### SEMESTER I

**15B101/15H101/15T101 CALCULUS AND ITS APPLICATIONS**

<table>
<thead>
<tr>
<th>Module</th>
<th>Credits</th>
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<tbody>
<tr>
<td>DIFFERENTIAL CALCULUS</td>
<td>3 2 0 4</td>
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<tr>
<td>INTEGRAL CALCULUS</td>
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<tr>
<td>ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER</td>
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<tr>
<td>LINEAR DIFFERENTIAL EQUATIONS OF SECOND ORDER</td>
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<tr>
<td>VECTOR CALCULUS</td>
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<tr>
<td>TEXT BOOKS:</td>
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<td>REFERENCES:</td>
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**15B102/15D102/15I102/15L102/15Z102 PHYSICS**

<table>
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<th>Credits</th>
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<tr>
<td>OSCILLATORY MOTION</td>
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<tr>
<td>WAVE MOTION</td>
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<tr>
<td>OPTICS</td>
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<td>HEAT</td>
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<td>ELECTROMAGNETISM</td>
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<td>TEXT BOOKS:</td>
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<tr>
<td>REFERENCES:</td>
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<tr>
<td>1. Searle’s apparatus and Lee’s disc apparatus.</td>
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<tr>
<td>2. Searl’s apparatus and Lee’s disc apparatus for determination of thermal conductivity.</td>
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<td>3. Maxwell’s equations and interpretation of Maxwell’s equations.</td>
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**Total L**: 45 + **T**: 30 = 75

### SEMESTER II

<table>
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<th>Module</th>
<th>Credits</th>
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<tr>
<td>LINEAR ALGEBRA:</td>
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<td>NUMERICAL METHODS</td>
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<td>MECHANICAL REASONING</td>
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<td>ENGINEERING PROBLEM SOLVING</td>
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<td>INTEGRAL EQUATIONS</td>
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<tr>
<td>TEXT BOOKS:</td>
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**Total L**: 45
TEXT BOOKS:

REFERENCES:

15B103 CHEMISTRY
3 0 0 3


WATER CHEMISTRY: Hardness, estimation - demineralization, phase rule:- Water system, binary liquids, distribution law, principle of extraction, solubility product, common-ion effect, ionization of weak electrolytes, solubility of gases in liquids, pH, dissociation of salts and pH of solutions.

Total L: 45

TEXT BOOKS:

REFERENCES:

15B104 PROBLEM SOLVING AND C PROGRAMMING
2 2 0 3

INTRODUCTION TO PROBLEM SOLVING: Program development - Analyzing and Defining the Problem - Algorithm - Flow Chart.

PROGRAMMING LANGUAGES: Definition - Types of programming language – Modular Programming - Program Development Environment.

CONTROL STATEMENTS: If else - Switch Case - While - Do While - For - Nested loops - break – continue – goto statements. (4+4)

FUNCTIONS: Function prototype - Defining a function – function call - Passing arguments to a function - Storage classes - auto - static - extern and register variables. (4+4)

ARRAYS: Defining an array - Processing an array - Passing array to a function - Multi dimensional array - Arrays & strings. (4+4)

POINTERS: Definition - Pointer Arithmetic - Pointer and arrays – Dynamic memory allocation. (2+2)

STRUCTURES AND UNIONS: Definitions - Processing a structure – Array and structures – Nested structures - Structures and pointers - Structures and functions. (4+4)

FILES: Need for files – Operations on files - Sequential and Random access file functions - File Handling Functions - Error handling functions. (2+2)

Preprocessor Directives - Command Line Arguments. (2+2)

Total L: 30 + T: 30 = 60

TEXT BOOKS:

REFERENCES:

15B105 BASIC OF ELECTRICAL AND ELECTRONICS ENGINEERING 3 0 0 3

ELECTRICAL CIRCUITS : Ohm’s law, Kirchhoff’s law-simple problems in DC circuits. Introduction to AC circuits-RMS Value, Power and Power factor, 1-phase and 3-phase balanced circuits. (8)

ELECTRICAL MACHINES : Principle of operation and characteristics of DC machines, Transformers, 1 phase and 3-phase Induction motors. (8)


LINEAR ICs AND DIGITAL ELECTRONICS : Linear ICs-Operational amplifier – Adder, Multiplier, Integrator, Differentiator.Digital Electronics – Binary number systems – AND, OR, NOT, NAND, NOR EXOR, EXNOR gates – Boolean algebra – Half and Full adder, Flipflops, Registers and Counters. (9)

SENSORS AND FEEDBACK DEVICES : Importance of sensors in biotechnology. Accuracy, repeatability, sensitivity, resolution, stability, errors and output Impedance of sensors. Static and Dynamic characteristics of sensors. (4)

ELECTRODES AND TRANSDUCERS: Basic electrode theory in biological : Ionic conduction, Metal electrolyte double layer, models of the cell membrane. Electrical signal detection in biological systems : Silicon, glass and metal electrodes, Micro electrode-skin surface electrode; Electrode materials – Blood gas electrode; Active transducer and passive transducers – Thermistor – Example of Industrial biosensors eg: for glucose monitoring and for DNA analysis. (8)

Total L: 45

TEXT BOOKS:

REFERENCES:

15T104 ENGLISH LANGUAGE PROFICIENCY

LEARNING LANGUAGE THROUGH STANDARD LITERARY AND GENERAL TEXTS: Integrated Tasks focusing on Language Skills – Training based on Text based Vocabulary, tone, register and Syntax features

GRAMMAR IN CONTEXT: Word Order – Subject Verb Concord – Style features – Tenses, Conditionals, Prepositions, Active and Passive Voice, Modals and Transformation of Sentences

GUIDELINES FOR WRITTEN COMMUNICATION: Principles of Clear Writing - Paragraph Writing – Essay Writing – Emphasis Techniques – Summarizing and Paraphrasing – Analytical Writing – Letter Writing

WRITING PRACTICE

FOCUS ON SPOKEN ENGLISH: Task – based activities with graded levels of difficulty and with focus on language functions

Level 1: Self – expression – Greetings in Conversation, Hobbies, Special interests, Daily routine
Level 2: General Awareness – Expression of Concepts, Opinions, Social Issues, Description of a process / picture/chart, news presentation / review
Level 3: Advanced Skills – Making Short Speeches and Participating in Role Plays

LISTENING ACTIVITY: Task- based Activities using Language Lab

TEXTBOOK:
1. Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:

15B110 ENGINEERING GRAPHICS

INTRODUCTION: Introduction to Engineering Drawing. BIS. Principles of dimensioning.


TEXT BOOKS:

REFERENCES:

15B111 PHYSICS LABORATORY I

List of Experiments:
1. Determination of wavelength of Mercury spectrum using diffraction grating
2. Measurement of Vibration Frequency of Melde’s Apparatus
3. Measurement of Temperature using LM35
4. Determination of fiber thickness – Air Wedge method
5. Study of reverse bias characteristics of Germanium diode and determination of band gap of Ge

Demonstration:
1. Optical phenomena using He – Ne Laser.
2. Ultrasonic cleaning.
3. Thin film deposition using DC/RF sputtering technique.
4. Hall effect

Total P: 30

REFERENCES:
1. Physics Practicals, Department of Physics, PSG College of Technology 2015

15B112 CHEMISTRY LABORATORY I

1. Determination of total, temporary, permanent, calcium and magnesium hardness of water by EDTA method.
2. Adsorption of oxalic acid on carbon – verification of Freundlich adsorption isotherm.
3. Determination of rate constant of acid hydrolysis of ester.
4. Estimation of amino acid by fixing with HCHO and determinations of its isoelectric point by pH metry

Total P: 30

REFERENCE:
1. Laboratory Manual Prepared by the Department

SEMESTER II

15B201/15H201/15T201 COMPLEX VARIABLES AND TRANSFORMS

COMPLEX VARIABLES: Complex differentiation-Analytic function, Cauchy Riemann equations, harmonic functions. (6+4)

COMPLEX INTEGRATION: Cauchy’s integral theorem, Cauchy’s integral formula, Taylor and Maclaurin series, Laurent series (concepts and statements only), singularities and zeros, residue integration method (Residue integration of complex integrals only). (8+5)

LAPLACE TRANSFORMS: Laplace transform, inverse transform, linearity, s-shifting, transforms of derivatives and integrals, unit step function, t-shifting, Dirac’s delta function, periodic functions, convolution, differentiation and integration of transforms, Method of solving differential equations and integral equations by using Laplace transform technique. (12+9)

Z-TRANSFORM: Introduction of Z-transform, Inverse transform, difference equation, application of Z-transform to solve difference equations.

TEXT BOOKS:

REFERENCES:

15B202 BIOMOLECULES

INTRODUCTION: Living systems - basics, chemical composition, structure and reactivity of simple biological molecules, chemistry of water and its relevance to living systems.  

CARBOHYDRATES: Monosaccharides, disaccharides, glycosidic linkages, oligosaccharides, polysaccharides, glycoproteins, glycolipids - structure and functions.


LIPIDS: Types- fattyacids, triacyl glycerides, phospholipids, sphingolipids, glycolipids, sterols, biological membranes- structure, composition and membrane proteins, membrane transport.

NUCLEIC ACIDS: Chemical composition of nucleic acids- bases, nucleosides, nucleotides, nucleic acid polymers, structure, complementarily and functions of nucleic acids.

ENZYMES: Introduction, classification, properties, kinetics, inhibition and regulation.

TEXT BOOKS:

REFERENCES:

15B203 C++ AND DATA STRUCTURES


FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by reference - Inline functions - Default, Const Arguments - Function Overloading - Friend and Virtual Functions - Classes and Objects - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static Member Functions - Arrays of Objects - Objects as Complex Arguments - Friend Functions - Returning Objects - Const Member functions - Pointers to Members.

CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors overloading - OverloadingUnary and Binary Operators - Overloading Binary Operators using Friend functions.

DATA STRUCTURES: Abstract data Types - Primitive data structures - Analysis of algorithms - Best, worst and average case time complexities - Notation.


STACKS: Primitive operations - Sequential implementation - Applications: Subroutine handling, Recursion.

QUEUES: Primitive operations - Sequential implementation - Dequeues - Applications: Image component labeling, Machine shop simulation.


REFERENCES:

TEXT BOOKS:


Total L: 45+ P: 30 = 75
TEXT BOOKS:

REFERENCES:

15B205 ORGANIC CHEMISTRY

ISOMERISM AND STEREOCHEMISTRY: Isomerism - structural and stereoisomerism, conformational isomerism. Fischer, Sawhorse and Newmann projection, Geometrical isomerism:- E and Z nomenclature. Optical isomerism, Chiral carbon, asymmetric molecule, absolute and relative configuration, D-L and R-S notations, specific rotation, determination of optical activity, enantiomers and diastereomers. Chiral resolution, asymmetric synthesis.

FUNCTIONAL GROUPS AND COMMON REACTION TYPES: Inductivity, hyperconjugative, and resonance effects. Reactive species (carbocations, carbanions, free radicals, carbenes), generations and structures, nucleophile, electrophile and free radical types of reactions. Classification of organic reactions - addition, substitution, elimination, oxidation and reduction processes:- general mechanisms. Important derivatization reactions of alcohols, thiols, aldehydes, ketones, carboxylic acids, esters, amines and amides.

BIOMINORGANIC CHEMISTRY: Role of iron, calcium, magnesium, manganese, cobalt, zinc and molybdenum in biology.

CHEMICAL SYNTHESIS OF BIOLOGICAL MOLECULES: General methods of amino-acid synthesis, properties and general reactions, Peptide synthesis, reagents for protection and de-protection, end group analysis, solid phase synthesis, oligonucleotide synthesis.

SPECTROSCOPIC ANALYSES: The electromagnetic spectrum - ultraviolet-visible spectrophotometry, Beer-Lambert law:- applications, fluorescence, quenching of fluorescence, infrared spectrophotometry, selection rules, finger print regions, common functional group frequencies, Nuclear magnetic resonance spectroscopy, chemical shifts, spin-spin splitting, mass spectrometry, base peaks, fragmentations types of common functional groups.

Total L: 45

TEXT BOOKS:

REFERENCES:

15B210 LABORATORY PRACTICES

Principle, Handling, Maintenance, Calibration, do’s and don’ts related to the following:
1. Laboratory discipline and procedures.
2. Material handling and laboratory safety.
3. Laboratory water quality- raw water, Distilled water, deionised water, Ultra pure water- Purification procedures - cost of purification.
4. Laboratory waste disposal.
8. Refrigerators, AC, Cryostat and cold room.
11. Centrifuge-Clinical, refrigerated and bowl centrifuge.
12. Safety cabinets.

REFERENCE:

15B211/15D211/15E211/15L211/15R211/15U211/15Z211 PHYSICS LABORATORY II

0 0 2 1

List of Experiments:
1. Study of I-V characteristics of a solar cell and determination of its efficiency
2. Determination of hysteresis loss of a ferromagnetic material
3. Determination of electrical resistivity of metal and alloy using Carey Foster Bridge
4. Determination of Temperature Coefficient of Resistance of metallic wire using post office box
5. Study the characteristics of a photo diode.

Total P: 30

Demonstration:
1. UV Visible spectrophotometer
2. Laser micromachining.
3. Determination of Crystal structure by powder photograph method.
4. Thin film deposition using electron beam and thermal evaporation.
5. Crystal Growth System

REFERENCES:
1. Physics Practicals, Department of Physics, PSG College of Technology 2015.

15B212 CHEMISTRY LABORATORY II

0 0 2 1

1. Determination of distribution coefficient and equilibrium constant (I₂ in water/ CCl₄ system)
2. Estimation of an acid by pH metry.
3. Determination of the ferrous ion by potentiometry and by photocolorimetric method.
4. Estimation of acids in a mixture by conductometry.

Total P: 30

REFERENCE:
1. Laboratory Manual Prepared by the Department.

SUMMER TERM COURSES

15B215 PROFESSIONAL SKILLS

6 0 9 2

Problem solving Software skills: Software environment -commands - Data types - Expression -vectors and matrix manipulations - reading inputs displaying outputs - correlations and regression - 2D and 3D plots - reading files. (L:12+P:12)

CONTROL STATEMENTS: Control structures - Looping statements - unconditional statements - functions -scripts – tools &utilities. (L:12+P:24)

Total L: 24+P: 36 = 60
REFERENCES:

15B216 IN-PLANT TRAINING AND TECHNICAL SEMINAR

OVERVIEW OF BIOTECH INDUSTRIES: Pharmaceutical industry, Sugar industry, Food processing industry, Leather and Paper industry, Biofertilizer and Biointicides production industry  

INDUSTRY VISIT: Visit to Sugar / Enzyme production/ Food processing industries – Observation and Report Submission.  

TECHNICAL PRESENTATION: Overview structure of technical presentation - Each student will be required to make one technical presentation for minimum 15 minutes.  

Total L: 24 + P: 36= 60

REFERENCES:

SEMESTER III

15B301/15H301/15T301 NUMERICAL METHODS

ERRORS: Approximations and round-off errors - truncation errors. (2+1)

LINEAR ALGEBRAIC EQUATIONS: Direct methods - Naïve Gauss elimination, Gauss-Jordan method, crout's method, iterative methods - Gauss-Jacobi method, Gauss-Seidel method, eigenvalues and eigenvectors - power method, Jacobi method. (5+5)

NONLINEAR EQUATIONS: False-position method, Newton-Raphson method, Bairstow's method, Graeffe's root squaring method. (4+4)

INTERPOLATION AND CURVE FITTING: Newton's forward and backward interpolating polynomials, Newton's divided-difference interpolating polynomials, Lagrange interpolating polynomials, coefficients of an interpolating polynomial. Curve fitting - least-squares regression . (4+4)

DIFFERENTIATION AND INTEGRATION: Numerical differentiation equally spaced and unequally spaced data, numerical integration, Newton-Cotes formulae, Trapezoidal rule, Simpson's 1/3 rule. (4+4)


PARTIAL DIFFERENTIAL EQUATIONS: Finite difference: Elliptic equations - Laplace equation, Poisson equation – Liebmann method, parabolic equations – heat conduction equation – Crank Nicolson’s method, hyperbolic equations – vibrating string. (5+6)

Total L: 30+T: 30=60

TEXT BOOKS:

REFERENCES:
15B302 BIOCHEMICAL METABOLISM 3 0 0 3

INTRODUCTION: Vitamins and cofactors, Bioenergetics principles. (6)

CARBOHYDRATE METABOLISM: Glycolysis, TCA cycle, Gluconeogenesis, Glycogen synthesis and breakdown, Pentose phosphate pathway – Photosynthesis, Respiration and oxidative phosphorylation. Regulation of carbohydrate metabolism. (15)

AMINO ACID METABOLISM: Amino acid oxidation, urea cycle, Amino acid Biosynthesis, Regulation. (10)

FATTY ACID METABOLISM: Fatty acid synthesis, elongation, unsaturation. Beta oxidation, ketone bodies; lipid biosynthesis – TAG synthesis and cholesterol biosynthesis – Regulation. (8)

NUCLEOTIDE METABOLISM: Salvage and de nova synthesis, degradation – Regulation. (6)

TEXT BOOKS:

REFERENCES:

15B303 INTRODUCTORY CHEMICAL ENGINEERING 3 2 0 4

STOICHIOMETRY: Units and Dimensions: Systems of Units, Dimensional Homogeneity and dimensionless quantities-significance, Dimensional Analysis– limitations, Stoichiometry principles: composition relations, density, specific gravity and basis of calculation. (6 + 4)


HUMIDITY AND SOLUBILITY: Humidity - saturation - vaporization - condensation - wet and dry bulb temperature, dew point, adiabatic saturation temperature, Solubility and Crystallization- solubility of gases. (9 + 6)

MATERIAL BALANCE: Material Balance with and without Chemical Reaction: Limiting and excess reactants, Single, Multiple Reactions, Reactions with Recycle, Purge and Bypass. (12 + 8)

ENERGY BALANCE: Steady state concept, Different energy types – formulas and evaluation, concept of latent heat, internal energy, enthalpy and problems on energy balance for systems with and without chemical reactions. (12 + 8)

TEXT BOOKS:

REFERENCES:

15B304 GENERAL MICROBIOLOGY 3 0 0 3

MICROBIAL DIVERSITY: Taxonomy and classification systems, Structure and functions of cellular components of bacteria, fungi, algae and virus. (8)


MICROBIAL CONTROL: Sterilization and Disinfectants. Antimicrobial Chemotherapy - Antibiotics, Source and mode of action. (8)

MICROBIAL METABOLISM: Nutritional types, Bacterial metabolism - Respiration, anaerobic respiration, fermentation and bacterial photosynthesis. (8)

ENVIRONMENT & MICROORGANISMS: Role of microbes in nitrogen, phosphorus and sulfur Cycle. Bioleaching. Bioremediation. (7)

TEXT BOOK:

REFERENCE:

15B305 CELL BIOLOGY

CELLULAR ORGANIZATION: Sub cellular structures - chromatin organization, biogenesis of nucleus, mitochondria and chloroplast, cytoskeleton, endoplasmic reticulum, golgi body, ribosomes, lysosomes; cell junctions; extracellular matrix; cell movement. (7)

MEMBRANE ARCHITECTURE AND FUNCTION: Membrane synthesis; Membrane proteins – pumps, channels transporters and receptors; types of membrane transport; Osmosis and cell volume; Endocytosis, Exocytosis; Intracellular Compartments; protein Trafficking and secretion. (8)

INTERCELLULAR INTERACTION: Cell signaling- autocrine, paracrine, juxtacrine, endocrine and synaptic signaling; Types of cell membrane receptors – GPCR, RTKs and voltage gated ion channel receptors; Signal transduction - Cellular response mechanisms to primary messengers; secondary signaling molecules – adenylate cyclase, calcium flux, phospholipases, protein kinases. (11)

SPECIALIZED CELL TYPES: Epithelial and mesenchymal cells; Stem cells - differentiation and lineage; neurons; gametes - sperm, egg, pollen, ovule; cells of immune system; plant cells – parenchyma, collenchyma, sclerenchyma. (11)

CELL CYCLE AND REGULATION: Mitosis, meiosis, cell cycle regulation – checkpoints, mitosis promoting factors, cyclins and cyclin dependent kinases, Eukaryotic life cycles - gametic, sporic and zygotic. (8)

TEXT BOOKS:

REFERENCES:

15T070 ECONOMICS FOR ENGINEERS

INTRODUCTION: Definition – Nature and Scope - Significance of Economics for Engineers. (4)


MARKET STRUCTURE: Types of Market - Perfect Competition – Characteristics –Monopoly –Monopolistic Competition –Oligopoly and Duopoly - Price Discrimination and Product Differentiation under different markets – Price and output determination in short run and long run. (6)


TEXT BOOKS:

REFERENCES:

15B310 BIOCHEMISTRY LABORATORY

Identification, quantification and Characterization of biological compounds

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of proteins
3. Write a program for computation from standard curve
4. Extraction and estimation of reducing sugar by Dinitosalycylate acid (DNS) method
5. Extraction and estimation of proteins by Lowry’s method
6. Extraction of lipids
7. Lipid analyses by titrimetry: acid value, iodine number, saponification value
8. Extraction and estimation of starch
9. Elemental analysis using flame photometry

REFERENCE:

15B311 MICROBIAL AND CELL BIOLOGY LABORATORY

Sterilization Techniques; Preparation of Culture Media
2. Culturing of Microorganism-Streak & spread plate,
3. Isolation and preservation of bacterial Culture
5. Microbial enumeration
6. Cell cycle experiments

REFERENCE:
SEMIESTER IV

15B401 BIOSTATISTICS

DESCRIPTIVE STATISTICS: Measure of location, properties of arithmetic mean, measure of spread, coefficient of variation, grouped data, graphic methods. (4+4)

PROBABILITY: Definition of probability, multiplication law, addition law, conditional probability, Baye's rule, prevalence and incidence. (4+4)

PROBABILITY DISTRIBUTIONS: Discrete probability distribution: Random variables, probability mass function, expected value, variance, cumulative distribution function, binomial and Poisson distributions. Continuous probability distribution: Probability density function, expectation, normal distribution, linear combinations of random variables. (5+5)

ESTIMATION: Relationship between population and sample. Estimation of the Mean and variance of a distribution: point estimation, standard error of the mean, central limit theorem, interval estimation. (4+4)

TESTING OF HYPOTHESIS: One-sample inference: Introduction, general concepts, test for mean of a normal distribution – one sided, two sided alternatives, the power of a test, sample size determination. Two-sample inference: Paired t-test, comparison of means from two paired samples, t-test for two independent samples with equal variances, testing for equality of two variances, t-test for independent samples with unequal variances. Chi-square test for independence of attributes and goodness of fit. (6+6)

REGRESSION AND CORRELATION: General concepts, fitting regression lines - method of least squares, inferences about parameters, goodness of fit, simple correlation. (4+4)

MULTIPLE INFERENCE: Analysis of variance: fixed – effects model, random effects model. (3+3)

Total L: 30+T: 30 =60

TEXT BOOKS:

REFERENCES:

15B402 UNIT OPERATIONS

FLUID FLOW BASICS: Hydrostatic equilibrium and applications, Newton’s law of viscosity, Rheology of fluids, Continuity equation, Bernoulli’s equation. Laminar and Turbulent flow through pipes, fittings, valves. Head losses due to friction in pipes. (16)

FLUID FLOW MEASUREMENT AND EQUIPMENTS: Flow measurements: Orifice meter, Venturimeter, Pitot tube and Rotameter. Equipments: Centrifugal pumps and positive displacement pumps (12)


MECHANICAL OPERATIONS: Filtration, Coagulation, Flocculation, Settling and sedimentation (7)

HEAT TRANSFER PRINCIPLES AND ITS APPLICATIONS: Basic Modes of Heat Transfer, Conduction on composite walls, Convection - Natural and forced convection, Heat exchangers – Applications in process industries. (9)

Total L: 60

TEXT BOOKS:

REFERENCES:
15B403 INDUSTRIAL BIOTECHNOLOGY

INTRODUCTION TO INDUSTRIAL BIOTECHNOLOGY: A historical overview of industrial fermentation process – traditional and modern biotechnology; metabolites and their screening, test systems, strain improvement for increasing yield, product characteristics and purification process; substrate for fermentation, fermentation principles, product recovery, systems; current good manufacturing practices. (10)

PRODUCTION OF PRIMARY METABOLITES: A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid, lactic acid, acetic acid); amino acids (glutamic acid, phenylalanine, aspartic acid) and alcohols (ethanol, butanol). (9)

PRODUCTION OF SECONDARY METABOLITES: Production processes for various classes of secondary metabolites: antibiotics: beta-lactams (penicillin, cephalosporin), aminoglycosides (streptomycin) macrolides (erythromycin), vitamins and steroids. (7)

PRODUCTION OF ENZYMES AND OTHER BIOPRODUCTS: Production of industrial enzymes - proteases, amylases. Production of biopesticides (Baculoviruses, entomopathogenic fungi, Bacillus thuringiensis) biofertilisers, biopreservatives (Nisin), biopolymers (xanthan gum), single cell protein. (10)

PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS: Products from animal and plant cell culture - recombinant proteins having therapeutic and diagnostic applications, vaccines, monoclonal antibodies. Plant secondary metabolites, Plants as bioreactors, Biofuel from algae. (9)

TEXT BOOKS:

REFERENCES:

15B404 MOLECULAR BIOLOGY

GENETIC MATERIAL: Evidence of DNA as genetic material, Physical structure, Nucleosomes, Forms of DNA, Gene structure. (7)

DNA REPLICATION: Replication mechanism and machinery, plasmid and phage replication. (9)

TRANSCRIPTION: In Prokaryotes and Eukaryotes, Inhibitors of Transcription, Processing of mRNA, rRNA and tRNA, splicing and post transcriptional modification, miRNA, siRNA, ncRNA. (9)

TRANSLATION: Genetic code, Initiation, elongation and termination, Inhibitors of translation, ost translational modification, targeting. (9)

REGULATION OF GENE EXPRESSION: Negative control (Lac operon), Positive control (arabinose operon), attenuation, Recombination and repair, Transposable elements, mutation, oncogene, Epigenetics. (10)

TEXT BOOKS:

REFERENCE:
15B405 ANALYTICAL METHODS AND INSTRUMENTATION

PRINCIPLES OF MEASUREMENT: Concepts of precision, accuracy, reproducibility, linear range, sensitive type of measurement errors and methods to quantify measurement errors, Positive and negative controls, calibration approaches, Signal to Noise Ratio.

SPECTROSCOPY: Chromophores and auxochromes, energy bands; principle, instrumentation and bioanalytical applications of the following techniques: absorption and emission spectroscopy; turbidometry, visible, ultraviolet, infrared spectroscopy; AAS, AES, NMR spectroscopy, data processing.

SPECTROMETRY: Mass spectrometry, single and double focusing, ToF, instrumentation and application in biotechnology.

IMAGING TECHNIQUES: Confocal Microscopy, Atomic Force.

SEDIMENTATION: Centrifugation, analytical centrifuges, analytical applications.

CHROMATOGRAPHY: Principle, van Deemter equation, elution methods, analytical methods, HPLC, HPTLC, GC, Gel filtration.

ELECTROPHORESIS: Principle, Isoelectrofocusing, SDS-PAGE, PFGE, Capillary electrophoresis.

ELECTROANALYTICAL TECHNIQUES: Potentiometry, electrochemical cells, Ion-selective electrodes, Voltametry & Polarography, applications in life sciences, patch clamp techniques.

TEXT BOOKS:

REFERENCE:

15B410 MOLECULAR BIOLOGY LABORATORY

1. DNA Extraction from plant and animal cells.
2. Agarose gel electrophoresis for quality and quantity assessment.
3. DNA quantification by UV spectroscopy.
4. Plasmid Extraction and restriction analysis.
5. DNA purification from gel and ligation.
6. RNA extraction and denaturing gel electrophoresis.
7. Protein isolation and SDS PAGE analysis.
8. Protein detection by Silver staining and Coomassie staining.

REFERENCES:

15B411 CHEMICAL ENGINEERING LABORATORY

1. Fluid flow measurement by Orifice meter, venturi meter and Rotameter.
2. Measurement of pressure drop through Packed Bed system.
3. Determination of the effect of various operating conditions in Fluid Mixing. (Impeller position, speed, baffles)
4. Studying the reaction kinetics using batch and Plug flow reactor system.
5. Leaf filtration.
7. Steam distillation.
9. Soxhlet Extraction
10. Leaching.
11. Adsorption

REFERENCE:

SEMESTER V

15B501 THERMODYNAMICS OF BIOCHEMICAL SYSTEMS 3 0 0 3


TEXT BOOKS:

REFERENCES:

15B502 ENZYME ENGINEERING AND TECHNOLOGY 3 0 0 3

KINETICS OF ENZYME ACTION: Models; Single, Bi substrate kinetics; inhibition; simple and complex interaction. (9)

IMMOBILIZATION: Immobilization of enzymes and coenzymes-CLE, CLEA - chemistry, carriers, advantages and disadvantages, diffusion barriers and kinetics; effectiveness, applications. (9)

BIOSensors: Sensing systems-Optical, Potentiometric, Amperometric, thermal sensing system; types of analytes and analysis. (9)

ENZYMES AND THEIR USES: sources; Commercial production and characterization, application in pharmaceutical, food and process industries; diagnostics, research. (9)

ENZYME ENGINEERING: Property alteration, Applications - Extreme conditions; reactions in organic solvents; antibodies as enzymes, Ribozymes. (9)

TEXT BOOKS:
REFERENCES:

15B503 GENETIC ENGINEERING

TOOLS OF GENETIC ENGINEERING: DNA Exonucleases and Endonucleases - Restriction Enzymes – Type I, II, III, Restriction analysis of DNA, RNAses, Ligase, Polymerases, DNA Modifying enzymes. DNA, RNA, and Protein blotting techniques, CRISPR CAS.

VECTORS FOR CLONING AND EXPRESSION: Plasmids, lambda phage, Ti plasmids, Bacterial expression vectors, Yeast vectors, Baculoviruses, Plant, animal viral vectors.

DNA MANIPULATIONS: Tailing, cohesive end, use of linkers, blunt end methods; Labeling and detection techniques PCR and its application, DNA Synthesis and Sequencing, site directed Mutagenesis, protein engineering.

EXPRESSION OF TRANSGENES: In vitro transcription and translation systems, Reporters for various expression systems, Preparation of cDNA, cDNA and genomic libraries, Transformation methods, Fusion proteins, Protein targeting and secretion.

APPLICATIONS OF TRANSGENICS: Transgenic plants, animals and gene therapy, Si RNA, Targeted drug delivery, Ethics, biosafety regulations, and GMOs status in India.

TEXT BOOKS:

REFERENCE:

15B504 MASS TRANSFER OPERATIONS

INTRODUCTION TO MASS TRANSFER AND DIFFUSION: Ficks law, Molecular and eddy diffusion, Theories of mass transfer, Diffusion in gaseous mixtures, liquid mixtures and solids, Pseudo steady state diffusion, measurement and calculation of diffusivities, Individual and overall mass transfer coefficient.

ADSORPTION: Types and choice of adsorbents, nature of adsorbents, Adsorption isotherm, Mechanism of adsorption, Operation of adsorption columns-Cross current and counter current operations, stage determination, Batch and continuous operations, Performance characteristics of fixed bed adsorbers, Concept of breakthrough curve, Industrial application of adsorption process.

ABSORPTION: Theory and principles of gas absorption, concept of equilibrium curve and operating line, Design of absorption towers, HTU,NTU and HETP concepts, Tower packing and packing characteristics.

DISTILLATION: Basic concepts of distillation- principle, theory, vapor liquid equilibria calculations, Methods of distillation- simple, flash, steam, azeotropic, extractive, molecular distillation, Design of single stage flash and simple distillation, Stage wise and continuous differential contact operations, Design calculations using McCabe thiele method.

EXTRACTION AND LEACHING: Liquid liquid extraction- Liquid liquid equilibria for different systems, Effect of pressure and temperature on LLE, Solubility criteria, Solvent selection, crosscurrent and countercurrent operations, Liquid liquid extraction equipment. Leaching (Solid-liquid extraction)- Theory, mechanism, equipments and applications.

TEXT BOOK:

REFERENCES:
15B505 IMMUNOLOGY

INTRODUCTION TO IMMUNOLOGY: Historic aspects; Innate immunity, humoral and cell mediated immunity. Primary and secondary lymphoid organs, production of blood cells, B cell, T cell and macrophages, Antigen and antigenicity, lymphocyte ontology, the complement system.

HUMORAL IMMUNITY: Molecular basis of antibody diversity, polyclonal and monoclonal antibody, complement, antigen-antibody reaction.

CELLULAR IMMUNITY: Antigen processing cells; T cells, killer cells; major histocompatibility complex (MHC) : antigen processing and presentation.

IMMUNE RESPONSE AND TOLERANCE: Regulation of immune response, immune tolerance; hyper sensitivity, autoimmunity; Transplantation.

IMMUNOTHERAPEUTICS: Antisera, Monoclonal antibody production and its application; vaccines – types and production.

TEXT BOOKS:

REFERENCES:
2. Sell S, and Max E E, "Immunology, Immunopathology and Immunity", ASM International

15B510 GENETIC ENGINEERING LABORATORY

1. DNA extraction – for Cloning.
2. Restriction digestion and ligation in plasmid vector.
3. Bacterial transformation and blue white selection.
4. Gene isolation (confirmation) by PCR.
5. Southern and northern blotting and hybridization.
6. Protein expression analysis.
7. Agrobacterium mediated transformation and expression analysis.
8. Electroporation.

REFERENCES:

15B511 ENZYME ENGINEERING LABORATORY

1. Enzyme isolation , assay. Specific and total activity calculation
2. Enzyme purification: Ammonium sulphate precipitation, Gel filtration and ion exchange chromatography,
3. Purity analysis: SDS gel electrophoresis, HPLC
4. Zymographic analysis of enzymes
5. Enzyme kinetics – Michaelis Menten parameters calculation
6. Enzyme inhibition kinetics

REFERENCES:
1. Enzyme isolation , assay. Specific and total activity calculation
2. Conformation and activity analysis
3. Zymographic analysis of enzymes
4. Enzyme inhibition kinetics
REFERENCE:

15B520 INDUSTRIAL VISIT CUM LECTURE

INDUSTRIAL LECTURE
Faculty will arrange for lectures by experts preferably from industries to highlight the recent technical and soft skill trends.

VISIT TO INDUSTRIES
Study tour / Industrial visit. Reports are to represent the observations of the students after the visits with their personal comments / suggestions.

Total P: 60

SEMESTER VI

15B601 BIOPROCESS ENGINEERING

MEDIA DESIGN AND OPTIMIZATION: Medium components, optimization methods, simplex method, RSM. (8)

BIOPROCESS KINETICS: Kinetics and models of growth, death, substrate utilization, product formation. (9)

HEAT AND MASS TRANSFER IN BIOPROCESSING: Mass transfer, oxygen transfer in different fermentation systems; determination of oxygen uptake rates. Transfer coefficients; mechanisms that affect oxygen transfer; Rheology, heat transfer in bioprocessing, Sterilization operations. (9)

DESIGN OF BIOREACTORS: Different culture processes: batch, fed-batch, continuous; recycling of reactants; modeling of bioreactor behaviour; Immobilized cell reactor design and analysis; packed bed and membrane reactors; design and operation of air lift, draft tube, fluidized bed, trickle bed reactors. Scale-up of Reactors. (9)

BIOPROCESS MONITORING: Sensors, Control loops, Online analysis of biomass, substrate and product. (4)

RECOMBINANT CELL CULTURE SYSTEMS: Host-vector systems, plasmid stability, over expression, metabolic constraints. (6)

Total L: 45

TEXT BOOKS:

REFERENCES:

15B602 GENOMICS AND PROTEOMICS

GENOMICS TECHNIQUES: Genome organization, genome mapping techniques; genome assembly analysis DNA microarrays, SAGE, MPSS, DNA Protein Interactions Human, genetic markers, Next generation sequencing. (15)

GENOMICS APPLICATIONS: Epigenetics, Copy number analysis, Transcriptome analysis, DNA protein Interactions, Genome wide mutations. (10)

PROTEOMICS TECHNIQUES: Introduction, Tools for proteomics-2D SDS PAGE, Mass spectrometry, Protein arrays, Phage display. (10)

PROTEOMICS APPLICATIONS: Post translational modifications- phospho proteomics, Glyco proteomics, Ubiquitinomics, Proteomics of organelles, blood plasma, and proteomics study in vivo. (10)

Total L: 45

TEXT BOOKS:

REFERENCE:

15B603 BIOREACTION ENGINEERING

3 0 0 3

REACTION KINETICS: Basic reaction theory, order and molecularity of reaction, homogeneous and heterogeneous reactions, elementary and non elementary reactions, and reaction yield, reaction rate, calculation of reaction rates from experimental data. (8)

HETEROGENEOUS REACTIONS IN BIOPROCESSING: Concentration gradients and reaction rates in solid catalysts, internal mass transfer and reactions, Thiele modulus and effectiveness factor, Solid-liquid mass transfer correlations, Minimizing mass transfer effects. (9)

REACTOR ENGINEERING: Ideal batch reactor; steady state continuous stirred tank reactor; steady state plug flow reactor; size comparison of single reactions; multiple reactor systems; recycle reactor; autocatalytic reactions. (9)

BIOREACTORS: Design and operation of airlift, draft tube, fluidized bed and trickle bed bioreactors, cell damage in animal cell bioreactor, shear damage, bubble damage, Methods of minimizing cell damage, scale up criteria for bioreactors. (9)

STIRRED TANK BIOREACTOR DESIGN: Introduction, basic features of stirred tank bioreactor, Standard geometry of stirred tank bioreactor, Head space volume, gas hold up, basic features of stirred tank bioreactor; agitation systems, oxygen delivery, foam control, temperature control systems, pH control systems, cleaning and sterilization facilities, design of heads/closures, agitator design and operation, sparger and shaft design, design of supports. (10)

TEXT BOOKS:

REFERENCES:

15B604 BIOETHICS, IPR AND BIOSAFETY

3 0 0 3

ETHICS AND PROFESSIONALISM: Morality, Professional conducts and responsibility, business ethics. (4)

BIOETHICS: Disease prevention Vs right to privacy, patentability of DNA, preimplantation genetic diagnosis, engineered organisms into environment, genetic tests in diagnostics and therapy. (9)


BIOSAFETY: Biotechnology development in India, safety issues concerning biotechnological products, Biopharma regulations, governing biosafety, Cartagena protocol on biosafety, conservation of biodiversity. (9)

TEXT BOOKS:

REFERENCES:
2. WIPO Academy – Learning material
15B610 BIOPROCESS LABORATORY

1. Growth media optimization by Placket-Burman and Response Surface methods
3. Substrate and product kinetics in Immobilization system – Enzyme and microbial cells
4. Mass transfer studies in immobilized system.

REFERENCE:

Total P: 60

15B611 IMMUNOLOGY LABORATORY

1. Handling of experimental animals – mice, rat, rabbit and guinea pig.
2. Routes of immunization of animals – intradermal, intramuscular, subcutaneous injections- demonstrations
3. Collection of blood and separation of serum
4. Complete blood count, differential count
5. Isolation of lymphocytes - Ficoll-Paque centrifugation
6. Affinity purification of antibody using protein A- agarose
7. HRP Labeling of antibody ELISA
8. Rocket Immunelectrophoresis
9. Dot blot based diagnostics developments
10. Agglutination methods– Haem agglutination- blood grouping, latex agglutination- widal test
11. Western blotting

REFERENCE:

Total P: 60

15B620 INNOVATION PRACTICES

Innovation Practices focus on Identification and analysis of biotechnology related problems, technology based solutions towards commercialization. This involves the following:

1. Preparing a project - brief proposal including
   a) Problem Identification
   b) A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
   c) List of possible solutions including alternatives and constraints
   d) Cost benefit analysis
   e) Time Line of activities

2. A report highlighting the design finalization [based on functional requirements & standards (if any) ]

3. A presentation including the following:
   a. Plan implementation an progress made
   b. Testing & Validation of the developed system/hypothesis
   c. Learning from the Project

4. Consolidated report preparation

Total P: 60
DATABASES: Biological data: types, mode of collection, documentation & submission; Biological databases- sequence databases & structure databases; File formats; Information retrieval systems. (4)

GENOME ANNOTATION: Structural annotation: ORFs, Gene Structure, Motifs and Coding regions, Functional annotation: Biochemical functions, Gene regulation and gene interaction, Gene expression. ASAP (A systematic Annotation Package), Caveats of genome annotation. (4)

SEQUENCE ALIGNMENT: Dot Matrix; Dynamic Programming; substitution matrices; gap penalty; statistical significance of alignment; multiple sequence alignment- Global vs Local; HMM; Molecular phylogeny . (8)

DATABASE SEARCH: BLAST: Algorithm; types of BLAST; Interpretation of BLAST results; MOTIF and Pattern search; Structural database: DALI. (7)

PREDICTION TOOLS: Eukaryotic gene prediction: Neural networks- GRAIL; Pattern discrimination methods; RNA structure prediction: Minimum free energy methods and co-variation site analysis; Protein structure Prediction: two dimensional structures- Neural networks, three dimensional structures- Rosetta Method. (12)

PROGRAMMING IN BIOINFORMATICS: Introduction to PERL; UNIX basics; Basic I/O, Variables, and Scalar Data; Arrays, Lists, and Hashes; References, Control Structures, and Functions; Regular expressions; Modules; Writing simple programs using Bio-PERL. (10)

TEXT BOOKS:

REFERENCES:

INTRODUCTION: Type of bio-products, Separation strategies to recover and purify bio-products - RIPP scheme. (2)


ENRICHMENT PROCESSES: Extraction: Liquid–liquid extraction and solid-liquid extraction, Equipments, operation and application. Aqueous two phase extraction, super critical fluid extraction and reverse micellar extraction – principle, operation and application. Adsorption: Adsorption isotherms, Types of adsorption process and application. High Gradient magnetic Fishing – principle and application. (9)


TEXT BOOKS:
REFERENCES:

15B703 ENVIRONMENTAL SCIENCE AND ENGINEERING 2002


ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT: Definition - causes, effects and control measures of (a) Air pollution (b) Water pollution (c) Soil pollution. Disaster management: floods, earthquake, cyclone and landslides. Bioremediation. (6)

ENVIRONMENTAL MONITORING: Physio-chemical and biological monitoring; Biosensors. Bio-indicators, Water quality monitoring - water quality parameters, air quality monitoring – air quality and emission standards. (6)

WASTE MANAGEMENT: Waste management hierarchy; Solid waste management - Characteristics of municipal solid waste and other specific industry wastes (hospital wastes, hazardous wastes and e-wastes) and their treatment – landfills, incineration, pyrolysis, gasification, composting and vermicomposting. Characteristics of domestic and industrial wastewater. Outline of waste water treatment - primary, secondary and tertiary treatment. (6)


TEXT BOOKS:

REFERENCE:

15B710 BIOINFORMATICS LABORATORY 0042

1. Sequence alignment tools.
2. BLAST.
3. Protein structure visualization and prediction tools.
5. Sequence analysis using PERL programming/ Gene expression analysis using R-programming.
6. Data quality analysis of NGS and microarray data.
7. NGS data retrieval and analysis.

Total P: 60

REFERENCES:

15B711 DOWNSTREAM PROCESS LABORATORY 0042

1. Isolation of intracellular products from cells using disruption techniques (Ultrasonication, High speed Homogenization, Bead disruption, solvent methods, enzymatic lysis).
3. Extraction of active components from given source by solvent extraction techniques – Liquid-liquid extraction and solid liquid extraction.
4. Aqueous two phase extraction of proteins.
5. Isolation of desired component from sample using chromatographic technique.
6. Evaluation of purity of isolated component using HPLC.
7. Drying kinetics for given sample.
8. Product formulation (crystallization and lyophilization techniques)
9. Design of purification process for proteins from microbial or plant source

REFERENCE:

15B720 PROJECT WORK I

1. Identification of a real life problem in thrust areas.
2. Developing a mathematical model for solving the above problem.
3. Finalisation of system requirements and specification.
4. Proposing different solutions for the problem based on literature survey.
5. Future trends in providing alternate solutions.
6. Consolidated report preparation of the above.

SEMESTER VIII

15B820 PROJECT WORK II

The project involves the following:

1. Preparing a project - brief proposal including
   a. Problem Identification
   b. A statement of system / process specifications proposed to be developed (Block Diagram / Concept tree)
   c. List of possible solutions including alternatives and constraints
   d. Cost benefit analysis
   e. Time Line of activities

2. A report highlighting the design finalization [based on functional requirements & standards (if any) ]
   A presentation including the following:
   a. Plan implementation an progress made
   b. Testing & Validation of the developed system/hypothesis
   c. Learning from the Project

3. Consolidated report preparation

LANGUAGE ELECTIVES

15T080 COMMUNICATION SKILLS FOR ENGINEERS


BUSINESS CORRESPONDENCE: Writing Emails, Preparing Resumes, Memos, Technical and Business Proposals.  
(7)

TECHNICAL COMMUNICATION: Seminars, Process Description and Group Discussions, Use of Visual Aids.  
(10)

TEXTBOOK:  
1. Monograph prepared by the Faculty, Department of English, 2015.  

REFERENCES:  

15T081 BASIC GERMAN  
3003

INTRODUCTION: German Culture, Tradition, Universities and Companies, Alphabets, Greetings, Countries, Nationalities and Languages.  
(3)

VOCABULARY: Context related to School, University, Professions, Family, Supermarket, Food and Beverages, Entertainment, Celebrations, Weather.  
(4)

(16)

GENERAL USAGE: Number system, Question words, Statements and Questions, Negation: nicht/kein. Imperatives Simple dialogues, Exercises.  
(5)

SYNTAX: Word order and sentence formation. Practice with mini-dialogues.  
(4)

COMMUNICATION SKILLS: Conversing in formal and informal situations, Dialogue writing, Letter writing, Email writing, Invitations and Telephone conversations.  
(7)

PRACTICALS: Listening, Speaking, Reading and Writing.  
(6)

TEXT BOOK:  
1. Monograph prepared by the Faculty, Department of English, 2015.  

REFERENCES:  

15T082 BASIC FRENCH  
3003

INTRODUCTION  
(2)

(10)

(11)


TEXT BOOK:

REFERENCES:

15T083 BASIC JAPANESE

Orientation Session, Geographic & Socio, economic perspective to Japan, Japanese people and culture and Basic greetings and responses. (3)

Basic script, Method of writing hiragana and katakana, and Combination sounds and simple words. (3)


Place markers “Koko”, “Soko”, “Asoko”, Direction markers “Kochira”, “Sochira”, “Achira” and Japanese department stores: Asking for and buying something. (2)

Asking for and telling the time, Particle “ni (at)” for time, kara (from) ~ made (until), Particle “to (and)”, Time periods: Days of the week, months, time of day, Verbs (Present / future and past tense) and Telephone enquiry: Asking for a phone no. And business hours. (2)

Destination particle “e”, Particles “de (mode of transportation)” and “to (with) and Japanese train station: Asking for Fare and track no. / types of trains. (2)

Direct object particle “o”, Particle “de (place of action)”, Verbs (“~masen ka”, “~mashou”) and “Ohanami” Cherry blossom viewing. (2)

Particle “de (by means of)”, Particle “ni (to)”, Aaemasu (give) and Moraimasu (receive) and Visiting a Japanese house. (2)

Adjectives (“i” and “na” type), Adjectives (Positive and negative usage). Particle “ga (however, but), “Dore which?”) and Leaving a room, thanking some one for hospitality. (2)

Likes and dislikes, Potential verbs (wakarimasu and dekimasu), “Kara (~ because)”, Adverbs and Asking some one out over the phone. (2)

Verbs denoting presence: “Imasu” and “arimasu”, Particle “ni (in)”, “Dare (who?)”, Adverbs (“Chikaku ni ~”), Particle “dare mo (negative ~ no one)”, Dare ka (anyone), dare ga (who), Nani ka (anything), Nani ga (what) - ~ya (and) ~ nado (etc.) and Asking for directions. (2)

Counters and Counting suffixes. (2)

Introduction to Adjectives (na and ii type), Different usages of adjectives, Comparison, Likes and dislikes and Going to a trip. (2)

Need and desire (ga hoshii), Wanting to … (Tabeti desu), Going for a certain purpose (mi ~ni ikimasu) and Choosing from a menu. (2)

Verb groups, I, II and III and Exercises to group verbs. (2)

Please do (te kudasai), Present continuous tenses (te imasu), Shall I? (~ mashou ka) and Describing a natural phenomenon (It is raining). (2)

To grant permission (~te mo ii desu), Asking for permission (~ te mo ii desu ka) and Should not do (~ te wa ikemasen). (2)

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Describing a continuing state and Describing a habitual action.  
(2)

Roleplays in Japanese.  
(2)

A demonstration on usage of chopsticks and Japanese tea party.  
(2)

**TEXT BOOK:**  

**REFERENCE:**  

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**OPEN ELECTIVES**  
**MATHEMATICS**

**15OH01 ADVANCED LINEAR ALGEBRA**  
3 0 0 3

**VECTOR SPACES:** General vector spaces, real vector spaces, Euclidean n-space, subspaces, linear independence, basis and dimension, row space, column space and null space.  
(8)

**INNER PRODUCT SPACES:** Inner products, length and angle in inner product spaces, orthonormal bases, Gram-Schmidt process, orthogonal matrices, QR decomposition, best approximation-least square.  
(12)

**LINEAR TRANSFORMATIONS:** General linear transformation - kernel and range, matrices of linear transformations, change of basis, rank and nullity.  
(12)

**EIGENVALUES AND EIGENVECTORS:** Eigenvalues and eigenvectors, diagonalization, orthogonal diagonalization, quadratic forms, application of conic sections, quadratic surfaces-discrete dynamical systems.  
(13)

**TEXT BOOKS:**  

**REFERENCES:**  

**15OH02 ALGEBRAIC STRUCTURES**  
3 0 0 3

**GROUPS:** Groups, subgroups, permutation groups, cosets and Lagranges’s theorem, normal subgroups and quotient groups, homomorphisms, isomorphisms, Cayley’s theorem.  
(15)

**CODING THEORY:** Group codes, the communication model and basic notions of error correction, generation of codes by using parity checks - error recovery in group codes.  
(5)

**RINGS:** Rings, sub-rings, properties of rings, integral domain, ideals and quotient rings, polynomial rings.  
(12)

**FIELDS:** Fields, roots of polynomials, construction of straightedge and compass.  
(13)

**TEXT BOOKS:**  

**REFERENCES:**  

**15OH03 CALCULUS OF VARIATIONS AND TENSOR ANALYSIS**

**CALCULUS OF VARIATIONS**: Basic concepts, method of variations in problems with fixed boundaries - variation and its properties, Euler equation. (12)

**FUNCTIONALS**: Functional involving first and higher order derivatives, functionals dependent on the functions of several independent variables, variational problems in parametric form – applications: vibrating string and membrane. (12)

**VECTOR ANALYSIS**: Basic concepts – gradient, directional derivative, divergence, curl, potential vector field, Laplacian vector field. Green’s theorem, Stoke’s theorem and Gauss divergence theorem (statement and concepts only) (7)

**TENSOR ANALYSIS**: Concepts of a tensor field – Ostrogradski’s theorem, field of tensor of rank 2 - flux, divergence and derivative in a direction of tensor field. Integral theorems - theorems related to Ostrogradski’s theorem – applications: equation of motion of a liquid, Archimedes’ law. (14)

**TEXT BOOKS**:

**REFERENCES**:

**15OH04 GRAPH THEORY AND ITS APPLICATIONS**

**GRAPHS AND DIGRAPHS**: Common families of graphs, degree sequence, handshaking lemma, Havel-Hakimi theorem (statement and concepts). Walk, trail and path, connected graph, distance, radius and diameter. Graph isomorphism. Representations of graphs – adjacency and incidence lists – adjacency and incidence matrices. (10)

**SPANNING TREES**: Cayley’s formula: Pruefer encoding-decoding algorithm. Matrix tree theorem (statement and problems only). Depth-first and breadth-first search algorithms, minimum spanning tree – Prim’s and Kruskal’s algorithms, shortest-path problem – Dijkstra’s algorithm. (9)

**EULERIAN AND HAMILTONIAN GRAPHS**: Eulerian graphs – Konigsberg bridge problem; Eulerian tour algorithm, characterization of Eulerian graph, optimal postman tour. Hamiltonian graphs - non Hamiltonian graphs, sufficient conditions for Hamiltonian graphs (only statements and concepts). Travelling salesman problem - nearest neighbour algorithm. (10)

**VERTEX-COLORING**: Vertex-coloring - chromatic number of a graph, vertex coloring algorithms – sequential vertex coloring, largest degree first algorithm, applications - scheduling problem, assignment of radio frequencies, fast register allocation for computer programming. (8)

**NETWORK FLOWS AND APPLICATIONS**: Flows and cuts in networks, solving the maximum - flow problem – characterization of maximum flow (Max-flow Min-cut Theorem), algorithms – outline for maximum flow, finding an augmenting path, FFEK – maximum flow and examples. (8)

**TEXTBOOKS**:

**REFERENCES**:
2. Narsingh Deo, Graph Theory with Applications to Engineering And Computer Science, Prentice Hall, New Delhi 2010.
15OH05 MATHEMATICAL FINANCE

FINANCIAL MATHEMATICS: Basic terminology, assumptions, derivative securities. (6)

FORWARD AND FUTURES CONTRACTS: Forward contract, forward price formula, value of a forward contract, futures contract, futures pricing. (12)

OPTION PRICING: Definition and preliminaries, behavior of option prices with respect to variables, pay-off curves, single period and multi period binomial lattice models for option pricing, pricing American options: a binomial lattice model, Black-Scholes formula. (12)

RISK FREE ASSETS: Time value of money, Simple interest, periodic compounding, streams of payments, continuous compounding. Money market: zero coupon bonds, coupon bonds, money market account. (9)

PORTFOLIO MANAGEMENT: Risk and return, expected return standard deviation as risk measure, two securities, risk and expected return on a portfolio. (6)

TEXT BOOKS:

REFERENCES:

15OH06 MATHEMATICAL MODELING AND SIMULATION

SYSTEM MODELS AND STUDIES: System- continuous and discrete system, system modeling, types of models - static physical, dynamic physical, static mathematical, dynamic mathematical models, principles in modeling, corporate model, environment, production, management segment, system analysis – corporate model, system design – message processing in a computer, system postulation – function of liver in the human body. (10)

SYSTEM SIMULATION: Technique of simulation, Monte Carlo Method – area under a curve, estimate of π, comparison of simulation and analytical methods, distributed lag models – national economy, cobweb Models – supply and demand, exponential growth and decay models, logistic curves, simple system dynamics diagrams – population, multi-segment models – product sales, representation of time delays, feedback in socio-economic systems, host and parasite fluctuation. (12)

STATIC SIMULATION: Basics and components of the simulation study, simulation as an analysis tool, static simulations - model for profit on a sale promotion, a financial model for an office building. Random number generation - linear congruential generator, Blum-Blum generator, random variates generation - Bernoulli, uniform, triangular, normal, exponential random variates, a model for loss ratio for an insurance agency. (15)

DYNAMIC SYSTEMS SIMULATION: Financial models and @risk - a model for the price of a stock, dynamic financial models of stock prices, correlated asset values, fitting a distribution to date. (8)

TEXT BOOKS:

REFERENCES:
1. Brian Albright, Mathematical Modeling with Excel, JonesBartlett publishers, Singapore 2010
15OH07 NUMBER THEORY FOR COMPUTING  

**DIVISIBILITY AND DIOPHANTINE EQUATIONS:** Theory of divisibility - Basic concepts and properties of divisibility, fundamental theorem of arithmetic, Euclid’s algorithm, continued fractions. Diophantine equations - Linear Diophantine equations (8)

**ARITHMETICAL FUNCTIONS AND DISTRIBUTION OF PRIME NUMBERS:** Multiplicative functions – functions $\tau(n)$, $\sigma(n)$ and $s(n)$ - functions $\varphi(n)$, and $\mu(n)$. Prime distribution function $\pi(x)$, prime number theorem, the $n^{th}$ prime. (10)

**THEORY OF CONGRUENCES:** Basic concepts and properties of congruences – linear congruences – Fermat’s Little theorem, Euler’s theorem, Chinese remainder theorem, Legendre and Jacobi symbols, primitive roots. (7)

**COMPUTATIONAL NUMBER THEORY:** Primality testing: Fermat’s pseudoprimality test, strong pseudoprimality test, integer factorization : trial division and Fermat method, quadratic and number field sieves. (10)

**APPLICATIONS TO CRYPTOGRAPHY:** Random number generation - linear congruential generator, basics of cryptography, public key cryptography: discrete logarithm based cryptosystems - RSA public-key cryptosystem. (10)

**TEXT BOOKS:**

**REFERENCES:**

15OH08 OPERATIONS RESEARCH  

**LINEAR PROGRAMMING:** Modeling with linear programming- graphical method - simplex method, two phase simplex method. Primal-dual relations, dual simplex method, transportation problem and its solution by MODI method, assignment problem and its solution by Hungarian method. (14)

**GAME THEORY:** Two person zero sum game, pure and mixed strategies, dominance principle, graphical solution, linear programming solution. (7)

**NON-LINEAR PROGRAMMING:** Constrained NLPP - Lagrange's multipliers method, convex NLPP - Kuhn-Tucker conditions, Quadratic programming-Wolfe's method. (8)

**QUEUING THEORY:** Elements of queueing model, relationship between exponential and Poisson queueing models, $(M/M/1)$, $(M/M/1/N)$, $(M/M/c)$, $(M/M/c/N)$ and self-service model. (9)

**REPLACEMENT THEORY:** Replacement of items that deteriorate, replacement of items that fail, group replacement. (7)

**TEXT BOOKS:**

**REFERENCES:**

15OH09 RELIABILITY AND QUALITY CONTROL  

**STATISTICAL PROCESS CONTROL:** Chance and assignable causes of quality variation, statistical basis of the control charts - basic principles, choice of control limits, analysis of patterns on control charts. (7)

**CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES:** $\bar{x}$ chart, R chart, $s^2$ chart, p chart, np chart, c chart, and u chart. (10)

54
ACCEPTANCE SAMPLING: Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans.

BASIC RELIABILITY MODELS: The failure distribution, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model: Exponential reliability function. Time - dependent Weibull failure model, Time - dependent normal failure model.

RELIABILITY OF SYSTEMS: Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system - system structure function, minimal cuts, minimal paths, common mode failures, three state devices.

TEXT BOOKS:

REFERENCES:

15OH10 SOFT COMPUTING

FUZZY SETS: Basic concepts, membership functions, basic operations on fuzzy sets, properties of fuzzy sets, fuzzy relations. Propositional logic and predicate logic, fuzzy If-then rules, fuzzy mapping rules and fuzzy implication functions.

NEURAL NETWORKS: Basic concepts, neural network architectures - single layer, multilayer, recurrent networks, learning methods, back propagation network.

GENETIC ALGORITHMS: Basic concepts, encoding, fitness function, reproduction, inheritance operators, cross over, inversion and deletion, mutation operator, bit-wise operators, generational cycle.


TEXT BOOKS:

REFERENCES:

15OH11 STOCHASTIC MODELS

STOCHASTIC PROCESSES: Definition, Markov chains: Classifications of states, absorption probability, period, Chapman-Kolmogorov equations, steady state probabilities.


BROWNIAN MOTION: First passage time distribution, maximum of a Brownian motion, zeros of Brownian motion, Brownian motion with drift, Geometric Brownian motion, applications to finance.

QUEUEING MODELS: Basic definitions, steady-state solution: M/M/1, M/M/1/K, M/M/c, M/M/c/c, M/M/c/k Models, queues with unlimited service.

TEXT BOOKS:
REFERENCES:

PHYSICS

15OH20 ANALYTICAL TECHNIQUES FOR MATERIALS CHARACTERIZATION 3003


ELECTRON AND ION SPECTROSCOPIC TECHNIQUES: Mass spectroscopy and X-ray emission spectroscopy (Principle and limitations) - Quadrapole mass spectrometer. Special surface techniques: X ray photoelectron spectroscopy (XPS or ESCA)- photoelectron process of spectrum- elemental analysis-Instrumentation and applications. Auger electron spectroscopy (AES)-Basic principles-Information in Auger spectra-methods for surface and thin film characterization, Secondary ion mass spectrometry(SIMS) – Dynamic and static SIMS-common modes of analysis, Rutherford Backscattering Spectrometry (RBS), Field Ion Microscopy (FIM). (10)

SURFACE STRUCTURE ANALYSIS: The need for surface study. Surface chemical composition: The extension of bulk techniques to surface studies - Unit meshes of five types of surface nets - diffraction from diperiodic structures. Surface methods using electron, low energy electron diffraction (LEED), reflection high energy electron diffraction (RHEED). (9)


SANNING PROBE MICROSCOPY: Instrumentation, Scanning Tunnelling Microscopy, Tunneling current, probe tips and working environments, operational modes, typical applications, atomic force microscopy, near field forces, force sensors, operational modes, applications, image artifacts (8)

Total L:45

TEXTBOOKS:

REFERENCES:

15OH21 LASER TECHNOLOGY 3003

LASER CHARACTERISTICS: Einstein coefficients - negative absorption, shape and width of spectral lines, spontaneous and stimulated emission. Laser resonators, types of resonators, stability diagram. Spatial and temporal coherence. (9)


DYE LASERS: Liquid lasers, dye lasers, fabrication and excitation mechanisms. Concept of Q-switching and mode-locking, second harmonic generation, theory and experiment, materials for optical SHG. (9)

INDUSTRIAL APPLICATIONS: Laser cutting, drilling & Piercing. Laser welding, operating characteristics and applications. medical. Spectroscopic (qualitative), laser Raman effect, stimulated Raman effect - Brillouin scattering. (9)

TEXTBOOKS:

REFERENCES:

15OH22 MICRO ELECTROMECHANICAL SYSTEMS

MEMS AND MICROINTEGRATED SYSTEMS: Introduction, history of MEMS development, intrinsic characteristics of MEMS.


TEXTBOOKS:

REFERENCE:

15OH23 NANOMATERIALS AND APPLICATIONS

INTRODUCTION AND CLASSIFICATION: Atoms, Clusters and Nanomaterials-Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties.

NANOMATERIALS SYNTHESIS AND PROCESSING: Top-down processes: Ball Milling, lithography, machining process; Bottom-up processes: i) Wet chemical synthesis of nanomaterials-sol-gel, liquid solid reactions; ii) Gas phase synthesis of nanomaterials–Furnace, Flame assisted ultrasonic spray pyrolysis; iii) Gas condensation processing; iv) Chemical vapour deposition (CVD)-plasma-assisted deposition process, MBE and MOVPE-Preparation, safety and storage issues -STM and AFM Techniques.

SEMICONDUCTOR NANOSTRUCTURES: Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques.


Total L: 45
15OH24 PHYSICS FOR SOLAR PV SYSTEMS AND SOLID-STATE LIGHTING SYSTEMS


TYPES OF SOLAR ENERGY CONVERTORS: Thermal and PV systems. Advantages of PV systems. Semiconductor PV systems. IV characteristics. Other electrical parameters. Conditions for maximum power transfer. Conversion efficiency. (8)

PHYSICS OF SEMICONDUCTOR JUNCTIONS: Elemental and compound semiconductors. Band structure of silicon p-n junctions and III-V compound semiconductor junctions. light emission and absorption. Creation and recombination of electron hole pairs. Lattice mediated recombination conservation of momentum. Direct and indirect band gap semiconductors. Structure of Solar PV devices and solid state lighting devices- LEDS. Factors limiting efficiency of conversion of light energy to electrical energy (PV) and vice versa (Lighting) High power LEDS (10)


Total L: 45

TEXT BOOKS:

REFERENCES:

15OH25 SENSORS FOR ENGINEERING APPLICATIONS

STRAIN AND PRESSURE MEASUREMENT: Resistance strain guage, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge. Using the transducers for applications (9)

MOTION SENSORS: Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders. (9)

LIGHT RADIATION: Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state transducers liquid crystal devices. (9)

HEAT AND TEMPERATURE: Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector. (9)
ELECTRONIC SENSORS: Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors.

TEXTBOOKS:

REFERENCES:

15OH26 THIN FILM TECHNOLOGY 3 0 0 3


DEPOSITION MONITORING AND CONTROL: Microbalance, Crystal oscillator thickness monitor, optical monitor, Resistance Monitor. Thickness measurement: Multiple Beam Interferometer, Fizeau (Tolansky) technique - Fringes of equal chromatic order (FECO) method - Ellipsometry (qualitative only).


DIELECTRIC PROPERTIES: DC conduction mechanism - Low field and high field conduction. Breakdown mechanism in dielectric films - AC conduction mechanism. Temperature dependence of conductivity.


TEXTBOOKS:

REFERENCES:

15OH27 NONLINEAR SCIENCE AND ENGINEERING APPLICATIONS 3 0 0 3

INTRODUCTION: Dynamical systems: Linear and Nonlinear Forces, Mathematical Implications of Nonlinearity- Linear waves-ordinary differential equations (ODEs): Partial differential equations (PDEs)- Methods to solve ODEs and PDEs- Numerical methods – Linear and Nonlinear oscillations- Nonlinear waves- Quantitative features


REFERENCES:
1. Hasegawa A
2. Lakshmanan M and Rajasekar

TEXT BOOKS:

15OH28 NONLINEAR FIBER OPTICS


OPTICAL SOLITONS AND DISPERSION MANAGEMENT: Soliton Characteristics - Soliton Stability - Bright and Dark Solitons – Other kinds of Solitons - Effect of Birefringence in Solitons - Solitons based Fiber Optic Communication System (Qualitative treatment) – Demerits - Dispersion Managed Solitons (DMS).


REFERENCES:

15OH29 CHAOTRONICS


REFERENCES:

TEXT BOOKS:  

CHEMISTRY

15OH30 ANALYTICAL CHEMISTRY

ULTRA-VIOLET SPECTROSCOPY: Absorption laws – types of electronic transitions – effects of solvent and hydrogen bonding on \( \lambda_{max} \) values –Woodward rules.  

INFRA-RED SPECTROSCOPY: Hooke law, calculation of wave numbers, degrees of freedom, types of vibrations, Characteristic IR absorptions of different functional groups (carbonyl, esters, acids), factors influencing the absorption of carbonyl groups. Spectral interpretation of simple organic compounds.  

NMR SPECTROSCOPY: The NMR phenomenon, magnetic moments, number of signals – chemical shift – factors influencing chemical shift, line broadening, (relaxation effects, and state of sampling). Equivalence of protons, spin-spin coupling (CH3OH, C6H5OH, CH3CH2Br, CH3COCH3, CH3CHO), first order and non-first order spectra, proton exchange reactions, simplification of complex spectra, (shift reagents, spin decoupling). NOE effect, (one example), correlation spectroscopy (one example).  


REFERENCES:
CHEMICAL SENSORS AND BIOSENSORS


**DETERMINATION OF METAL IONS BY FLUORESCENCE ANISOTROPY**: Theory of anisotropy based determination of metal ions – fluorescent aryl sulfonamides for zinc determination – removal of zinc from carbonic anhydrase – determination of zinc using reagent approach – determination of copper and other ions by using reagentless approach.

**TEXT BOOKS**:

**REFERENCES**:

COMPUTER APPLICATIONS

**15OH46 COMPUTER GRAPHICS AND VIRTUAL REALITY**


**AREA FILLING, TRANSFORMATIONS AND VIEWING**: Area filling: Inside/outside Test - scan line polygon fill algorithm - Boundary fill and flood fill algorithm. Basic geometrical 2D and 3D transformation. Viewing pipeline - view coordinate reference frame - window to viewport transformation.

**BASICS OF ANIMATION**: Key frame animation - sequence - motion control methods - morphing - warping.

**VIRTUAL REALITY**: Components of VR system - types of VR - position trackers - navigation - gesture interface – displays - Open GL rendering pipeline.

**VR PROGRAMMING**: VRML, defining and using nodes and shapes - VRML browsers - Java 3D – visual object definition by shape 3D instances - ColorCube class - Geometric utility classes.

**TEXT BOOKS**:

**REFERENCES**:
15OH47 DATA AND FILE STRUCTURES  

INTRODUCTION: Data structures - Abstract data Types - Primitive data structures - Algorithms: Structure, properties – analysis of time complexities. (4)  

ARRAYS: Representation of linear and multi dimensional arrays – Operations - Applications. (5)  

STACKS: Representation - Operations - implementation - Applications: Recursion handling; Evaluation of expressions. (5)  

QUEUES: Representation - Operations - sequential implementation – Circular Queues-Priority Queues - Deque – Applications: Job Scheduling systems. (7)  

LISTS: Singly linked lists, Doubly linked lists, Circular lists, Multiply linked lists – Operations - Linked stacks - Linked queues-Applications: Addition of Polynomials; Sparse Matrix representation. (9)  

FILES: File Types – Basic file operations – Heap Organization- Sequential file organization – Indexed Sequential File – Direct file organization (8)  

SORTING: Insertion Sort - Shell Sort - Bubble Sort - Quick Sort - Merge Sort – Algorithms - Analysis. (7)  

Total L: 45  

TEXT BOOKS:  

REFERENCES:  

15OH48 DATABASE MANAGEMENT SYSTEM  


DATAMODELING: Introduction to Hierarchical data model - Network data model- ER model: Entities, Attributes, relationships – Weak and strong entity types – Design of Entity Relationship data models. (7)  

RELATIONAL MODEL: Relational data model basics - properties of Relations- Domains and Key concept – Enforcing data integrity constraints - Relational algebra operations. (8)  

RELATIONAL DATABASE MANIPULATION: Introduction to Structured Query Language(SQL) – SQL commands for defining database – Manipulations on database – Basic data retrieval operations - aggregate function- order by/group by clause- sub queries-in-any-all-views in SQL. (13)  

DATA BASE DESIGN THEORY: Functional dependencies - Normal forms – Normalization: 1NF to 5NF- Domain Key Normal Form – losses join and dependency preserving decomposition. (7)  

DATABASE TRANSACTION & SECURITY: - Transaction processing – properties - Concurrency control mechanism - security and integrity threats - Defense Mechanism. (5)  

Total L : 45  

TEXT BOOKS:  

63
REFERENCES:

15OH49 HIGH PERFORMANCE COMPUTING


PARALLEL COMPUTERS: Parallel architectures -Trends in architectures, CMPs, GPUs, and Grids, Multiprocessors, Multicomputers, Multithreading, Pipelining- Data access optimization - Balance analysis and lightspeed estimates - Storage order - Taxonomy of parallel computing paradigms - Shared memory computers - Distributed memory computers - Hierarchical systems – Networks - Basics of parallelization- Parallelism – Parallel scalability.


PRINCIPLES OF PARALLEL ALGORITHM DESIGN: Preliminaries - Decomposition techniques - Characteristics of tasks and interactions - Mapping techniques for load balancing - Methods for containing interaction overheads - Parallel algorithm models – Basic communication operations.


TEXT BOOKS:

REFERENCES:

15OH50 MAINFRAME SYSTEMS

EVOLUTION OF MAINFRAME: Overview of Computer Architecture -Classification of Computers -micro, mini, mainframes and super computer -key features – benefits.

MAINFRAME SYSTEM: Attributes of Mainframes - Reasons for opting Mainframes - Users of Mainframes - Difference between Centralized and Distributed computing - Batch processing - Online/Interactive transactions.

MAINFRAME WORKLOADS : Concept - strategy and benefits of the z/OS environment - Application enablement in z/OS - Overview of e-business support in z/OS - Connectivity to the z/OS environment - Security support provided by z/OS

SYSTEM MANAGEMENT: Scalability – availability - backup and recovery features in z/OS - z/OS system services - zSeries processor configurations.
COBOL: Introduction to COBOL - Program Structure - Procedure Division - Table Handling - File Handling.  

CASE STUDY: z/VM – Linux – zVSE – zTPF.  

TEXT BOOKS:  

REFERENCE:  

15OH51 MOBILE APPLICATION DEVELOPMENT 3003


BUILDING MENUS: Menus and types – Creating menus through XML – Creating menus through coding – Using the ActionBar – Drop-down List ActionBar.  


PUBLISHING ANDROID APPLICATIONS: Setting versioning information – Signing and publishing the applications – Distributing applications - Monetizing the applications.

TEXT BOOKS:  

REFERENCE:  

15OH52 MULTICORE PROGRAMMING 3003

BASICS OF MULTICORE : Definition - hybrid architectures - The software developer's viewpoint - single core - multicore – Types: multicore designs.  

CHALLENGES : Sequential model – Concurrency – software development - Processor architecture - Operating systems role.  


COMMUNICATION AND SYNCHRONIZATION: Thread strategy approaches - Decomposition and encapsulation of work - Approaches to application design - PADL and PBS.  

Total L: 45
UML: Modelling the structure of a system - UML and concurrent behavior - Basic testing types - Defect removal for parallel programs - Standard software engineering tests.

TEXT BOOK:

REFERENCES:

15OH53 OBJECT ORIENTED PROGRAMMING


FUNCTIONS IN C++: Function Prototyping - Call by Reference - Return by reference - Inline functions - Default - Const Arguments

CLASSES AND OBJECTS: Data members - Member functions - Nesting of Member functions - Private member functions - Memory allocation for Objects - Static data members - Static Member Functions - Arrays of Objects - Objects as Function Arguments - Friend Functions - Returning Objects.

CONSTRUCTORS: Parameterized Constructors - Multiple Constructors in a Class - Constructors with Default Arguments - Dynamic Initialization of Objects - Copy and Dynamic Constructors - Destructors.


POLYMORPHISM: Compile and Run Time Polymorphism - Operators Overloading - Unary and Binary Operators Overloading - Function Overloading.

TEXT BOOKS:

REFERENCE:

15OH54 PROGRAMMING IN PYTHON

BASICS: Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Basic Syntax-Comments - Strings and Numeric Data Types - Simple Input and Output.


ERROR HANDLING: Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions - Data Streams - Access Modes Writing - Data to a File Reading - Data From a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions - Working with Directories.

TEXT BOOKS:  

REFERENCES:  

15OH55 RESPONSIVE WEB DESIGN  


CASCADEING STYLE SHEETS: Introduction - Levels of Style Sheets - Style Specification Formats – Style Classes - Properties and Property Values - Color - The span and div Tags.  

HTML5: Media Queries supporting different viewports – Syntax - Fluid Layouts- Fluid Images- Serving Different Images for different screen sizes - HTML 5 for responsive designs - semantic elements in HTML5 – Embedding Media in HTML5.  

CSS3: Selectors - Typography and Color Modes - Aesthetics with CSS3 – Text shadows - Box shadows - Background Gradients – patterns - Multiple Background images Transitions - Transformations and Animations Forms with HTML5 and CSS3.  


TEXT BOOKS:  

REFERENCE:  

15OH56 SOCIAL WEB MINING  


STRUCTURAL PROPERTIES OF SOCIAL NETWORKS: Notions of centrality - cohesiveness of subgroups - roles and positions - structural equivalence - equitable partitions.  

WEB LINKAGE MINING: Hyperlinks- co-citation and bibliographic coupling- page rank and HITS algorithm – web community discovery – web graph measurement and modelling - using link information for webpage classification. (9)

TEXT BOOKS:

REFERENCES:

15OH57 SOFTWARE ENGINEERING

INTRODUCTION: Software Characteristics-Comparison with other Engineering disciplines-Software Crisis and Myths-Software life cycle models-Selection of process models for projects- Agile methods- Software Engineering paradigms. (8)

REQUIREMENTS GATHERING: Requirements gathering tasks – Requirements Engineering Process - Qualities of good requirements-Types of Requirements-Requirements elicitation- Requirements documentation- Analysis Documentation. (7)


PROGRAMMING STANDARDS: Structured programming coding standards-Maintainability of code. (5)

SOFTWARE TESTING FUNDAMENTALS – Black-Box and White-Box testing – Basis Path testing – Requirements phase testing - Design phase testing - Program phase testing - Desk debugging and program peer view test tools - Evaluating test results - Installation phase testing - Acceptance testing – Testing GUI – Testing Web Applications (8)


TEXT BOOKS:

REFERENCES:

15OH58 JAVA PROGRAMMING

INTRODUCTION: Features of Java – Java Development Environment – Java Virtual Machine- byte codes in java - Naming conventions and Data Types - Operators - Control Structures - Arrays and Strings. (3+3)

OBJECT ORIENTED CONCEPTS: Classes and objects- creation- access specifiers- constructors – Methods - static- Inheritance - Composition-polymorphism -nested classes–wrapper classes- Abstract classes. (5+6)

PACKAGES AND INTERFACES: - Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface. (3+3)

EXCEPTION HANDLING: Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested try statements - throw - throws - Java Built-in Exception - Creating user defined exceptions- Assertions. (4+4)

INPUT/OUTPUT: Files – Stream classes – Byte Streams – Character Streams – Serialization. (3+3)
MULTI THREADED PROGRAMMING: Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Synchronization - Interthread Communication. (4+4)

GUI PROGRAMMING: AWT-Swing classes - Components - Labels, Buttons, Check Boxes, combo box - Controls Menus – Frames Event delegation model –listener and listener methods –Event classes- Applets. (5+4)

DATABASE CONNECTIVITY: Architecture – connect RDBMS – Exploring java.sql package. (3+3)

TEXT BOOKS:

REFERENCES:

15OH59  GEOGRAPHIC INFORMATION SYSTEM


DATA MANAGEMENT AND OUTPUT: Import / Export – Data Management functions - Raster to Vector - Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs Desktop GIS - Distributed GIS. (5+5)


TEXT BOOKS:

REFERENCES:

15OH60  PROGRAMMING FOR ROBOTICS

BASICS OF ROBOTICS: History – Definition – Components – Building a robot – The Robot drive mechanism. (3+2)

ROBOT SIMULATION: Mathematical modeling of the robot - Robot kinematics – Concepts of ROS and Gazebo. (4+4)

DESIGNING CHEFBOT HARDWARE: Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad - Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators. (5+5)
WORKING WITH ROBOTIC SENSORS: Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit. (4+4)

PYTHON AND ROS: Introduction to OpenCV, OpenNI, and PCL - Programming Kinect with Python using ROS, OpenCV, and OpenNI - Working with Point Clouds using Kinect, ROS, OpenNI, and PCL. (6+6)


TEXT BOOKS:

REFERENCES:

HUMANITIES

15OH61 AN INTRODUCTION TO INDIAN CONSTITUTION

PREAMBLE AND ITS PHILOSOPHY: Introduction and Evolution of Indian Constitution preamble and its Philosophy. (4)

CENTRE-STATE RELATIONS: Directive Principles of State Policy, Fundamental Rights and Duties, Centre-State Relations. (6)

UNION GOVERNMENT: Powers, Functions and Position of President, Vice-President and Council of Ministers . (6)


JUDICIARY: The Union Judiciary - Supreme Court and High Court. (6)

PUBLIC SERVICES: All India Services, Central Civil Services, State Services, Local Services and Training of Civil Services. (5)

INTERNATIONAL POLITICS: Foreign Policy of India, Foreign Policy of USA, International Institutions like UNO, WTO, SAARC and Environmentalism. (5)

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH62 ENTREPRENEURSHIP

INTRODUCTION TO ENTREPRENEURSHIP: Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Seminar in R5 & R6. (5)


DEVELOPING AN EFFECTIVE BUSINESS MODEL: The Importance of a Business Model – Starting a small scale industry - Components of an Effective Business Model. (5)


INTELLECTUAL PROPERTY PROTECTION AND ETHICS: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.  

TEXT BOOKS:  

REFERENCES:  

15OH63 HUMAN RESOURCE MANAGEMENT


TRAINING AND DEVELOPMENT: Principles of Learning, Objectives, Types and Training Methods, Management Development: Its Meaning, Scope and Objectives. 


INTERNATIONAL HRM: Model, Variables that outline difference between local and International HRM approaches to IHRM, Linking HRM to International Expansion Strategies.  


TEXT BOOKS:  

REFERENCES:  
15OH64 INDUSTRIAL PSYCHOLOGY

INDUSTRIAL PSYCHOLOGY: Introduction – Concept and Meaning – Characteristics and Scope. (3)


PERCEPTION AND ATTITUDE: Importance of Perception – Need for Shaping Perception – Workplace Attitude. (6)


INTERPERSONAL RELATIONSHIP: Managing emotions – Emotional Intelligence – Building Interpersonal Relations– Managing the Boss – Dealing with Subordinates. (6)

STRESS: Dynamics – Types – Signs – Causes – Workplace Stress and Coping Strategies. (4)

ORGANISATION CULTURE: Meaning – Types – Importance – Changing Organizational Culture and Matching People with Organizational Culture – Working Environment. (5)

INDUSTRIAL FATIGUE BOREDOM: Types of Industrial Fatigue – Symptoms – Causes and Remedies of Industrial Fatigue Industrial Boredom – Causes – Effective Ways to Reduce Boredom. (6)

JOB SATISFACTION: Job Satisfaction – Consequences – Tips for Reducing Job Dissatisfaction. (3)

PERFORMANCE MANAGEMENT: Concept – Objectives – Process – Methods of Performance Evaluation. (3)

Total L: 45

TEXT BOOKS:

REFERENCES:

15OH65 PRINCIPLES OF MANAGEMENT

PRINCIPLES OF MANAGEMENT: Meaning, Definition and Significance of Management, Basic Functions of Management – Planning, Organizing, Staffing, Directing and Controlling. (5)

ENGINEERS AND ORGANIZATIONAL ENVIRONMENT: Social, Economic, Technological and Political. Social Responsibility of Engineers. (3)

MANAGEMENT CONCEPTS: MBO, Theory Z, Kaizen, Six Sigma, Quality Circles and TQM. (Case Study) (5)

BUSINESS PROCESS REENGINEERING: Need for BPR, Various phases of BPR, Production and Productivity in six sigma and TQM – Factors Influencing Productivity. (7)

ORGANISATIONAL BEHAVIOUR: Significance of OB, Role of Leadership, Personality and Motivation, Stress, Attitudes, Values and Perceptions at work. (7)

INDUSTRIAL AND BUSINESS ORGANIZATION: Growth of Industries (Small Scale, Medium Scale and Large Scale Industries). Forms of Business Organizations. Resource Management – Internal and External Sources. (6)

MANAGING INFORMATION: Why Information Matters – Strategic Importance of Information – Cost of Useful Information – Getting and Sharing Information. (6)


Total L: 45

TEXT BOOKS:
REFERENCES:

15OH66 BUSINESS STATISTICS

STATISTICS INTRODUCTION: Definition, Types of Statistics, Types of Variables, Descriptive Measures, Basic Definition and Rules of Probability, Independence of Events. (9)

DESCRIPTIVES MEASURES: Measures of central tendency, dispersion, Probability Distributions. (6)

SAMPLING: Definition, Selection of Statistical tools, Sampling Methods, Sampling Frame determining the sample size. (6)

HYPOTHESIS TESTING: ANOVA- Independent sample t test, Paired t test. (4)

PARAMETRIC TEST: Concept, Chi square tests for Association and homogeneity, One sample t test. (4)

CORRELATION AND REGRESSION: Karl Pearson Correlation, Linear regression (Both manual and software applications), Components, Trend -Method of least squares and moving averages, seasonal variation-Simple average method only. (10)

STATISTICAL DECISION THEORY: Uncertainty and risk and Decision tree analysis (6)

TEXT BOOKS:

REFERENCES:

15OH67 DISASTER MANAGEMENT

INTRODUCTION: Disaster – Definition, Factors and Significance, Difference between Hazard and Disaster, History of Disasters and Types, Disaster Aids. (4)

NATURAL DISASTERS: Cyclones, Floods, Drought and Desertification - Earthquake, Tsunami, Landslides and Avalanche. (5)

MAN MADE DISASTERS: Chemical industrial hazards, major power breakdowns, traffic accidents, Fire, War, Atom bombs, Nuclear disaster. - Forest Fire-Oil fire –accident in Mines. (8)

GEOSPATIAL TECHNOLOGY: Remote sensing, GIS and GPS applications in real time disaster monitoring, prevention and rehabilitation- disaster mapping. (8)

RISK ASSESSMENT AND MITIGATION: Hazards, Risks and Vulnerabilities. -Disasters in and India ,Assessment of Disaster Vulnerability of a location and vulnerable groups- Preparedness and Mitigation measures for various Disasters- Mitigation through capacity building -Preparation of Disaster Management Plans. (8)

DISASTER MANAGEMENT: Legislative responsibilities of disaster management- Disaster management act 2005- post disaster recovery & rehabilitation, Relief & Logistics Management; disaster related infrastructure development- Post Disaster, Emergency Support Functions and their coordination mechanism. (8)

GLOBAL PERSPECTIVE: Study of Environmental Impacts Induced by Human Activity, Industrial Accidents, Outbreaks of Disease and Epidemics, War and Conflicts. (4)

TEXT BOOKS:

REFERENCES:

15OH68 FINANCIAL AND MANAGERIAL ACCOUNTING

INTRODUCTION TO ACCOUNTING: Meaning, Definition and significance of Accounting, Accounting Principles, Concepts and Conventions, Classifications of Accounts. (9)

BASIC ACCOUNTING: Journal Entry, Ledger, and Trial Balance Sheet, preparation of final accounts: Trading, Profit & Loss Account, Balance sheet. (9)

BASIC FINANCIAL STATEMENTS: Meaning – Types of Financial Analysis Income Statement, common analysis, trend analysis, ratio analysis, corporate cash flow, DuPont Model. (9)

COST ACCOUNTING: Accounting for overheads, Cost sheet, Marginal and Absorption costing, Break even analysis, Effect on profits, Activity Based Costing system. (6)

ACCOUNTING FOR DECISION MAKING: CVP Analysis -Relevant Costs and Revenue for Decision Making, Pricing Decisions, Operational Decisions, Exploring New markets, Make or buy decisions. (6)

ACCOUNTING FOR PLANNING AND CONTROLLING: Budgets, Budgetary Control -Variance Analysis - Cost and Financial Variances. (6)

TEXT BOOKS:

REFERENCES:

15OH69 MARKETING MANAGEMENT


MARKETING STRATEGY: Formulating Marketing Strategy, Key Drivers of Marketing Strategy, Marketing Strategies- Marketing Mix Components. (7)

COMPETITOR ANALYSIS: Analysis of Consumer & Industrial Markets, Building Competitive Advantage. (6)


MARKETING RESEARCH & TRENDS IN MARKETING: Marketing Information System, Marketing Research Process & Purpose, Ethics in Marketing, Online Marketing Trends. (7)

TEXT BOOKS:

REFERENCES:
15OH70 DEFENCE PRACTICES AND DISASTER MANAGEMENT 3003

HISTORY & ENVIRONMENTAL AWARENESS: NCC- Army, Navy, Air force; Aim and Motto; Ranks and Equivalent Ranks; Honors and Awards; Organization; Training – Nation Building; Civil affairs; Social Service & Needs; Environment & Ecology; Pollution; Rain Water Harvesting; Law and Order; Corruption.

(7)

WEAPONS: Introduction; Types of Weapons; Armed Forces Fighting Arms; Service Corps; Section Formation & Types; Firing Order; Judging Distance; Types of Land; Working Principle of Rifle, Tank, Missiles; Characteristics of supporting Rifle and its ammunitions; Field Craft and Battle Craft; Fighting - Role of Fighting Arms and map reading.

(7)

DISASTER MANAGEMENT: Definition; Types of Disaster Management; Foundations of Disaster Studies; Review of Concepts, Organizations – NDMA, NIDM, NDMRT, NEC, Disaster Mitigation, Disaster Preparedness, Disaster Relief, Reconstruction Planning, Economic and Social Rehabilitation, Globalization and Disaster Studies, Social Science and Domains Approach.

(7)

LIFE SKILL MANAGEMENT: Introduction; Concept of Life Skills; Internalizing of Life Skills; Self awareness and Empathy; Knowing Myself; Self care; Empathizing with others; Creative Thinking & Critical Thinking; Practicing Decision making & Problem Solving; Effective Communication – Inter Personal Relationship; Coping with Emotions & Stress; Facilitation skills – Verbal & Non verbal; Training Methodologies.

(7)

HEALTH AND HYGIENE: Anatomy, Physiology, Microbiology – Personal and Mental Health ; Infectious and Contagious Diseases, its prevention; First Aid in common Medical Emergencies; Basics of Home Nursing; Treatment and care of Wounds and Fractures.

(7)

FIELD TRAINING: Foot Drill; Handling-Inspection Training; MapReading; Physical Proficiency Training; Introduction to Yoga.

(10)

Total L: 45

TEXT BOOKS:

REFERENCES:

ENGLISH

15OH75 ENGLISH AND SOFT SKILLS FOR EMPLOYABILITY 3003

SELF MANAGEMENT AND ATTITUDES: Self Concept, Stress management, Positive attitude, Influential Skills, Initiative, Empathy, Social Etiquette

(5)

COMMUNICATION STYLES : Presentation Skills, Interpersonal Communication Skills, Interviewing Skills, Verbal and Nonverbal (body language) skills, Active Listening, Professional Writing, Effective email writing

(16)

TEAM WORK: Inter team cooperation, Intra team cooperation, Diversity, Productivity, Goal Setting and action

(4)

LEADERSHIP SKILLS : Empowerment, Planning, Establishing Credibility, Vision & direction, Supervision, Mentoring, Decision-making, Creativity, Flexibility, Team problem solving

(5)

MANAGING TIME AND PRESSURES: Managing Change, Time management, Effective meetings

(5)

EFFECTIVE AND EXCELLENT CUSTOMER SERVICE: Communication with the customer- telephonic and online services, Managing conflicts or Challenging communication, Setting and resetting customer expectations, Building customer confidence, Growing customer relationship, Opportunity management, Developing team approach to meet customer needs.

(10)

Total L: 45

TEXTBOOK:
Monograph prepared by the Faculty, Department of English, 2015.

REFERENCES:
**15OH76 ENGLISH FOR COMPETITIVE EXAMINATIONS**

**READING COMPREHENSION:** Focus on different levels of Comprehension- Literal, Inferential, Analytical and Critical reasoning (7)
Identifying key words and signal words, decoding the building blocks of a passage, understanding jargons and double distractors (2)

**LISTENING COMPREHENSION:** Micro skills and Macro skills of Listening (4)
Identifying tone and purpose, eliminating distracters in objective type questions (2)

**SPEAKING:** Sub skills of speaking- Genre-specific oral communication (4)

**VERBAL ABILITY:** Word formation and expansion, Selecting and ordering words - Identifying and correlating synonyms and antonyms - Collocations (5)
Sentence Completion (5)
Verbal analogies (3)
Spotting and correcting errors (4)

**WRITING** : Mapping ideas, developing points and employing Variety in sentence types (3)
Referencing, Ellipsis and substitution in writing – Skillful paragraphing (unity, coherence and cohesion) (3)
Register and Tone in Critical, Analytical writing - Useful Language for describing graphs - Expressing strong opinions (3)

Total L: 45

**TEXTBOOK:**
Monograph prepared by the Faculty, Department of English, 2015

**REFERENCES:**

**15OH77 GERMAN LANGUAGE – INTERNATIONAL LEVEL A1.1**

**GUTEN TAG! - LEARNING:** To greet, learn numbers till 20, practice telephone numbers & e mail address, learn alphabet, speak about countries & languages ; **Vocabulary:** related to the topic; **Grammar:** W – Questions, Verbs & Personal nouns I. (7.5)

**FREUNDE, KOLLEGEN UND ICH - LEARNING:** To speak about hobbies, jobs, learn numbers from 20; **Vocabulary:** related to the topic; **Grammar:** Articles, Verbs & Personal pronouns II, sein & haben verbs, ja/nein Frage, singular/plural. (7.5)

**IN DER STADT – LEARNING:** To know places, buildings, question, know transport systems, understand international words; **Vocabulary:** related to the topic; **Grammar:** Definite & indefinite articles, Negotiation, Imperative with Sie. (7.5)

**GUTEN APPETIT! – LEARNING:** To speak about food, shop, converse; **Vocabulary:** related to the topic; **Grammar:** Sentence position, Accusative, Accusative with verbs. (7.5)

**TAG FÜR TAG – LEARNING:** To learn time related expressions, speak about family, ask excuse, fix appointments on phone; **Vocabulary:** related to the topic; **Grammar:** Preposition – am, im, um, von...bis, Possessive articles, Modalverbs. (7.5)

**ZEIT MIT FREUNDEN – LEARNING:** To speak about birthdays, understand & write invitations, converse in the restaurant; **Vocabulary:** related to the topic; **Grammar:** Accusative personal pronouns and prepositions. (7.5)

Total L: 45

**TEXTBOOK:**
REFERENCES:

15OH78 GERMAN LANGUAGE – INTERNATIONAL LEVEL A1.2

KONTAKTE - LEARNING: To arrange appointments, understand and give instructions, understand and reply letters, find information in the text, identify the situations and understand the conversation; Vocabulary: related to the topic; Grammar: Dative Preposition & Article, Accusative Possessive Article.

MEINE WOHUNGS - LEARNING: To understand the advertisements related to flats/houses, describe a flat, write a text about a flat; Vocabulary: related to the topic; Grammar: Adjective with sein (sehr/zu), wechselpräposition with Dat.

ALLES ARBEIT? – LEARNING: To describe daily routine, talk about the past, speak about jobs, position, advertisements, prepare telephone conversation; Vocabulary: related to the topic; Grammar: Conjunctions, Perfect tense (regular & irregular verbs).

KLEIDUNG UND MODE – LEARNING: To speak about clothes, understand the conversation at shopping centers, about Berlin. Vocabulary: related to the topic; Grammar: Perfect tense (trennbar & nicht trennbar verbs), personal pronoun & verbs with Dat.

GESUND UND MUNTER – LEARNING: To make personal statements, name body parts, understand sport activities, conversation with the doctor, get & give tips to healthy life, e-mail writing; Vocabulary: related to the topic; Grammar: Imperative, Modalverbs.

AB IN DEN URLAUB! – LEARNING: To suggest a city tour, describe the directions, write a postcard, describe the weather, make a complaint in the hotel, speak about the trips, letter writing; Vocabulary: related to the topic; Grammar: Adverbs (time).

Total L: 45

TEXTBOOK:

REFERENCES:

APPLIED MATHEMATICS AND COMPUTATIONAL SCIENCES

15OH81 DATA STRUCTURES AND ALGORITHMS

INTRODUCTION: Data structures - Abstract Data Types - Basic data structures – Arrays, stacks, queues and linked lists - Operations and applications

ALGORITHMS: Introduction - Analysis of algorithms - Best, worst and average case time complexities - notations.


SORTING AND SEARCHING: Insertion sort, selection sort, heap sort, count sort and radix sort – searching, Linear Search.

BINARY SEARCH TREES: Searching – Insertion and deletion of elements - Balanced BST- AVL trees - Definition – searching – insertion and deletion of elements, AVL rotations


Total L: 45
GRAPHICS: Definition – representations (Adjacency matrix, packed adjacency list and linked adjacency list) – Graph search methods (Breadth first and depth first traversals) . (2)

DIVIDE AND CONQUER: Method – Merge sort, Quick sort, Binary Search. (3)

GREEDY METHOD: Optimization problems – method – examples – Minimum cost spanning tree (Kruskal’s and prim’s algorithms), Knapsack problem (3)

TUTORIAL PRACTICE:
Implementation of the following problems:
1. Sparse and dense Matrix operations using arrays.
2. Linked Lists: Singly linked, Doubly linked and Circular lists.
4. Problems using Queues.
5. Binary trees
6. Problems related to sorting and searching algorithms.
7. Binary search tree
8. Minimum cost spanning tree

Total L: 30+T: 30 = 60

TEXT BOOKS:

REFERENCES:

15OH82 OPTIMIZATION TECHNIQUES

LINEAR PROGRAMMING: Graphical method for two dimensional problems – Central problems of Linear Programming – Definitions – Simplex Algorithm – Phase I and Phase II of Simplex Method. (8)

CONVEX OPTIMIZATION: Convex sets and cones- Convex functions- Convex optimization problems- linear and quadratic programs; second-order cone and semi-definite programs; quasi-convex optimization problems; vector and multi-criterion optimization. (5)


INTEGER PROGRAMMING: Gomory cutting plane methods for all integer and mixed integer programming problems - Branch and Bound method (Land – Dolg and Dakin algorithms) – Zero-One Implicit enumeration Algorithm. (5)


TUTORIAL PRACTICE:
1. Solving inequalities using Simplex, Two-phase, Dual simplex methods, Revised simplex method.
2. Finding initial basic feasible solution using (i) North-West corner rule(ii) Matrix minimum and (iii) Vogel’s approximation method and also perform optimalitytest using MODI method.
4. Gomory’s cutting plane methods for all IPP and mixed IPP.
6. Critical path for the given PERT and CPM networks.

Total L: 30+T:30 = 60

TEXT BOOK:

REFERENCES:
INTRODUCTION TO DATA SCIENCE: Data wrangling, cleaning, and sampling to get a suitable data set - Mathematics for understanding the data – Descriptive statistics: Visualizing Data - Central Tendency –Variability –Standardizing - Normal Distribution - Sampling Distributions.

DATA MANIPULATION AT SCALE: Parallel databases, parallel query processing, in-database analytics, MapReduce, Hadoop, Key-value stores and NoSQL; tradeoffs of SQL and NoSQL.


COMMUNICATING RESULTS: Visualization - descriptive statistics and visualization, privacy, ethics – multivariate visualization.

SPECIAL TOPICS: Graph Analytics: structure, traversals, analytics, PageRank, community detection, recursive queries, Semantic web.

CASE STUDY: Community Detection – Collaborative Network – Opinion mining – Co-citation network

TUTORIAL PRACTICE:
1. Introduction to R and problems using R.
2. Collect datasets from Kaggle and Data Analysis.
3. Implementation of various predictive models.
4. Generate the results using Confidence levels.
5. Implementation of SVD.

Total L: 30+T:30 = 60

TEXT BOOK:

REFERENCES:
5. Matthew A. Russell, "Mining the Social Web: Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites", O'Reilly Media, 2013.


STATIC DATA VISUALIZATION – tools – working with various data formats

DYNAMIC DATA DISPLAYS: Introduction to web based visual displays – deep visualization – collecting sensor data – visualization – D3 framework - Introduction to Many eyes and bubble charts

MAPS – Introduction to building choropleth maps

TREES – Network visualizations – Displaying behavior through network graphs

BIG DATA VISUALIZATION – Displaying behavior through network graphs – visualization of text data and Protein sequences

TUTORIAL PRACTICE:
Note: Explore software like R, Python, Google Vision, Google Refine, and ManyEyes; Data sets are available on Gapminder, Flowing data.

1. Visualization of static data.
2. Visualization of web data.
3. Visualization of sensor data.
4. Visualization of protein data.

**Total L: 30 + T: 30 = 60**

**TEXT BOOK:**

**REFERENCES:**

**15OH85 ARTIFICIAL INTELLIGENCE**

**INTRODUCTION:** The foundations of AI - The History of AI - Intelligent agents- Agent based system.


**KNOWLEDGE REPRESENTATION AND REASONING:** Knowledge representation - Logics – First order logic- Inference in first order logic – Higher order logic - Markov logic.


**DECISION-MAKING:** basics of utility theory, sequential decision problems - decision network- policy -Decision process in infinite horizon: Optimal policy, Value iteration - policy iteration- Partially observable decision process – Decisions in Multi agent system: elementary game theory.

**LEARNING:** Learning from observation - Knowledge in learning – Supervised Learning - Unsupervised and Reinforcement learning.

**ROBOTICS:** Introduction.

**TUTORIAL PRACTICE:**
Lab assignments will be provided for all the topics given below.
2. Hill climbing and genetic algorithm
3. Constraint satisfaction techniques.
4. Simple games – minimax and expectimax
5. Logic based exercises.
6. Implementing HMM models
7. Applications of sequential decision making and multi agent decision making
8. Implementing decision network and dynamic networks.

**TEXT BOOKS:**

**REFERENCES:**
INTRODUCTION: Past, present, future; the pervasive computing market, m-Business, challenges and future of pervasive computing - modelling key for pervasive computing - pervasive system environment interaction - architectural design for pervasive system, application examples of pervasive computing: Healthcare, Tracking, emergency information systems, home networking appliances and entertainment.

DEVICE TECHNOLOGY FOR PERVERSIVE COMPUTING: Hardware, computing devices and their characteristics - pervasive information access devices-smart identification, smart card, labels, tokens - embedded controls, smart sensors, actuators -Human-machine interfaces, Biometrics - Various operating systems for pervasive devices.


APPROACHES FOR DEVELOPING PERVERSIVE APPLICATIONS: Categorization - smart services for pervasive application development - developing mobile applications – presentation transcoding – device independent view component – heterogeneity of device platforms - Context Awareness and Mobility to build pervasive applications.

CONTEXT AWARE SYSTEMS: Modelling - mobility awareness - spatial awareness - temporal awareness - ICT system awareness - Intelligent Systems - basic concepts- autonomous systems - reflective and self-aware systems - self management and autonomic computing - complex systems.


TUTORIAL PRACTICE:
1. Create application with onClick, onKeyDown, onFocusChanged Event Handlers.
2. Create application with Toast Notifications.
3. Create application with Android's Advanced User Interface Functions.
5. Create application to Create, Modify and Query an SQLite Database.
6. Create application that Works with an Android Content Provider.
7. Create application that performs Data Storage and Retrieval from Android External Storage.
8. Create Location-Aware application that uses Proximity Alerts and Google Maps API.
9. Implementation of small packages to demonstrate all APIs.

Note: All implementations using android.

Total L: 30+T: 30=60

TEXT BOOKS:

REFERENCES:
PARALLEL PROGRAMMING MODELS: Overview - Shared Memory Model - Threads Model - Message Passing Model - Data Parallel Model - Other Models.


PRAM ALGORITHMS & BSP: PRAM model of computation - Work-Time formalism and Brent’s Theorem; algorithm design techniques-parallel prefix, pointer jumping,

HIGH PERFORMANCE COMPUTING ARCHITECTURES - Latency Hiding Architectures - Multithreading Architectures - Dataflow Architectures.


TUTORIAL PRACTICE:
1. Basic Master – Worker program and send messages.
2. Write a program to find the sum of largest number in a very large array of integers. (The contents of the array should be equally distributed to all processes )
3. Write a parallel program in SPMD to calculate the Pi value using integral approximation method.
5. Select your own choice of very dense computational problem having divide and conquer method and implement it in parallel algorithm. And produce the performance chart with 2, 4, 6 and 8 nodes.

Total L:30+T:30=60

TEXT BOOKS:

REFERENCES:

15OH88 CYBER SECURITY 2 2 0 3


WEB SECURITY: Overview, various types of web application vulnerabilities, Reconnaissance, Authentication, Authorization (Fuzzing and Privilege Escalation), Session Management, Cross Site Scripting (XSS), Cross Site Request Forgery (CSRF), SQL Injection and Blind SQL Injection.

TUTORIAL PRACTICE:
1. Design of a Client server application for a basic cryptosystem.
2. Detection of a Buffer overflow attack.
3. Packet Sniffing using Wireshark Tool to perform the traffic analysis attack.
4. Key distribution using RSA (KDC) – Key hacking.
6. Password authentication.
7. Transaction security using SQL Injection attacks.
8. Port scanning tools.
9. Performing attacks and testing with attack tools.
10. Security testing for Web applications.

Total L:30+TP:30 = 60

TEXT BOOKS:

REFERENCES:

15OH89 RANDOMIZED ALGORITHMS

INTRODUCTION: Randomized algorithms, randomized quick sort, Karger’s min-cut algorithm Las Vegas and Monte Carlo algorithms, computational models and complexity classes.


PROBABILISTIC METHODS: Overview of the method – maximum satisfiability - finding a large cut, Expander graphs.

MARKOV CHAINS AND RANDOMWALKS: Markov chains, Random walk on graphs - connectivity in undirected graphs – Expanders and rapidly mixing random walks.


ONLINE ALGORITHMS: Paging problem-adversary models- paging against an oblivious adversary-relating the adversaries-the adaptive online adversary, k-server problem.

PARALLEL AND DISTRIBUTED ALGORITHMS: Sorting on a PRAM – Maximal Independent sets.


TUTORIAL PRACTICE:
1. Implementation of randomized quick sort and solve real time problems using it.
2. Find solution for s-t min-cut problem adapting min cut algorithm.
3. Implementation of randomized selection and problems related to it.
4. Implementation of treap data structure.
5. Problems using randomized hash table.
6. Implement the shortest path and fast min-cut algorithms.
7. Implementation of randomized primality testing.

Total L: 30+TP:30 = 60

TEXT BOOKS:
REFERENCES:

**15OH90 APPROXIMATION ALGORITHMS**

**INTRODUCTION:** Definition-performance ratios, vertex-cover problem.

**COMBINATORIAL ALGORITHMS:** lower bounding techniques and Metric TSP, multiway cut problem, the minimum k-cut problem, FPTAS for knapsack, greedy algorithms for Makespan-PTAS for minimum Makespan, Euclidean TSP.

**LINEAR PROGRAMMING RELAXATIONS:** LP-duality, min-max relations and LP-duality, rounding applied to vertex cover-simple rounding algorithm-randomized rounding, primal dual method and vertex cover.

**CUTS, METRICAL RELAXATIONS AND EMBEDDINGS:** multiway cut, sum multi-commodity flow, some applications of multicut, rounding for Sparsest Cut via L1 Embeddings.

**SEMIDEFINITE PROGRAMMING:** Strict quadratic programs and vector programs, properties of positive semidefinite matrices, the semidefinite programming problem, improving the guarantee for MAX-2SAT.

**HARDNESS OF APPROXIMATION:** reduction, graphs, and hardness factors, the PCP theorem, hardness of MAX-3SAT.

**TUTORIAL PRACTICE:**
1. Implementation of vertex-cover algorithm.
2. Implementation of Greedy algorithm for makespan.
3. Problems related to Euclidean TSP.
4. Implementation of different algorithms with rounding.
5. Implementation of applications of multicut.

**TEXT BOOKS:**

REFERENCES:

**15OH91 NETWORK SCIENCE**

**INTRODUCTION:** Basics of networks and graphs, random network model - degree distribution, evolution, small world property, six degrees of separation, Watts-Strogatz model, local clustering coefficient, random networks and network science.

**BARABÁSI-ALBERT MODEL:** Growth and preferential attachment, Barabási-Albert model, degree dynamics, degree distribution, diameter and the clustering coefficient, preferential attachment - absence of growth, measure, non-linearity, the origins.

**SCALE-FREE PROPERTY:** Power laws and scale-free networks, Hubs, Universality, Ultra-small property, role of the degree exponent, Generating networks with a pre-defined degree distribution.

**EVOLVING NETWORKS:** Bianconi-Barabási model, measuring fitness, Bose-Einstein condensation, evolving networks.

**DEGREE CORRELATIONS:** Assortativity and disassortativity, Measuring degree correlations, Structural cutoffs, Degree correlations in real networks, Generating correlated networks, impact of degree correlations.

**TUTORIAL PRACTICE:**
1. Implementation of Barabási-Albert model.
2. Implementation of Watts-Strogatz model.
3. Implementation of Bianconi-Barabási model.
4. Obtaining Degree correlations in real networks.
5. Case studies of the theory concepts on real networks.

**TEXT BOOK:**
REFERENCES:

15OH92 APPLIED STOCHASTIC PROCESSES

STOCHASTIC PROCESSES: Introduction – Classification of Stochastic Processes – Markov Chain


RANDOM WALK MODELS: Symmetric random walk – Random walk on graphs – Gambler’s Ruin model


GENERAL QUEUEING MODELS: Single and Multi server Poisson Queues - Single Server Queue with Poisson input and general service– General input and exponential service Queueing models.

TUTORIALS PRACTICE:
1. Case Study for Markov Chain: Passport Credit Card Company, Manufacturing, Telecommunication
2. Case Study for generalized Markov Process: Healthy Heart Coronary Care Facility
3. Modeling Network Protocols using Queueing Models
4. Performance Evaluation of Communication Systems
5. Page Ranking Algorithms

Total L:30 T:30= 60

TEXT BOOKS:

REFERENCES:

15OH93 MODELLING AND SIMULATION

PRINCIPLE OF COMPUTER MODELLING AND SIMULATION: Monte Carlo simulation. Nature of computer modeling and simulation.Limitations of simulation, areas of application.

SYSTEM AND ENVIRONMENT:Components of a system - discrete and continuous systems. Models of a system - A variety of modelling approaches.


DESIGN AND EVALUATION OF SIMULATION EXPERIMENTS: Input - Output analysis - variance reduction techniques - Antithetic variables - verification and validation of simulation models.

15OH94 GRAPH ALGORITHMS


MATCHING: Maximum and perfect matchings, augmenting path, Berge’s, Konig’s and Tutte’s theorems, Hall’s theorem, Hungarian algorithm, Edmond-Blossom algorithm. Kuhn-Munkre’s algorithm for optimal assignment. (4)

NETWORK FLOW: Maximum flow in a network, minimum cut, Ford-Fulkerson algorithm, Max-flow min-cut theorem. Similarity between matching and flow theories. (3)


VERTEX COLORING: Vertex coloring and bounds. Sequential coloring, largest degree first algorithms. Maximum clique and vertex coloring. Mycielski’s construction for large chromatic number. (3)

GRAPH ISOMORPHISM: Isomorphism, subgraph isomorphism, László Babai’s quasi-polynomial time solution for graph isomorphism problem. (4)

PLANAR GRAPHS: Euler’s formula, dual graph, Kuratowski’s theorem, 4-color problem, Wagner’s theorem. Planarity testing – Hopcraft-Tarjan algorithm. (3)

Total L: 30+T: 30=60

TUTORIAL PRACTICE:
1. VLSI Physical design – maximum Independent set, maximum clique and minimum coloring for interval graphs, Steiner minimum tree in routing.
2. Isomorphism/subgraph isomorphism problem in Data mining - common subgraph pattern in networks, chemical compound within a chemical database.
3. Link verification using Eulerian trails.
4. Network flow – finding maximum flow in network
5. Register allocation, frequency assignment using vertex coloring
6. Traveling salesman problem using Hamiltonian concept
7. Planar graph embedding
8. Solving optimal assignment problem
OPEN ELECTIVES OFFERED BY ENGINEERING DEPARTMENTS

DEPARTMENT OF MECHANICAL ENGINEERING

15MH02 TOTAL QUALITY MANAGEMENT

3 0 0 3

INTRODUCTION: Definitions of the terms – quality planning , quality control, quality assurance, quality management , total quality management as per ISO 8402 – overview on TQM – the TQM axioms – Commitment – scientific knowledge – involvement

Consequences of total quality. (7)

THE DEMING APPROACH TO TQM: Deming’s fourteen points on quality management – five DDs – implementing the Deming philosophy - action plan – the Deming cycle – questions and opinions of Deming. (7)

JURAN ON QUALITY: Developing a habit of quality – Juran quality trilogy – the universal break through sequence – comparison Juran and Deming approaches (5)

CROSBY AND THE QUALITY TREATMENT: Crosby’s diagnosis of a troubled company - Crosby’s quality vaccine - Crosby’s absolutes for quality management - Crosby’s fourteen steps for quality improvement. (6)

KAIZEN : Meaning – kaizen and innovation – the kaizen management practices – total quality control (TQC) –Ishikawa – kaizen – kanban systems – small group activities – quality control circles – comparison of kaizen and Deming’s approach (6)


ISO 9000 SERIES QUALITY SYSTEM STANDARDS: The structure of ISO 9000 series quality system standards – certification process. (3)

STRATEGIC QUALITY MANAGEMENT: Integrating quality into strategic management – quality and the management cycle – resources for quality activates – training for quality – self managing teams – role of the quality Director – obstacles to achieving successful strategic quality management. (3)

Total : L : 45

TEXT BOOKS:

REFERENCES:
DEPARTMENT OF ROBOTICS & AUTOMATION

15RH02 INTRODUCTION TO ROBOTICS AND AUTOMATION 3003


DIRECT KINEMATICS: Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link co-ordinates, D-H Representation, Arm equation - Two axis, three axis, and four axis robots. (6)

INVERSE KINEMATICS & WORKSPACE ANALYSIS: Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots Workspace analysis of Four axis robots. (7)

INTRODUCTION TO FACTORY & PROCESS AUTOMATION: Industrial Versions - Control elements of Industrial Automation - IEC/ISA Standards for Control Elements - Selection criteria for control elements - Construction of Relay Ladder logic with different control elements - Need for PLC - PLC evolution. (7)

PROGRAMMABLE LOGIC CONTROLLERS: Architecture of PLC - Types of PLC - PLC modules, PLC Configuration - Scan cycle - Capabilities of PLC: Selection criteria for PLC - PLC Communication with PC and software - PLC Wiring - Installation of PLC and its Modules. (7)

PROGRAMMING OF PLC: Types of Programming - Bit Instructions - Timers and counters - PLC arithmetic functions PTO / PWM generation - High Speed Counter - Analog Scaling - Encoder Interfacing - Serve drive control - Stepper Motor Control. (12)

TEXT BOOKS:

REFERENCES:

DEPARTMENT OF INFORMATION TECHNOLOGY

15IH03 GRAPHICS AND MULTIMEDIA 3003

INTRODUCTION: Digital image representation, Image format, Graphics format, Computer image processing: Image synthesis - Image analysis - Image transmission. (7)

MULTIMEDIA: Sound, Audio file formats, MIDI, Images, Computer image processing, Animation, Video, CD Technologies, Multimedia workstations, Multimedia applications. (8)

MULTIMEDIA TOOLS: Basic tools, Image editing tools, Painting and drawing tools, Sound editing programs, Video formats, Linking multimedia objects, OLE, Presentation tools, Authoring tools. (8)

DATA COMPRESSION: Source entropy and hybrid coding, JPEG: Image preparation – Lossy sequential DCT based mode - Expanded lossy DCT based mode, MPEG: Video encoding - Audio encoding - Data stream, H.261, DVI. (7)

MULTIMEDIA OPERATING SYSTEMS: Introduction, Real time OS, Resource management, Process management, File systems, Database systems: Multimedia Database Management System (MDBMS) - Characteristics of an MDBMS - Data analysis - Data structure - Operations on data - Integration in a database model. (8)

MULTIMEDIA COMMUNICATION SYSTEMS: Application subsystem, Transport subsystem, Synchronization: A reference model for multimedia synchronization - Synchronization in distributed environment. (7)

Total L: 45
TEXT BOOKS:

REFERENCES:

PROFESSIONAL ELECTIVES

GENERAL ELECTIVES

15B001 PLANT BIOTECHNOLOGY

INTRODUCTION: Crop evolution and heterosis breeding, Marker Assisted selection, Organization and Expression of Plant Genes, Mitochondrial and chloroplast genomes, plant molecular genetics of photosynthesis and development. (10)

PLANT TISSUE CULTURE: methods, types, application, secondary metabolite production, Agrobacterium rhizogenes and hairy root induction. (6)

GENETIC ENGINEERING TECHNIQUES – Agrobacterium mediated transformation, protoplast fusion, direct gene delivery methods, Plant viruses as vectors and chloroplast transformation. (6)

STRATEGIES FOR PLANT MODIFICATIONS: introducing biotic and abiotic stress resistance/tolerance, phytoremediation, herbicide resistance. (15)

APPLICATIONS: Molecular farming/pharming, symbiotic microorganism and their role in enhancing plant growth, cyanobacterial and algal modifications. Growing of GM crops - their regulations, Case studies pertinent to Indian scenario. (8)

Total L: 45

TEXT BOOKS:

REFERENCES:

15B002 ENVIRONMENTAL BIOTECHNOLOGY

STATUS OF THE ENVIRONMENT: Global environmental issues – challenges to sustainability; anthropogenic activities and their environmental impacts; climate change; feeding a growing population. (5)

BIOFUELS: Current energy scenario and its impacts; biofuel from biomass, algae; hydrogen from bacteria; biochemical engineering in biofuels production - engineering cellulolytic organisms, metabolic engineering of fatty acid metabolism in single cellular algae. (12)

BIOREMEDICATION: Ecological principles; capability of microbial process for pollutant management. Bioremediation processes; Factors affecting the bioremediation processes; In situ and ex-situ bioremediation; Microbial degradation of contaminants in gas phase; biofiltration, biotrickling filtration, bioscrubbers; Phytoremediation of organic, metals and inorganic contaminants; transgenics in bioremediation. (15)

BIODIVERSITY AND ITS CONSERVATION: Biodiversity analysis: molecular methods to analyse biodiversity – gene sequencing, phylogenetic trees, ISSR, RAPDs, isozymes. DNA Barcoding, Metagenomics, Conservation of endangered species: micropropagation, cryopreservation, ART, DNA and tissue banking. (5)
BIOFERTILIZERS AND BIOPESTICIDES: Nitrogen fixers, phosphorous solubilising bacteria, phosphorous mobilizing bacteria, plant growth promoting microorganisms, Baculoviruses, entomopathogenic fungi, Bacillus thuringiensis. (8)

TEXT BOOKS:  

REFERENCES:  

15B003 PHARMACEUTICAL TECHNOLOGY 3003

DRUG DEVELOPMENT STRATEGIES: Lead generation, Structure-Activity relationship, pharmacaphore, QSAR, In Silico drug development, clinical trials. (6)

PHARMACODYNAMICS AND PHARMACOKINETICS: Pharmacokinetics, Pharmacodynamics, Pharmacogenomics. (9)

DOSEAGE FORMS, MANUFACTURING AND QUALITY CONTROL: Compressed tablets, coating of tablets, capsules sustained action dosage forms-parental solutions-oral liquids-injections-ointments-topical applications, preservation, analytical methods and test for various drugs and pharmaceuticals, Quality management, GMP. (14)

PHARMACEUTICAL PRODUCTS AND THEIR CONTROL: Therapeutic categories such as vaccines, analgesics, oral contraceptives, antibiotics. (10)

REGULATORY ASPECTS: Forensic pharmacy, Drugs and Cosmetics Act, Pharmacopoeias, Drug regulatory authorities. (6)

TEXT BOOKS:  

REFERENCES:  
1. Indian Pharmacopoeia, New Delhi, 2010.  

15B004 FOOD SCIENCE AND TECHNOLOGY 3003

INTRODUCTION TO FOOD SCIENCE AND TECHNOLOGY: Dimension of food science, food processing industry. Major classes of food components. Food categorization & composition. Human nutrition and food. (5)

FOOD CHEMISTRY: Functional groups and properties, Water and acids, Carbohydrates, lipids, Proteins, color, flavor & texture, food additives. (8)

FOOD PROCESSING AND PRESERVATION: Food preservation, Manufacturing or processing in Dairy products, egg, meat, sugar, fat & oils, Beverages, cereal grains, fruits and vegetables. (8)

MICROBIOLOGY AND FERMENTED FOODS: Factors affecting microbial growth, food borne microorganism, food spoilage quality control; preservation techniques. Fermented Foods, Food safety, Food toxicology. (8)

FOOD ENGINEERING: Food material science, food micro structure, Psychometrics, Rheology, Extrusion technology. (8)

FOOD BIOTECHNOLOGY: Improving plant products, Animal products, Food processing aids through biotechnology. Safety in Biotechnology derived foods. Major concerns. (8)

Total L: 45
ANIMAL CELL CULTURE: Cell culture, Cell lines, Characterization and preservation of animal cells, chemically defined and serum free media for cell culture, scaling up of animal cell cultures, organ culture, insect cell lines, Products from animal cell culture. (12)

BIOTECHNOLOGICAL APPROACHES FOR ANIMAL PRODUCTIVITY IMPROVEMENT: Animal breeding, superovulation, Artificial insemination, invitro fertilization, embryo splitting and sexing. (9)

TRANSGENIC ANIMALS: Transgenic mice – generation and applications of oncomice, knock out mice , cattle & other farm animals, transgenic fish- methodology & application. Production of spider silk, improvement of wool quality. (11)

GENE THERAPY: Stem Cells, Nucleic acid as therapeutic agents, ex vivo gene therapy, in vivo gene therapy, viral gene delivery systems, nonviral gene delivery systems, prodrug activation therapy. (13)

INDUSTRY OVERVIEW: Market survey for product / service, availability of technology, resources, raw material, utility requirements, waste generation and management; sustainability issues; regulatory factors, competition factors. (9)

PROCESS DESIGN AND DEVELOPMENT: Technical feasibility, process development, flow diagrams, equipment design and specifications; design software support. (10)

COST ANALYSIS: Cost and Asset Accounting, Capital investment – fixed capital, working capital investments; manufacturing costs – direct costs, fixed charges; overhead costs – administration, safety, payroll, warehouse, storage; Taxes and insurance ,Depreciation profitability analysis – return on investment, interest rate of return, uncertainty, upgradation and development. (10)

PROCESS OPTIMIZATION: Linear and dynamic programming; optimization strategies; Good Manufacturing Practices. (9)

BIOSAFETY REGULATIONS: Industrial safety, Environmental safety, National & International guidelines, r DNA guidelines for research & product development. (7)

TEXTBOOKS:

REFERENCES:
POPULATION AND QUANTITATIVE GENETICS: Hardy-Weinberg principle, mutation, migration, gene flow, genetic drift, QTL mapping.

CYTOGENETICS AND CHROMOSOMAL DISORDERS: Karotyping, ideogram for G-banding, FISH, CCG, Aneuploidy and Deletions, Translocation, Mosaicism and Chimerism.

MOLECULAR ASPECTS OF DISEASES: Triplet-Repeat Diseases, Tay Sachs disease, cystic fibrosis, Thalasemia, DMD, cancer, genealogical charts.

DIAGNOSIS AND THERAPY OF GENETIC DISORDERS: Genetic diseases in prenatal, the neonatal period, childhood and adulthood, screening of diseases, gene therapy.

TEXT BOOKS
1. Jai Rup Singh, “Human Genetics: Health and Disease perspective” ESS ESS Publications, New Delhi, 1994,
2. Lynn B, John C Carey “Medical Genetics” Mosby publications, 1999

REFERENCES
2. Kingston HM “ABC of Clinical Genetics”, Third edition Consultant Clinical Geneticist, Regional Genetic Service, St Mary’s Hospital, Manchester, UK.

15B008 NANOMATERIALS FOR BIOAPPLICATIONS


STEALTH AND BIOMIMETIC CORE-CORONA NANOPARTICLES: Biodistribution of intravenously administered particles-Protein-rejecting abilities Polyethylene glycol coatings stealth PEG coated Drug carriers-detection and characterization of the PEG corona-Drug encapsulation–Biodistribution-toxicological considerations.


NANOMOTORs: General classification of bionanomotors - kinesin motor and nanoactuators, myosin, F0-F1 ATPase motor- in vitro generation of F0-F1, ATPase motor -bacterial flagella motor-viral DNA packaging motor-helicase-RNA polymerase

Total L: 45

TEXT BOOKS:

REFERENCES:

15B009 SMART NANOPARTICLES IN CANCER THERAPY


MAGNETIC MICRO AND NANOPARTICLES: Introduction-histroy of magnetic drug targeting-embolotherapy-hyperthermic therapy-magnetic particles for delivery of chemotherapeutic drugs-brachy therapy-magnetic particles for gene therapy


Total L: 72
ULTRASOUND IN DRUG DELIVERY: Ultrasound energy deposition in body-modes of ultrasound applications in drug delivery-ultrasound cavitation-effect of doxorubicin on transient cavitation-ultrasound interaction with cells-ultrasound induced drug delivery from micelles-ultrasonics micelles-targeting effect of ultrasound and surfactants micelles-targeting effect of ultrasound (9)


TEXT BOOKS:

REFERENCES:

RESEARCH ELECTIVES

15B021 RESEARCH TOPICS IN CANCER BIOLOGY

INTRODUCTION: Molecular Biology, Cancer overview. (4)

CELL CYCLE: Mitotic spindle; MPF and cell cycle control; yeast model; complex genetic diseases; cyclins and kinases. (7)

SIGNALS AND REGULATION: TGF-β; CIP1; G2 cyclins; differentiation and reversal; disease mechanisms in acute promyelocytic leukemia. (8)

APOPTOSIS: c-rel and cell death; Bcl2 interactions in cell survival; DNA replication control; growth factor dependence and apoptosis suppression. (7)

ONCOGENE: ATC, Tcf-4, β-catenins and c-myc; Waf1 and p53; phosphatase 2A. (7)

TUMORIGENESIS: Anticancer agents and p53; dosage effects of tumor suppressor; colon cancer; breast cancer metastasis. (7)

THERAPY: Control of vasculogenesis; stem cell and CML dynamics; temporal targeting. (5)

TEXT BOOK:

REFERENCE:
1. Selected papers from Cell, Nature, Science and PNAS will be studied.

15B022 MOLECULAR PATHOGENESIS

PATHOGENESIS: Bacterial flora of humans; Endogenous and Exogenous infection, Noninvasive and invasive pathogens. (8)

VIRULENCE: Virulence factors, toxins; Genetic basis of virulence; virulence genes and their regulation. Virulence protein secretion pathways. Microbial evasion strategies of host defense; Regulation of virulence associated genes, Methods to identify bacterial pathogenicity factors. (16)

PARADIGMS OF PATHOGENESIS: E. coli, Mycobacterium tuberculosis, Candida, Hepatitis B virus, Plasmodium. (15)

THERAPEUTIC CHALLENGES: Antibiotic resistance-molecular mechanisms, transposon mediation. Vaccine development in Malaria. (6)

TEXT BOOKS:

REFERENCES:
3. Journal Review articles

15B023 DEVELOPMENTAL BIOLOGY


PATTERNS OF DEVELOPMENT: Gametogenesis, Fertilization, Cleavage, Gastrulation, Neurulation and the ectoderm, Axonal specificity, Mesoderm and endoderm.

MECHANISM OF CELLULAR DIFFERENTIATION: Transcription factors –activation of specific promoters, chromatin. Control of development by differential RNA processing and translation.

SPECIFICATION OF CELL FATE AND THE EMBRYONIC AXES: Autonomous, conditional and syncytial specification; Genetics of axis specification in Drosophila, Specificity of cell fate by progressive cell- cell interactions, Establishment of body axes in mammals and birds.


TEXT BOOK:

REFERENCE:

15B024 PROTEIN ENGINEERING

PROTEIN STRUCTURE: Primary structure and its determination; secondary structures and supersecondary structures; folding pathways; tertiary structure; quaternary structure; Circular dichroism and X ray crystallography for protein structure determination, post translational modifications. Techniques for studying post translational modifications.


ENGINEERING PROTEINS: Protein engineering methods- directed and random mutagesis, Engineering thermal stability and other properties; Antibody engineering; Therapeutic insulin; Engineering Subtilisin and other proteases; Rationale of Protein design, examples.

TEXT BOOKS:

REFERENCES:

15B025 IMMUNOTECHNOLOGY

ANTIGENS AND EXPERIMENTAL ANIMAL MODELS: Antigens: Epitopes, B cell & T cell epitopes, Types of antigen, factors affecting immunogenecity, Haptens, preparation of antigens for raising antibodies, adjuvants and their mode of action. Handling experimental animals, inbred strains, SCID mice, Nude mice, knock out mice.


ASSESMNT OF CELL MEDIATED IMMUNITY: Identification of lymphocytes and their subsets in blood, T cell activation parameters, estimation of cytokines, macrophages activation, macrophage microbicidal assays, in-vitro experimentation- application of the above technology to understand the pathogenesis of infectious disease.
IMMUNOPATHOLOGY: Preparation and storage of tissues, identification of various cell types and antigens in tissues, isolation and characterisation of cell types from inflammatory sites and infected tissues, functional studies on isolated cells, immunocytochemistry-immunofluorescence, immunoenzymatic and immunoferritin techniques, immunoelectron microscopy. (9)

MOLECULAR IMMUNOLOGY: Preparation of vaccines, recombinant vector vaccines, application of recombinant DNA technology for the study of immune systems, Antibody engineering, antidiotopic antibodies, catalytic antibodies. (11)

TEXT BOOKS:

REFERENCES:

15B026 BIOFUEL TECHNOLOGY

INTRODUCTION: Current energy scenario and the need for alternative fuels, overview of biofuel, bioenergy and biorefinery concepts. Biomass sources and classification, Physical and chemical characteristics and potential of different biomass materials, First, second and third generation biofuels. (7)

BIODIESEL: Transesterification reaction mechanism; Basics and chemistry of fats and oil, oil resources and feedstock, methods for biodiesel production, Different types of catalysts employed; heterogeneous catalysis, enzyme based biodiesel; microalgae based biodiesel. (10)

BIOETHANOL: Different feedstock for Bioethanol production, Fermentation process, Sugarcane molasses and other sources for fermentation process. Cellulosic pretreatment methods, biochemical engineering of cellulosic ethanol, Saccharification process, Hydrolysis, Hydration, Lignin upgradation, economics of bioethanol production. (9)

PYROLYSIS AND GASIFICATION: Thermo-chemical conversion of lignocellulose biomass, Biomass processing for liquid fuel production, Biohydrogen production process; Chemical method; Factors affecting biohydrogen production, Thermo chemical gasification principles and its application for different biomass treatment. (9)

BIOGAS TECHNOLOGY: Feedstock for biogas production, Aqueous wastes containing biodegradable organic matter, animal residues; Microbial and biochemical aspects; Operating parameters for biogas production, Kinetics and mechanism, Dry and wet fermentation, Digesters for rural application. (10)

TEXT BOOKS:

REFERENCES:
1. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology) Springer 2007
2. Rezaiyan, J and N. P. Cheremisinoff, “Gasification Technologies, A Primer for Engineers and Scientists”, Taylor & Francis, 2005

15B027 STUDIES IN PARADIGMATIC DEVELOPMENTS IN BIOLOGY

BIRTH OF MOLECULAR GENETICS: Reviving the contributions of Mendel; identifying the chromosomal location of the hereditary material; developing facile models to study and experiment: microbial systems, the phage group; Contributions of Morgan, Beadle, Luria and Delbruck. (13)

BEHAVIORAL GENETICS: Study of individual and social behavior has always puzzled and promoted learning: vitalists and reflexologists models; inspiring experimental design case studies; insect, bird and fish behavior; Contributions of Tinbergen, von Frisch. (8)

DECODING THE CODE: Protein synthesis and nucleic acid synthesis; manipulation of genetic material, and extracting the information; deliberations at Asilomar; Contributions of Holley, Nirenberg, Khorana, Berg, Sanger and Gilbert. (12)
DYNAMICS OF THE GENOME: Intuition and observation in experimental research; technical developments in the aid of solving old problems; disrupted genes; viral systems – their constraints and opportunities, visible proteins; Contributions of McClintock, Tonegawa, Sharp, Tsien.

TEXT BOOKS:
1. Nobel lectures and associated publications and multimedia

REFERENCE:

15B028 ADVANCES IN GENOMICS

RECENT TRENDS IN GENOME SEQUENCING TECHNIQUES: Next Generation Sequencing, Re and deep sequencing, analysis of deep sequencing data for SNP and miRNA identification and differential expression
METAGENOMICS: Techniques and Strategies for metagenomics analysis, use of metagenomic analysis for agriculture, environment and clinical applications - case studies
EPIGENETICS AND EPIGENOMICS: Epigenetic and Epigenomic regulation - Techniques used in Epigenomic analysis, ChIP, ChIP on chip, ChIP sequence, ChIP- PCR, bisulfate sequencing, enzyme based methods, NGS based sequencing of the epigenome. Epigenome systems - Human epigenome, epigenomics in plants, fungi, Applications of Epigenomics
PHARMACOGENOMICS: Polymorphisms in metabolizers, transporters and receptors and their consequences in drug efficacy and drug discovery - case studies
CLINICAL GENOMICS: Databases of diseases namely cancer and Alzheimer's diseases and workflow approaches for data analysis.

REFERENCES:

15B029 SYSTEMS BIOLOGY

INTRODUCTION TO SYSTEMS BIOLOGY: What is Systems Biology? – Models and Modelling - Basic concepts of computational models – Applications - Scope and Future.


DATABASES, DATA FORMATS, STANDARDS AND SIMULATION TOOLS: Available Internet Databases for Modelling - Systems Biology Markup Language - BioPAX – Systems Biology Graphical Notation – Other standards - Simulation Tools and Softwares
Tutorial Practice
Mathematical Modelling using COPASI (3)

Total L:45

TEXT BOOKS:

REFERENCES:

ONE CREDIT COURSES
OFFERED BY THE DEPARTMENT OF BIOTECHNOLOGY

15BF01 CHALLENGES IN FRUIT AND VEGETABLE PROCESSING INDUSTRY

TRANSPORTATION: Challenges in transportation of fruits and vegetables from farm to consumer. (2)
RIPENING: Controlled ripening of fruits and maintaining batch consistency. (2)
STORAGE: Procurement and storage of agricultural produce – onions, potatoes; Storage of processed products for customer acceptance – onion powder. (3)
WASTAGE MANAGEMENT: Solid waste issues in fruit / vegetable processing industry. (1)
VALUE RECOVERY: Purification, compression and use of biogas for transport and electricity generation in processing industry. (1)
PULP PROCESSING: Application of enzyme technology for increasing the output of juice or pulp from different fruits. (3)
DEBITTERING: Application of enzyme technology for debittering of pomegranate juice to acceptable level. (3)

Total L: 15

REFERENCE:  

15BF02 HERBAL MEDICINES

SYSTEMS OF MEDICINE: Modern, Traditional, Ethnic – philosophy and practices. (2)
CONSTITUENTS OF TRADITIONAL SYSTEMS OF MEDICINE: Herbals, animal products, minerals and heavy metals. (2)
DISEASES THAT EVADE MODERN MEDICINES: Liver and connected maladies; gastroenterological disorders; metabolic diseases – hyper cholesterol, hyper glycemia; neurological and immunological. (4)
ROLE OF HERBALS IN THE ALTERNATE SYSTEMS OF MEDICINES: Important herbs, identification. Phytochemistry, preparatory drugs. (2)
ANIMAL AND MINERAL PRODUCTS: Sources, purification and preparation. (3)
COMMERCIALIZATION: Setting up of Analytical and Manufacturing Facilities. (2)

Total L: 15

REFERENCES:  

15BF03 BIOCATALYSIS AND BIOTRANSFORMATION

**INTRODUCTION**: Biocatalysis and biotransformation, opportunities and constraints. (3)

**BIOREACTORS AND IMMOBILIZED REACTORS**: Types of reactors, design features. Methods of protein immobilization, kinetic parameters. (3)

**ENZYMATIC AND MICROBIAL BIOTRANSFORMATION**: Examples drawn from various industries. (5)

**DOWN-STREAM PROCESSING**: Product recovery and optimization. Recent trends in biotransformation industry and emerging opportunities. (4)

**REFERENCES**:

15BF04 NEXT GENERATION SEQUENCE ANALYSIS

**R AND BIOCONDUCTOR**: Features of R and its utility; Data structures in R; Conditional statements, loops; Plotting; Few important R functions for sequence analysis; Features of Bioconductor (2)

**INTRODUCTION TO NEXT GENERATION SEQUENCE ANALYSIS**: NGS platforms, Raw data formats, Quality scores, Read filtering (adapter and low-quality base filtering), Sequence alignment (bowtie), Alignment file formats, Post alignment processing (Samtools and bamtools), Visualization (IGV), Typical NGS analysis workflows, Sample RNA-Seq data analysis – identifying differentially expressed genes using R-packages (DESeq), Gene Set Enrichment Analysis, GO analysis, ChIP-Seq data analysis using R packages (chipseq), Plotting the results for easy interpretation using R(ggplot2) (6)

**LABORATORY**
NGS Data Analysis using R and Bioconductor (8)

**REFERENCES**:
   http://eebweb.arizona.edu/nachman/Further%20Interest/Metzker_2009.pdf
2. https://www.ebi.ac.uk/training/online/course/embo-practical-course-analysis-high-throughput-seq.

15BF05 DIRECTED EVOLUTION FOR ENZYME ENGINEERING

**STRATEGIES FOR ENZYME MODIFICATION**: structure function relationship- Protein modeling- specific examples. (5)

**PROTEIN ENGINEERING**: directed molecular evolution, error prone PCR library, DNA shuffling, optimal experimental design, high throughput screening. (6)

**APPLICATION TESTING**: Mimicking the real time applications – down scaling strategy - specific applications (4)

**REFERENCES**:
15BF06 QUALITY ASSURANCE AND CONTROL IN FOOD INDUSTRY


QUALITY CONTROL: Prevention and inspection as used in quality control in food industry, Process quality, control charts, statistical process control, root cause analysis of quality issues, addressing Internal and External Quality Issues & Complying with Government Regulations.

QUALITY ASSURANCE: Quality risk management, Assessing quality concerns at different work units or areas, Quality certifications & accreditations, Setting up quality control checks, Inspections and Audits.

REFERENCES:

15BF07 CHALLENGES IN LARGE SCALE BIOPROCESS

CHALLENGES IN SCALE-UP: Handling of fluids-pre and post operation; Sterilization of reactors, media, gases; maintenance of adequate Dissolved Oxygen, pH and temperature

STRATEGIES: strategies for maintaining productivity, sterility, pH, temperature and dissolved oxygen in bioreactors. Scheduling of plant operations. Maintaining master cultures and preventing strain variability


REFERENCES:

15BF08 SAFETY PRACTICES AND MANAGEMENT IN PROCESS INDUSTRIES

Brief history of safety management practices in Process Industries and safety management - Journey, till date


Safety principles and practices at the stage of process planning, design, operation, product life cycle.

Safety tools, training and accreditation.

Economics of safety, learning’s from Industrial accidents and disasters and best and modern safety practices.

REFERENCES:

15BF09 PATENTS AND COPYRIGHT


COPYRIGHT– Idea-expression dichotomy, literary works, copyrights for software, fair use, ownership of copyright, Creative Commons.
PATENTS: Inventions not patentable, Sections 3(d), (e), (i), (j), (k) Novelty, inventive step, utility, prior art, anticipation, Contents of patent specification. (3)

PATENT RESEARCH FOR R&D: Patent searching for state of the art, patentability, identifying gaps, optimizing R&D. (2)

INTERNATIONAL PATENTING: Paris Convention. PCT, the EPO, a comparative study of patent law in the US and Europe. (2)

IP COMMERCIALIZATION: Valuation, Technology transfer, University spin-offs, exclusive & non exclusive licensing, agreement tools. (2)

ENFORCEMENT OF IPR – Infringement of Copyright and patents, injunctions, Reliefs. (2)

REFERENCE:

OFFERED BY THE DEPARTMENT OF HUMANITIES

15OF01 EXPORT - IMPORT MANAGEMENT

INTRODUCTION: Export – Import Business – Preliminaries for starting Export – Import Business Registration. (3)

EXPORT PROCEDURES: Obtaining an Export License – Export Credit Insurance – Procedures and Documentation. (4)

FOREIGN EXCHANGE: Finance for Exports – Pricing - Understanding Foreign Exchange Rates. (3)

IMPORT PROCEDURES: Import Policy – License - Procedure and Documentation. (3)

EXPORT INCENTIVES: Incentives – Institutional Support. (2)

REFERENCES:

Total L: 15

15OF02 INSURANCE & RISK MANAGEMENT

INTRODUCTION TO RISK MANAGEMENT: Risk in Our Society. (2)

INSURANCE AND RISK: Client Side – Components of the Costs of Risk. (2)


MASS CONTROL: Insurance Intermediaries – Insurance Companies and their Role in Deducting Business / Role Risks. (4)

FINANCIAL RISKS: Shift of Risks – Risk Derivatives. (3)

REFERENCES:

Total L: 15
15OF03 VALUES AND ETHICS AT WORK PLACE

HUMAN VALUES AND ETHOS: Meaning and Significance of Values – Sources of Individual Values - Value crisis in the Contemporary Indian Society – Moral and Ethical Values. (4)

APPLICATION OF VALUES: Relevance of Values in Management – Personal Values and Values at Work place – Values for Managers. (2)

WORK ETHICS: Professional Values & Ethics – Need – Issues – Challenges – Ethical Leadership – Ethical dilemma - Case Study. (4)

SHARED VALUES IN THE ORGANIZATION AND ITS IMPACT: Need to identify and share values – the Value Construct and How to Promote Shared Values. (2)

UNIVERSAL VALUES: Cross Cultural Values - Impact of Culture on Organizations and Managing Workforce Diversity. (3)

REFERENCES:

15OF04 DEVELOPMENT OF INDUSTRIALISATION

EVOLUTION OF MODERN ECONOMY- Colonialism, Capitalism and economic development. (2)

AMERICAN HISTORY- Before and After European arrival. (4)

ROLE SLAVERY and trade in America. (4)

INDIAN ECONOMY – Pre and Post Independence, (3)

INDUSTRIALIZATION IN ASIA AND AFRICA – Colonialism – anti-colonialism and Socialism. (2)

REFERENCES:

15OF05 CREATIVITY AND SOCIAL ENTERPRISE

CREATIVITY- Understanding the creative skills (2)

WAYS TO IMPROVE creativity and exercises. (4)

INNOVATION – Process of Innovating new ideas - Importance of Innovation. (4)

ENTREPRENEURIAL skills and development – Intrapreneurship. (3)

SOCIAL ENTREPRENEUR and social enterprise – success stories of entrepreneurs – Leadership styles adopted by successful entrepreneurs. (2)

REFERENCES:
15OF06 SOCIAL AND PSYCHOLOGICAL WELL BEING 1001

DEFINING SOCIAL PSYCHOLOGY and social influences on behavior. (2)

ANALYSIS OF SOCIAL and psychological problems and the solutions to address social problems. (4)

ROLE OF SPORTS AND GAMES, yoga practices, tracking and outdoor activities in addressing social and psychological problems. (4)

ORIGINS OF PSYCHOLOGICAL DISORDER – roots of social anxiety - prevention of psychological disorders. (3)

NATURE OF INTERVENTIONS – Evaluation of Interventions and implementing the interventions. (2)

REFERENCES:

Total L: 15

15OF13 SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT 1001

INVESTMENTS ENVIRONMENT: Classification - Financial Instruments – Security Trading. (2)

TYPES OF SECURITY: Trading – Orders, Margin Trading – Clearing and Settlement Procedures. (5)

SECURITY ANALYSIS: Industry Analysis – Company Analysis. (4)

PORTFOLIO: Measuring Risk and Returns and Treatment in Portfolio Management. (4)

REFERENCES:

Total L: 15

15OF14 IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM 1001

INTRODUCTION – Need for Quality – Definitions of Quality – Dimensions of Product and Service Quality – Basic Concept of TQM – Contributions of Deming, Juran and Crosby – Barriers to TQM. (2)


REFERENCES:

Total L: 15
15OF15 FINANCIAL MANAGEMENT


OBJECTIVE OF FINANCIAL MANAGEMENT: Profit Maximization and Wealth Maximization.

CAPITAL STRUCTURE: Designing of Capital Structure - Profitability and Liquidity Aspects.

DIVIDEND POLICY: Determinants of Dividends - Bonus share – Tax aspects.

CORPORATE RESTRUCTURING: Merger and Acquisition (M&A) - Case Studies.

REFERENCES:

Total L: 15

15OF16 PERSONALITY DEVELOPMENT THROUGH TRANSACTIONAL ANALYSIS

EXPLORING THE PERSONALITY - Structural Ego states - Functional Ego states.

MOTIVATION – Strokes Maslow’s Hierarchy of Needs.

INTERPERSONAL RELATIONSHIP - Time Management – Transactions - Time Structuring.

STRESS MANAGEMENT - Working Styles – Contamination.

ASSERTIVENESS AND LEADERSHIP SKILLS - Life positions – Competency.

REFERENCES:

Total L: 15

OFFERED BY THE DEPARTMENT OF ENGLISH

15OF10 CORPORATE COMMUNICATION


ORAL COMMUNICATION: Communicating in Organizational Settings - Recognizing effective Communication - Mastering Listening and Nonverbal Communication Skills - Overcoming Barriers to Communication - Communicating in Teams and adapting to Cross Cultural Communication contexts.

WRITTEN COMMUNICATION: Planning, Writing, and completing business messages - Writing messages for Electronic Media - Creating effective E-mail messages - Writing routine and positive and negative messages - Writing persuasive messages – Training on writing Reports and proposals – Mastering the Format and layout of Business Documents.
Presentation and Negotiation Skills. (3)

REFERENCES:

15OF11 - INTERPERSONAL AND ORGANIZATIONAL COMMUNICATION 1 0 0 1

UNDERSTANDING ORGANIZATIONAL COMMUNICATION: Communication Networks in an Organization; Intra-organizational communication; Inter-organizational communication; Flow Nomenclature; Workplace diversity and intercultural aspects of communication (4)

COMMUNICATION FUNCTIONS IN ORGANIZATIONS: Teamwork and team dynamics; Conflict resolution strategies and styles; Leading and influencing others-facilitation skills (3)

WRITTEN COMMUNICATION: Email Writing, Professional Reports, and Memos (4)

INTERPERSONAL SKILLS: Nature and Dimensions of Interpersonal Communication; Personality and Communication styles; Active listening and intentional responding; Working with emotional intelligence. (4)

REFERENCES:

15OF12 – HUMAN VALUES THROUGH LITERATURE 1 0 0 1


DRAMA: Karnad, Girish, Tughlaq – Statesmanship and friendship (3)

ONE-ACT PLAY: Chekhov, Anton. The Bear – Love (1)

SHORT STORY: Maugham, Somerset. “Mr. Know-All” – Empathy, Desai, Anita. “Devoted Son” – Family Bond. (2)

NOVEL: Murthy, Sudha. Gently Falls the Bakula – Gender equality (2)

REFERENCES:
3. Additional readings on individual texts

OFFERED BY THE DEPARTMENT OF MATHEMATICS

15OF21 PRINCIPLES OF BUSINESS ANALYTICS 1 0 0 1

PREDICTIVE ANALYTICS: CLASSIFICATION AND DISCRETE CHOICE PROBLEMS: Simple linear regression - multiple linear regression model development and diagnostics - analysis of transactional data using binary logistic and multinomial logistic regression models - discrete choice models, non-linear regression: Classification Trees, Classification and Regression Tree (CART) forecasting.


REFERENCES: