ACADEMIC CURRICULA
UNDERGRADUATE DEGREE PROGRAMME
B.TECH. (First Year)
(2023–2024)

Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University U/S 3 of UGC Act, 1956
Bhubaneswar, Odisha, India

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Course Structure and Detailed Syllabi
For B. Tech. Students Admitted in the
Academic Session
2023-2024

Kalinga Institute of Industrial Technology (KIIT)
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Bhubaneswar, Odisha, India

SCHEME I
FIRST SEMESTER

Theory							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	PH10001	Physics	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional subject)						**10**	**6**
Total Credit (Semester)						**25**	**21**

SCHEME I
SECOND SEMESTER (Computer Science and Electronics)

Theory							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	EE10002	Basic Electrical Engineering	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						**10**	**5**
Total Credit (Semester)						**25**	**20**

SCHEME I
SECOND SEMESTER (Civil, Mechanical and Electrical)

Theory							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	CH10001	Chemistry	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	ME10001	Engineering Mechanics	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	ME18001	Workshop	0	0	2	2	1
2	YG18001	Yoga	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						**10**	**5**
Total Credit (Semester)						**25**	**20**

SCHEME II
FIRST SEMESTER

Theory							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	CH10001	Chemistry	3	0	0	3	3
2	MA11001	Differential Equations and Linear Algebra	3	1	0	4	4
3	HS10001	English	2	0	0	2	2
4	EC10001	Basic Electronics	2	0	0	2	2
5	EE10002	Basic Electrical Engineering	2	0	0	2	2
6		HASS Elective I	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	CH19001	Chemistry Lab	0	0	2	2	1
2	EX19001	Engineering Lab	0	0	2	2	1
Sessional							
1	YG18001	Yoga	0	0	2	2	1
2	ME18001	Workshop	0	0	2	2	1
3	HS18001	Communication Lab	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						**10**	**5**
Total Credit (Semester)						**25**	**20**

SCHEME II
SECOND SEMESTER

Theory							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	PH10001	Physics	3	0	0	3	3
2	MA11002	Transform Calculus and Numerical Analysis	3	1	0	4	4
3		Science Elective	2	0	0	2	2
4		Engineering Elective	2	0	0	2	2
5	LS10001	Science of Living Systems	2	0	0	2	2
6	CH10003	Environmental Science	2	0	0	2	2
Total Credit (Theory Subjects)						**15**	**15**
Practical							
1	PH19001	Physics Lab	0	0	2	2	1
2	CS13001	Programming Lab	0	2	4	6	4
Sessional							
1	CE18001	Engineering Drawing & Graphics	0	0	2	2	1
Total Credit (Practical & Sessional Subjects)						**10**	**6**
Total Credit (Semester)						**25**	**21**

LIST OF ELECTIVES

Engineering Elective							
Sl. No.	**Course Code**	**Subjects**	L	T	P	Total	Credit
1	CE10001	Basic Civil Engineering	2	0	0	2	2
2	ME10003	Basic Mechanical Engineering#	2	0	0	2	2
3	EE10001	Elements of Machine Learning*	2	0	0	2	2
4	EC10003	Biomedical Engineering	2	0	0	2	2
5	EE10003	Basic Instrumentation	2	0	0	2	2

Not for students of Mechanical Engineering
* Not for students of Computer Engineering

Science Elective							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	CH10005	Nanoscience	2	0	0	2	2
2	PH10003	Smart Materials	2	0	0	2	2

3	LS10003	Molecular Diagnostics	2	0	0	2	2
4	PE10002	Science of Public Health	2	0	0	2	2
5	MA10003	Optimization Techniques	2	0	0	2	2

HASS Elective I							
Sl. No.	**Course Code**	**Subjects**	**L**	**T**	**P**	**Total**	**Credit**
1	HS10013	Society, Science, and Technology	2	0	0	2	2
2	HS10202	Essential of Management	2	0	0	2	2
3	HS10102	Shades of Economics	2	0	0	2	2
4	HS10123	Indian Economy Post Liberalisation	2	0	0	2	2
5	SO10043	Socio-Political Environment	2	0	0	2	2
6	PS10043	Thinking Perspectives	2	0	0	2	2
7	PS10045	Creativity, Innovation and Entrepreneurship	2	0	0	2	2
8	EX17001	Community/Environment-based Project	0	0	4	2	2

PHYSICS

Course Code: PH10001
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of physics and to support the engineering and research programs. The subject will also help the students to develop mathematical models to understand the behavior of physical systems and phenomena.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn the basic concepts of oscillation, waves, wave function and fields,
CO 2: Understand the principles of wave phenomena in light and matter, and the quantum mechanics,
CO 3: Apply the principles of oscillation, superposition of waves, electromagnetic theory, and quantum mechanics in different fields,
CO 4: Analyze different types of particle motion in different media,
CO 5: Evaluate the problem-solving skills for the topics learnt, and
CO 6: Develop critical thinking ability supported by the learned concepts of Physics.

COURSE DETAILS

Oscillation
Damped Harmonic Oscillation (underdamped, overdamped and critically damped), Energy decay, Relaxation time, Quality factor, Forced oscillation, Resonance, Coupled oscillations, Applications**.**

Waves and Interference
Wave equation, Superposition of waves, Interference of light, Types of interference: Division of wavefront and division of amplitude.

Interference in thin films
Wedge shaped thin film, Newton's rings and their applications, Michelson interferometer, Applications.

Diffraction
Diffraction and its applications, Types of diffraction, Fraunhofer diffraction by a single slit, Plane diffraction grating (condition of maxima, minima), Maximum order of observable spectra, Absent spectra, and Dispersive power, Applications.

Quantum Mechanics
Dual nature of radiation and matter, de Broglie hypothesis for matter waves, Phase velocity and Group velocity, Heisenberg's uncertainty principle and applications, Wave function and its interpretation, Concepts of operators, Schrodinger's time-dependent and time-independent equations, Postulates of Quantum mechanics, Particle in one-dimensional box and applications, Quantum tunnelling and applications.

Electromagnetic Theory
Vector calculus: scalar and vector field, Gradient, divergence and curl, Line, surface and volume integrals, Gauss divergence and Stoke's theorem, Maxwell's equations in differential and integral form with necessary derivations. Electromagnetic wave equations, Transverse nature of electromagnetic waves.

Laser and Fiber Optics
LASER: Properties and applications, Spontaneous and stimulated emission, Meta-stable state, Population inversion, Pumping, Three and four-level Laser, Ruby Laser.

Optical fiber
Principle, Construction, Types of optical fiber, Acceptance angle, Numerical aperture, Applications.

Text book

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference books

1. D J Griffiths, Introduction to Electrodynamics, Pearson Education, 4th Edition, 2015.
2. L. I. Schiff and J. Bandhyopadhyay, Quantum Mechanics, Tata McGraw-Hill Publications, 4th Edition, 2014, ISBN- 9781259062865.
3. A K Ghatak, Optics, Tata McGraw-Hill Publications, 4th Edition, 2008, ISBN: 9780070262157.
4. A. Beiser, Concepts of Modern Physics ,Tata McGraw-Hill Publications, 6th Edition, 2002, ISBN 10: 0071234608.
5. R K Gaur and S. L. Gupta, Engineering Physics, Dhanpat Rai Publications, New Delhi, 2nd Edition, 2012, ISBN-10: 8189928228.

CHEMISTRY

Course Code: CH10001
Credit: 3
L-T-P: 3-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to enrich the students with the basic concepts in Chemistry and to strengthen their fundamentals which will support them to pursue education and research in engineering. The course will help the students to conceptualize alternative sources of energy by electrochemical means and use the instrumental techniques to explore chemical products.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Rationalize bulk properties and processes using thermodynamic consideration and apply the knowledge to decide the feasibility of a given process,
CO 2: Analyze the kinetics of multistep reactions as well as the theories of reaction rates,
CO 3: Understand the importance of catalysis and their mechanism of action and applications,
CO 4: Apply the principles of electrochemistry to evaluate properties, such as pH, solubility Product, etc. and understand the working principle of modern batteries,
CO 5: Apply different spectroscopic techniques, such as UV-Vis, IR and NMR, for structural Elucidation, and
CO 6: Differentiate between smart and intelligent materials.

COURSE DETAILS

Chemical Equilibrium and Thermodynamics
Introduction, Internal energy, Enthalpy, Entropy and free energy, Dependence of free energy on temperature and pressure, Gibbs-Helmholtz equation, Free energy change and equilibrium constants, Van't Hoff isotherm and isochore, Clapeyron- Clausius equation, Partial molar properties, Chemical potential, and Gibbs-Duhem equation.

Chemical Kinetics
Rate of reaction and rate laws of multiple reactions (steady-state approximation), and of parallel, opposing and consecutive reactions; Theories of reaction rate: Collision theory, Lindemann modification, Absolute reaction rate; Catalysis: Types, theories, and kinetics of enzyme catalysis (Michaelis-Menten mechanism).

Spectroscopy
UV-Vis spectroscopy: Beer-Lamberts law, Types of transition, Concept of auxochrome and chromophores, Factors affecting λ_{max} and, Woodward-Fieser rules for calculation of λ_{max} in diene systems; IR spectroscopy: Types of vibration, Hooks law, detection of functional groups like C=C, -OH, -NH_2 and -C=O**;**

NMR Spectroscopy
Basics of NMR Spectroscopy: Theory, Chemical shift, Shilding-deshilding effect, Structural elucidation of simple compounds**.**

Electrochemical Energy Systems
Types of electrodes, electrode/cell potential; Nernst equation and application to: find electrode and cell potential, equilibrium constant, solubility product and pH; Modern batteries: Fuel cells (AFCs, PEMFs, SOFCs, MCFCs), Zn-air battery, Li-ion battery, Na-ion battery, Ni-MH battery.

Smart and Intelligent Materials
Introduction to smart materials, Properties and types of smart materials, Structures, System intelligence-components and classification of smart structures, Common smart materials and associated stimulus-response, Application areas of smart systems.

Text book

1. S Chawala, Engineering Chemistry, Dhanpat Rai and Co, 4th Edition, ISBN: 9788177001938.

Reference books

1. S Agarwal, Engineering Chemistry: Fundamentals and Applications, Cambridge University Press, ISBN: 9781107476417.
2. S. Chakroborty, S. Sen, and S. Mittal, Engineering Chemistry, Cengage Learning India Pvt. Ltd., ISBN: 9386668645.
3. B.R. Puri, L.R Sharma, and M. S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., 47th Edition, ISBN: 978-9382956013.
4. R M. Silverstein, Fransis X, Webster, D J Kiemle, Spectrometric Identification of Organic compounds, -Jhon Wiley& Sons, INC, 7th Edition.
5. S Glasstone, Elements of Physical chemistry-, Macmillan publishers, 2nd Edition ISBN: 978-0333038437.
6. D.J. Leo, Engineering Analysis of Smart Material Systems, Wiley 2007, 1st Edition ISBN: 978-0471684770.

ENVIRONMENTAL SCIENCE

Course Code: CH10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to create awareness in the students on monitoring, assessment, and management of environmental pollutants. The subject will also make the students aware of more benign chemistry, i.e.,green chemistry, and help them to understand the implementation of Environmental Impact Assessment (EIA).

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the components and composition of the environment along with the radiation balance model,
CO 2: Rationalize the different types of pollutants, their sources, effects, and control measures,
CO 3: Develop the idea of water purification strategies,
CO 4: Identify toxic wastes and conceptualize the principles of solid waste management,
CO 5: Conceptualize the principles of green chemistry and implement them in the synthesis of advanced material, to reduce pollution, and
CO 6: Provide for Environmental Impact Assessment (EIA) requirements before planning a project.

COURSE DETAILS

Overview of the Environment
Overview of the environment, terminologies, Components of Earth: Lithosphere, atmosphere, hydrosphere and biosphere, Concept of black body radiation and albedo, eZro-dimensional energy balance model.

Air Pollution and Control
Primary and secondary air pollutants, CFC, Smog (oxidizing and reducing), Important environmental issues: Depletion of the ozone layer, Acid Rain, Greenhouse effect and global warming, Control measures: Baghouse filter, Cyclone separator, Electrostatic precipitator, Catalytic converter, and Scrubber.

Water Pollution and Control
Types and sources of water pollutants, wastewater treatment techniques: Ultrafiltration, aerobic and anaerobic treatment, Reverse osmosis, Electrodialysis, Ddisinfection by chlorination, Ozonization, Modern water purification system, Water quality parameters like hardness, Water softening process (permutit), WHO guidelines for drinking water.

Soil Pollution and Solid Waste Management
Soil pollution: Sources of pollutants and mitigation measures. Types of solid wastes: Heavy metal, bio-medical and radioactive wastes, Toxic and biochemical effects of solid wastes, Solid waste management (landfilling, incineration, and composting).

Green Chemistry and EIA
Basic principles of green chemistry with examples, Matrices to explain greenness, R^4M^4 model, life cycle analysis. Importance, scope and principles of EIA with a case study.

Text book

1. A. K. De, Environmental Chemistry, New Age International Publishers, 9th Edition.

Reference books

1. S. Chakroborty, D. Dave, and S. S. Katewa, Environmental Chemistry-, Cengage Learning India Pvt. Ltd., 1st Edition.
2. Aloka Debi, Environment Science and Engineering, Universities Press,2nd Edition.
3. Erach Bharucha, Textbook of Environment studies for undergraduate courses, Universities Press, 2nd Edition.
4. D. De and D. De, Fundamentals of Environment and Ecology, S. Chand &Co, 2013.
5. Jain and Jain, Engineering Chemistry, Dhanpat Rai,Publishing Company.
6. S.C. Santra, Environmental Science,New Central Book Agency, ISBN: 9788173814044.

PHYSICS LABORATORY

Course Code: PH19001
Credit: 1
L-T-P: 0-0-2
Prerequisite: Nil

COURSE OBJECTIVE

This lab course covers different measurement techniques of various parameters using the instruments i.e. interferometer, spectrometer, spherometer, screw gauge, vernier calliper, microscope, and telescope. It includes the application of photoelectric effect and photovoltaic effect in photo cell and solar cell respectively. Evaluation of the mechanical strength of materials by calculating elastic constants such as Young's modulus, rigidity modulus and Poisson's ratio are also included. This course provides hands on training for the usage of electrical, optical and mechanical systems for various measurements with precision and analysis of the experimental data by graphical interpretation and error calculation.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the wave nature of light through experiments based on interference and diffraction Phenomena,
CO 2: Apply the laws of quantum physics to understand the photoelectric emission using the particle nature of light,
CO 3: Characterize photovoltaic cells to find out efficiency in terms of power output,
CO 4: Evaluate mechanical properties of materials using their elastic properties,
CO 5: Apply the principles of optics such as refraction, total internal reflection to calculate refractive index and related parameters,and
CO 6: Use the principles of oscillation to understand phenomena such as damping, resonance and to determine the factors (such as gravity, elasticity etc) affecting the time period of various oscillators.

Topics

Measurement by vernier callipers, screw gauge, spherometer: A review

- Determination of wavelength (λ) of a monochromatic light by Newton's ring experiment.
- Determination of wavelength (λ) and difference (dλ) between wavelengths of sodium D-lines by Michelson's interferometer.
- Determination of grating element (e+d) of a plane diffraction grating.
- Determination of Planck's constant using photocell.
- Study of the characteristics of a photo cell.
- Study of the characteristics of a solar cell.
- Determination of Young's modulus (Y) of a material by bending of beam method.
- Determination of Poisson's ratio (σ) of rubber.
- Determination of rigidity modulus (η) of a material by dynamic method.
- Determination of refractive index (μ) of a transparent liquid by Boy's method.
- Determination of numerical aperture of optical fibre.
- Determination of acceleration due to gravity (g) by bar pendulum.
- Determination of damping coefficient, relaxation time and quality factor of damped harmonic oscillation by simple pendulum.
- Measurement of velocity of sound in air using resonance column method.
- Studies on dielectric/multi-ferroic materials (Open ended)
- Diffraction studies using Laser sources (Open ended)

Reference Materials

1. Physics laboratory instruction manual, School of Applied Sciences, Department of Physics, KIIT Deemed to be University, Bhubaneswar.
2. S. L. Gupta and V. Kumar, 2018, Practical Physics, Pragati Prakashan, 33rd Edition, ISBN: 978-93-87151-58-1.

CHEMISTRY LABORATORY

Course Code: CH19001
Credit: 1
L-T-P: 0-0-2
Prerequisite: Nil

COURSE OBJECTIVE

This lab course covers different types of chemical experiments ranging from volumetric analysis to spectroscopic techniques. This course provides the students with hands-on training in many of the advanced spectroscopic and analytical techniques in chemistry. The experiments in the course span over diverse applications in chemistry. It contains experiments dealing with environmental chemistry, volumetric analysis, organic and inorganic synthesis, electrochemistry, and spectroscopy**.**

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Handle different chemicals with proper safety protocols in an advanced Chemistry laboratory,
CO 2: Learn and apply basic techniques used in Chemistry laboratory for preparation, purification and identification,
CO 3: Analyze the kinetics of 1^{st} order reactions and estimate the rate constant,
CO 4: Use different instrumental techniques such as Conductometry, pH-metry, Potentiometry and Colorimetry,
CO 5: Analyse basic water quality parameters like hardness, dissolved oxygen, alkalinity, chloride, ferrous iron contents etc,and
CO 6: Rationalize and learn the spectroscopic and synthesis techniques in chemistry.

Topics

- Estimation of total hardness in a given water sample in terms of calcium and magnesium hardness by EDTA method.
- Estimation of the amount of NaOH and Na_2CO_3 present in a given mixture solution
- (a) Determination of the strength of $KMnO_4$ solution by using standard sodium oxalate solution. (b) Determination of the amount of Ferrous (Fe^{2+}) ions present in the Mohr's salt solution by using standard $KMnO_4$ solution.
- Determination of the amount of dissolved oxygen present in a given water sample by Winkler's method.
- Finding the strength of Fe^{2+} present in the supplied Mohr's salt solution by potentiometric titration.
- Determination of the rate constant of acid-catalyzed hydrolysis of ethyl acetate.
- Determination of the chloride ion (Cl^-) present in a given water sample by the argentometric method.
- Finding the strength of supplied acid by pH-metric titration against a standard alkali.
- Finding the strength of a given hydrochloric acid solution by titrating it against standard sodium hydroxide solution conducto-metrically.
- Verification of Beer Lambert's Law and application of this law to determine the unknown concentration of a given solution.

- Determination of the concentration of ferric ions (Fe^{3+}) in a given water sample by a spectrometric method using KCNS as color developing agent.
- Determination of the Isoelectric point (pI) of glycine amino acid.
- Synthesis of transition metal complexes and characterization by using IR and ^{1}H-NMR. (Open ended)
- Determination of the concentration of different ions (cations and anions) in a given water sample by colorimetry. (Open ended).
- Application of potentiometric titrations (Open ended).

Reference Materials

1. Chemistry laboratory Instruction manual, School of Applied Sciences, KIIT Deemed to be University
2. Vogel's Quantitative Chemical Analysis, J. Mendham, R.C. Denney J. D. Barnes, M.J.K. Thomas, 6th Edition, Longman
3. Standard methods for examination of water and wastewater, 23rd Edition, APHA.

DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA

Course Code: MA11001
Credit: 4
L-T-P: 3-1-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations and linear algebra. It aims to equip the students to tackle advanced level of mathematics and applications that they would find useful in their disciplines.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the concept of modelling and formulation of Differential equation of physical problems,
CO 2: Apply different methods to solve ODE problems involving growth-decay, cooling effects and electrical circuits etc,
CO 3: Develop an ability to solve 2nd and higher order ODEs,
CO 4: Apply the knowledge of special function in engineering problems,
CO 5: Use the essential tool of matrices and linear algebra in a comprehensive manner, and
CO 6: Apply the knowledge of Eigen value and Eigen vector in the field of engineering and also get the concept of complex matrices.

COURSE DETAILS

Ordinary Differential Equations of First Order

Introduction and formation of differential equations, Overview: Variable separable, homogeneous, equations reducible to homogeneous form.Exact differential equations, equations reducible to exact form, linear differential equations, equations reducible to linear form (Bernoulli's equation). Applications of differential equations: Growth-Decay Problem, Newton's Law of Cooling, Mixing problem, Orthogonal trajectories.

Linear Differential Equations of second order

Second order linear homogeneous equations with constant coefficients; differential operators; solutions of homogeneous equations; Euler-Cauchy equation; linear dependence and independence; Wronskian; Solutions of non-homogeneous equations: general solution, complementary function, particular integral; solution by variation of parameters; undetermined coefficients. Applications of 2nd order differential equations in Electric circuit.

Special Functions

Improper Integrals for one variable, some test for convergence of improper integrals, Gamma function, Properties, Beta function, Relation between Gamma and Beta functions. Radius of convergence of power series, Legendre equation. Legendre polynomial. Recurrence relations and Orthogonality property of Legendre polynomial. Bessel's equation, Bessel's function, Recurrence relation.

System of Linear Equations and Vector Space

Linear system of equations; rank of matrix; consistency of linear systems; Solution of system of linear equations: Gauss elimination, inverse of a matrix by Gauss Jordan method, Vector Space, Sub-space, Basis and dimension, linear dependence and independence, Linear transformation.

Matrix-Eigen value problems

Eigen values, Eigen vectors, Eigen basis, quadratic form; Hermitian, Skew-Hermitian forms; similar matrices; Diagonalization of matrices.

Text book

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley INC, 10th Edition,2011.

Reference books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition.
2. H.K. Das, Introduction to Engineering Mathematics, S.Chand & Co Ltd, 11th Edition.
3. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications 2007.
4. J. Sinha Roy and S. Padhy, A course on ordinary & partial differential Equation, Kalyani Publication, 3rd Edition.

TRANSFORM CALCULUS AND NUMERICAL ANALYSIS

Course Code: MA11002
Credit: 4
L-T-P: 3-1-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to familiarize the students with the methods of Laplace and Fourier transformation and various numerical techniques to solve engineering problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Apply Laplace Transform to problems in the field of science and engineering,
CO 2: Use Fourier series and Transform as a tool to solve differential equations,
CO 3: Estimate the error in the results obtained in the numerical methods,
CO 4: Solve nonlinear equations that arise in engineering problems and interpolation,
CO 5: Know various numerical methods of differentiation and integration, and
CO 6: Apply numerical solution of differential equations and systems of linear equations.

COURSE DETAILS

Laplace Transforms
Laplace Transform, Inverse Laplace Transform, Linearity, Transform of derivatives and integrals, Unit Step function, Dirac delta function, Second shifting theorem, Differentiation and integration of transforms, Convolution, Solution of ODEs and integral equation by Laplace transform.
Fourier Series and Transform: Fourier series, Arbitrary periods, Even and odd functions, Half range expansions, Fourier integral, Cosine and sine transforms, Fourier Transform, Inverse Fourier Transform, Linearity, Fourier Transform of derivative, Convolution.

Approximations & Errors
Approximation of numbers by truncation and rounding-off, Types of errors.
Numerical solution of Nonlinear equations: Solutions by Bisection Method, Fixed Point Iteration Method, Newton-Raphson Method, Regula-Falsi and Secant Method, Rate of Convergence of Secant & Newton-Raphson Method.

Interpolation & Approximation Finite Differences, Operators and Relation between them. Interpolation: Newton's forward and backward difference interpolation, Newton's divided difference interpolation and Lagrange interpolation.

Numerical Differentiation & Integration: Numerical differentiation of first- and second-order equations using difference table. Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Gauss-Legendre's two-point and three -point formulae. Error in Numerical Integration.

Numerical Solution to ODE
Taylor's (OK?) series Method, Euler's Method, Modified Euler's Method, Runge-Kutta Methods of order 2 and 4, Reduction of second-order ODE to system of first-order ODEs and its solution by R-K method of order four.

Solution of System of Linear Equations, Solutions by Gauss-Seidel and Gauss-Jacobi methods.

Text books

1. E Kreyszig, Advanced Engineering Mathematics by Wiley, INC, 10th Edition.
2. Jain, Iyenger and Jain, Numerical Methods for Scientific and Engineering Computation, New age International (P) Ltd., 6th Edition.

Reference books

1. B.S. Grewal, Khanna ,Higher Engineering Mathematics, Publishers, 44th Edition.
2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill Publications, 2007.
3. A, Thangapandi and Somasundaram, Numerical Methods, Scitech Publishers, 2nd Edition.

SCIENCE OF LIVING SYSTEMS

Course Code: LS10001
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to enrich the basic knowledge of students in the field of biology and use that knowledge to support the engineering and research programs. Besides, the course also helps to learn methodology to establish models for various biological phenomena and apply the aforementioned models to predict/analyse the functionality of various systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn the typical characteristics that distinguish life forms and analyze life process at cellular level,
CO 2: Apply concepts on structure and function of simple biomolecules in life processes
CO 3: Understand different process involved in life and analyse their effects,
CO 4: Analyse different biological phenomena and relate them to engineering applications,
CO 5: Comprehend different physiological functions and relate them to computer-based techniques, and
CO 6: Implement concepts of biology and their relevance to engineering and technology.

COURSE DETAILS

Cellular Organization of a Living Organism
Biology in engineering, The Living World: Biodiversity of living world, Microorganisms, Cell as the basic unit of life, Cell theory, Structure and function of Prokaryotic and Eukaryotic cells, Cell growth and reproduction, Homeostasis, Concept of gene, Basic structure and function of chromosomes.

Molecular and Biochemical Basis of an Organism
Chemical Context of Life: Water, Carbon, Structure and Function, Types of bonding, Bio- macromolecules (Carbohydrates, Proteins, Amino acids, Lipids and Nucleic acids), Protein synthesis, Cell differentiation, Stem cells and their applications.

Enzymes, Photosynthesis, Metabolism and Bioenergetics
Enzymes: Introduction, structure, properties, Classification, Mechanism of enzyme actions, Factors affecting enzyme action, Strategies utilized by enzymes to affect catalysis. Photosynthesis: Introduction, pigments, process of photosynthesis, Mechanism of photosynthesis (light reaction and dark reaction). Metabolism and Bioenergetics: Anabolism and catabolism.

Nervous system, Immune system and Cell Signaling
Nervous system: Introduction, History of neuroscience, Types of glial cells, Nerve cells - Neurons, Organization of the nervous system, Action potential, Diseases of the nervous system, Computer-based Neural Networks. Immune system: Introduction, Innate Immunity, Adaptive or acquired immunity, Diseases of the immune system, Immune engineering. Cell signaling: General principles of cell signaling.

Molecular Machines, Biosensor and Bioremediation
Molecular Machines: Introduction, Molecular motors and Machines, F0F1-ATP synthase motors, Cytoskeleton associated motors. Biosensors: Concept of biosensor, Working principle, Types of biosensors, Glucose biosensors, Bio-detectors: DNA detection biosensor, Detection of pollutants, Biosensor in food industry. Bioremediation: Introduction, Role of microorganisms, Factors determining bioremediation, Types – *in situ/ex situ*, Advantages and disadvantages, Biofuel.

Text book

1. S. Thyagarajan, N. Selvamurugan, M.P Rajesh, R.A Nazeer, Richard W. Thilagarajan, S. Bharathi and M.K. Jaganathan, Biology for Engineers, McGraw Hill Education (India),7th Edition, 2022.

Reference books

1. P. H. Raven and G.B. Johnson. Biology (Indian Edition), Tata McGraw Hill Education Publication,13th Edition, 2023.
2. E D. Enger, Feederick C, Ross and David B. Bailey. Concepts of Biology,Tata McGraw-Hill Publication, 14th Edition, 2011.
3. Neil A. Campbell and Jane B. Recee, Biology, Pearson Education, 8th Edition , December 2007.
4. Cecie Starr, Biology Concepts and Application, Thomson Books, 6th Edition, January 2006.

ENGLISH

Course Code: HS10001
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to develop and improve, in the students, the skills of active listening, speaking, reading, and writing in English, through lecture classes and practice sessions, and improve their professional communication abilities. The course will help the students to enhance their critical thinking and situational communicative skills through the study of contemporary social issues depicted in literature.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Apply verbal and non-verbal modes of communication effectively in practical Situations,
CO 2: Retain a grammatically correct and logical flow while drafting reports and other technical pieces of writing,
CO 3: Develop competence in reading and comprehension,
CO 4: Implement active listening responses in professional practice,
CO 5: Utilize neutral accent in English pronunciation successfully, and
CO 6: Understand situational and conversational English used for different purposes and contents.

COURSE DETAILS

Professional Communication

Process of Communication: Definition, Explanation & Diagram, Difference Between General and Technical Communication; Methods of Communication (Verbal & Non-Verbal); Non-Verbal Communication (Kinesics, Proxemics, Chronemics, Oculesics, Olfactics, Gustorics, Haptics, and Iconics); Paralanguage; Flow of Communication (Formal & Informal); Levels of Communication; and Barriers of Communication (Intrapersonal, Interpersonal, and Organizational**).**

Basics of Grammar and Writing Skills

Error Detection in Sentences: Articles, Prepositions, Tense, Subject-Verb Agreement, Active and Passive Voice; Use of Punctuation: Full Stop, Comma, Colon, Semi-colon, Single & Double Inverted Commas, Exclamation & Interrogation Marks, Hyphens and Dashes, and Ampersand;
Paragraph Writing – Components; Writing Bias-free English; Business Letters: Enquiry, Claim/Complaint, and Order; Technical Reports: Formats, Style & Referencing; and Reading Techniques: Skimming, Scanning, Intensive & Extensive Reading.

Basic Sounds of English

Hearing & Listening: Types of Listening – Appreciative, Empathetic, Critical, Comprehensive, Superficial, Differences between Listening & Hearing; Introduction to Basic Sounds of IPA: Symbols of IPA, Types of Vowels & Consonants; and Problem Sounds & Mother Tongue Influence: Concept of MTI with Examples.

English Literature

Short Story – O. Henry: 'Gift of the Magi;'Short Story – Ismat Chughtai: 'Sacred Duty;'; Poem – Robert Frost: 'Stopping by Woods on a Snowy Evening;'Poem – Tennessee Williams: 'We Have Not Long to Love;' and Drama: William Shakespeare: Merchant of Venice.

Text book

1. M. Ashraf Rizvi, Effective Technical Communication, Tata McGraw Hill Education Publication, 2005.

Reference books

1. Sidney Greenbaum. The Oxford Grammar (English). Oxford University Press, 1st Edition. 2005.
2. S Verma,Technical Communication for Engineers, Vikas Publishing House,2015.
3. R Dove,The Penguin Anthology of 20th Century American Poetry,Penguin Books. 2013.
4. The Merchant of Venice (The New Cambridge Shakespeare). Mahood & Lockwood eds. CUP. 2018.

COMMUNICATION LABORATORY

Course Code: HS18001
Credit: 1
L-T-P: 0-0-2
Prerequisite: NIL

COURSE OBJECTIVE

This subject is designed to enrich the basic knowledge of engineering students in the field of communication and to support the engineering and research programs.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Use English grammar correctly and unambiguously in technical writing,
CO 2: Apply verbal and non-verbal modes of communication effectively in practical situations,
CO 3: Have a basic understanding of the communication process and to know the practical implementations in the workplace,
CO 4: Retain a logical flow while drafting reports and other technical pieces of writing,
CO 5: Develop competence in reading and comprehension, and

CO 6: Be familiar with English pronunciation and use neutral accent successfully.

COURSE DETAILS

Reading Comprehension

Understanding meaning and sequence of ideas in written language
Activity based on matching, multiple choice questions, open close, appropriate headings.

Time & Tense + Subject-Verb Agreement
Applying correct grammar in everyday writings.

Vocabulary Building (Mind Mapping/Phrasal Verbs)
Developing vocabulary through associating key ideas, and learning idioms and phrases.

Listening Comprehension
Interpreting meaning and syntax in spoken language.

E-mail Writing
Formulating appropriate e-mails with relevant salutation, language &conclusion

Resume Writing/ Video Resume
Creating suitable, job-orientedresume

Thematic Speaking:
Practising and implementing theme-based individual speaking skills.

PowerPoint Presentation
Developing skills to design and deliver engaging, informative and impactful presentations

Class Participation.

BASIC ELECTRONICS

Course Code: EC10001
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The subject is designed to familiarize students of all branches to the all-pervasive field of Electronics, enable them to carry out research in interdisciplinary fields involving semiconductor devices, and utilize the knowledge in solving practical problems in real life in today's age of electronics.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the properties of semiconductor and current conduction mechanism,
CO 2: Comprehend the working of P-N junction diodes; identify different diode circuits and analyze them,
CO 3: Understand the working of different types of transistors,
CO 4: Know about OP-AMP and its applications,
CO 5: Analyze the working of op-amp using either inverting or non-inverting configurations, timing circuit, regulated power supply ICs, and their applications, and
CO 6: Realize the importance of various analog and digital electronic systems and electronic devices.

COURSE DETAILS

Semiconductors, Diodes and Transistors
Properties of semiconductor materials, Applications of semiconductors as p-n junction diode, Diode characteristics and breakdown mechanisms, Half-wave and full-wave rectifiers with filters, Zener diode, Transistor constructions, operations and their characteristics. Transistor biasing, amplifiers, and load line analysis, Concepts of JFET and MOSFET.

Operational Amplifier (Op-amp) and applications
Introduction to Op-amp and its Characteristics. Application of Op-Amp as Inverting amplifier, Non-inverting Amplifier, Summing, Difference amplifier and comparator

Introduction to Digital Electronics
Different number systems and its conversions, Logic gates and truth tables of OR, AND, NAND, EX-OR. Combinational circuit and Sequential circuit.

Miscellaneous Electronic Devices
SCR, Opto-electronic devices and fiber techniques, Introduction and description of sensor performance, Fundamentals of analog communication techniques (AM and FM).

Text book

1. J Millman, Christos C. Halkias & C D. Parikh, Integrated Electronics: Analog and digital circuits and Systems , 9th Edition, 2021.

Reference books

1. R. L. Boylestad & L. Nashelsky, Electronic Devices & Circuits,PHI,7th Edition,2021
2. D. A. Bell. Electronic Devices and Circuits.(Oxford)5th Edition,2021.
3. D. Chattopadhyay and P. C. Rakshit. Fundamentals & Applications ,New Age International, 15th Edition 2021.

BASIC ELECTRICAL ENGINEERING

Course Code: EE10002
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to provide to the students a comprehensive overview of the basics of the electrical engineering discipline. In particular, the course includes fundamental aspects of DC, AC and magnetic circuit analysis, working principles and applications of machines, and safety measures used in various electrical apparatus and appliances.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Analyze the concept of DC circuit,
CO 2: Understand the concepts of AC circuits,
CO 3: Analyze the three phase circuit,
CO 4: Interpret the behavior of magnetic circuits,
CO 5: Remember the principles and operation of electrical machines, and
CO 6: Know the concepts of electrical safety and protection systems.

COURSE DETAILS

D. C. Circuits
Kirchhoff's law, Source transformation, Star-delta transformation and equivalent resistance of the circuits, Mesh and Nodal analysis, Superposition theorem.

A.C. Circuits
Peak, average, R.M.S. values of sinusoidal quantities, Peak factor, Form factor, Phase difference, Phasor representation, AC through R, L, C, AC Series Circuit (RL, RC, RLC), Three-phase AC circuits: Voltage, current and power in star and delta connections.

Electromagnetic Circuits
Magnetizing Force, Reluctance, Permeance, Magnetic field, Magnetic permeability, Analogy between Electric Circuits and Magnetic Circuits. Series magnetic circuit, BH curve.

Scope and Safety Measures
Electrical Energy Scenario in India, Application of Transformer, Three-phase and single-phase induction Motors, Power ratings of air conditioners, PCs, laptops, printers, refrigerator, washing machine, different lamps, electricity tariff, calculation of electricity bill for domestic consumer**.**

Personal Safety Measures
Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Equipment Safety Measures
Working principles of fuse and miniature circuit breaker (MCB), Residual Current Circuit Breaker (RCCB).

Text books

1. V K Mehta, Rohit Mehta, Principles of Electrical Engineering and Electronics S Chand and Company, New Delhi ,Revised Edition 2013.
2. D.C. Kulshreshtha, Basic Electrical Engineering Tata Mcgraw publication, 1st Edition 2011.
3. T.K. Nagasarkar and M.S. Sukhija Basic Electrical Engineering, , Oxford University press, 3rd Edition 2017.

Reference book

1. Sanjeev Sharma, Basics Electrical Engineering I.K.International, New Delhi ,Third Reprint 2010.

ENGINEERING MECHANICS

Course Code: ME10001
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

Engineering Mechanics is a specialized need-based extension of Applied Physics and uses the principles of Statics and Dynamics. The objective of this course is to build the foundational knowledge of the students which is required for the design of mechanical systems. In particular, the course will cover aspects of analysis of rigid body, frame and machine under the action of force system, and analysis of free body diagram of a system whether at rest or in motion.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Draw complete and correct free-body diagrams and write the appropriate equations from the free-body diagram,
CO 2: Use scalar analytical techniques for analyzing forces and moments in mechanical systems,
CO 3: Analyze forces in statically determinate structures such as trusses, frames and problems related to friction,
CO 4: Determine the centroid and second moment of area,
CO 5: Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple and practical problems, and
CO 6: Solve real life problems by using mathematics, physical laws and theorems.

COURSE DETAILS

Concurrent Forces in a Plane
Introduction to Engineering Mechanics, Free-body diagrams, Composition and resolution of forces, Methods of moments. Friction: Concept of friction, Wedge friction.

Force Analysis of Plane Trusses
Methods of joints, Method of Sections, Centroid: Parallel forces in a plane, Centroid of plane figures, Theorem of Pappus, and Centroid of composite plane figures.

Moment of Inertia
Moment of Inertia of plane figures, Parallel axis theorem, Perpendicular axis theorem, and Moment of Intertia of composite figures.

Principle of Virtual Work
Equilibrium of Ideal Systems, Virtual work.

Dynamics of Particles
Differential equations of rectilinear motion, Free vibration, D'Alembert's Principle, Momentum and Impulse, Work & Energy, Conservation of energy, Impact.

Curvilinear Motion
Normal and tangential acceleration, Motion of a projectile, Work and Energy in curvilinear motion.

Rotation of a Rigid Body
Kinematics of rotation, Rotation under the action of a constant moment.

Text book

1. S Timoshenko, D. H Young & J.V. Rao, Engineering Mechanics, Tata McGraw-Hill Publication 5th Edition, 2017.

Reference books

1. I H Shames, Engineering Mechanics (Statics and Dynamics) , Prentice Hall, 4th Edition, 2005.
2. S.S. Bhavikatti, Engineering Mechanics –New Age International,8th Edition, 2021.
3. S. Rajasekaran and G. Sankarasubramanian Engineering Mechanics (Statics and Dynamics),Vikas publishing House, 3rd Edition, 2017.

WORKSHOP

Course Code: ME18001
Credit: 1
L-T-P: 0-0-2
Prerequisite: Nil

COURSE OBJECTIVE

This workshop practice is designed to impart students the basic knowledge on manufacturing or developing a given object irrespective of their branch of engineering. While furnishing the given object, students will familiar with various mechanical operations and the respective tools or machines. This course involves four different sections namely Fitting, Welding, Turning and Sheet metal which cover both conventional and advanced tools to provide students the updated manufacturing experience. Students are also advised with various safety precautions to be followed during a specific manufacturing practice. At the end, students will also gain knowledge on different advanced machines such as CNC machine tools and 3D printing.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Practice different operations related to fitting shop,
CO 2: Use different welding tools to prepare a given type of joint,
CO 3: Demonstrate various turning operations including taper turning and knurling using a conventional lathe machine,
CO 4: Design a tray and prepare it using sheet metal equipment involving soldering,
CO 5: Appraise different operations using a CNC machines,and
CO 6: Interpret different advanced machines such as 3D printing/additive manufacturing.

Topics

- Turning operations
- Sheet metal operations
- Fitting
- Welding

ENGINEERING DRAWING & GRAPHICS

Course Code: CE18001
Credit: 1
L-T-P: 0-0-2
Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to provide students with knowledge and abilities to design a 3D object on 2D paper by hand sketching method and by means of computer aided drafting software.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Use common drafting tools properly,
CO 2: Select, construct and interpret appropriate drawing scale as per the situation,
CO 3: Draw orthographic projections of points, lines and planes,
CO 4: Draw orthographic projection of solids like cylinders, cones, prisms and pyramids,
CO 5: Develop the section of solids for practical situations, and
CO 6: Communicate ideas effectively using Computer Aided Drafting.

Topics

- Introduction to Engineering graphics
- Lettering
- Projection of points & lines
- Line inclined to both the planes
- Projection of planes
- Introduction to Computer Aided Drafting
- Projection of solids
- Section of solids
- Development of surface

Text book

1. K. Venugopal,Engineering Drawing + AutoCAD New Age Publishers, 1st Edition, 2011.

Reference book

1. S. N. Lal Engineering Drawing with an Introduction to AutoCAD, Cengage India Private Limited, 1st Edition, 2017.

PROGRAMMING LABORATORY

Course Code: CS13001
Credit: 4
L-T-P: 0-2-4
Prerequisite: Nil

COURSE OBJECTIVE

The course aims to provide exposure to problem-solving through programming. It aims to train the student to the basic concepts of the C-programming language. This course involves lab component which is designed to give the student hands-on experience with the concepts.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1 : Have fundamental knowledge of computers hardware and number systems with commands in Linux,
CO2 : Write, compile and debug programs in C language.
CO3 : Design programs involving decision structures, loops, and functions.
CO4 : Construct arrays to store, manipulate, search and display data.
CO5 : Apply the dynamics of memory by the use of pointers.
CO6 : Use different data structures and create/update basic data files.

Topics

- Basic linux commands
- Operators and Expressions
- Branching statements (if-else, switch).
- Control statements (looping - for, while, do-while).
- Arrays
- Character Arrays (strings).
- Functions.
- Pointers and Dynamic Memory Allocation.
- Structures and Unions
- File Handling

SCIENCE ELECTIVE

NANOSCIENCE

Course Code: CH10005
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course is designed to educate, inspire, and motivate young students about nanoscience, nanotechnology, and their applications. The course provides information on the latest innovations in this field to get insights into the nanomaterials synthesis/fabrication and applications that can be achieved at a nanoscale.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn fundamental aspects of nanoscience,
CO 2: Classify different types of nanomaterials based on their dimension and composition
CO 3: Understand different synthesis techniques to grow nanomaterials,
CO 4: Analyse nanomaterials using different characterisation techniques,
CO 5: Apply the acquired knowledge to design new materials, and
CO 6: Evaluate the importance of nanoscience in engineering applications.

COURSE DETAILS

Introduction
Concept and Classifications based on dimensions and compositions, Significance of nanosize: Surface area to volume changes; Properties changing with size (reactivity, melting point, catalytic,
electrical, optical), Nanoscience in nature, and Quantum dots as data storage.

Synthesis of nanomaterials
Top-down synthesis (Mechanical method-ball milling, Photolithography, Laser ablation, sputtering), Bottom up (pyrolysis, sol-gel, CVD, self-assembly), Green synthesis (metallic nanoparticles, metal oxides), Biosynthesis.

Characterization
XRD-X-ray generation, Working principle (Bragg's law), Peak broadening in nanomaterials (Scherrer formula), Electron microscopy (SEM, TEM)—high energy electron generation, electron optics, Scanning Electron Microscopy (SEM)—secondary, back scattered, EDX, Transmission Electron Microscopy (TEM)—bright field imaging, dark field imaging, and Selected area diffraction pattern.

Applications

Cosmetics—ZnO, SiO_2, TiO_2 Nanoparticles in cosmetics, SiO_2 TiO_2 in toothpaste, silver, gold, copper nanoparticles in skin care product; ***Medical Fields*—**MRI, CT scan contrast enhancement agent, Drug and gene delivery system, Magnetic hyperthermia treatment; ***Agriculture*—**Nano-pesticides, herbicides, and fungicides, Food packaging**;** ***Aerospace and Aviation Industries*—**Carbon nanotubes (CNT)nanocomposites, Metal Nanoparticle-Polymer composites, SiC Nanoparticle reinforced alumina (high temperature strength, creep resistance); and ***Nanomaterials for Environmental Remediation*—**Degradation/removal of pollutants.

Text book
1. B S Murty, P Shankar, Baldev Raj, B B Rath and James Murday,Textbook of Nanoscience and Nanotechnology, 1st Edition, 2012, ISBN-13: 978-8173717383.

Reference books
1. Luisa Filipponi and Duncan Sutherland.,Nanotechnologies: Principles, Applications, Implications and Hands-on Activities, Edited by the European Commission Directorate-General for Research and Innovation Industrial technologies (NMP) program, 2012, ISBN: 978-92-79-21437-0.
2. Charles P. Poole Jr., Frank J. Owens., Introduction to Nanoscience and Nanotechnology, An Indian Adaptation, 3rd Edition, 2020, ISBN-13: 978-9354240201.
3. P. I. Varghese, T. Pradeep. A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education, 2017, ISBN: 9781259007323.

SMART MATERIALS

Course Code: PH10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course is designed with the objective of enabling engineering students to get a flavour of advances in materials science. The knowledge of smart materials learnt by the students in the course will let them to realize the usefulness of various new-age materials for technological advances and allow them to explore further in their higher semesters. This course will help them bridge the gap between traditional text book science put into physics, chemistry, etc. and the state-of-the-art science of materials.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1 : Learn about smart materials, their properties and applications,
CO2 : Understand types of smart material based on their electrical and magnetic properties,
CO3 : Characterize piezoelectric, ferroelectric and multiferroic materials,
CO4 : Identify novel functions of smart materials,
CO5 : Apply the acquired knowledge of smart materials in different applications, and
CO6 : Evaluate the importance of smart materials in day-to-day life.

Introduction to Smart Materials
common smart materials and associated stimulus-response, Classification: active and passive, Piezoelectric, Shape-memory alloys, Photo-responsive polymers, Electroactive polymers, Magnetostriction and Electro-strictriction, Thermo-responsive polymers, Dielectric elastomers, Halochromic, Thermoelectric materials; Application areas of smart materials: Space, health care and biomedical sectors**.**

Piezoelectric Materials: Piezoelectric Effect
Direct and Converse, Piezoelectric coefficients, Piezoceramics, Piezopolymers, Piezoelectric Materials as Sensors, Actuators etc.

Shape-memory Alloys
Shape memory alloys (SMAs) and properties, Phase change in SMAs, Shape memory effect: One-way and two-way, binary, and ternary alloy systems, Applications.

Chromic Materials
Photochromic, Thermochromic, Electrochromic, Magneto-chromic and Piezo-chromic Materials.

Multiferroic Materials
Multiferroics definitions, Ferroic phases, Magnetoelectric coupling; Type-I and Type-II multiferroics, Mechanism: Charge ordering, lone pair, geometric effect, and spin driven mechanism; Multiferroic materials, Applications.
Text book

1. B. K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Publication, New Delhi, 2nd Edition 2022, ISBN-13: 978-81-953536-7-5.

Reference books

1. Mohsen Shahinpoor, Fundamentals of Smart Materials, 2020, Royal Society of Chemistry, ISBN**:** 9781782626459.
2. M. Schwartz, Smart Materials, 1st Edition, 2008, CRC Press, ISBN 9781420043723.

MOLECULAR DIAGNOSTICS

Course Code: LS10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of the course is to understand methods and techniques that are used to study biological processes in living beings. They include experimental and methodological approaches, protocols and tools for biological research.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Learn the basics of Genes, Chromosomes, DNA, RNA and proteins along with their Aberrations,
CO 2: Understand the principles and working mechanisms of various instruments used in the study of biological processes in living things,
CO 3: Apply the knowledge of different diagnostics methods for quantitative estimation of xenobiotics (drugs and their metabolites) and biotics (proteins, DNA, metabolites) in biological systems,
CO 4: Analyze the recent developed techniques which are required for gene editing and their Applications,
CO 5: Evaluate the role of various bio-analytical techniques in environmental studies, biomedical sciences, life sciences, molecular biology, and biotechnological research, and
CO 6: Implement the knowledge of diagnostics in designing point-of-care instruments for different diseases.

COURSE DETAILS

Biomolecules
Overview of DNA, RNA, and Proteins, Chromosomal structure & mutations, DNA polymorphisms; and Gene and Genetic errors.

Molecular Basis of Diseases
Infectious, non-infectious; Diagnosis- traditional, modern tools, Concepts of molecular diagnostics.

Molecular Diagnosis and Techniques
DNA fingerprinting, Auto-antibody fingerprinting, Southern blotting, PCR, Real-time PCR and variations; Nucleic acid sequencing: New generations of automated sequencers, CRISPR technology and its use in diagnostics and gene editing.

Protein Diagnostics Techniques
Antigen-antibody reactions, ELISA, variations of ELISA; Western blotting.

Point-of-Care Devices
Biosensors and nano-biosensors for disease and metabollites detection.

Text book

1. M K. Campbell, S O. Farrell, O M. McDougal, AE Biochemistry, Cengage Publisher,9th Edition 2017, ISBN-13: 9789814846448.

Reference books

1. N Rifai, Andrea Rita Horvath and Carl T. Wittwer, Principles and Applications of Molecular Diagnostics,2018, Elsevier Publisher, 1st Edition, 2018.
2. K G Ramawat & Shaily Goyal, Molecular Biology and Biotechnology, ISBN9788121935128 Publisher S Chand & Co., 2nd Edition, 2010.
3. H Lodish, Arnold Ber, Molecular Cell Biology, WH Freeman Publisher, 8th Edition, 2016, ISBN-10 9781464187445.

SCIENCE OF PUBLIC HEALTH

Course Code: PE10002
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is to orient the students to core scientific disciplines in public health practice.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand and enlist the scientific approaches in public health,
CO 2: Understand and apply the epidemiologic and biostatistical science in evidence synthesis,
CO 3: Understand and apply the environmental health science in public health practice,

CO 4: Understand and apply the social and behavioral science in public health practice,
CO 5: Understand and apply the health economic and health management principles in setting priority for resource allocation, and
CO 6: Understand and apply the health economic and health management principles in health system optimization.

COURSE DETAILS

Scientific Approaches to Public Health
Health and public health concepts, Science and practice of applied public health: Scientific disciplines as part of interdisciplinary public health, Examples of use of behavioral model in changing the community perception of public health interventions

Social and Behavioral Sciences in Public Health
Social and behavioral determinants of health and disease, WHO and CDC models of social determinants of health, Disease and social status, Disease and poverty, Social interventions for good health.

Health behavior change models for public health interventions, Health Belief Model, Transtheoretical Model. The theory of planned behavior, Health communication to improve the outcome of public health interventions

Environment Health Sciences in Public Health
Environment & climate change, Ecosystem, Lifestyle and dietary effects on health, food safety and sanitation, Environmental pollution, waste disposal and treatment.

Epidemiology and Data Science in Public Health
Epidemiology and achievements in public health, Measurements in Epidemiology—Incidence and prevalence, Causation and association, and Measures of association.

Outline of study designs (including cross-sectional study design, case-control study design, cohort study design and randomized control trials); Introduction to confounding and bias; Screening tests- validity and reliability methods.

Management and Economic Sciences in Public Health

Systems approach (input, process and outcome) in public health. Health management information system, Horizontal and vertical integration of public health interventions, Public-Private mix.

Understanding community, Community health related needs assessment, Community orientation and Community mobilization, Introduction to digital health.

Text books

1. R Detal, Oxford Textbook of Global Public Health, Oxford, 7th Edition, 2021.
2. K Parks, Textbook of Preventive and Social Medicine, M/S Banarsidas Bhanot Publishers, . 26th Edition, 2021.

Reference books

1. Robert H. Friis,. Essentials of Environmental Health, Jones & Bartlett Publishers, 2018
2. Warrier S,. Information and Communication Technologies in Public Health ASociological Study,CBS Publishers, 2020.

3. Baker JJ. Baker RW, Dworkin NR, Health Care Finance: Basic Tools for Non-financial Managers., Jones and Bartlett Publishers, Inc, 5th edition. 2017.
4. Ross TK, Practical Budgeting For Health Care: A Concise Guide, Jones andBartlett Publishers, Inc, 2020.

OPTIMIZATION TECHNIQUES

Course Code: MA10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

To familiarise the students with a few rudimentary and popular optimization techniques to enable them to solve resource-constrained real world problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Know the concept of Linear programming problem (LPP) and will able to formulate linear programming problem,
CO 2: Understand the basic terminology and concepts of solving LPP,
CO 3: Solve LPP by simplex method,
CO 4: Know the concept of duality in Optimization technique,
CO 5: Apply optimization technique to solve transportation problem, and
CO 6: Solve assignment problem.

COURSE DETAILS

Linear Programming
Mathematical foundations and basic definitions, Linear optimization: Formulation and graphical solution of linear programming problems, Simplex method, Duality.

Transportation:
General structure of a transportation problem, Finding initial basic feasible solution by North-West corner rule, Least-Cost method and Vogel's Approximation Method, and Testing for optimality.

Assignment Problem
Hungarian assignment method, Unbalanced assignment problems, Restrictions in assignment, Travelling Salesman model.

Text book

1. H.A. Taha, Operation Research, An Introduction, Pearson Education, 10^{th} Edition.

Reference books

1. K. Gupta, Kanti Swarup, and Man Mohan .,Operations Research, P., S.Chand &Co, 2004.
2. N. S. Kambo, Mathematical Programming Techniques.,East West Press, 1997.
3. R. Fletcher., Practical Methods of Optimization, 2nd Ed., John Wiley, 1987.
4. Hanif D, Sherali, M. S. Bazarra. & J.J. Jarvis, Linear Programming and Network Flows, Wiley Publication. 2nd Edition.

ENGINERING ELECTIVE

BASIC CIVIL ENGINEERING

Course Code: CE10001
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to provide an overview of different aspects of civil engineering profession , namely, surveying, materials, structural, and geotechnical engineering, hydraulics and water resources, environmental engineering, and transportation engineering and their roles in the societal development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the importance and practical applications of different types of surveying,
CO 2: Learn about the different construction materials and understand the philosophy of structural analysis and design,
CO 3: Understand engineering behaviour of soil and types of foundations,
CO 4: Understand different hydraulics, hydrological and water resources engineering applications,
CO 5: Learn about the management strategies of wastewater and solid waste, and
CO 6: Understand the basics of different types of highways, railways, ports and harbours.

COURSE DETAILS

Introduction
Role of civil engineers in designing, building, and maintaining infrastructure and improving quality of life,Specializations in the civil engineering and their specific roles.

Surveying
Plans, maps, scales, divisions of surveying, classification of surveying, leveling, and advanced methods of surveying.

Construction Materials & Structural Engineering
Different construction materials and their uses**,** structural analysis and design philosophy.

Geotechnical Engineering
Overview on origin of soil, engineering properties and their classification; Soil exploration; Foundations: Their importance and purpose; Factors to consider in foundation design and stability of slopes; and Improving site soils for foundation use.

Hydraulics & Water Resources Engineering
Overview of fluid properties, open channel flow, surface and groundwater hydrology, and irrigation infrastructures.

Environmental Engineering
Types of waste water, Principles of wastewater management, Types of solid waste, and Principles of solid waste management.

Transportation Engineering
Classification of highways, Typical construction methods of roads, traffic surveys and their applications in traffic planning, Railways, Ports and Harbours.

Text book

1. Er. Shrikrishna A. Dhale and Er. Kiran M. Tajne, Basics of Civil Engineering, S. Chand & Co., 1st Edition, 2014.

Reference books

1. S. S. Bhavikati, "Basic Civil Engineering" by New Age International Publisher, 1st Edition, 2021.
2. M. S. Palanichamy "Basic Civil Engineering", Tata McGraw-Hill Publication.

BASIC MECHANICAL ENGINEERING

Course Code: ME10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to give an overview of the fundamental aspects of mechanical engineering so that a student pursuing any branch of engineering will realize the possibilities that the branch of mechanical engineering offers.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the basic principles of thermodynamics,
CO 2: Develop an understanding of fluid machines like turbine and pump,
CO 3: Determine stress and strains in a component subject to a load,
CO 4: Understand the working and design aspect of power drives,
CO 5: Recognize appropriate material for a particular engineering application, and
CO 6: Understand the fundamentals of manufacturing processes.

COURSE DETAILS

Concepts of Thermodynamics
Systems, properties, state, and cycle, Thermodynamic equilibrium and quasi-static process, First law of thermodynamics for closed system, First law of thermodynamics for open/flow systems, Second law of thermodynamics, Kelvin Plank statement, Clausius statement, and Basic concept of entropy

Fluid Mechanics and Hydraulic Machines
Introduction to fluids, Properties of fluids, Pressure variation with depth, Bernoulli's equation and its applications, and Introduction to hydraulic turbines and pumps.

Mechanics of Materials
Stress, Strain, Stress-Strain diagrams for ductile and brittle materials, Elastic constants, Hooks Law, Factor of Safety, One-dDimensional loading of members of varying vross sections.

Power Transmission
Gear, , Belt, and Chain Drives, Shaft under varying loading conditions, Introduction to robots, Applications of robotics, Basic robot motions, Sensors and Actuators.

Manufacturing Processes
Introduction to engineering materials, Types and classification of materials, Properties of materials, Introduction to casting, forming, forging, rolling, extrusion and welding, Introduction to machine tools, NC, CNC, and 3-D Printing.

Text book

1. P Kumar, Basic mechanical Engineering, Pearson Education, 2nd Edition, 2018

Reference books

1. J K Kittur and G D Gokak, Elements of Mechanical Engineering Willey, 1st Edition, 2015.
2. B Agrawal, C M Agrawal ,Basic Mechanical Engineering, Willey, 1st Edition, 2011.

ELEMENTS OF MACHINE LEARNING

Course Code: EE10001
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

Today, we have access to massive data which get generated through information and computer technology in our connected world. Most of these data lie unused and often overwhelm us due to their size and variety. The objective of this course is to introduce to the students to the field of learning from data, discovering data patterns, converting them into knowledge, and applying it to solve real-world problems**.**

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Demonstrate fundamentals of machine learning,
CO 2: Identify data types, apply suitable processing and visualize using suitable methods,
CO 3: Describe Unsupervised Learning and apply clustering techniques,
CO 4: Describe Supervised Learning and apply classification techniques,
CO 5: Demonstrate perceptron and Multi-layer Perceptron models, and
CO 6: Apply machine learning techniques for real world requirement**.**

COURSE DETAILS

Introduction
Importance and Applications of Machine Learning, Supervised, Unsupervised, Reinforcement Learning and Evolutionary Learning.

Data Analysis
Measurement Scales and Data Types; Visualization, Pre-processing and Transformation of Data; Dimensionality Reduction; and Data (Dis)Similarity.

Unsupervised Learning
K-means and Density-based,Clustering Methods.

Supervised Learning
K-Nearest Neighbour, Decision Tree by Qualitative and Quantitative(information Gain method); Evaluation by Confusion Matrix of Supervised Learning Methods**.**

Learning with Neural Networks
Perceptron, Multi-layer Perceptron and, Error Backpropagation Learning.

Text books
1. Gopal, M., Applied Machine Learning, McGraw Hill Education, 2018
2. Pradhan, M. and U. D. Kumar,Machine Learning Using Python,Wiley India Pvt.Ltd, 2019.

Reference books

1. Alpaydin, E., Introduction to Machine Learning, 3rd Edition, The MIT Press, 2014.
2. Bishop. C M, Pattern Recognition and Machine Learning, Springer, 2006.
3. Jain, V. K., Big Data Science Analytics and Machine Learning, Khanna Publishers, 2021
4. Mitchell, T. M.,Machine Learning, McGraw Hill, 1997.
5. Müller, A. C.,Introduction to Machine Learning with Python, O'Reilly Media, Inc, 2016
6. Raschka, S. and V. Mirjalili, Python Machine Learning, 3rd Edition, Packt Publishing, 2019.
7. Shalev-Shwartz, S. and S. Ben-David ,Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

BIOMEDICAL ENGINEERING

Course Code: EC10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

Biomedical Engineering is a multidisciplinary field that combines knowledge available in a wide range of disciplines such as engineering, medicine, and societal science. The course focuses on innovating newer equipment and technologies to improve human health and enhance health care facilities in a holistic manner.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Apply knowledge of basic engineering and biology to solve the problems,
CO 2: Knowledge of human body about cell, potential and organs of body,
CO 3: Develop a thorough understanding on principles of bio-instrumentation,
CO 4: Explain the role of bio-potential electrodes, and design of sensors,
CO 5: Differentiate and analyse the biomedical signal sources, and
CO 6: Knowledge about imaging techniques used in hospital.

COURSE DETAILS

Introduction and Overview
Introduction to biomedical engineering, Applications of biomedical engineering.

The Human Body

cCll-structure and function, Tissue & organs, Bio-potentials, Action potential, Major human systems (musculoskeletal, circulatory, nervous, and respiratory system)

Bio-instrumentation
Instruments in medical practice, Man-instrumentation system, Basic components, Linear network analysis, Bioelectric amplifier (OpAmp, isolation amplifier, instrumentation amplifier), Bio-instrumentation design, and Intelligent medical instrumentation.

Biomedical Electrodes and Sensors
Ssignal acquisition, Bio-potential measurements, Active and passive sensors, and Electrodes for biophysical sensing (Ag-AgCl, surface electrodes, microelectrodes), transducers, sensors.

Biomedical Signals, Imaging and Informatics
Bioelectric phenomena, Sources of biomedical signals, Origin of biopotentials, Basics of bio-signal processing, noise, Interference, Electrical safety issues, Principle of medical imaging techniques, such as X-ray, US, MRI, CT scan, and nuclear imaging, and Fundamentals of bio-informatics.

Text book

1. John D. Enderle & Joseph D. Bronzino Introduction to Biomedical Engineering, Academic press, 3rd Edition, 2012.

Reference books

1. Joseph D. Bronzino, Donald R. Peterson,The Biomedical Engineering Handbook, CRC press, 4th Edition 2015.
2. G.S. Sawhney, Fundamentals of Biomedical Engineering, New Age International (P) Ltd, 2011.

BASIC INSTRUMENTATION

Course Code: EE10003
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The course is designed to impart, to the students, the principles of analog and digital measuring instruments which include the working mechanisms of sensors and transducers and their applications in industrial and biomedical systems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Know the basics of measuring instruments,

CO 2: Measure different electrical quantities,
CO 3: Understand the working principles of optical and electrical transducers and sensors,
CO 4: Understand the working of electrical transducers and sensors,
CO 5: Apply the transducers in industrial applications, and
CO 6: Use instruments in biomedical applications.

COURSE DETAILS

Analog and Digital Instruments
Basics of measuring instruments, Types of analog instruments, Measurement of voltage, current, power and energy in single and three phase circuits; Digital Instruments: Digital voltmeter, Digital multimeter, Timer/counter, and Time, phase and frequency measurements in oscilloscope.

Sensors and Transducers
Optical sources and detectors: LED, photo-diode, light dependent resistor; Basics of fiber optic sensing, IR Sensors. Resistive, capacitive, inductive, piezoelectric, and Hall effect sensors, Temperature transducers: Thermocouple, RTD , and thermistor.

Transducers in Industrial Applications
Measurement of displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure, flow, liquid level, pH, conductivity and viscosity.

Instruments in biomedical applications
ECG, Blood Pressure measurement, CT Scan, and Sonography

Text book

1. R. K. Rajput ,Electrical and Electronic Measurements and Instruments,S Chand Publication, 4th Edition, 2015,William David Cooper,Electronic Instrumentation and Measurement Techniques, by PHI, 2010.

Reference books

1. Er. R.K. Jain, Mechanical and Industrial Measurements (Process Instrumentation and Control), Khanna Publishers, 1995.
2. A.K Sawhney, A course in Electrical and Electronics Measurements and Instrumentation Dhanpat Rai Publication, 10th Edition, 2012.
3. D Patranabis, Sensors And Tranducers, PHI Publication, 2ndEedition, 2017.

HASS ELECTIVE I

SOCIETY, SCIENCE AND TECHNOLOGY

Course Code: HS10013
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

There is a circular relationship between society, science, and technology. Society creates a need and an ambience to develop science and technology, and science and technology create means to meet societal needs and new opportunities to make human life better. Studying this relationship is the objective of this subject. The subject will expose, before the students, the past developments of science and technology and the social forces that played a dominant role in making these developments possible and the way these were used in the society. The subject will also present the ethical principles that underlie the development and use of science and technology in the society**.**

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the forces that shape the development of science and technology,
CO 2: Understand the major milestones of scientific discoveries have impacted human thought processes,
CO 3: Understand the effect of technological developments in societal transformation,
CO 4: Analyse the contribution of Science and Technology in solving societal and Environmental problems,
CO 5: Evaluate the ethical issues related to abuse of science and technology, and
CO 6: Apply the skills learned to suggest solutions to global problems linked to science and Technology.

COURSE DETAILS

Introduction
Human Curiosity to Know the Truth of Nature, Need to Improve Quality of Life, Emergence of Science and Technology, Characteristics of Society, Science, and Technology, and Impact of Science and Technology on the Society.

Scientific Discoveries
Milestone Scientific Discoveries of the Past and the Ways They Impacted Human Thought Process and Culture; Scientific Method, Developing a Theory, and Making of a Discovery; Discoveries in the Physical, Biological, and Mathematical Sciences; Normal Science, Paradigms, Anomalies, Crisis and Emergence of Scientific Theories, and Scientific Revolutions.

Technological Developments

Milestone Developments of Technologies and the Ways They Transformed the Society. Stories of Technological Developments such as Steam Engines, Electricity, Semiconductors, and IoT.

Science and Technology in the Service of the Society
Contributions of Science and Technology to Solving Societal, Environmental, and Global Problems. Successes and Limitations, and Abuses and Control of Science and Technology; Ethical Considerations.

Text book

1. Bucchi, M., Science In Society: An Introduction to Social Studies of Science, Routledge Publication, 1st Edition,2004.

Reference books

1. Collins, H. and T. Pinch, The Golem: What You Should Know about Science, 2nd Edition, New York: Cambridge University Press,1998.
2. Collins, H. and T. Pinch,The Golem: What You Should Know about Technology, 2nd Edition. New York: Cambridge University Press, 2014.
3. Kuhn, T. S.,The Structure of Scientific Revolutions, 4th Edition, Chicago University Press, 2012.
4. Hatton, J. and P. B. Plouffe, Eds., Science and Its Ways of Knowing, New Jersey: Prentice Hall,1997.
5. Moskovites, M., Ed., Science and Society, Ontario: House of Anansi Press Limited,1997
6. Sismondo, S. An Introduction to Science and Technology Studies, 2nd Edition. Maldon, MA: Blackwell Publishing, 2009.
7. Sarukkai, S. What Is Science?, New Delhi: National Book Trust, India, 2012.
8. USSR Academy of Sciences Science and Society, Moscow: Nauka Publishers, 1989.

SOCIO-POLITICAL ENVIRONMENT

Course Code: SO10043
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The objective of this course is providing basic knowledge on socio-political environment of India and to equip the students with an understanding of their roles, duties and responsibilities in a democratic set up.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand contemporary Indian social problems,
CO 2: Understand the roles and functions of the three political institutions in our democratic up,

CO 3: Familiarize the students with the Rights and Duties enlisted in the Indian Constitution,
CO 4: Grasp the interrelationships among political, social and economic issue,
CO 5: Visualize contemporary changes in Political Institutions, and
CO 6: Realize the importance of equity, equality, and dignity in a democratic system.

COURSE DETAILS

Social Problem in India

Meaning and Definition of Social Problems, Characteristics, Causes and Consequences, Problems of Poverty, Unemployment, Population growth, Problems ofWomen and Aged, Corruption and Nepotism, Illiteracy, Substance Abuse, and Terrorism.

Social Stratification

Equity and Equality, Caste, Religion, Class, Gender Discrimination, UrbanSlums.

Political Institutions

Meaning and Basic Concepts of PoliticalInstitutions: Legislative, Executive and Judiciary Systems of the Indian Constitution.

Fundamental Rights and Duties

Fundamental Rights and Duties in Indian Constitution, Directive Principles of State Policy.

Contemporary Changes in Political Institutions

Changing Role of the Government in Contemporary India, Role of Government in the Formation of National and International Policies and Their Impact on Business and Trade.

Text books

1.C. N. Shankar Rao, S. Chand., Indian Social Problems,by S.cahand Publication,2017
2. M. Laxmikanth., Constitution of India,Cengage Learning,2020.
3. Himanshu Roy & M.P Singh Indian Political System, Pearson publisher,4th Edition,2018.
4. Ram Ahuja ,Social Problems in India, Rawat publisher,4th Edition,2014.

Reference books

1. Our Parliament, Subhash C Kashyap, NBT, 2021.
2. Social Stratification, Dipankar Gupta (Ed), Oxford India Publication, 1997.
3. Modernisation of Indian Tradition, Yogendra Singh, Rawat Publication, 1986.

THINKING PERSPECTIVES

Course Code: PS10043
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

Cognition plays a significant role in accumulation and processing of information. This subject provides an in-depth understanding of some of the cognitive processes in terms of current theories, models and applications. It helps learners to understand the importance of these cognitive processes and the rationale behind cognition, problem solving, critical thinking, and scientific thinking. It facilitates students to identify and analyze the key conceptual and theoretical frameworks underpinning cognitive process.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the definition and scope of cognition, problem solving, and creativity,
CO 2: Understand the theories related to cognition, decision making, and critical thinking,
CO 3: Understand the classic and current experimental research in cognitive processes,
CO 4: Develop skills essential in designing and conducting experiments in cognition, reasoning, and problem solving,
CO 5: Understand various aspects of critical thinking, scientific thinking, and design thinking process, and
CO 6: Apply the knowledge of cognitive processes to one's own personal life and to real life issues.

COURSE DETAILS

Basics of Cognition
A Brief History, Emergence of Modern Cognitive Approach, Thinking, Basic Elements of Thought: Forming Concepts, Propositions, Images.
Reasoning, some Basics sources of error, Information-processing approach, connectionist approach, evolutionary approach, ecological approach.

Memory Processes and Critical Thinking
Organization of Long Term Memory, Forgetting, Retrieval and Metamemory; Proactive and Retroactive inference; Amnesia and Retrieval, Flashbulb Memory, Eyewitness Memory, Traumatic Memory, False Memories.
Phases of Critical Thinking: Intellectualization, Suggestion, Hypothesis, Reasoning, and Testing, Critical Thinking Abilities: Thinking, Observational, and Questioning and Dispositions, Critical Thinking Skills: Analysis, Communication, Creativity, Problem-solving Skills, and Open-mindedness.

Systems Thinking and Scientific Thinking

System Definition and Characteristics, Approaches to System Modelling, Causal-Loop Diagramming, System Archetypes, Micro world and Learning Laboratory, The Learning Organization and the Fifth Discipline, Systems Thinking Study, Examples.
Characteristics of Science: Systematic observation and experimentation, Inductive and deductive reasoning, Lessons from Scientific Thinking: Empirical Evidence, Logical Reasoning.

Creativity and Designing Thinking
Creative Thinking, Stages in Creative Thinking, Nature of Creative Thinking, Features of Creativity—Novelty, Originality and Usefulness, Guilford's Measure of Creativity—Fluency, Flexibility, and Originality, Barriers to Creativity, Enhancing Individual and Organizational Creativity.
Designing Thinking as a Process of Problem Solving: Defining Problems, Challenging Assumptions, Developing Concepts, identifying Alternative Strategies and Solutions, Prototyping, and Experimenting Problem Solving through Innovative Solutions, Stages of Design Thinking—Empathize, Define, Ideate, Prototype and Test.
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Text books

1. Solso, R. L.,Cognitive Psychology, Pearson Education, 6th Edition. 2004.
2. Baron, R. A. Psychology,Pearson Education, 5th Edition, 2002
3. Rathus, S.A. Introductory Psychology Wadsworth Cengage,5th Edition, 2016.
4. Ciccarelli, S. & White, N.J, Psychology 5th Edition, Pearson Education.2017
5. The Fifth Discipline: The Art & Practice of the Learning Organization, Cengage Publication,2nd Edition, 2006.
6. Cross, N., Design Thinking: Understanding How Designers Think and Work, Berg Publishers.

Reference books

1. Baddley, A.,Human memory: Theory and practice. New York Psychology Press,1997.
2. Treror, A.,The psychology of language: From data to theory. Taylor Francis,2002
3. Smith, E.E. &Kosslyn, Cognitive psychology: Mind and brain. Prentice Hall,2007.
4. Tripathi, A.N. &Babu, Nandita (2008). Cognitive processes. In Misra, G. Psychology in India: Advances in Research, Vol. 1,Pearson Education.
5. Vaid, J., & Gupta, Ashum,Exploring word recognition in a semi-alphabetic script: the case of Devanagari. Brain and Language, 81, 679-690.

CREATIVITY, INNOVATION AND ENTREPRENEURSHIP

Course Code: PS10045
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

The course is designed for students who want to enhance their creative and innovative skills and apply them to prepare business plans to form entrepreneurial enterprises. More specifically, the course is designed to help students to stimulate creativity in themselves and learn the impact of innovation on growth creation and design thinking in real-world business situations. In this course, the concepts of entrepreneurship and the environment in which the entrepreneurs act will be developed along with business plans and business models for start-ups.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the key elements of creativity and innovation,
CO 2: Visualize the impact of innovation on growth creation,
CO 3: Apply creative and design thinking to real-world business situations,
CO 4: Create a foundation of entrepreneurship development and its theories,
CO 5: Develop business plans and business models to start entrepreneurial enterprises, and
CO 6: Analyze the business plan and implement it in real field.

COURSE DETAILS

Introduction

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples.

Creativity

Definitions, Importance, and Relationships among Creativity, Innovation, and Entrepreneurship; Examples, Creative Thinking and Stages of Creative Thinking, Barriers to Creativity, Enhancing Individual Creativity, Guilford's Usual Unusual Test, Psychometric Approaches to Tests of Creativity, Structured tools of Creativity (Developing Creative Focus, Exercising Mind, Setting Directions, Suspending Rules, Thinking Differently, Establishing Formatted Work Space, Stimulating Mechanisms, Utilizing Experiences.

Innovation

Innovation, Benefits, Keys to Successful Innovations, Types of Innovation, Barriers to Innovation, Methods of Generating Ideas, Design Thinking. Creative Problem Solving, and Measures of Innovation.

Entrepreneurship

Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur, Social Entrepreneur, Case Study on the Entrepreneurial Excellence of N. R. Narayan Murthy, Introduction to Agricultural, Rural, Tourism, Social and Digital Entrepreneurship, Entrepreneurial Motivational Behavior (Creativity, Self-Efficacy, Locus of Control, Risk Taking, Leadership, Communication),

Converting Ideas into Products/Services with Differentiating Features, Niche Market, Design of the Products/Services, Bootstrap Marketing, Formulation of Business Plan, Business Model, Financial Planning, and Sources of Finance.

Practical classes will be devoted to organizing practicing sessions on creativity, case study discussion sessions and market analysis sessions on generating novel ideas, and developing and presenting business plans. Students, in groups, will design a new product/service, do a bootstrap market study, develop a business plan, and make an elevator pitch.

Text books

1. Khanka, S. S. Creativity, Innovation, and Entrepreneurship, S.Chand .
2. Praveen Gupta, Business Innovation, S. Chand , 2007

Reference books

1. Barringer B. R. and R. Duane,Entrepreneurship: Successfully Launching New Ventures: Pearson Prentice Hall, Ireland, 3rd Edition 2009.
2. Duening, T. N., R. D. Hisrich, and M. A. Lechter , Technology Entrepreneurship: Taking Innovation to the Marketplace, Elsevier, Amsterdam, 2nd Edition 2015.
3. Harrington, H. J., Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization, Routledge, 2019.

ESSENTIALS OF MANAGEMENT

Course Code: HS10202
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course explores the basic concepts and processes of management. Students will learn the importance of management in their professional life from the stories on the evolution and practices of management. Students will examine the fundamental roles and processes of planning, organizing, staffing, directing and controlling that comprise the managers' role. This course also examines the fundamentals of marketing and financial management for the success of the organization. This course will make an attempt to introduce students to the business environment and strategic management process to understand the nuances of business. Students will develop skills related to the manager's function as required in today's competitive environment.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO1: Learn different approaches, theories and stories of various practitioners of management and know how such knowledge could be applied to achieve goals of Organizations within the changing environment,

CO 2: Understand the core functions of management in order to facilitate efficient and effective decision making both at individual and organizational level,
CO 3: Identify the human resource requirement of the organization for achieving its objective effectively,
CO 4: Synthesize various marketing and financial skills and techniques in order to be successful in corporate world,
CO 5: Assess the business environment and understand the importance of various types of business environment for better decision making, and
CO 6: Acquire the lesson learnt in strategic management process for strategic decision making by leveraging the core competencies of the organization.

COURSE DETAILS

Evolution of Management Thoughts
Concept, Scope and Significance of Management; Classical Approach; Scientific, Bureaucratic & Administrative theory of Management; Neo-classical and Modern Approach; Contribution of Management Practitioners

Functions of Management (Part I)
Nature, scope and significance of Planning; Types of Planning; Process of Planning; Barriers to effective planning; Decision making: concept, types and process; Organizing: concept and significance; Delegation of

authority; Authority vs.Responsibility; Structure of Organization: departmentalization, Centralization vs. Decentralization

Functions of Management (Part II)
Concept of Staffing, Manpower planning and Job design; Recruitment and selection; Training and development; Performance Appraisal; Directing: Concept, Direction and Supervision; Controlling: Concept, Importance and levels; Process and types of controlling

Marketing and Financial Management
Marketing Mix (Product, place, price, Promotion); Market Segmentation; Introduction, scope, importance and functions of Financial management; Introduction to Financial statements: Profit and loss account; balance sheet

Business Environment and Strategic Management
Business environment: concept, importance, elements; Types of business environment; Strategic Management: Concept, Importance and levels of strategy; Process of Strategic Management

Text Books

1. S.A. Sherlekar & V.S. Sherlekar, Modern Business Organization & Management (Systems Approach) by Himalya Publishing House, 2018.

2. Harold Koontz and Heinz Weihrich ,Essentials of Management: an International Perspective by, McGraw Hills, 2020

Reference Books

1. K. Ashwathappa, Essentials of Business Environment, Himalaya Publishing House, 2017.
2. Joseph L. Massie, Essentials of Management Pearson Education India, Fourth edition, 2015.
3. Azhar Kazmi & Adela Kazmi, Strategic Management, McGrawHill, 5th edition 2020.

SHADES OF ECONOMICS

Course Code: HS10102
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

This course will provide technical students with knowledge in concepts of environmental economics, resource economics, and circular economy, allowing prosperity for present and future generations. The course will equip future engineers with skill to handle resources efficiently and effectively. Acquaint them with the contemporary trends in business settings and thereby innovate novel solutions to existing problems.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Understand the economic drivers that shape the future of India,
CO 2: Understand sustainability issues related to usage of factor endowment,
CO 3: Ability to create linkage between Economics, Science and Technology,
CO 4: Apply knowledge, reasons and the need for regulating circular economy,
CO 5: Assess and analyses scope for global market opportunities, and
CO 6: Explore yet to be unearthed employment opportunities.

COURSE DETAILS

Purple Economy: Economics of Glocalization
Introduction to colours and world of economics (including White, Blue, Black, Green, Purple, Grey, Red, Pink, Silver); Concept and definition of purple economy; Cultural footprint; Local and global cultural economy; Culture and well being; Rethinking employment and training in the purple economy; Vocal for Local; Make in India.

Grey Economy: Economics of Informal Sector
Concept and definition of grey economy; Introduction to formal and informal Sector; Formal and informal sector linkage; Labour absorption and dualism in economy; Theoretical and policy issues; Migration in informal sector.

Green Economy: Economics of Reduce, Reuse, and Recycle
Concept and definition of green economy; Green investment and green bond; Green technology and renewable resources; Carbon footprint; Waste management.

Blue Economy: Economics of Ocean Resources
Concept and definition of blue economy; The marine environment; Fisheries and aquaculture; Tourism; Ocean-based renewable sources of energy; Transportation and the blue economy; ; Pollution of water resources; Water resource management.

Black Economy: Economics of Unsanctioned Sector
Concept and definition of black money; Causes and consequences of black economy; Global black income generation; Extent of black money in India. Government measures to curb black money.

Text book

1.S.K Mishra and V. K. Puri, Indian Economy. Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6

Reference books

1.Uma Kapila. Indian Economy:Economic Development and Policy. Academic Foundation ISBN-10 : 9332705550 and ISBN-13 : 978-9332705555,2022.
2. Taneja and Myer :Economics of development and Planning, Vishal Publishing Co. ISBN-13 : 978-9382956068.
3. Datt Gaurav & Mahajan Ashwani , Indian Economy, S Chand & Company Limited. 2017.
4. Adrian C. Newton, Elena Cantarello, An Introduction to the Green Economy. Science, Systems and Sustainability,2014

5. Shalini Goyal Bhalla. Circular Economy- (Re) Emerging Movement.,2020.
6. Somnath Hazra & Anindya Bhukta,The Blue Economy. An Asian Perspective.
The Informal Economy: an Employer's Approach. The Informal Economy: an Employer's Approach. 2021.
7.The Purple Economy: An Objective, An Opportunity, 2013.
8. Tom Tietenberg, Lynne Lewis, Environmental and Natural Resource Economics. 2018.

INDIAN ECONOMY POST LIBERALISATION

Course Code: HS10123
Credit: 2
L-T-P: 2-0-0
Prerequisite: Nil

COURSE OBJECTIVE

Study of this course provides an extensive understanding of changing structure of Indian economy over time. This course targets to put emphasis on inclusive growth, reducing poverty, inequality and creating decent employment in the economy. This course will give an understanding about the issues faced by an economy in achieving sustainable development.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Interpret the changing structure of Indian economy,
CO 2: Perceive the issues and challenges faced by Indian economy,
CO 3: Evaluate the policies and programmes required to achieve inclusive growth,
CO 4: Realise the importance of human capital in triggering economic development,
CO 5: Comprehend the state and role of external sector in strengthening Indian economy,and
CO 6: Help in achieving sustainable development for the economy.

COURSE DETAILS

Introduction and features
Changing structure of the Indian economy Changing paradigms of Development Strategies and Economic Reforms.

Poverty, Inequality and Employment
Various concepts and estimates of poverty; Income inequality; Problem of unemployment; Interface among growth, poverty and employment; Inclusive growth and Human Development; Sustainable Development Goals—Targets for reduction in Poverty, Inequality and Decent Employment.

Demographic Issues
Demographic trends, size and structure of population; Health and Education; Skill challenges and demographic dividends; Sustainable Development Goals—Targets forGreater Wellbeing and Better Human Capital.

Perspectives in Agriculture, Industry and Services

Agricultural growth performance and food security; Growth, trends and changing pattern of Indian industries, industrial reforms and policies; Services in India's growth process; Sustainable Development Goals—Targets for Inclusive and Sustainable Growth.

External Sector and Issues in Indian Public Finance

Foreign trade and trade policy; fiscal devolution, Indian Union Budget and Tax System

Text book

1. Uma Kapila, Indian Economy Perfomance and Policies,academic foundation, 2020,ISBN:978-933270545

Reference books

1. S.K. Mishra, and V. K. Puri, Indian Economy, Himalaya Publishing House,2022, ISBN: 978-93-5596-423-6
2. Gaurav Datt and Ashwani Mahajan,Indian Economy, GENERIC. Classic Edition,2022 ISBN-10 : 9352531299 ISBN-13 : 978-9352531295

COMMUNIT/ENVIRONMENT-BASED PROJECTS

Course Code: **EX17001**
Credit: **2**
L-T-P: **0-0-4**
Prerequisite: **Nil**

COURSE OBJECTIVE

This course is offered to give the students an opportunity to connect with the community and the environment, learn and prioritize their problems, and define the problems in ways that make them amenable to scientific analysis and pragmatic solution. Appreciating the community problems, visualizing and experiencing them in person, self-learning, applying to realities, searching for and finding implementable solutions are the primary benefits of this project-based subject.

COURSE OUTCOMES

After successfully completing the course, the students will be able to

CO 1: Identify need of the community,
CO 2: Formulate objective of a project,
CO 3: Communicate orally and through formal technical write-ups,
CO 4: Analyze and interpret data wherever essential,
CO 5: Provide an implementable solution to the problem, and
CO 6: Work in team following ethical manners.

The projects will be applied to problems uppermost in the minds of the community regarding the problems that they confront regularly. The problems may range from social inequality and social justice to lack of common services such as health, education, water, power, banking, and from lack of access to government subsidies and policies to deforestation and environmental problems.

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