solve Eigen value problems and apply Cayley Hamilton Theorem.
- **CO-2.** Study the functions of more than one independent variable and calculate partial derivatives along with their applications
- **CO-3.** Explore the idea for finding the extreme values of functions and integrate a continuous function of two or three variables over a bounded region.
- **CO-4.** Understand Curl, divergence and gradient with their applications and have the idea of directional derivatives and derive the equations of tangent planes and normal lines.
- **CO-5.** Calculate line integral, surface integral and volume integral and correlate them with the application of Stokes, Green and Divergence theorem.

Unit - 1: Matrix Algebra

Types of Matrices, Inverse of a matrix by elementary transformations, Rank of a matrix (Echelon & Normal form). Linear dependence. Consistency of linear system of equations and their solution, Characteristic equation. Eigen values and Eigen vectors, Cayley-Hamilton Theorem, Diagonalization, Complex and Unitary Matrices and its properties

Unit -2: Differential Calculus -I

Successive Differentiation, Leibnitz's theorem, Limit, Continuity and Differentiability of functions of several variables. Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Change of variables, Curve tracing: Cartesian and Polar coordinates.

Unit - 3: Differential Calculus - II

Taylor's and Maclaurin's Theorem, Expansion of function of several variables, Jacobian, Approximation of errors. Extrema of functions of several variables, Lagrange's method of multipliers (Simple applications).

Unit - 4: Vector Calculus

Point function. Gradient, Divergence and Curl of a vector and their physical interpretations. Vector identities. Tangent and Normal, Directional derivatives. Line, Surface and Volume integrals. Applications of Green's, Stake's and Gauss divergence theorems (without proof).

Unit - 5: Multiple Integrals

Double and triple integrals. Change of order of integration. Change of variables. Application of integration to lengths, Surface areas and Volumes - Cartesian and Polar coordinates. Beta and Gamma functions, Dirichiefs integral and its applications.

Text Books:

- 1. E. Kreyszig, Advanced Engineering Mathematics, John-Wiley & Sons
- 2. B. V. Ramana, Higher Engineering Mathematics, Tata Me Graw- Hill Publishing Company Ltd.
- 3. R.K.Jain & S.R.K. lyenger. Advance Engineering Mathematics, Narosa Publishing House.

- 1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- 2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
- 3. Thomas & Finley, Calculus, Narosa Publishing House
- 4. Rukmangadachari, Engineering Mathematics -1, Pearson Education.
- 5. A.C.Srivastava&P.K.Srivastava, Engineering Mathematics, Vol.1, PHI Learning Pvt. Limited, NewDelhi.

AS 101 Engineering Physics - I

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Course Outcomes (COs):

After the completion of the course, students are expected to have the ability to:

- **CO-1.** Develop the concept of relativistic mechanics and to explain it in different domains.
- **CO-2.** Develop the understanding of Modern Physics and their application in various micro and macro systems.
- **CO-3.** Develop the understanding of Interference and Diffraction with different experimental results.
- **CO-4.** Illustrate the nature of EM waves and to apply the ideas of production of different types of polarized light and to know about the components and types of laser i.e pulsed and continuous wave.
- **CO-5.** Develop the understanding of components and types of optical fiber with light propagation mechanism and to illustrate construction and reconstruction of holograms.

Unit -1: Relativistic Mechanics

Inertial & non-inertial frames of reference, Galilean transformations, Michelson-Morley experiment, Einstein's postulates, Lorentz transformation equations. Length contraction & Time dilation. Relativistic addition of velocities; Variation of mass with velocity. Mass energy equivalence. Mass less particle.

Unit-II: Modem Physics

Black body radiation, Weins law and Rayleigh-Jeans law. Quantum theory of radiation, Planck's law. Wave-particle duality, de-Broglie matter waves, Bohr's quantization rule. Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications. Wave function and its significance, Time dependent and time independent Schrodinger's wave equations - particle in one dimensional potential box. Eigen values and Eigen function.

Unit - III: Wave Optics

Interference: Coherent sources, condition for sustained Interference in thin films (parallel and wedge shaped film), Newton's rings and its applications.

Diffraction: Types of diffractions, Single, double and N- Slit Diffraction, Diffraction grating. Grating spectra, dispersive power, Rayleigh's criterion and resolving power of grating.

Unit - IV: Polarization and Laser

Polarization: Phenomena of double refraction, Construction and working of Nicol prism. Production and analysis of plane, circular and elliptical polarized light. Retardation Plate, Optical Activity, Fresnel's theory. Specific rotation.

10 Hrs.

08 Hrs.

10 Hrs.

08 Hrs.

Laser: Spontaneous and stimulated emission of radiation, population inversion, Einstein's Coefficients, Coherence, Concept of 3 and 4 level Laser, Construction and working of Ruby, He-Ne lasers, Laser applications.

Unit - V: Fiber Optics and Holography

Fiber Optics: Fundamental ideas about optical fiber. Propagation mechanism. Acceptance angle and cone. Normalized frequency, Numerical aperture. Single and Multi Mode Fibers, Dispersion and Attenuation. **Holography:** Basic Principle of Holography, Construction and reconstruction of Image on hologram and applications of holography.

Reference Books:

- 1. Concepts of Modem Physics AurthurBeiser (Mc-Graw Hill)
- 2. Introduction to Special Theory of Relativity- Robert Resnick (Wielly)
- 3. Optics -AjoyGhatak(Tata McGraw Hill Education Private Ltd. New Delhi)
- 4. Optics Brijlal& Subramanian (S. Chand)
- 5. Engineering Physics- C. Mani Naidu(Pearson)
- 6. Lasers Principles, Types and Applications- K R Nambiar (New Age)
- 7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New.

06 Hrs.

AS 102/AS 202

Engineering Chemistry

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to: **CO-1**. The students will gain knowledge of basic theories of solid materials, nanomaterials and liquid crystals. CO-2. Demonstrate the knowledge of synthesis of polymeric material, which are required for engineering applications. CO-3. Apply basic knowledge of Science and fundamental aspect of cell working, equations in solving electrochemistry problems, functioning of lubricants and the techniques controlling the corrosion. **CO-4**. Analyze the water sample parameters & identify the impurities and its effects. Able to design process for purification of water that is concern with safety of public health & environment. CO-5. Apply basic knowledge of fuels and experimental techniques used in identification of structure of organic/inorganic moieties. 8 Molecular orbital theory and its applications to homo-nuclear diatomic molecules. Band theory of solids. Liquid crystals and its applications. Point defects in Solids. Structure and applications of Graphite and Fullerenes. Concepts of nano-materials and its applications 8 Polymers: Basic concepts of polymer- blends and composites. Conducting

and biodegradablepolymers. Preparations and applications of some industrially important polymers(Buna N, Buna S, Neoprene, Nylon 6, Nylon 6,6, Terylene). General methods of synthesis of organometallic compound (Giignard Reagent) and their applications in polymerization. Unit-3 Electrochemistry: Galvanic cell, electrode potential. Lead storage battery. 8 Corrosion, causes and its prevention. Setting and hardening of cement, applications of cement. Plaster of paris. Lubricants- Classification, mechanism and applications.. Unit-4 Hardness of water. Disadvantage of hard water. Boiler troubles. Techniques 8 for water softening; Lime-soda, Zeolite, Ion exchange resin. Reverse osmosis. Phase Rule and its application to water system. Unit-5 Fuels; Classification of fuels. Analysis of Coal. Determination of Calorific 8 values (bomb calorimeter & Dulong's method). Biogas. Elementary ideas and simple applications of UV, Visible, IR and H^NMR spectral Techniques.

Text Book:

Unit-1

Unit-2

1. Chemistry for Engineers, by S. Vairam and Suba Ramesh; Wiley India

- 1. Textbook of Engineering Chemistry by Dr. Gopal Krishna Bhatt, Acme Publishers
- 2. Chemistry (9th ed), by Raymond Chang, Tata McGraw-Hill
- 3. Chemistry Concepts and Applications by Steven S. Zumdahl; Cengage Learning

- 4. Engineering Chemistry, Wiley India
- 5. Engineering Chemistry Author: Abhijit Mallick, Viva Books
- 6. Text Book of Engineering Chemistry by Harsh Malhotra; Sonali Publications
- 7. Concise Inorganic Chemistry by J.D. Lee; Wiley India
- 8. Organic Chemistry (6 ed) by Morrison & Boyd; Pearson Education
- 9. Physical Chemistry by Gordon M. Barrow; Mc-Graw Hill
- 10. Organic Chemistry, Volume 1(6 ed) & 2 (5ed) by I. L. Finar; Pearson Education
- 11. Atkins' Physical Chemistry by Peter Atkins & Julio De Paula; Oxford University Press.

AS 104/AS 204 Professional Communication

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Course Outcomes (COs): Students are able to demonstrate the following:

- **CO-1.** Understand the communication system for specific purpose.
- **CO-2.** Be able to communicate professionally.
- CO-3. Be able to communicate across organizational levels and cultures effectively.
- **CO-4.** Be able to negotiate with the odds and bring in best of the results with specific success.
- **CO-5.** Be able to understand the human needs and adjust accordingly the set goals.

Unit-I: Fundamentals of Communications

Technical Communication: features: Distinction between General And Technical Communication; Language as a tool of communications; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of communication: Downward, Upward, Lateral/Horizontal (Peer group): Importance of technical communication; Barriers to Communication

Unit-II: Written Communication

Words and Phrases: Word formation, Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; correct Usage: all Parts of Speech; Modals; Concord; Articles; Infinitives; Transformation of sentences; Requisites f Sentence Construction: Paragraph Development: Techniques and Methods- Inductive, Deductive, Spatial, Linear, Chronological etc.

Unit-III: Business Communication

Principles, Sales & Credit letters; Claim and Adjustment Letters; Job Application and Resumes. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal; Parts; Types; Writing of Proposal; Significance; Negotiation skills.

Unit-IV: Presentation Strategies and Soft Skills.

Nuances and Modes of Delivery; Body Language; Dimensions of Speech: Syllable; Accent; Pitch; Rhythm; Intonation; Paralinguistic features of voice; Interpersonal communication: Definition; Types; Team work; Attitude; Way to improve Attitude Listening Skills : Types; Methods for improving Listening Skills.

Unit -V: Value- Based Text Readings

Following essays from the prescribed text book with emphasis on Mechanics of writing.

1. Humanistic and Scientific Approaches to Human Activity by Moody E. Prior

- 2. The Language of Literature and Science by A. Huxley
- 3. Man and Nature by J. Bronowski
- 4. Science and Survival by Barry Commoner
- 5. The Mother of the Sciences by A.J. Bahm.

Text Book:

- 1. Improve your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
- 2. Technical Communication- Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2007, New Delhi.
- 3. Functional skills in Language and Literature, by R.P. Singh, Oxford Univ. Press, 2005, New Delhi.

- 1. Communication Skills for Engineers and Scientists, Sangeeta Sharma et.al. PHI Learning Pvt. Ltd, 2011, New Delhi.
- 2. Business Correspondence and Report Writing by Prof R.C., Sharma& Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
- 3. Word Power Made Easy by Norman Lewis, W.R. Goyal Pub. & Distributors, 2009, Delhi.
- 4. Developing Communication skills by Krishna Mohan, MecraBannerji- Macmillan India Ltd. 1990, Delhi.
- 5. Manual of Practical Communication by L.U.B. Pandey: A.I.T.B.S. Publications India Ltd.; Krishan Nagar, 2013, Delhi.
- 6. English Grammar and Usage by R.P.Sinha, Oxford University Press, 2005, New Delhi.
- 7. Spoken English- A manual of Speech and Phonetics by R.K. Bansal & J.B. Harrison Orient Blackswan, 2013, New Delhi.

AS 203 Engineering Mathematics - II

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Course Outcomes (COs):

After the completion of the course, students are expected to have the ability to:

- **CO-1.** Understand and implement the concept of differential equations and learn various methods to solve ordinary differential equation.
- **CO-2.** Extend the concept of series solutions to solve differential equations and learn orthogonality about the functions.
- **CO-3.** Implement the integral transformation using the concept of Laplace transformation and application to solve differential equations.
- **CO-4.** Learn Fourier series and Fourier transformations for initial and boundary values problems.
- **CO-5.** Application of Partial differential equation as heatequation, wave equation and Laplace equation.

Unit - 1: Ordinary Differential Equations

Linear differential equations of order with constant coefficients. Complementary function and Particular integral. Simultaneous linear differential equations. Solution of second order differential equations by changing dependent & independent variables. Method of variation of parameters. Applications to engineering problems (without derivation).

Unit - 2: Series Solution and Special Functions

Series solution of second order ordinary differential equations with variable coefficient (Frobenius method), Bessel and Legendre equations and their series solutions. Properties of Bessel function and Legendre polynomials.

Unit - 3: Laplace Transform

Laplace transform. Existence theorem, Laplace transforms of derivatives and integrals. Initial and final value theorems. Unit step function, Dirac- delta function, Laplace transform of periodic function. Inverse Laplace transform. Convolution theorem. Application to solve simple linear and simultaneous differential equations.

Unit - 4: Fourier Series and Partial Differential Equations

Periodic functions, Dirichlet's Conditions, Fourier series of arbitrary periods, Euler's Formulae, Even and odd functions, Half range sine and cosine series, Gibbs Phenomena.

Solution of first order Lagrange's linear partial differential equations. Second order linear partial differential equations with constant coefficients.

Unit - 5: Applications of Partial Differential Equations

Classification of second order partial differential equations, Method of separation of variables for solving partial differential equations, Solution of one and two dimensional wave and heat conduction equations, Laplace equation in two dimension, Equation of transmission lines.

Text Books:

- 1. E. Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
- 2. B. V. Ramana, Higher Engineering Mathematics, Tata Me Graw- Hill Publishing Company Ltd.
- 3. R.K.Jain& S.R.K. lyenger, Advance Engineering Mathematics, Narosa Publishing House.

- 1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
- 2. Peter V. O' Neil, Advanced Engineering Mathematics, Thomas (Cengage) Learning.
- 3. Chandrika Prasad, Advanced Mathematics for Engineers, Prasad Mudranalaya
- 4. A. C. Srivastava & P. K. Srivastava, Engineering Mathematics, Vol. II, PHI Learning Pvt. Ltd.
- 5. Rukmangadachari, Engineering Mathematics II, Pearson Education.

AS 201 ENGINEERING PHYSICS - II

Course Outcomes (COs):

After the completion of the course, students are expected to have the ability to:

- CO-1. Know about the fundamentals of crystal physics and illustrations of Nacl and diamond structures.
- CO-2. Understand the concepts of dielectrics and its polarization and different properties of magnetic materials with their hysteresis curve.
- CO-3. Formulate and solve the engineering problems on electromagnetism with the help of Maxwell's equations.
- Understand the basics of band theory of solids and discuss the Fermi energy for **CO-4**. semiconductors.
- CO-5. Develop the understanding of superconductors and its types, superconductivity with BCS theory and to understand the various applications of nanotechnology with the help of nano materials.

Unit -1: Crystal Structures and X-ray Diffraction

Space lattice, basis. Unit cell. Lattice parameter. Seven crystal systems and Fourteen Bravais lattices. Co-ordination number. Atomic radius and Packing factor of different cubic structures. Crystal structure of NaCl and diamond. Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer. Compton Effect.

Unit - II: Dielectric and Magnetic Properties of Materials

Dielectric Properties: Dielectric constant and Polarization of dielectric materials. Relation between E, D and P, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One- Dimensional), Claussius-Mossotti equation. Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Ferroelectricity, Piezoelectricity.

Magnetic Properties: Magnetization, Origin of magnetic moment, Dia, para and ferro magnetism, Langevin's theory for diamagnetic material. Phenomena of hysteresis and its applications.

Unit - III: Electromagnetic Theory

Equation of continuity, Maxwell's Equations (Integral and Differential Forms) and its derivations, Displacement Current, Poynting vector and Poynting theorem, EM - Wave equation and its propagation characteristics in free space, non-conducting and conducting media, energy density of electromagnetic wave, Skin depth.

Unit - IV: Band Theory of Solids

Free electron Theory, Formation of bands in Solids, Classification of solids on band theory. Density of states, Fermi-Dirac distribution, Concept of effective mass. Charge carrier density (electrons and holes), Conductivity of semiconductors, carrier concentrations Fermi energy. Position of Fermi level in intrinsic and in extrinsic semiconductors. Temperature dependence of conductivity in semiconductors.

Unit - V: Physics of some technologically important Materials

Superconductors: Temperature dependence of resistivity in superconducting materials. Effect of magnetic field (Meissner effect), Temperature dependence of critical field, London equations, Josephson theory, persistent currents. Type I and Type II superconductors, BCS theory (Qualitative), High temperature superconductors and Applications of Super-conductors.

06 Hrs.

06 Hrs.

08Hrs.

10Hrs.

10 Hrs.

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Nano-Materials: Basic principle of nanoscience and technology, structure, properties and uses of Fullerene, Carbon nanotubes Single and double walled nanotubes, synthesis of nanotubes. Properties and Applications of nanotubes.

- 1. Concept of Modem Physics by Beiser (Tata Mc-Graw Hill)
- 2. Solid State Physics by C. Kittel, 7th edition (Wiley Eastern)
- 3. Materials Science and Engineering by V. Raghavan (Prentice- Hall India)
- 4. Solid State Physics by S.O. Pillai, 5th edition (New Age International).
- 5. Introduction to Electrodynamics by David J. Griffith (PH I)
- 6. Engineering Physics- C. Mani Naidu(Pearson)
- 7. Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New Delhi)

AS - 301 MATHEMATICS- III

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Course Outcomes (COs):

After completion of the course student will be able to:

- **CO-1.** Deal with sequences and various types of series and their convergence,
- **CO-2.** Determine whether a given complex function is differentiable, and if so find its derivative. Express complex- differentiable functions as power series, find the Singularities, Zeroes and Poles, Residue.
- **CO-3.** Identify of Integral Transforms Fourier integral, Applications of Fourier transform and Z- transform and its application to solve difference equations.
- **CO-4.** Analyze of different Statistical Techniques–I Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Correlation, Linear, nonlinear and multiple regression analysis,.
- **CO-5.** Analysis of Statistical Techniques II Binomial, Poisson and Normal distributions, Sampling theory, Tests of significations: Chi- square test, t-test, and Analysis of variance (one way), Application of. Time series and forecasting.

Unit- I: Sequences and Series

Sequences, Limit of a sequence, Convergence, Divergence and Oscillation of a sequence, Infinite series, Necessary condition for convergence, Standard infinite series, Geometric series and Harmonic series. Tests for convergence and divergence, Comparison test (only for series with positive terms), Cauchy's integral test, D'alembert's ratio test, Cauchy's nth root test, Raabe's test (higher ratio test), Logarithmic test, Demorgan's and Bertrand's tests, Alternating series Leibnitz's theorem (without proof), Absolute convergence and Conditional convergence, Power series.

Unit-II: Function of Complex variable

Analytic function, C-R equations, Harmonic functions, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions, Taylor's and Laurent's series, Singularities, Zeroes and Poles, Residue theorem, Evaluation of real integrals of the type $\int_{0}^{2\pi} f(\cos\theta, \sin\theta)d\theta$ and $\int_{-\infty}^{+\infty} f(x)dx$.

Unit- III: Integral Transforms

Fourier integral, Complex Fourier transform, Inverse transform, Convolution theorem, Fourier sine and cosine transform, Applications of Fourier transform to simple one dimensional heat transfer equations, wave equations and Laplace equations, Z- transform and its application to solve difference equations.

Unit- IV: Statistical Techniques – I

Moments, Moment generating functions, Skewness, Kurtosis, Curve fitting, Method of least squares, Fitting of straight lines, Polynomials, Exponential curves etc., Correlation, Linear, non-linear and multiple regression analysis, Probability theory.

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Unit-V: Statistical Techniques – II

Binomial, Poisson and Normal distributions, Sampling theory (small and large), Tets of significations: Chi- square test, t-test, Analysis of variance (one way), Application to engineering, medicine, agriculture etc. Time series and forecasting (moving and semi-averages), Statistical quality control methods, Control charts, \overline{X} , R, p, np and c charts.

Test Books:-

- 1. Peter V. O'Neil, Advance Engineering Mathematics Thomson (Cengage) Learning, 2007.
- 2. J.N. Kanpur, Mathematical Statistics, S. Chand & company Ttd., 2000

Reference Books:-

- 1. R.K. Jain & S.R.K. Iyenger, Advance Engineering Mathematics, Narosa Publication House, 2002.
- 2. Chandika Prasad, Advanced Mathematics for Engineers, Prasad Mudralaya, 1996.
- 3. B. V. Ramana, Higher Engineering Mathematics, Mc Gra Hill Education, 2016.
- 4. E. Kreysig, Advanced Engineering Mathematics, John Wiley & Sons, 2005.
- 5. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 2005.
- 6. S.P. Gupta, Statistical Methods, Sultan and Sons, New Delhi, 2004.
- 7. Devore, Probability and Statistics, Thomson (Cengage) Learning, 2007.
- 8. Walpole, Myers, Myers & Ye, Probability and Statistics for Engineers & Scientists, Pearson Education, 2003.

AS – 302/402 HUMAN VALUES AND ETHICS

Course Outcomes (COs):

After completion of the course student will be able to

- **CO-1.** This course would help to assess ideas about ethics, self-exploration and happiness through reflective enquiry.
- **CO-2.** It will aid in evaluating the prevailing problems in society due to differentiation and understanding the importance of human values in relationships.
- **CO-3.** The course would lead to knowledge of the ideas of globalization and the world as a nation, for a transformative world order.
- **CO-4.** It will help in analyzing ideas of leadership and creativity and using leadership qualities in day-to-day lives.
- **CO-5.** It will augment an understanding of cross-cultural ethics and help students learn the art of resolving ethical dilemmas in business.

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UNIT 1

Course Introduction

- 1. Understanding: Why humans are ethical, why they are not;
- 2. Understanding the need, basic guidelines, content and process for Value Education;
- 3. Self Exploration–what is it? It's content and process;
- 4. 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration;
- 5. Right understanding of Relationship and Physical Facilities- the basic requirements for fulfilment of aspirations of every human being with their correct priority;
- 6. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario;
- 7. Method to fulfil the above human aspirations: understanding and living in **harmony** at various levels

UNIT 2

Understanding of Human Values and Ethics

- *1*. Understanding the needs of Self ('I') and Body ('Me');
- 2. Understanding values in human-human relationship;
- 3. Meaning of Co-existence and Mutual Satisfaction;
- 4. Understanding Respect;
- 5. Understanding Comprehensive Human Goals;

UNIT 3

Effects of Holistic Harmony on Professional Ethics

- 1. World as a Nation;
- 2. Definitiveness of Ethical Human Conduct;
- 3. Basis for Humanistic Education and Humanistic Universal Order;
- 4. Competence in professional ethics:
 - a) Ability to utilize the professional competence for augmenting universal human order;

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- b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,;
- c) Ability to identify and develop appropriate technologies and management patterns for above production system;
- 5. Strategy for transition from the present state to Universal Human Order:
 - a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers;
 - b) At the level of society: as mutually enriching institutions and organizations;

UNIT 4

Effects of Holistic Personality for Success

- 1. Negotiation as a tool for success;
- 2. Leadership as an attribute of a successful Professional;
- 3. Managing Stress and Time;
- 4. Team Building--creating a harmonious environment with apathy to each other;
- 5. Understanding difference between evolution and revolution;

UNIT 5

Managing Relationship for Success

- 1. Understanding and valuing Cross-Cultural Ethics;
- 2. Managing Relationships (Networking), Personal Effectiveness and Self Leadership;
- 3. Theory of Constraints;
- 4. A Decision Making Model: Ethics as making decisions and choices;
- 5. Conflicts and Ethical Dilemmas;
- 6. Entrepreneurship and Ethics: A sense of business Ethics;
- 7. Pragmatic Behaviour of Business to its Colleagues/Competitors

Text Books:

- 1. Kazuo Ishiguro, 1989, The Remains of the Day, Faber and Faber
- 2. B. L. Bajpai, 2004, *Indian Ethos and Modern Management*. New Royal Book Co., Lucknow. Reprinted 2008;
- 3. Sussan George, 1976, How the Other Half Dies. Penguin Press, Reprint 1991;

Reference Books:

- 1. Amitabh Ghosh, 2008, Sea of Poppies. John Murray Publications.
- 2. R. K. Narayan, 1958, The Guide, Viking Press.
- 3. P. L. Dhar, R. R. Gour, 1990, Science and Humanism, Commonwealth Publishers;
- 4. R. R. Gaur, R. Sangal and G. P. Bagaria, 2010, A Foundation Course in Human Values and Professional Ethics, Excel Books.

Relevant movies and documentaries:

- 1. Story of Stuff (Documentary);
- 2. The Remains of the Day (Movie);
- 3. Pursuit of Happyness (Movie);
- 4. Fences (Movie);
- 5. Gifted (Movie)

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AS – 303/ AS - 403 ENVIRONMENT AND ECOLOGY

Course Outcomes (COs):

After the completion of the course, students are expected to have the ability to:

- **CO-1.** Get the information about environment, ecosystem and also about its functions like Food chain, Ecological pyramids etc.
- **CO-2.** Get the complete information about EIA- Environmental Impact Assessment in which the student will get the knowledge about the projects and the process involved in getting the projects.
- **CO-3.** Get the knowledge about the different types of resources like land, water, mineral and energy and also about the effects of environment by the usage of these resources. Also get the knowledge about the analysis of polluted water.
- **CO-4.** Gain the knowledge about different types of pollution and their treatment techniques like waste water treatment, solid waste management etc.,
- **CO-5.** Get the complete information about the all legal aspects of environment protection.
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Unit I- Fundamentals of Environment & Ecology

Definition, Scope & Importance and Need for public awareness.

Ecosystem- Definition, Energy flow in ecosystem, Ecological succession and Balanced ecosystem. Effect of human activities on food, Shelter, Economic and social security.

Effect of human activities on environment - Agriculture, Housing, Industry, Mining and Transportation activities.

Basics of Environmental Impact, Assessment and Sustainable development.

Unit II- Natural Resources & Environmental Quality standard

Water resources- Availability and quality aspects. Mineral resources, Material Cycle- Carbon, Nitrogen & Sulphur cycles, DO, BOD and COD.

Modern techniques used in analysis of Pollutants- Determination of disinfectants, Pesticides, Ambient Quality standards, Water quality parameters and standards, Turbidity, pH, Suspended solids and hardness,

Unit III- Environmental Pollution & Current Environmental issues

Environmental Pollution-Definition, Causes, Effects and control measure of:

- 1. Air Pollution
- 2. Water Pollution
- 3. Soil pollution
- 4. Marine Pollution

Current environmental issues of importance: Population growth, Climate change & Global warming- effects, Urbanization, Cause of global warming, Acid rain. Ozone layer depletion- causes and effects on health, Control measures. Photochemical smog, Solid waste management, Waste water treatment.

Unit IV- Energy-Types, Sources and Uses

Different types of energy, Conventional and nonconventional sources- Hydro-electric, Fossil fuel based, Nuclear, Solar, Biomass, Geothermal energy and Biogas. Hydrogen as alternative future source of energy.

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Unit V- Environmental protection

Role of Government, Legal aspects, Environment protection Act, Introduction to ISO 14000, Green building concept.

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Text Book-

- 1. Environmental Studies- Dr. D. L. Manjunath, Pearson Education
- 2. Text book of Environment Science and Engineering- M. Anji Reddy- B S Publication
- 3. Elements of Environmental Science and Engineering- Dr. P. Meenakshi- Prentice-Hall of India Pvt Ltd, New Delhi, 2008.
- 4. Environment and Ecology- P.D. Sharma- Rastogi publication 2009.

- 1. Principle of Environmental Science and Engineering- P. Venugopalan Rao, Prentice Hall of India.
- 2. Environmental studies- R. Rajagopalan- Oxford Publication-2005.

CS - 302

NUMERICAL AND STATISTICAL TECHNIQUES IN COMPUTER SCIENCE

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Course Outcomes (COs):

After the completion of the course, students are expected to have the ability to:

- **CO-1.** Apply numerical methods to obtain the approximate solutions to the linear and non-linear transcendental and polynomial equations and find error.
- **CO-2.** Identify numerical methods for various mathematical operations and tasks, such as interpolation formulae like forward, backward, and divided difference formulae.
- **CO-3.** Apply the appropriate techniques for numerical differentiation and integration problems
- **CO-4.** Design the numerical solution of initial value problems of the ordinary differential equations with implicit and explicit methods as appropriate
- **CO-5.** Work numerically on the partial differential equations using different methods through of finite difference.

Unit-I:Introduction

Numbers and their accuracy, Computer Arithmetic, Mathematical preliminaries, Errors and their Computation, General error formula, Error in a series approximation

Solution of Algebraic and Transcendental Equation:

Bisection Method, Iteration method, Method of false position, Newton-Raphson method, Methods of finding complex roots, Muller's method, Rate of convergence of Iterativemethods, Polynomial Equations.

Unit-II: Interpolation

Finite Differences, Difference tablesPolynomial Interpolation: Newton's forward and backward formulaCentral Difference Formulae: Gauss forward and backward formula, Stirling's, Bessel's, Everett's formula.

Interpolation with unequal intervals:Langrange's Interpolation, Newton Divideddifference formula, Hermite's Interpolation

Unit-III: Numerical Integration and Differentiation

Introduction, Numerical differentiationNumerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Boole's rule, Waddle's rule.

Unit-IV: Solution of differential Equations

Picard's Method, Euler's Method, Taylor's Method,Runge-Kutta Methods, Predictor Corrector Methods, Automatic Error Monitoring andStability of solution

Unit-V: Boundary Value problems

Finte difference method, solving eigenvalue problems, polynomial method and power method.

Numerical solution of Partial Differential equations. Elliptic, Parabolic and hyperbolic PDEs.

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Text Books:

1.Jain, Iyengar and Jain, "Numerical Methods for Scientific and Engineering Computations", New Age Int

2.Grewal B S, "Numerical methods in Engineering and Science", KhannaPublishers, Delhi **Reference Books**

- 1. Rajaraman V, "Computer Oriented Numerical Methods", Pearson Education
- 2. Gerald & Whealey, "Applied Numerical Analyses", AW
- 3. T Veerarajan, T Ramachandran, "Theory and Problems in Numerical Methods, TMH
- 4. Pradip Niyogi, "Numerical Analysis and Algorithms", TMH
- 5. Francis Scheld, "Numerical Analysis", TMH
- 6. Sastry S. S, "Introductory Methods of Numerical Analysis", Pearson Education.
- 7. Gupta C.B., Vijay Gupta, "Introduction to Statistical Methods", Vikas Publishing.
- 8. Goyal, M, "Computer Based Numerical and Statistical Techniques", FirewallMedia, New Delhi.

9. JaanKiusalaas, Numerical methods in engineering with MATLAB, Cambridge University

Press

10. C. Woodford and C. Phillips, Numerical methods with worked examples: MATLAB Edition,

Springer

AS - 401 COMPUTER ORIENTED NUMERICAL TECHNIQUES

Course Outcomes (COs):

After completion of the course student will be able to;

- **CO-1**. Apply numerical methods to obtain the approximate solutions to the linear and nonlinear transcendental and polynomial equations and find error.
- **CO-2**. Identify numerical methods for various mathematical operations and tasks, such as interpolation formulae like forward, backward, and divided difference formulae.
- CO-3. Apply the appropriate techniques for numerical differentiation and integration problems
- **CO-4**. Design the numerical solution of initial value problems of the ordinary differential equations with implicit and explicit methods as appropriate
- CO-5. Work numerically on the partial differential equations using different methods through of finite difference.
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Unit I

Problem solving on computer, Algorithms and flow charts.

Introduction to numerical computing, approximations and errors in numerical computations, truncation and round off errors, propagation of errors.

Root finding: Bisection method, regula-falsi method, iteration method, Newton Raphson method.

Secant method, systems of nonlinear equations. Rate of convergence of iterative methods.

Unit II

Matrix algebra & solution of simultaneous linear algebraic equations: Gauss elimination, Gauss Jordan method, LU Decomposition, Jacobi method, Gauss Seidel method, SOR method, convergence of iterative methods. Tridiagonal systems and Thomas algorithm, Condition of a system and stability issues.

Unit III

Interpolation and Extrapolation: Finite differences, Newton's forward and backward interpolation formula, Lagrange interpolation formula. Divided differences and Newton's formula.

Numerical differentiation. Numerical integration: Trapezoidal and Simpson's rules. Newton-Cotes integration formulas, Romberg integration, Gaussian quadrature.

Unit IV

Numerical solution of O.D.E.: Taylor series method, Euler's method, Runge Kutta method. Multistep method: Milne,s method, Adams method, accuracy, convergence criteria, stiffness.

Unit V

Boundary Value problems: Finte difference method, solving eigenvalue problems, method. Numerical solution of Partial Differential polynomial method and power equations. Elliptic, Parabolic and hyperbolic PDEs.

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Text Books :

- 1. Jain, Iyengar and Jain, Numerical Methods for Scientific and Engineering Computation (2003), New Age International, New Delhi.
- 2. Grewal B.S., Numerical Methods in Engineering and Science, Khanna Publishers, Delhi.
- 3. E.Balagurusamy, Numerical Methods, Tata Mc Graw hill.

- 1. Sastry, S.S. Introductory Methods of Numerical Analysis, 3rd ed. Prentice Hall of India, New Delhi (2002).
- 2. Schaum's Outlines: Numerical Analysis, 2nd ed. Tata Mc Graw Hill Publishing Co. Limited (1968).
- 3. Kandasamy, P. Thialagawathy, K. &Gumawathy, K. Numerical Method, S Chand & Company Ltd., New Delhi (1999)
- 4. Balaguruswanmy, E. Numerical Methods. Tata Mc Graw Hilll Publishing Co. Limited, New Delhi (2001)

AS - 404 **DISCRETE MATHEMATICAL STRUCTURE**

Course Outcomes (COs):

After the completion of course, the student will be able to:

- **CO-1**. Apply logical skills developed in this course, in various computer applications.
- CO-2. Apply the computing skills to formulate, solve and analyse interdisciplinary realworld problems for higher study and research.
- **CO-3**. Apply various algebraic structures in different branches of computer science
- **CO-4**. Apply Graph theoretical concepts to modal, analyse and solve real-world problems.

UNIT I

Set Theory: Introduction, Combination of sets, Multi sets, ordered pairs, Set identities. Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Order of relations.

Functions: Definition, Classification of functions, Operations on functions, Recursively defined functions.

UNIT II

Propositional Logic: Proposition, Logical connectives, Truth tables, Well formed formula, Tautology, Contradiction, Algebra of proposition, Normal forms, Modus ponens, Modus tollens, Validity.

Predicate Logic: First order predicate, Well formed formula of predicate, Quantifiers, Inference theory of predicate logic.

Notion of Proof: Proof by implication, converse, inverse, contra-positive, Negation and contradiction, Direct proof, Proof by using truth table, Proof by counter example.

UNIT-III

Combinatories: Mathematical induction, Basics of counting, Pigeonhole principle, Permutations, Combinations, Inclusion-exclusion.

Recurrence Relations & Generating function: Recurrence relation of order n with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation, Generating function Closed form expression, Properties of G.F., Solution of recurrence relation using G.F., Solution of combinatorial problem using G.F.

UNIT IV

Algebraic Structures: Binary composition and its properties, Definition of algebraic structure, Semi group, Monoid, Group, Abelain group, Properties of groups, Permutation group, Sub group, Cyclic group, Rings and Fields(definition and standard results), and Integers modulo n.

UNIT V

Elements of coding theory: Introduction, Definitions, Error detecting & correcting code, Harmonic Code and distance, Theorems.

Group (Linear) Codes, Decoding methods. Parity check and Generator matrix, Definition parity check Matrix decoding, Coset decoding.

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Hamming's Codes: Concept, implementation as error correcting code, single error correcting (SEC) Code and single error correcting & double error detection code (SEC-DED).

Text Books:

- 1. Liu and Mohapatra, "Elements of Discrete Mathematics", McGraw Hill
- 2. Y.N. Singh, "Discrete Mathematical Structures", Wiley India, New Delhi, 2010.
- 3. R.P. Grimaldi, Discrete and Combinatorial Mathematics, Addison Welsy,
- 4. S.K. Sarkar, "A Text Book of Discrete Mathematics", S.Chand& Company Ltd., 2012.

- 1. Kenneth H. Rosen, "Discerete Mathematics and its Applications", Mc Graw Hill, 2002.
- 2 J.P. Tremblay & R. Manohar, "Discrete Mathematical Structure with Applications to Computer Science" Mc Graw Hill, 1975.
- 3. V. Krishnamurthy, "Combinatories: Theory and Applications", East-West Press.
- 4. Seymour Lipschutz, M.Lipson, "Discrete Mathematics" Tata Mc Graw Hill, 2005.
- 5. Kolman, Busby Ross, "Discrete Mathematical Structures", Prentice Hall Internatinal.

AS-701 ENGINEERING ECONOMICS

Course Outcomes (COs):

After completion of the course student will be able to:

- **CO-1.** Understand key economic analytical principles for decision-making among alternative courses of action in engineering
- **CO-2.** Learn about the nature of economics and demand analysis.
- **CO-3.** Understand about concept of supply, cost analysis and demand forecasting.
- **CO-4.** Learn about market structure.
- **CO-5.** Learn about nature and characteristics of Indian economy
- **CO-6.** Using analytical techniques including benefit-cost ratio and breakeven analysis, solve economic problems involving comparison and selection of alternatives.

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Unit-1

Introduction of Engineering Economics and Demand Analysis: Meaning and nature of economics, relation between science, engineering, technology and economics; Meaning of demand, determinants of demand, shifts in demand, law of demand, price elasticity of demand &types, income elasticity, cross price elasticity, determinants of elasticity and uses and importance of elasticity. **08**

Unit-2

Concept of Supply: Law of supply, factors affecting supply, and elasticity of supply. Demand forecasting: introduction, meaning and forecasting, methods or techniques of demand forecasting, criteria for good demand forecasting and demand forecasting for a new product. 08

Unit-3

Cost Analysis: Introduction, types of costs, cost-output relationship: cost function, costoutput relationships in the short run, and cost-output relationships in the long run; Short run and long run, break- even analysis; Production functions: laws of variable proportions, law of returns and economies of scale: internal and external. **08**

Unit-4

Market Structure: Market structure perfect competition, imperfect competition – monopolistic, oligopoly and duopoly sorbent features of price determination and various market conditions. 08

Unit-5

Nature and characteristics of Indian economy: Concepts of LPG, elementary concepts of national income, inflation and business cycles ,concept of N.I and measurement, meaning of inflation, types and causes and phases of business cycle investment decisions for boosting economy(national income and per capital income). 08

Text Books:

1. Premvir Kapoor, "Sociology and Economics for Engineers", Khanna Publishing.

- 2. D. Salvatore, "Principles of Microeconomics", Oxford University Press.
- 3. A. Koutsoyiannis, "Modern Microeconomic", Macmillan Education Ltd.

- D. N. Dwivedi, "Principles of Microeconomics", Pearson Education.
 F. A. Cowell, "Microeconomic Principles and Analysis", Oxford University Press.
 J. L. Riggs, "Engineering Economics", McGraw Hills.

AS-702 INDUSTRIAL MANAGEMENT

Course Outcomes (COs):

After completion of the course student will be able to:

- **CO-1.** Understand the basic concept of Industrial management and its types and ownership.
- **CO-2.** Know the functions of management with the help of scientific theory and human resource management.
- **CO-3.** Know the objective and measurement in work study and use the different model of inventory control.
- **CO-4.** Design the control chart for variable and attributes in statistical quality control and implementing sampling plan.
- **CO-5.** Analyze the project management scheme in project network analysis

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Unit-1

Introduction: Concept and scope of industrial management. **Productivity:** definition, measurement, productivity index, types of production system and industrial ownership. **08**

Unit-2

Functions of Management: Taylor's scientific management theory, Fayol's principles of management, social responsibilities of management, introduction to human resources management: nature of HRM, functions and importance of HRM. **08**

Unit-3

Work Study: Introduction, definition, objectives, steps in work study; **Method study:** Definition, objectives, steps of method study; **Work measurement:** Purpose, types of study: Stop watch methods steps: Allowances, standard time calculations, work sampling, production planning and control inventory control: inventory, cost, models of inventory control: EOQ, ABC, VED. **08**

Unit-4

Quality Control: Statistical quality control, control charts for variables and attributes, acceptance sampling: single sampling- double sampling plans and introduction to TQM. 08

Unit-5

Project Management: Project network analysis, CPM, PERT and project crashing and resource leveling. 08

Text Books:

- 1. Gideon Halevi, "Industrial Management- Control and Profit: A Technical Approach" Springer.
- 2. A.P. Verma and N. Mohan "A Textbook of Industrial Management" S.K. Kataria& Sons.
- 3. S. K. Sharma, Savita Sharma "Industrial Engineering and Organization Management", Kataria and Sons.

- 1. S.C. Sharma & T.R. Banga, "Engineering Management" (Industrial Engineering & Management), Khanna Book Publishing Co.
- 2. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd.
- 3. Paneer Selvam, "Production & Operation Management", PHI.

APPENDIX

List of Open Electives

Note: Students may opt any one subject from the following list of open electives with restriction in some subjects as mentioned-

S.No.	Subject	Subject Name	Subject Offered by	Remark
	Code		Department of	
1.	OE -8024	Advances in Polymer Science	Applied Science&	
		Technology	Humanities	
2.	OE -8025	Mathematical Modeling and	Applied Science&	
		Simulation	Humanities	
3.	OE -8026	Nanoscience and Quantum	Applied Science&	
		Computing	Humanities	
4.	OE -8027	Entrepreneurship Development	Applied Science&	
			Humanities	
5.	OE -8028	Critical And Logical Thinking	Applied Science&	
			Humanities	

OE-8024

ADVANCES IN POLYMER SCIENCE TECHNOLOGY

COURSE OUTCOMES (COs)

After the completion of the course, students are expected to have the ability to:

- **CO-1.** Get knowledge of calculation of molecular weight of polymers.
- **CO-2.** Get know about rate of different polymerization reactions
- **CO-3.** Get know about morphology and deformation causes in polymers.
- **CO-4.** Get know the use of composites and conducting in technology
- **CO-5.** Get knowledge about various processing techniques of polymers like plastic, fibres and elastomers.

UNIT 1:

Characteristics and Analysis of Polymers

Basic concept of Polymer Science, Measurement of molecular weight and size, Polymer degradation, Analysis and testing of polymers.

UNIT 2:

Mechanism and Kinetics of Polymerisation

Free radical, Cationic, Anionic, Coordination polymerization and their kinetics. Step Growth polymerization and their kinetics, Ring opening polymerization.

UNIT 3:

Structure and Properties of Polymers

Morphology in crystalline polymers, Calculation of crystallinity, Polymer structure and physical properties, Deformation, flow and melt characteristics, Rheology and mechanical properties of polymers.

UNIT 4:

Composites, Conducting Polymers

Definition, types of composites, preparation methods, testing of composites, Applications of composites in technology. Conducting polymers- Definition, Synthesis and application in technology.

UNIT 5:

Processing of Polymers- Plastics, Fibers and Elastomers

Plastics-extrusion, injection molding, blow molding, compression and transfer molding; Spinning of fibers. Elastomers: Utility of Vulcanization and Reinforcement in Engineering.

Text Books:

- F.W. Billmeyer, "Text Book of Polymer Science", 3rdEdn., Wiley Inter Science.
- V. R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar, "Polymer Science" 3rd Edition, New Age International Publishers.

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- F. Rodriguez, "Principles of polymer systems",4thEdn., Taylor and Francis, Washington.
- Fried, J.R., "Polymer Science and Technology", Prentice Hall, Inc.

OE-8025

Mathematical Modeling and Simulation

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Course Outcome (COs):

After completion of the course student will be able to:

- **CO-1**. Define, describe and apply basic concepts related to modeling and simulation.
- **CO-2**. Importance of simulation, how to simulate real world problems.
- Simulation of real world problems like water reservoir, autopilot, servo **CO-3**. system.
- **CO-4**. Develop mathematical model for real world problems.
- Model and simulate mechanical and electrical systems using the computer CO-5. tools Simulink.

UNIT I

Introduction to Modeling and Simulation:System definition and components, stochastic activities, continuous and discrete systems, system modeling, types of models, static and dynamic physical models, static and dynamic mathematical models, full corporate model, types of system study. Introduction to Simulation, appropriate and not appropriate, advantages and disadvantage, application areas, history of simulation software, MATLAB as a Simulation tool.

UNIT II

System simulation, why& when to simulate, nature and techniques of simulation, comparison of simulation and analytical methods, types of system simulation, real time simulation, hybrid simulation, simulation of pure-pursuit problem, single-server queuing system and an inventory problem, Monte-Carlo simulation, Distributed Lag models, Cobweb model.

UNIT III

Simulation of continuous systems, analog vs. digital Simulation, Simulation of water reservoir system, Simulation of a servo system, simulation of an autopilot, Discrete system simulation, fixed time-step vs. even to even model, generation of random numbers, test for randomness, Monte-Carlo computation vs. stochastic simulation.

Unit IV

System dynamics, exponential growth models, exponential decay models, modified exponential growth models, logistic curves, generalization of growth models, system dynamic diagrams.

Introduction to SIMSCRIPT: Program, system concepts, origination, and statements, defining the telephone system model.

UNIT V

Simulation of PERT Networks, critical path computation, uncertainties in activity duration, resource allocation and consideration. Simulation languages and software, continuous and discrete simulation languages, expression based languages, object oriented simulation, general purpose vs. application - oriented simulation packages, CSMP-III, MODSIM-III.

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Text Books:

- 1. Geoftrey Gordon, "System Simulation", PHI
- 2. Narsingh Deo, "System Simulation with digital computer"PHI

Reference Books

1. Jerry Banks, John S. C Barry L. Nelson David M. Nicol, "Discrete Event System Simulation", Pearson Education

2. V P Singh, "System Modeling and simulation", New Age International.

3. Averill M. Law, W. David Kelton, "System Modeling and simulation and Analysis", TMH

OE-8026 Nanoscience and Quantum Computing

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Course Outcome:

After completion of the course student will be able to:

- **CO-1.** Apply engineering and physics concepts to the nano-scale and noncontinuum domain. Identify and compare state-of-the-art nanofabrication methods and perform a critical analysis of the research literature. Design processing conditions to engineer functional nanomaterials.
- **CO-2.** Explain the fundamental science and quantum mechanics behind nanoelectronics. Explain the concepts of a quantum well, quantum transport and tunnelling effects. Differentiate between microelectronics and nanoelectronics and to understand basic and advanced concepts of nanoelectronic devices, sensors
- **CO-3.** Understand the general concepts of photon trapping and plasmons in nanooptics, nano-photonics etc and to explain the basic functions, properties and different methods of Nanoholes and photons, solar energy, solar cells, optically used nanomaterials, Photoniccrystals.
- **CO-4.** Impart knowledge on *Nanomaterials* for *biomedical* applications such as Proteins and applications, Drug delivery systems and to explain fabrication of nanoporous and nanofluidic devices and itsapplications.
- **CO-5.** Provide a brief idea about quantum information and quantum Computing, Superposition, Measurement and working principle of quantum computers.

UNIT - I: Nanomaterials and Nano-structures

Brief review of nanomaterials: Fullerenes, Nanotubes, Nanowires, Quantum Dots, Dendrites, Synthesis- Top Down, Bottom Up, Plasma arcing, Chemical vapour Deposition, sol-gel methods, Characterization using Electron Microscopy Techniques: Scanning Electron Microscopy, Transmission Electron Microscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy, Scanning Probe Microscopy, X ray methods, Fluorescence, Properties of nanomaterials.

UNIT –II:Nanoelectronics

Introduction – micro, and nano fabrication: Optical lithography, Electron beam lithography, Atomic lithography, Molecular beam epitaxy, Quantum electronic devices: High electron mobility transistors, Quantum interference Transistor, Single electron Transistor, MEMS, NEMS

UNIT - III: NanotechnologyinOptics

Properties of light – interaction of light and nanomaterials: Photon trapping and Plasmons, Dielectric Constant and Polarisation, Refractive index, Nanoholes and photons, solar energy, solar cells, optically used nanomaterials, Photoniccrystals

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UNIT – IV: NanotechnologyinBiomedicine

Self assembled monolayers, Bio molecular motors: Function of Motor Proteins and applications, Drug delivery systems, Nanofluidics: Fluids at micro andNanometer scale, fabrication of nanoporous and nanofluidic devices and itsapplications.

UNIT – V: Quantum Computers

Brief idea about quantum information and quantum Computing: Superposition, Measurement, Unitary evolution, qubits-single and multiple qubits, quantum memory, Elementary gates-quantum teleportation, working principle of quantum computers.

TextBooks:

- **1.** Nanotechnology- Basic Science and Emerging Technologies, Mick Wilson, KamaliKannangara Geoff Smith, Michelle Simmons and Burkhard Raguse, I Edition – Overseas Press,2005
- 2 Introduction to Nanoscale Science & Technology, Ed. By Massimilano DiVentra – I Edition, Kluwer Academic - 2004
- 3. Nanotechnology, Gregory Timp I Edition, Springer International –2005

Reference Books:

- 1. Nanotechnology, Michael Kohler I Edition, Wiley VCH –2004
- 2. Nano-Engineering in Science & Technology, Michael Rieth I Edition, World Scientific –2004
- 3. Nano, The NwextRevoliution, Mohan SundaraRajan I Edition, National Book Trust 2004
- 4. Nanotechnology, Gregory Timp-I Edition, Springer International 2005

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OE-8027 ENTREPRENEURSHIP DEVELOPMENT

Course Outcome (COs):

After completion of the course student will be able to:

- **CO-1.** Define, describe and apply basic concepts related to entrepreneurship.
- **CO-2.** Understand the systematic process to analyze and evaluate project, prepare project report.
- **CO-3.** Prepare balance sheet, financial report.
- **CO-4.** Interpret their own business plan.
- **CO-5.** Consider the legal and financial conditions for starting a business venture.

UNIT-I

Entrepreneurship- definition. growth of small scale industries in developingcountries and their positions vis-a-vis large industries; role of small scale industries in the national economy; characteristics and types of small scale industries; demand based and resources based ancillaries and sub-control types.Government policy for small scale industry; stages in starting a small scale industry.

UNIT-II

Project identification- assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, benefit cost analysis, discounted cash flow, internal rate of return and net present value methods.

UNIT-III

Accountancy- Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, quality control, marketing, industrial relations, sales and purchases, advertisement, wages and incentive, inventory control, preparation of financial reports, accounts and stores studies.

UNIT-IV

Project Planning and control: The financial functions cost of capital approach inproject planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. control of financial flows, control and communication.

UNIT-V

Laws concerning entrepreneur viz, partnership laws, business ownership, salesand income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.

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Text Books:

- 1. Khana.S.S., "Entrepreneurial Development" S.Chand &Co.Ltd.,Ram Nagar,New Delhi,2013.
- Donald F Kuratko, "Entrepreneurship-Theory, Process and Practice",9th Edition, Cengage Learning 2014.

- 1. Forbat, John, "Entrepreneurship" New Age International.
- 2. Havinal, Veerbhadrappa, "Management and Entrepreneurship" New Age International
- 3. Joseph, L. Massod, "Essential of Management", Prentice Hall of India

OE-8028 CRITICAL AND LOGICAL THINKING

Course Outcome (COs): After completion of the course student will be able to:

- CO-1. Analyzing, reasoning, evaluating, decision-making and problem-solving attributes to play a vital role in organizational growth.CO-2. Understand and comprehend the complexity of the professional domain and implement Interpersonal Skills.
- **CO-3.** Negotiate with the odds and provide best opinions to the higher officials.
- **CO-4.** Logical leadership with critical bent to produce positive results in unfavorable situations.

Unit I: Fundamentals of Critical Thinking

Introduction to Critical Thinking, Recognizing Arguments, Key Concepts – Thinking Reflection and Creativity; Rhetorical Language; Principles of Interpretations; Process of Elimination; The Parts of an Argument – Claims and Propositions, Evidence, Reasoning; Argument and Critical thought; Communicating Arguments; Co-orientational, Cultural and Ethical View of Arguments

Unit II: Critical Thinking and Logical Communication

Language and Critical Thinking; Citing and listing references – How to refer appropriately to the work of others; Putting your thinking into words; Writing about reflection - How to structure and report your thoughts; Editing and presenting your assignment – How to review your own work and follow academic conventions; Preparing for employment – How to transfer your thinking skills to a career.

Unit III: Logical Concepts and Philosophy of Science

Truth and Validity; Hypothesis; Methods of Experimental Enquiry; Logic: Inductive and Deductive;Syllogism and Fallacies; Aristotle's conception of Virtue and Well-being; Kant's conception of Good Will, Duty and Categorical Imperative; Joseph Butler's Theory of Conscience and Self Love; J. S. Mill's Utiliterianism, Freedom and Responsibility, Chankya'sArthsashtra

Unit IV: Select School of Thought and Criticism

Structuralism (Ferdinand de Saussure), Post Structuralism, Deconstruction (Jacques Derrida), Reader Response Theory (Roland Barthes), Gender Studies, Cultural Studies (Raymond Williams).

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Unit V: Select School of Thought and Criticism

- 1) *Hind Swarajby Mahatma Gandhi
- 2) *Tradition and Individual Talentby T.S. Eliot
- 3) *"*Phenomenal Woman*" by *Maya* Angelou
- 4) Heart of Darkness by Joseph Conrad

Note: (*) denotes texts for detailed study.

Text Books:

- 1 Rangarajan, L.N. Kautilya The Arthashashtra. Penguin Classics, New Delhi, 2000.
- 2 Gandhi, M. K. Hindi Swaraj. Delhi Open Books, New Delhi, 2019.
- 3 Eliot, T. S. *Tradition and the Individual Talent*, The Sacred Wood, New York, 1921.
- 4 Conrad, Joseph. Heart of Darkness. Signet Classic Publishers, New York, 1997.
- 5 Angelou, Maya. *Phenomenal Woman: Four Poems Celebrating Women*. New York: Random House, 1994.
- 6 *Critical Thinking: A Student's Introduction* by Gregory Bassham and William Irwin and Henry Nardone and James Wallace, McGraw-Hill, Noida, 2019.
- 7 *How to Improve your Critical Thinking & Reflective Skills* by Jonathan Weyers, Pearson Education, New York, 2011.

Reference Books:

- 1 *Critical Thinking* by Brooke Noel Moore and Richard Parker, McGraw-Hill, Noida, 2019.
- 2 *Critical Thinking and Communication* by Edward S Inch, Pearson Education, New York, 2011.
- 3 *A glossary of literary terms* by M H Abrams& Geoffrey Galt Harpham, Cengage Learning, San Francisco, 1957.
- 4 *English Literary Criticism and Theory* by M.S. Nagarajan, Orient BlackSwan, Hyderabad, 2006.
- 5 *The Penguin Dictionary of Philosophy* by Thomas Mautner, Penguin Reference, New Delhi, 1997.
- 6 *Western Philosophy: An Anthology* by John Cottingham, Wiley-Blackwell, New Jersey, 1996.